Third National Communication

of the Republic of Moldova

Under the United Nations Framework Convention on Climate Change

2013

MINISTRY OF ENVIRONMENT

Third National Communication of the Republic of Moldova

Under the United Nations Framework Convention on Climate Change

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FOREWORD

It is well known that climate change is a global ecological problem that endangers sustainable development of the humanity. It can have diverse negative impact such as world ocean level rise, increased frequency of natural disasters (floods, droughts, heat waves, hurricanes and tornadoes), higher vulnerability of natural and artificial ecosystems to new climate conditions, etc. This requires from the world's nations to undertake actions aimed at both minimization of climate change, and its possible consequences.

The Third National Communication of the Republic of Moldova under the United Nations Framework Convention on Climate Change has been developed with the financial assistance of the Global Environment Facility through the Project "Republic of Moldova: Enabling Activities for the Preparation of the Third National Communication under the United Nations Framework Convention on Climate Change" managed by the United Nations Environment Programme and implemented by the Ministry of Environment of the Republic of Moldova.

This Report presents an overview of the state of work in the Republic of Moldova for the main issues covered by the Convention and the Kyoto Protocol. They affect the assessment of greenhouse gas emissions pace and dynamics at national and sectoral level, the need to decrease these emissions, the assessment of vulnerability and adaptation needs to new climate conditions caused by the climate change phenomenon for the main sectors of national economy and human health.

It is important to note that these results underpinned the forecast of climate changes for the XXI century, which served as basis for developing a set of recommendations to minimize the negative impact of such change.

These recommendations underlie the Low Emission Development Strategy of the Republic of Moldova until 2020 and the Climate Change Adaptation Strategy of the Republic of Moldova until 2020, developed during the Project implementation.

This report and the implementation of the Low Emission Development Strategy and of the Climate Change Adaptation Strategy represent the Republic of Moldova's essential input to finding a solution to the national as well as to the global climate change problem.

Gheorghe SALARU

Minister of Environment

LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

AAA	Economic and Sector Activity and Technical Assistance
A&A ROSC	Accounting and Auditing Reports on the Observance of Standards and Codes
AD	Activity Data
ADA	Austrian Development Agency
ADC	Austrian Development Cooperation
AE	Agricultural ecosystems
AEE	Agency on Energy Efficiency
AEZ	Agro-Ecological Zone
AGeoM	Agency for Geological Production and Exploration
AI	Aridity Index
AIDS	Acquired Immunodeficiency Syndrome
AITT	Agency for Innovation and Technology Transfer
AOGCMs	Coupled Atmosphere–Ocean General Circulation Models
AR4	IPCC Forth Assessment Report
Art.	Article
ASM	Academy of Science of Moldova
a.s.	Active substance
ATU	Administrative-Territorial Unit
ATULBD	Administrative Territorial Units on the Left Bank of Dniester
B	Billion
BAS	Business Advisory Service
BAU	Business-As-Usual
BCCR_BCM2.0	Global circulation model developed by Bjerknes Centre for Climate Research, Norway
BM	World Bank
BMZ	Federal Ministry for Economic Cooperation and Development, Germany
BOD	Biochemical oxygen demand
BSP	Budget Support Program
^0C	Celsius degrees
C	Carbon
Ca^{++}	Calcium ions
CAA	Central Administrative Authorities
¢	cents
CBD	Convention on Biological Diversity
CCCma_CGCM3_T63	Global circulation model developed by the Canadian Centre for Climate Modelling and Analysis, Canada
CCGIS	Research and Geographic Information System within the State Hydrometeorological Service
CCl_4	Carbon tetrachloride
CCO	Climate Change Office
CCPP	Combined Cycle Power Plant
CDM	Clean Development Mechanism
CEA	Central Environmental Authority

CE	Council of Europe
CEB	Council of Europe Bank
CEDB	Commerce and Economic Development Bureau
CER	Certified Emission Reductions
CF_4	Perfluoromethane
C_2F_6	Perfluorethane
C_3F_8	Perfluoropropane
C_4F_{10}	Perfluorobutan
$c\text{-}C_4F_8$	Perfluorciclobutan
C_5F_{12}	Perfluorpenthan
C_6F_{14}	Perfluorhexan
CFC	Chlorofluorocarbons
C.I.F.	Cost, Insurance and Freight
CH_4	Methane
CHE	Hydro Power Plant
CHEAP	Hydro-power plant with accumulation by pumping
CHP	Combined Heat Power Plant
CIEMIM	Centre on Integrated Ecological Monitoring and Information Management
CID	Cooperation activities in international development
CISC	Intergovernmental Panel for Climate Change
CIUDAD	Cooperation in Urban Development and Dialogue
Cl^-	Ions of chlorine
CLICOM	Climate Computing
CMIP3	Coupled Model Intercomparison Program phase 3
CMTP	Central Management Team of the Program
CO	Carbon monoxide
CO_2	Carbon dioxide
COD	Chemical oxygen demand
COEST	Committee for Eastern Europe and Central Asia of the Council of the European Union
COP	Conference of the Parties
COPS	Comite politique et de securite (Political and Security Committee - PSC)
CORINAIR	European Emissions Inventory Guidebook developed by European Environment Agency
cm	Centimetre
cm^2	Square centimetre
CNG	Compressed natural gas
CPA	Cooperation and Partnership Agreement
CPA	Central Public Authorities
CPS	Country Partnership Strategy
CS	Country Specific
CSC	Carbon Storage and Capture

CSIROMk3	Climate model developed by Australia's Commonwealth Scientific and Industrial Research Organization
CVI	Climate Vulnerability Index
CzDA	Czech Development Agency
D	Default
dal	dekalitre
DAWBEE	Data Access for Western Balkan and Eastern European Countries
DCFTA	Deep and Comprehensive Free Trade Agreement
DEPA	Danish Environment Protection Agency
DFI	Direct Net Foreign Investments
DFID	Department for International Development
DJF	Winter season: December, January and February
DKK	Danish Krone
Dm	Decimetre
d.m.	Dry matter
DO	Dissolved oxygen
DOC	Degradable Organic Carbon
DOC_F	Dissimilated DOC fraction
EaPIC	Eastern Partnership Integration and Cooperation Programme
EB	Energy Balance
EBRD	European Bank for Reconstruction and Development
EC	Environmental capacity
EEE	Electrical and Electronic Equipment
EEF	Energy Efficiency Fund
EEN	Enterprise Europe Network
EF	Emission Factor
EFR	Environmental Fiscal Reform
EHGeoM	Hydrogeological Expedition of Moldova
EIA	European Integration Alliance
EIB	European Investment Bank
EIC	Environmental Information Centre
ECHAM5-OM	Atmospheric general circulation model developed at the Max-Planck Institute for Meteorology, Germany
ECMWF	European Centre for Medium Range Weather Forecasting
EMEP	Programme on Observations and Assessment of Long-Range Transboundary Air Pollution in Europe
EnMS	Energy Management System
ENP	European Neighbourhood Policy
ENPEP	Energy and Power Evaluation Program
ENPI	European Neighbourhood and Partnership Instrument
ENPT	European Neighbourhood Partnership Tool
ENTSO-E	European Network of Transmission System Operators for Electricity
ENVSEC	Environment and Security Initiative
EP	Eastern Partnership
E5P	Eastern Europe Energy Efficiency and Environmental Partnership
ESCO	Energy Service Company
EU	European Union
EUA	European Union Allowances
EU ETS	European Union Emission Trading Scheme
EUMETSTAT	European Organisation for the Exploitation of Meteorological Satellites
EUREM	European Energy Manager Training
EUR	Euro
EV	Emissions Volume
eq	Equivalent
FAO	Food and Agriculture Organization
FNS	First National Communication
F.O.B.	Free on Board
FOD	First Order Decay Method
FP7	Framework Program 7 of the European Union
FRG	Federal Republic of Germany
FRMI	Forestry Research and Management Institute
FS	Food security
g	Grams
g.c.e.	Grams of coal equivalent
Gcal	Gigacalory
GCM	Global Climate Model
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEF	Global Environmental Facilities
GFDL_CM2.1	Global circulation model developed by the Geophysical Fluid Dynamics Laboratory, USA
Gg	Gigagram (10^9 grams)
GHG	Greenhouse gases
GIS	Geographic Information System
GPG	Good Practice Guidance
GR	Government Resolution
GrEF	Greed Emission Factor
GIZ	German International Cooperation Agency (germ.: Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH)
GNI	Gross National Income
GOST	Regional Standardization System used by the Euro-Asiatic Council for Standardization, Metrology and Certification
GSTI	Gas-steam turbine installations
Gt	Gigatonnes
GWP	Global-warming potential
h	hour
ha	Hectare
H_2CO_3	Carbonic Acid
HadCM3	Hadley Centre Coupled Model, version 3, a circulation model developed by the Met Office in United Kingdom
HCl	Hydrochloric acid
HDI	Human Development Index
HFC	Hydrofluorcarbons
HH	Human health
HIV	Human Immunodeficiency Virus
hl	hectolitre
HNO_3	Nitric acid
H_2O	Water

HPP	Hydro-Power Plant
HR	Human Resources
H_2S	Hydrogen sulphide
HTC	Hydro-Thermal Coefficient
HUF	Hungarian Forint
HUN-IDA	Hungarian International Development Assistance
JHA	Justice and Home Affairs
JJA	Summer season: June, July, August
JICA	Japan International Cooperation Agency
JSC	Joint-stock Company
IAAE	International Agency for Atomic Energy
IBEC	Index of the Biological Effectiveness of the Climate
IBRD	International Bank for Reconstruction and Development
ICSID	International Centre for Settlement of Investment Disputes
IDA	International Development Association
IDC	International Development Cooperation
IE	Included Elsewhere
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IFI	International Financial Institutions
IGCC	Integrated gasification combined cycle groups on coal
ILO	International Labour Organization
IMF	International Monetary Fund
IMPACT	Emission calculation model, from ENPEP software package
INOGATE	Interstate Oil and Gas Transportation to Europe
INTAS	International Association for the promotion of cooperation with scientists from the independent states of the former Soviet Union
IOM	International Organization for Migration
IPA	Instrument for Pre-Accession Assistance
IPCC	Intergovernmental Panel for Climate Change
IPE ASM	Institute of Power Engineering of the Academy of Science Moldova
ITC	International Trade Centre
ITTA	Innovation and Technology Transfer Agency
K^+	Ions of potassium
KfV	Kreditanstalt Für Wiederaufbau (engl.: German Development Bank)
kg	kilogram
kg c.e.	Kilograms coal equivalent
km	kilometre
km^2	Square kilometre
kPa	Kilopascal
KC	Key Categories
KSA	Key Sources Analysis
kt	kilotonne
kV	kilovolt
kW	kilowatt
kWh	kilowatt-hour
l	litre
L	Level
LEAP	The Long range Energy Alternatives Planning System
LEDS	Low Emissions Development Strategy
LEF	Local Environmental Fund
LNG	Liquefied Natural Gas
LPA	Local Public Authorities
LPG	Liquefied Petroleum Gases
Ltd.	Limited
LULUCF	Land Use, Land-Use Change and Forest
LVI	Livelihood Vulnerability Index
m	metre
m^2	Square metre
m^3	Cubic metre
MAED	Model for Analysis of the Energy Demand
MAFI	Ministry of Agriculture and Food Industry
MAM	Spring season: March, April and May
MARKAL	Market Allocation Model
Mb	Megabyte
MC	Ministry of Culture
MCC	Millennium Challenge Corporation
MD	Moldova
MDB	Multilateral Development Bank
MDG	Millennium Development Goals
MDL	Moldovan Lei
MEC	Ministry of Economy
MED	Ministry of Education
MENR	Ministry of Environment and Natural Resources
MF	Ministry of Finance
MFAEI	Ministry of Foreign Affairs and European Integration
MJ	Ministry of Justice
Mg^{++}	Ions of magnesium
Mg	Milligram
MH	Ministry of Health
MIA	Ministry of Internal Affairs
MIGA	Multilateral Investment Guarantee Agency
mil.	Million
MITC	Ministry of Information Technology and Communication
Ml	Millilitre
MLFSP	Ministry of Labour, Family and Social Protection
MJ	Megajoule (10^6 joule)
mm	millimetres
MOP	Meeting of the Parties to the Kyoto Protocol
MOST	Moldovan Office for Science and Technology
MoEN	Ministry of Environment
MoSEFF	Moldovan Sustainable Energy Financing Facility
MoREFF	Moldovan Residential Energy Efficiency Financing Facility
MR	Moldovan Railways

MRDC	Ministry of Regional Development and Constructions
MRI_CGCM2.3.2	Global circulation model developed by the Meteorological Research Institute, Japan
MRV	Monitoring, Reporting and Verification
MSW	Municipal Solid Waste
Mt	Megatonne (10^6 tonnes)
MTU	Moldova Technical University
MW	Megawatt (10^6 watt)
MYS	Ministry of Youth and Sport
Na^+	Ions of Sodium
NaOH	Sodium Hydroxide
NA	Non Applicable
NAER	National Agency for Energy Regulation
NAMA	National Appropriate Mitigation Actions
NAP	National Action Plan
NATO	North Atlantic Treaty Organization
NBM	National Bank of Moldova
NBS	National Bureau of Statistics
NCs	National Communications
NCAR_CCSM3	Global circulation model developed by the National Centre for Atmospheric Research, USA
NE	Not Estimated
NECP	National Energy Conservation Program
NEEG	Norwegian Energy Efficiency Group
NEF	National Environmental Fund
NGO	Non-Governmental Organization
NH_3	Ammonia
NH_4^+	Ammonium
NHDR	National Human Development Reports
NHMN	National Hydrological Monitoring Network
NIES_MIROC3.2_hires	Global circulation model developed by the National Institute for Environmental Studies, Japan
NIF	Neighbourhood Investment Facility
NIP	National Indicative Program
NIR	National Inventory Report
NIS	National Inventory System
NIT	National Inventory Team
NITL	National Inventory Team Leader
NMVOC	Non methane volatile organic compounds
NO	Not Occurring
No.	Number
NO_x	Nitrogen Oxide
NO_3^-	Nitrate
N_2O	Nitrous Oxide
NPAI	National Public Audiovisual Institution
NPEE	National Program on Energy Efficiency
NSCE	Norwegian Society of Charted Engineers
NSPCPM	National Scientific and Practice Centre for Preventive Medicine
O_3	Ozone
ODA	Official Development Assistance
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substances
ODIMM	Organization for Small and Medium Enterprises Sector Development
OECD	Organization for Economic Cooperation and Development
OHCHR	Office of the High Commissioner for Human Rights
OSCE	Organization for Security and Cooperation in Europe
P	Precipitations
p-value	Indicates statistical significance
Pag.	Page
PDD	Project Document Design
PE	Potential Evaporation
PFC	Perfluorcarbons
PIN	Project Identification Note
PJ	Petajoule (10^{15} joule)
PHRD	Policy and Human Resources Development
PLN	Polish Zloty
PM10	10 μm fraction particulate matter
PPP	Purchasing Power Parity
PR	Parliament Resolution
PRC	People's Republic of China
POP	Persistent Organic Pollutants
ppb	Parts per billion of volume
ppm	Parts per million of volume
ppt	Parts per trillion of volume
PRECIS	Providing Regional Climates for Impacts Studies
PST	Pre-Service Training
Q	Quintals
QA	Quality Assurance
QC	Quality Control
R	Sum precipitation level
R^2	Coefficient of Determination
r	Pearson Correlation Coefficient
RBEC	UNDP Bratislava Regional Centre for Europe and Community of Independent States
RCGIS	Researches Centre and Geographical Information System
REC	Regional Environment Centre
RES	Renewable Energy Source
RM	Republic of Moldova
s	second
SAICM	Strategic Approach to International Chemicals Management
SAIP	State Agency for Intellectual Property
SAR	IPCC Second Assessment Report
SCSTD	Supreme Council for Science and Technological Development
SDC	Swiss Agency for Development and Cooperation
SEI	State Ecological Inspectorate
SEV	Specific Emissions Values
SF_6	Sulphur Hexafluoride
SGP	Small Grant Program
SHS	State Hydrometeorological Service
SIDA	Swedish International Development Cooperation Agency

SMS	Standardization and Metrology Service
SO_2	Sulphur Dioxide
SOM	Soil Organic Matter
SON	Autumn season: September, October and November
SRES	Special Report on Emissions Scenarios
STDSC	Science and Technological Development Supreme Council
$	Dollars
SY	Statistical Yearbook
SYNOP	Surface synoptic observations
t	tonne
T	Temperature
T1	Tier 1
T2	Tier 2
TA	Technical Assistance
TACIS	Technical Aid to the Commonwealth of Independent States
TAIEX	Technical Assistance and Information Exchange
TAR	IPCC Third Assessment Report
t.c.e.	tonnes of coal equivalent
TEMPUS	Trans-European Mobility Scheme for University Studies
TG	Teragram (10^{12} grams)
THI	Temperature-Humidity Index
TJ	Terajoule (10^{12} joule)
TI	Total Investments
TNA	Technology Needs Assessment
TNC	Third National Communication
TOWdom	Total organic wastewater contained in domestic wastewater
TOWind	Total organic wastewater contained in industrial wastewater
TRACECA	Transport Corridor Europe-Caucasus-Asia
TSU	Tiraspol State University
TTNM	Technology Transfer Network of Moldova
TUE	Total updated expenditures
TV	Television
UCTE	Union pour la Coordination du Transport de l'Electricite
UK	United Kingdom
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNCTAD	United Nations Conference on Trade and Development
UNECE	United Nations Economic Commission for Europe
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNFP	United Nations Population Fund
UNICEF	United Nations Children's Fund
UNCITRAL	United Nations Commission on International Trade Law
UNDAF	United Nations Development Action Framework
UNIDO	United Nations Program for Industrial Development
UNHCR	United Nations High Commissioner for Refugees
UNODC	United Nations Office on Drugs and Crime
UN Women	United Nations Agency for Gender Equality and Women's Empowerment
USA	United States of America
USAID	United States Agency for International Development
US EPA	United States Environment Protection Agency
USD	$ US
USSR	Union of Soviet Socialist Republics
VAT	Value Added Tax
VRIM	Vulnerability-Resilience Indicator Model
WAM	With Additional Measures Scenario
WASP	Wien Automatic System Planning
WB	World Bank
WCRP	World Climate Research Programme
WF	Wind Farms
WHO	World Health Organisation
WS	Wind Source
WM	With Measures Scenario
WMO	World Meteorological Organization
WS	Water Supply
Y	Yield
Σ	Sum
Δ	Difference
σ	Standard deviation
°	Degrees
′	Seconds
%	Per cent
‰	Promile

CONTENTS

SUMMARY

SUMMARY

S.1. Introduction

S.1.1. Convention's Ultimate Objective

The ultimate objective of the United Nations Framework Convention on Climate Change (UNFCCC) is aimed to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. To-date 192 countries are Parties to the Convention. Republic of Moldova signed the UNFCCC on June 12, 1992 and it was ratified by the Parliament on March 16, 1995.

Article 4, paragraph 1(a) and Article 12, paragraph 1(a) of the UNFCCC stipulate that each Party has to make available to the Conference of the Parties (COP) a national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, to the extent its capacities permit, using comparable methodologies to be agreed upon by the Conference of the Parties; also a general description of steps taken or envisaged by the Party to implement the Convention; and any other information that the Party considers relevant to the achievement of the objective of the Convention and suitable for inclusion in its communication, including, if feasible, material relevant for calculations of global emission trends".

S.1.2. Reporting under the Convention

The main mechanism for making this information available is National Communications. COP 2 (Geneva, 1996) adopted the Guidelines on national communications for non-Annex I Parties (Decision 10/CP 2). In conformity with the respective Guidelines, in 1998-2000 under the *UNDP-GEF Project "Enabling Activities for the preparation of the FNC under the UNFCCC"*, Republic of Moldova developed its First National Communication to UNFCCC (including a national GHG inventory for a time series from 1990 through 1998), submitted to the COP 6 (Hague, 2000).

The COP 8 (New Delhi, 2002) adopted new Guidelines on national communications for non-Annex I Parties (Decision 17/CP 8). In conformity with these Guidelines, in 2005-2009 under the *UNEP-GEF Project "Enabling Activities for the preparation of the SNC under the UNFCCC"*, Republic of Moldova developed its Second National Communication under the UNFCCC, while in 2010-2013, respectively its Third National Communication under the UNFCCC.

The COP 3 (Kyoto, 1997) adopted the Kyoto Protocol, representing an instrument setting binding targets for the Parties under Convention, by committing industrialized countries and economies in transition included in Annex I to Convention, to reduce total emissions of direct GHG by at least 5 per cent, against 1990 levels over the five-year period 2008-2012.

The Republic of Moldova ratified the Kyoto Protocol on February 13, 2003. As a non-Annex I Party, the Republic of Moldova had no commitments to reduce GHG emissions under the first commitment period of the Kyoto Protocol.

In January 2010, the Republic of Moldova associated itself with the Copenhagen Accord and submitted an emissions reduction target that is specified in Annex II of this Agreement "National Appropriate Mitigation Actions in Developing Countries." The target of mitigation actions for Republic of Moldova under this Agreement is "*to reduce, to not less than 25% compared to the base year (1990), the total national level of greenhouse gas emissions by 2020, by implementing economic mechanisms focused on global climate change mitigation, in accordance with the principles and provisions of the Convention*".

This target is presented without indicating specific national appropriate mitigation actions, identified and quantified, and without further clarification of the necessary support to achieve it. Simultaneously, it is recognized that achieving this target will require significant financial, technological and capacity-building support, which can be provided through the UNFCCC mechanisms.

During 2010-2013, it was drawn the *Low Emissions Development Strategy of the Republic of Moldova until 2020*, a strategic document that will allow the country to adjust its development path towards a low carbon economy and to achieve a green sustainable development, based on the socio-economic and development priorities of the country. Also, LEDS supports overall objectives, providing strategic national context for the mitigation efforts, for which countries receive international support. The measures proposed in the Action Plan, an Annex to LEDS, include prioritized national appropriate mitigation actions, as provided for non-Annex I Parties to the United Nations Framework Convention on Climate Change. LEDS also provides information on implementation procedures and timeframes, as well as provisions on monitoring, measurement, reporting and assessment of the results. It is anticipated that LEDS will be approved by the Government in the first quarter of 2014 year.

During 2010-2013, it was also drawn the *Climate Change Adaptation Strategy of the Republic of Moldova until 2020*, a strategic document ensuring that the social and economic development of the country can become resilient to the impact of future climate change. This document will create the national strategic framework necessary for the good functioning of the mechanism through which the RM will be able to receive international support for developing countries, provided by industrialized countries using the financial mechanisms of the UNFCCC. The Strategy is also intended to serve as a framework strategy that creates an enabling environment which allows certain sectors and ministries to integrate climate change adaptation activities and risk management actions into current and future sectoral strategies and national adaptation plans. It is anticipated that the *Climate Change Adaptation Strategy of the Republic of Moldova until 2020* will be approved by the Government in the first quarter of 2014 year.

S.2. National Circumstances

S.2.1. Physical Context

S.2.1.1. Geographical Location

Republic of Moldova, covering an area of 33,846 square km, is located in Central Europe, in the north-western Balkans. Republic of Moldova borders on Ukraine in the North, East and South and on Romania in the West, with the Western border line going along the river Prut. The Republic of Moldova is a Black Sea region country. Its southern border extends almost as far as the Black Sea coast, and the access to the Black Sea is open for Moldova through the Dniester estuary and the Danube.

S.2.1.2. Relief

The relief of the Republic of Moldova is represented by hills and flatland areas, with uplands mostly in the central part of the country. The absolute altitudes are within the range of 429 m (Balanesti Hills) and 4 m above the sea level in the Dniester flood land (Palanca village).

S.2.1.3. Climate

The climate of the Republic of Moldova is moderately continental, characterized by relatively mild winters with little snow, long warm summers and low humidity. The average annual air temperatures vary between 6.3-12.3°C, and amount of precipitations, respectively between 300-960 mm per year.

S.2.2. Natural Resources

S.2.2.1. Land Resources

Republic of Moldova has unique land resources characterized by predominant black earth soils (~75 per cent) with high productivity potential, very high utilization rate (>75 per cent); and rugged topography (above 80 per cent of the total arable land are located on hill slopes).

S.2.2.2. Water Resources

The hydrographical network accounts for circa 2.7 per cent of the country's territory and has a total length of circa 16 thousand km. The main rivers are Dniester and Prut, with a small opening to the Danube in the South. Moldova's hydrographical network density is 0.48 km per square kilometre on the average, varying between 0.84 km/km^2 in the northern regions and 0.12 km/km^2 in the regions on the left bank of the Dniester. There are approximately 60 natural lakes and more than 3.5 thousand water storage reservoirs. There are also about 4.8 thousand boreholes (water-wells) in the RM drawing from the ground water resources, estimated at circa 3478.3 thousand m^3/day.

S.2.2.3. Biological Resources

Currently the flora of the Republic of Moldova comprises about 5558 plant species (with 2044 superior plants and 3524 inferior plants). The ecosystems which have the richest flora composition include: the forest (above 850 species), steppe (above 600 species), high-water basin (approximately 650 species), petrophyte (about 250 species), water and swamp (about 160 species) systems. The Republic of Moldova's fauna is relatively rich and manifold. There are above 15.5 thousand species of animals in the Republic of Moldova, including 461 species of vertebrates and above 15 thousand species of non-vertebrates. The vertebrates include 70 species of mammals, 281 bird species, 14 reptile species, 14 amphibian species and 82 fish species. Birds are highest in number among the vertebrates (281 species and subspecies), and insects - among non-vertebrates (above 12 thousand species). There are five natural reservations established for scientific research purposes (Codrii, Iagorlic, Padurea Domneasca, Plaiul Fagului, Prutul de Jos) with the total area of 19.2 thousand ha in the RM.

S.2.2.4. Mineral Resources

In the RM mineral resources are extracted from 415 deposits, the most important being limestone, granite, bentonite clay and sandy clay, diatomite, gypsum and chalk stone. Most of the minerals are extracted from open mines, and only certain limestone varieties are mined from stone quarries (underground galleries).

S.2.3. Administrative-Territorial Organization, Population and Human Context

S.2.3.1. Administrative-Territorial Organization

The Republic of Moldova is administratively divided into 32 districts (Anenii Noi, Basarabeasca, Briceni, Cahul, Cantemir, Calarasi, Causeni, Cimislia, Criuleni, Donduseni, Drochia, Dubasari, Edinet, Falesti, Floresti, Glodeni, Hincesti, Ialoveni, Leova, Nisporeni, Ocnita, Orhei, Rezina, Riscani, Singerei, Soroca, Straseni, Soldanesti, Stefan Voda, Taraclia, Telenesti, Ungheni), 5 municipalities (Chisinau, Balti, Comrat, Tiraspol and Bender) autonomous territorial unit Gagauzia (ATU Gagauzia) and the administrative-territorial units on the left bank of the Dniester (ATULBD).

S.2.3.2. Population

As of 01.01.2012, Moldova's population represented 4073.8 thousand people, with the density of approximately 120.4 persons per square kilometre. Females prevail with 52.2 per cent in the nation's population - as opposed to 47.8 per cent of males in the total population. The majority of the population is concentrated in the rural areas. The existing 1614 rural settlements have 2237.7 thousand residents (54.9 per cent of the total population), averaging about 1400 residents per settlement. The urban population is 1836.1 thousand residents making 45.1 per cent of the total (on average circa 27 thousand population in a settlement). According to the data of the 2004 population census held separately in the areas on the right bank of the Dniester and in the administrative-territorial units on the left bank of the Dniester, Moldovans/Romanians accounted for about 71.5 per cent of the country's population, Ukrainians – 11.2 per cent, Russians – 9.4 per cent, Gagauz – 3.8 per cent, Bulgarians – 2.0 per cent, Gypsies – 0.3 per cent, Jews – 0.1 per cent and other nationalities – 1.6 per cent.

S.2.3.3. Demographic situation

During 1990-2011 the demographic processes featured a distinctive negative development pattern, which showed itself in the general instability of demographic indicators and phenomena as well as falling birth rate, growing mortality, demographic ageing, depopulation, etc. For example, the 2011 birth rate was 11.0‰ (17.7‰ in 1990), equal to the mortality rate (11.0‰ in 2011, respectively 9.7‰ in 1990); the infant mortality rates was 10.9‰ (19.0‰ in 1990); the share of population aged under 15 decreased down to 17.7 (27.9 per cent in 1990), and the age group of persons above 57/62 years increased respectively from up to 15.7 (12.6 per cent in 1990); the 'average life expectancy at birth' indicator somewhat increased - from 69.0 years in 1990 to 71.1 years (the respective indicator increased from 65.5 years to 67.1 years for males and from 72.3 years to 75.0 years for females).

S.2.3.4. Public Health

By the end of 2011 the health facilities network in the Republic of Moldova included: 86 hospitals, 759 medical facilities of ambulatory or polyclinic type, 42 sanitary-epidemiological facilities, 136 emergency stations and posts, three children homes and two tuberculosis sanatoriums. The number of beds in hospitals was circa 22.0 thousand or 61.9 beds per 10,000 population; respectively, the total number of doctors was 12.9 thousand, or 36.3 doctors per 10,000 population. The health care expenditures accounted for circa 13.3 per cent of the State Budget for 2011 year. Over the period from 1990 to 2011 the overall mortality rate tended to increase. The mortality breakdown analysis has demonstrated that cardiovascular pathologies are still the main cause of death (57.5 per cent), followed by tumours (14.4 per cent) and intestinal diseases (9.1 per cent). The mortality rates by region are not uniform, registering dramatic differences between the regions. In the last few years the lowest mortality rates were reported in urban areas (the municipality of Chisinau and in Balti), whereas the highest rates in northern districts (Donduseni, Briceni, Rascani, Drochia, Soldanesti and Glodeni).

S.2.3.5. Educational System

The Ministry of Education, the Municipal Education Departments, Regional General Departments of Education and Educational Establishments are responsible for the delivery of the primary, secondary general, secondary professional, secondary vocational and university education. At the beginning of the 2012/2013 school year the RM had 1397 operating primary and secondary general educational establishments, 67 secondary professional educational establishments, 47 secondary vocational education establishments (colleges), and 34 higher education establishments; post graduate studies for a doctoral degree being provided in 46 scientific research institutes and higher education establishments. The expenditures for education accounted for circa 21.4 per cent of the State Budget for 2011.

S.2.4. Institutional Arrangements

S.2.4.1. Institutional Arrangements Relevant for the Preparation of the NCs

On behalf of the Government of the Republic of Moldova, the Ministry of Environment (MoEN) is responsible for the implementation of international environment treaties to which RM is a Part (including the United Nations Framework Convention on Climate Change). Representatives of the MoEN also perform the function of the GEF Policy and Operations Focal Points, as well as the UNFCCC Focal Point. The Climate Change Office under the MoEN is totally responsible for the activities related to preparation of National Communications, National Inventory Reports and GHG Inventories in the Republic of Moldova.

S.2.5. Economical Context

S.2.5.1. Gross Domestic Product

In 2011 the share of Industry Sector in the GDP structure was 13.7 per cent, Agriculture – 12.3 per cent, Transport and Communications – 10.7 per cent, Constructions – 3.4 per cent, Wholesale and Retail Trade – 13.3 per cent, Financial Activities – 5.6 per cent, Other Sectors – 26.1 per cent, Net Product and Import Taxes – 17.0 per cent.

The country's economy was in decline even before 1991, but the separation from the USSR has accelerated that process considerably. Gross Domestic Product levels were decreasing continuously during the period from 1990 to 1999 inclusively, when it fell down to as little as 34 per cent of the 1990 level. The only exception was year 1997, when a slight increase by 1.6 per cent versus the previous year was registered due to the excellent agricultural yields as result of the very favourable weather. The reasons for the economic collapse were multiple. First, the Republic of Moldova had been integrated completely in the USSR economic system, and the independence resulted, among other things, in the cessation of any subsidies or cash transfers from the centralized government. Second, the end of the Soviet Era with its well established commercial links has resulted in the emergence of multiple obstacles for free movement of products, and in access restrictions introduced by the emerging markets. Third, the lack of domestic energy resources and raw materials in the Republic of Moldova has contributed considerably to the nation's strong dependence on other former Soviet Republics. Certain internal reasons should be mentioned as well, such as: transition from a centralized economy to a market economy; loss of the industries located in Transnistria (separatist region on the left bank of Dniester river); frequent droughts; and the civil conflict. The considerable GDP growth achieved since 2000 seems to indicate that the economy is finally developing in the correct direction, although it should be remembered that in 2011 the GDP reached only 61.0 per cent of the 1990 level (Figure S-1).

S.2.5.2. Inflation

The inflation rate grew dramatically up to approximately 788.5 per cent in 1993 and slowed down to 7.7 per cent in 1998. The 1998 depreciation of the Russian Rubble caused rapid growth of the inflation up to 39.3 per cent. Later, the RM achieved a significant progress in terms of controlling its inflation rate, and the inflation rate decreased to 5.2 per cent in 2002; however, the 2003 average inflation rate for the year increased up to 11.7 per cent driven by the growing prices for agricultural products (as result of a severe drought), and the above growth pattern persisted in the subsequent years; the inflation reached 12.4 per cent in 2004, but decreased to 11.9 per cent in 2005 – only to grow up to 12.7 per cent in 2006, in particular due to the increased prices for the natural gas imported from Russian Federation, for fuels and medications. The average inflation rate for the year was about 12.4 per cent in 2007 and 12.7 per cent in 2008. This increase was determined by the growing prices for public utilities, increasing food demand and the growth of the purchasing power. In 2009, the inflation rate represented about 0.006 per cent, increasing up to 7.4 per cent in 2010 and to 7.6 per cent in 2011, in particular, due to the more evident growth of food and fuels prices, and partly being influenced by developments in the foreign exchange markets.

S.2.5.3. Trade Balance Deficit

Moldova's import expenses exceed considerably the nation's proceeds from its exports, thus indicating a serious problem in terms of the nation's trade balance deficit. That deficit reached 24 per cent of the GDP in 2000, up to 42.5 per cent of the GDP in 2011. The above reflects the nation's dependence on the imports of energy resources and the growing demand for the imported products. The imports growth is driven by the massive inflow of cash transfers from abroad, which are channelled in domestic consumption.

S.2.5.4. Cash Transfers and Remittances

Cash transfers from outside the country, and in particular cash inflows from the Moldovans working abroad are of major importance for the economy of the Republic of Moldova. In 2011 the total net inflow of foreign currency from the Moldovans employed abroad was approximately USD 1.6 billion or about 22.9 per cent of the GDP. Globally, the RM is among the leaders regarding the share of remittances in GDP[1].

S.2.5.5. Investments

Investments play an essential role in the economic growth of the country, increasing significantly over the last years. In 2012, the investments in the national economy represented about 18.0 billion MDL, equivalent of 1.5 billion USD (20.5

[1] <http://data.worldbank.org/indicator/BX.TRF.PWKR.CD.DT/countries/1W?order=wbapi_data_value_2008%20wbapi_data_value%20wbapi_data_ value-first&sort=asc&display=default>.

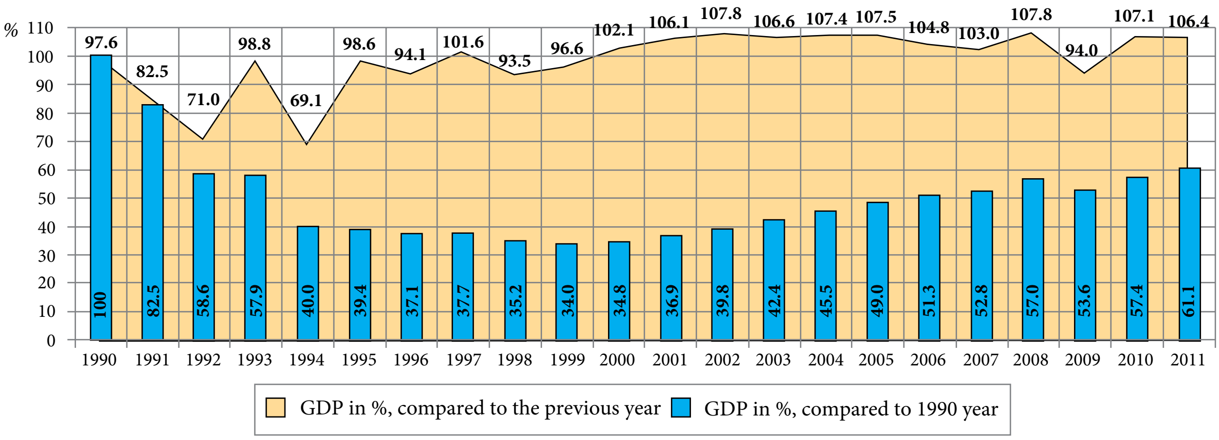


Figure S-1: Gross Domestic Product in the Republic of Moldova during 1990-2011 time series per cent of GDP). In 2011, the direct foreign investments attracted to the national economy (net values) accounted for USD 0.294 billion (4.2 per cent of GDP). The top investor countries for the Republic of Moldova include: the Netherlands, Russian Federation, Spain, USA, Germany, Romania, France, UK and Turkey. The international investment position represented at the end of 2012 – USD 3.22 billion; in 2011 – USD 3.17 billion; in 2010 – USD 2.65 billion; in 2008 – USD 1.81 billion; in 2006 – USD 2.09 billion; in 2005 – USD 1.72 billion; in 2004 – 1.64 billion; in 2003 – USD 1.69 billion.

S.2.5.6. Social Sphere

The average monthly salary of an employee in the national economy was MDL 3477.7 in 2012, a 8.9 per cent increase versus the same period of 2011. The average monthly old-age pension was MDL 957.6 as of January 1, 2013, increasing by 9.6 per cent as compared to its level as of January 1, 2012. The number of pensioners registered by the social security authorities as of January 1, 2013, represented 649.9 thousand people, with 11.3 thousand more compared to January 1, 2012. The number of unemployed in 2012 was 62.2 thousand, compared to 81.5 thousand in 2010. The unemployment rate (unemployed persons as a percentage of the total economically active population) recorded at the country level represents 4.8 per cent (5.9 per cent for males and 3.7 for females).

S.2.6. Current State of the National Economy

S.2.6.1. Industry

In 2011 the industrial production reached 51.6 per cent of the 1990 level (Figure S-2). During 1990-2011 the industrial production featured certain fluctuations, showing the best performance between 2000-2005 and 2010-2011 and the worst performance between 1990-1999; 2006-2007 and in 2009 year. The situation in the manufacturing industry was determined mainly by the processing industry which account for 82.6 per cent of the total production of the large enterprises whose main business was manufacturing. Food and drinks industry accounted for the highest share in the processing industry performance (processing and canning of meat and meat products, fruit and vegetables, production of dairy products, pastry, fodder, bread and baked products, sugar, confectionary, cocoa, chocolate, confectionary, alcoholic drinks, wine, beer, etc.) (circa 41.5 per cent of the total production), as well as production of other products of non-ferrous minerals (manufacturing of glass and glass products; fritted bricks and tiles; cement; lime; gypsum and concrete elements) (8.2 per cent of the total volume).

S.2.6.2. Energy

Total energy consumption in 2011 in the RM accounted for as little as circa 22.4 per cent versus the level of 1990 (electricity consumption – 47.7 per cent, and heat consumption, respectively circa 20.9 per cent). The main power generation facilities in the RM are: Moldovan Thermal Power Plant (MTPP) in Dnestrovsk (ATULBD) with the installed capacity of 2520 MW (available output of around 950 MW); Combined Heat Power Plant No. 1 (CHP-1) in Chisinau with the installed electricity generation capacity of 46 MW (available output of about 40 MW) and installed heat generation capacity of 455 MW; Combined Heat Power Plant No. 2 (CHP-2) in Chisinau with the installed electricity generation capacity of 240 MW (available output of around 210 MW) and installed heat generation capacity of 1425 MW; Combined Heat Power Plant North (CHP-North) in Balti with the installed electricity generation capacity of 28.5 MW (available output of about 24 MW) and installed heat generation capacity of 610 MW; CHPs of the sugar mills with the total installed capacity of 98 MW (available output of around 20 MW), Dubasari Hydro-Power Plant (HPP) with the installed capacity of 48 MW (available output of about 30 MW) and Costesti HPP with the installed capacity of 16 MW (available output of about 10 MW).

S.2.6.3. Agriculture

In 2011, the agriculture production by all categories of producers totalled only 59.0 per cent of the 1990 level (Figure S-2).

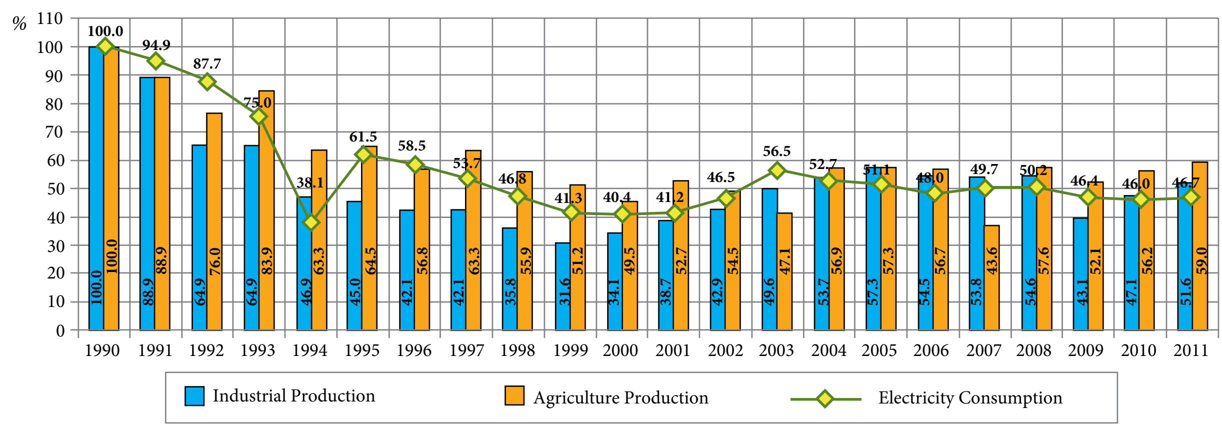


Figure S-2: Dynamics of the Main Economic Indicators of the Republic of Moldova, compared to 1990 year (in %), 1990-2011

The agricultural production over 1991-2012 was characterized by fluctuations, with the best performance reported in 1993, 1997, 2004 and 2008, and with poor results – respectively in 1992, 1994, 1996, 1998, 2003, 2007 and 2012, in most cases being caused by unfavourable climate conditions (severe droughts in 2003, 2007 and 2012). In 2012, irrigation was available on 30 thousand ha of the agricultural plantations, or 89.7 per cent less than in 1990 (292 thousand ha). The amount of synthetic and organic fertiliser applied to soil has reduced significantly as compared to 1990: 30.9 thousand tonnes of synthetic fertilisers in 2011, and 31.5 thousand tonnes of organic fertilisers, or by 86.7 per cent and respectively 99.7 per cent less than in 1990 (232.4 thousand tonnes of synthetic fertilisers and 9.74 million tonnes of organic fertilisers). As compared to 1990 (standing by the end of the year), the number of domestic livestock and poultry has reduced considerably: cattle - by 78.8 per cent (1060.7 thousand in 1990, 224.4 thousand in 2011), sheep - by 42.0 per cent (1244.8 thousand in 1990, 721.9 thousand in 2011), swine - by 74.5 per cent (1850.1 thousand in 1990, 472.0 thousand in 2011), and rabbits – by 1.6 per cent (283.0 thousand in 1990, 278.4 thousand in 2011); at the same time, increased the number of goats – by 235.9 per cent (37.1 thousand in 1990, 124.3 thousand in 2011), poultry – by 40.4 per cent (24625.0 thousand in 1990, 34563.9 thousand in 2011), asses and mules – by 25.0 per cent (1.7 thousand in 1990, 2.5 thousand in 2011) and horses – by 8.7 per cent (47.2 thousand in 1990, 51.1 thousand in 2011) .

S.2.6.4. Transport

RM's transport sector is comprised of the following segments: road transportation, railway transport, air transportation and naval transportation. The national network of roads has a total length of 10,826 km (including 9,352 km – on the right bank of Dniester, 1,474 km – on the left bank of Dniester; hard-surface roads: 8,827 km – on the right bank of Dniester and 1,430 km - on the left bank of Dniester). The network of roads is sufficiently developed (the public roads density represents about 320 km/1000 km^2, while the hard-surface roads - circa 303 km/1000 km^2), but the state of the roads and the infrastructure in general is deplorable, though in the last five years repairs and restoration of the national road network are being widely performed. In 1990-2011 the number of road vehicles in the RM has significantly increased: trucks – by 79.1 per cent (from 79.192 thousand to 141.851 thousand), buses and minibuses – by 82.2 per cent (from 12.033 thousand to 21.919 thousand), and cars - by 105.6 per cent (from 261.204 thousand to 537.145 thousand). The history of railway transportation dates back 140 years. The total length of railway lines is 1,157 km, while the density per 1,000 km^2 is 34.2 km. RM's river transport is in the process of development and growth in terms of both the number of ships and the number of river ports. The length of waterways for general use is currently about 624 km (including 558 km on the right bank of Dniester, respectively 66 km on the left bank of Dniester). There are 4 airports in the RM: in Chisinau, Balti, Cahul and Marculesti, of which only the Chisinau airport offers regular scheduled flights. The airports in Cahul and Marculesti are still in the process of obtaining the required statutory approvals and certificates. The Balti Airport is certified, but it offers only charter flights. In comparison with 1990 the freight transportation has reduced considerably, both in terms of the freight transportation turnover (by 90.7 per cent: from 331.1 mil. tonnes in 1990, to 30.7 mill. tonnes in 2011), as well as freight transportation distance (by 77.8 per cent: from 21,648 mill. tonnes-km in 1990, to 4,795 mil. tonnes-km in 2011). The same period of time witnessed the significant reduction in number of passengers (by 68.9 per cent: from 757.7 mill. passengers in 1990, to 235.7 mill. passengers in 2011), as well as in passengers transportation distance (by 57.6 per cent: from 10,102 mill. passengers-km in 1990, to 4,286.3 mill. passengers-km in 2011).

S.3. National Greenhouse Gases Inventory

S.3.1. Republic of Moldova's Contribution to Global Warming

In 1990, RM's contribution accounted for only about 0.3 per cent of total global GHG emissions. Within the 1990-2010, the total national GHG emissions (without LULUCF) decreased by 72.3 per cent, from 43.2598 Mt CO_2 eq. in 1990, to 13.2761 Mt CO_2 eq. in 2010.

S.3.2. Institutional Arrangements for Inventory Preparation

Within the Ministry of Environment (MoEN), the Climate Change Office is totally responsible for the activities related to preparation of National Communications (NCs), National Inventory Reports and National Greenhouse Gas Inventories.

S.3.3. Methodological Issues

The national inventory is structured to match the reporting requirement of the UNFCCC and is divided into six main sectors, and each of these sectors is further subdivided within the inventory into source categories. Emissions of direct (CO_2, CH_4, N_2O, HFC, PFC and SF_6) and indirect (NO_x, CO, NMVOC and SO_2) greenhouse gases were estimated based on methodologies contained in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997), Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), Good Practice Guidance for LULUCF (IPCC, 2003), Atmospheric Emissions Inventory Guidebook (CORINAIR, 1996, 1999, 2009) and 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006).

S.3.4. Key Categories

In order to prioritize efforts aimed at improving the overall quality of the inventory, based on recommendations set forth in the Good Practice Guidance (IPCC, 2000), the key categories were identified for the time series 1990 through 2010, the analysis of which was carried out based on Tier 1 methodological approach, with LULUCF: 18 key categories by level (L) and 17 key categories by trend (T); and without LULUCF: 17 key categories by level (L) and 15 key categories by trend (T).

S.3.5. Quality Assurance and Quality Control

The basic Quality Assurance and Quality Control activities carried out in the Republic of Moldova included detailed specific procedures implied by Tier 1 approach (general procedures) and Tier 2 approach (source-specific), and standard verification and quality control forms and checklists that serve to standardize the process of implementing quality assurance and quality control activities meant to ensure the quality of the national inventory; technical review (audit) carried out by experts who were not directly involved in the national inventory compilation/development process; activity data quality check, including by comparing data obtained from different sources, as well as further documentation of the national inventory development process. As the entity responsible for the national inventory development, the CCO holds all documentation used for inventory compilation.

S.3.6. Recalculations

The National GHG Inventory Team revised and recalculated GHG emissions and CO_2 removals for each calendar year covered by the Second National GHG Inventory for the period from 1990 through 2005, a component part of the SNC (2009). These activities were carried out during the ongoing process of improving the quality of the National GHG Inventory. Under current inventory cycle, improvements were made in all sectors (use of higher tier methodologies, revision of previously used methodological approaches and emission factors, activity data, inclusion of new emission sources, etc.), entailing the need to make recalculations of national GHG emissions for the time period from 1990 through 2005. In comparison with the results reported under the SNC, the changes performed during the development of the current inventory, resulted in increased values of national direct greenhouse gas emissions for the 1990-2005 periods, with a variation from a minimum of 0.5 per cent in 1992, to a maximum of 11.4 per cent in 1998.

S.3.7. Uncertainty Assessment

In the Republic of Moldova, the GHG emissions were estimated with the highest possible accuracy; however, the obtained results have a certain degree of uncertainty. Some emissions estimates, such as for example, CO_2 emissions from fossil fuels combustion, or CO_2 emissions from cement production, are considered to have minimal uncertainty. For other source categories, because of the poor quality of activity data, the use of default emission factors, as well as a consequence of limited understanding of the emissions generation process, the uncertainty is quite high. The overall inventory uncertainty was estimated for the period 1990-2010 using a Tier 1 methodological approach (IPCC, 2000), that is ±7.7 per cent uncertainty by level, and ±3.6 per cent uncertainty by trend.

S.3.8. Completeness Assessment

Generally speaking, the national inventory of the Republic of Moldova is a complete register of the following direct greenhouse gases – CO_2, CH_4, N_2O, HFC, PFC and SF_6. The national inventory also covers the following indirect greenhouse gases: CO, NO_x, NMVOC and SO_2. Despite the effort to cover all existent source/sink categories, the inventory still has some gaps, most being determined by lack of activity data needed to estimate certain GHG emissions and removals.

S.3.9. Reporting Direct Greenhouse Gas Emissions

Carbon dioxide continues to contribute most to the total national direct GHG emissions in the Republic of Moldova (Figure S-3).

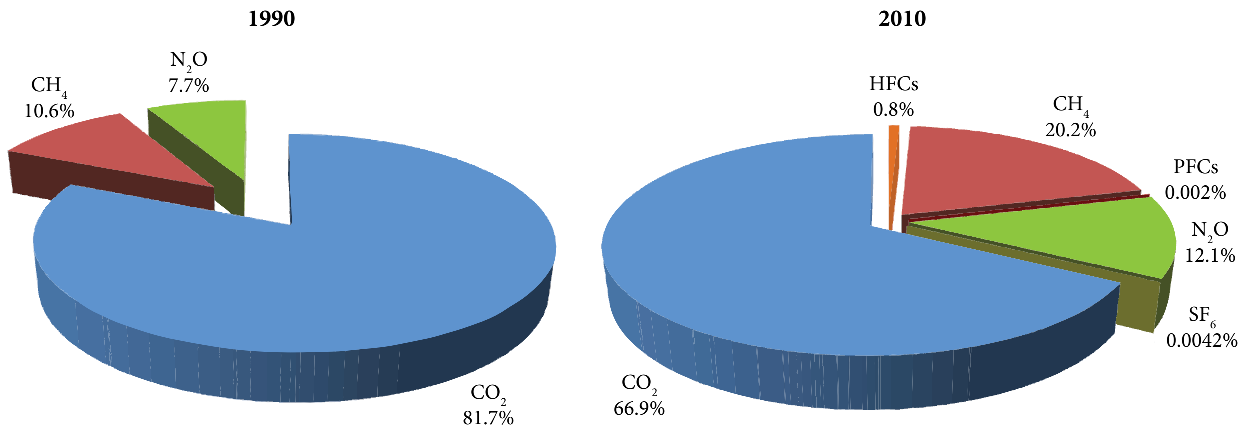


Figure S-3: Republic of Moldova's Direct GHG Emissions by Gas, 1990 and 2010

In the time series from 1990 through 2010, the total CO_2 emissions (without LULUCF) decreased by circa 74.9 per cent; emissions of CH_4 (without LULUCF) have decreased by circa 41.6 per cent, while emissions of N_2O (without LULUCF) decreased by circa 51.5 per cent (Table S-1). Evolutions of F-gases emissions show a steady trend towards increase, though their share in the total national GHG emissions structure is insignificant for now.

Energy Sector is the most important source of national direct GHG emissions (without LULUCF), its share varying from 79.8 per cent to 67.3 per cent over the time series from 1990 through 2010. Other relevant sources are represented by the Agriculture Sector (having a share of 11.8 per cent in 1990 and respectively 16.0 per cent in 2010), Waste Sector (3.8 per cent in 1990 and respectively 11.9 per cent in 2010), and Industrial Processes Sector (4.4 per cent in 1990 and respectively 4.2 per cent in 2010) (Figure S-4).

In the time series 1990 through 2010, total direct emissions and removals in the Republic of Moldova tended to decrease, so emissions under Energy Sector decreased by circa 74.1 per cent; Industrial Processes Sector – by circa 70.3 per cent; Solvents and Other Products Use Sector – by circa 40.7 per cent; Agriculture Sector – by 58.4 per cent; LULUCF Sector – by 100.4 per cent; and Waste Sector – by 3.0 per cent (Table S-2).

S.3.10. Reporting Ozone and Aerosol Precursors Emissions

Photochemically active gases, such as carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC) are not regarded as greenhouse gases; however they contribute to greenhouse effect in an indirect way. These gases are considered to be ozone precursors influencing formation and disintegration of ozone in the atmosphere. Mainly, they persist in the exhaust gases

Table S-1: Greenhouse Gas Emission Trends in the RM within 1990-2010 time periods, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996
CO_2 (without LULUCF)	35.3561	31.0769	21.8231	16.5959	14.9995	11.5570	11.6641
CO_2 (with LULUCF)	28.1758	25.9968	16.7116	14.1791	12.6202	10.3962	10.6555
CH_4 (without LULUCF)	4.5884	4.4620	4.3616	4.1363	4.0357	3.8149	3.7936
CH_4 (with LULUCF)	4.5907	4.4640	4.3635	4.1388	4.0371	3.8169	3.7950
N_2O (without LULUCF)	3.3153	3.3255	2.4631	2.4338	1.8684	2.0071	1.8367
N_2O (with LULUCF)	3.3163	3.3263	2.4639	2.4348	1.8690	2.0079	1.8373
HFCs	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	0.0019	0.0041
PFCs	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
SF_6	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
Total (without LULUCF)	43.2598	38.8643	28.6479	23.1660	20.9036	17.3809	17.2985
Total (with LULUCF)	36.0828	33.7870	23.5389	20.7527	18.5263	16.2228	16.2919
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
CO_2 (without LULUCF)	10.6911	9.0655	7.1684	6.3903	7.0002	6.6770	7.4889
CO_2 (with LULUCF)	10.8640	8.8753	6.6077	5.6070	6.7194	6.6052	6.4424
CH_4 (without LULUCF)	3.3948	3.2648	3.2389	3.1089	3.0090	3.0052	2.9385
CH_4 (with LULUCF)	3.3973	3.2671	3.2411	3.1097	3.0102	3.0055	2.9386
N_2O (without LULUCF)	1.9338	1.7038	1.5323	1.3983	1.5634	1.6227	1.3892
N_2O (with LULUCF)	1.9348	1.7047	1.5332	1.3986	1.5639	1.6228	1.3892
HFCs	0.0066	0.0095	0.0115	0.0134	0.0165	0.0195	0.0259
PFCs	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
SF_6	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	0.0000
Total (without LULUCF)	16.0263	14.0435	11.9511	10.9108	11.5891	11.3244	11.8425
Total (with LULUCF)	16.2026	13.8565	11.3935	10.1287	11.3099	11.2530	10.7960
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
CO_2 (without LULUCF)	7.9717	8.3678	7.6996	7.6515	8.7307	8.9607	8.8852
CO_2 (with LULUCF)	8.2813	8.2632	7.2964	5.0388	8.8607	8.0887	8.9113
CH_4 (without LULUCF)	2.8866	2.8704	2.7878	2.6925	2.6923	2.6825	2.6808
CH_4 (with LULUCF)	2.8868	2.8706	2.7881	2.6942	2.6929	2.6828	2.6810
N_2O (without LULUCF)	1.6608	1.6622	1.5833	0.9846	1.6218	1.3935	1.6071
N_2O (with LULUCF)	1.6609	1.6623	1.5835	0.9859	1.6222	1.3937	1.6072
HFCs	0.0320	0.0394	0.0471	0.0604	0.0763	0.0871	0.1024
PFCs	NE, NO	NE, NO	0.0000	0.0000	0.0000	0.0000	0.0000
SF_6	0.0000	0.0000	0.0003	0.0004	0.0004	0.0005	0.0006
Total (without LULUCF)	12.5511	12.9399	12.1180	11.3894	13.1216	13.1243	13.2761
Total (with LULUCF)	12.8611	12.8357	11.7152	8.7796	13.2525	12.2528	13.3025

Abbreviations: NE – Not Estimated; NO – Not Occurring.

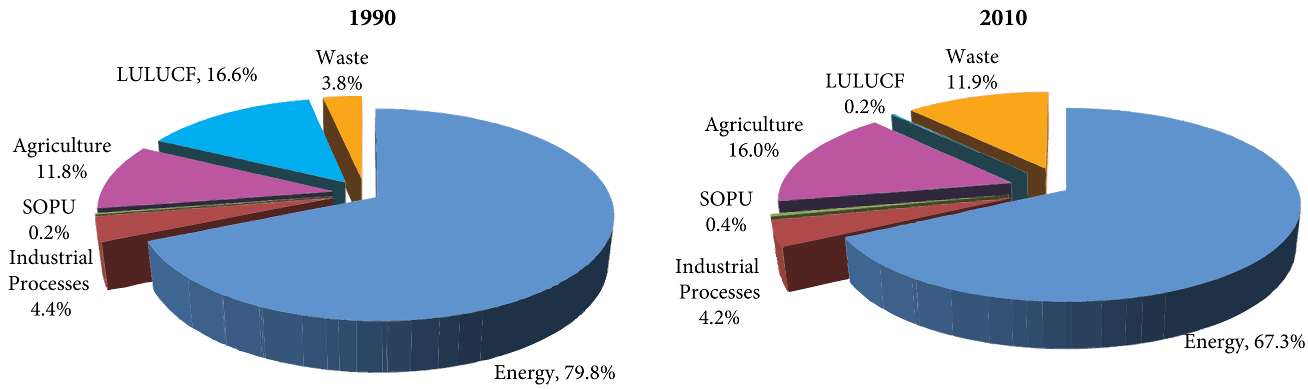


Figure S-4: Sectoral Breakdown of the RM's GHG Emissions in 1990 and 2010

Table S-2: GHG Emission/Removals Trends by Sector in the RM within 1990-2010, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996
1. Energy	34.5204	30.2204	21.3842	16.4752	15.0077	11.7107	11.9417
2. Industrial Processes	1.9010	1.8067	1.1743	0.7701	0.6230	0.4915	0.4368
3. Solvents and Other Products Use	0.0908	0.0782	0.0625	0.0508	0.0417	0.0382	0.0339
4. Agriculture	5.1202	5.0028	4.1542	4.0033	3.4099	3.3591	3.0718
5. LULUCF	-7.1770	-5.0773	-5.1089	-2.4133	-2.3773	-1.1581	-1.0066
6. Waste	1.6274	1.7563	1.8727	1.8665	1.8213	1.7815	1.8143
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
1. Energy	10.7761	9.2605	7.3728	6.6623	7.2653	6.9497	7.7622
2. Industrial Processes	0.4898	0.3433	0.3086	0.2812	0.2727	0.3304	0.3828
3. Solvents and Other Products Use	0.0299	0.0238	0.0309	0.0316	0.0453	0.0385	0.0357
4. Agriculture	2.9873	2.7318	2.4885	2.2770	2.4541	2.5246	2.1969
5. LULUCF	0.1763	-0.1870	-0.5577	-0.7821	-0.2791	-0.0714	-1.0465
6. Waste	1.7432	1.6841	1.7503	1.6586	1.5517	1.4812	1.4650
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
1. Energy	8.2344	8.5189	7.7036	7.4085	8.4274	9.0660	8.9465
2. Industrial Processes	0.4288	0.5684	0.6638	0.9458	1.0222	0.5201	0.5650
3. Solvents and Other Products Use	0.0438	0.0682	0.0482	0.0522	0.0536	0.0485	0.0539
4. Agriculture	2.4012	2.3734	2.2682	1.5151	2.1177	1.9249	2.1324
5. LULUCF	0.3099	-0.1042	-0.4028	-2.6098	0.1309	-0.8715	0.0264
6. Waste	1.4430	1.4111	1.4343	1.4678	1.5007	1.5649	1.5783

from the vehicles, result from fossil fuel combustion in stationary sources, from solvents and other products use etc. The national GHG inventory of the RM includes emissions of the following ozone precursors and aerosol gases: NOx, CO, NMVOC and SO_2.

In 1990-2010, NO_x emissions decreased by 73.0 per cent; CO emissions decreased by 73.9 per cent; NMVOC emissions decreased by 81.4 per cent, while SO_2 emissions deceased by 93.6 per cent (Table S-3).

Table S-3: Ozone and Aerosol Precursors Emission Trends in the RM within 1990-2010, Gg

	1990	1991	1992	1993	1994	1995	1996
NO_x	137.2194	118.9043	79.9920	63.1479	56.7902	47.8938	45.1745
CO	428.0672	376.9457	195.6386	160.3229	146.6000	145.3208	142.8140
NMVOC	512.2303	424.0149	334.4593	266.7580	175.1392	162.6902	148.9657
SO_2	294.9063	256.1539	170.1669	146.0971	102.6067	61.0006	58.9692
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
NO_x	41.9948	35.2592	25.8379	24.5483	26.7705	27.4538	30.8025
CO	138.7959	122.6704	86.9378	84.2057	87.3850	99.7837	118.1225
NMVOC	75.1749	62.6311	39.5516	37.4619	45.6717	45.6605	48.3082
SO_2	33.9676	26.9756	14.0259	9.9288	9.4514	10.5082	13.0501
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
NO_x	32.3275	49.3686	31.0410	31.4840	34.8908	34.9055	37.0635
CO	121.9150	124.7128	116.0094	118.1991	120.5858	114.0031	111.9294
NMVOC	56.2400	67.3736	65.8121	129.9583	87.1732	60.5991	95.2324
SO_2	11.2448	11.8426	12.3622	10.7123	14.8404	18.2960	18.7756

S.4. Climate Change Mitigation Policies and Measures

In 2012, the Government of the Republic of Moldova approved the National Development Strategy „Moldova 2020", which outlines seven country priorities. Although none of these are dedicated to climate change, many of them are directly related to reduction of greenhouse gas emissions. Along with this, the Government realized the importance of climate change mitigation, and decided that the latter be addressed by drafting a separate strategy. Thus, Republic of Moldova has developed the Low Emission Development Strategy (LEDS) until 2020 and plans to approve it the first quarter of 2014. The LEDS will consolidate and guide the sector development approach outlining the medium term objectives and strategy for climate change mitigation.

The overall objective of the Strategy is: *„reducing by 2020 the total direct greenhouse gas emissions by at least 20% compared to the Business-As-Usual (BAU) scenario to support the global effort in maintaining the average global temperature growth trend in the following 100 years within the limit of up to 2°C"*.

It is envisaged that the overall objective will be reached by fulfilling respective sector commitments. Thus, the reduction by 2020 of direct greenhouse gas emissions compared to the BAU scenario will register 20% in the energy sector, 15% in transport sector; 20% in buildings; 15% in industry; 15% in agriculture sector, 25% in the forestry sector, and 10% in waste sector.

The LEDS effectively consolidates the objectives relating to GHG mitigation, stipulated in a number of country policies and legislative acts, including in the National Development Strategy „Moldova 2020", Energy Strategy of the Republic of Moldova until 2030, Law on Energy Efficiency, Law on Renewable Energy, National Strategy for Sustainable Development of Agro-Industrial Complex of the Republic of Moldova (2008-2015), National Strategy for Waste Management 2013-2027, and others.

The Government has also approved the National Energy Efficiency Program for 2011-2020, the Methodology for determination, approval and application of tariffs for electricity produced from renewable energy sources and biofuel, the Soil Fertility Conservation and Enhancement Program for the period 2011-2020, the State Program for Regeneration and Afforestation of the Forestry Fund Land Areas for 2003-2020, and others. The country has the institutional structures needed for the implementation of outlined policies.

S.4.1. Economic Instruments

Taxes are known as the most influential instruments for accomplishing the greenhouse gas reduction objective. We have to acknowledge that, until to date, few levers of such kind are used in Moldova in this regard, while those designed for greenhouse gas emissions mitigation practically have not worked. With the view to improve the situation regarding environmental taxes, in 2011, the GEF launched a project on Capacity building to promote fiscal reforms in the environment area.

S.4.2. Climate Change Mitigation Policies and Measures by Sector

S.4.2.1. Energy Sector

Energy sector policies are reflected in the Energy Strategy of the Republic of Moldova until 2030, which has three main objectives: insuring energy supply security, the country imports circa 95% of the energy resources needed; creating competitive markets and insuring their regional and European integration; ensuring environment sustainability and combating climate changes.

Under "Environment sustainability and combating climate changes" objective, it is envisaged to improve energy efficiency and increase the use of renewable energy by establishing a modern regulatory framework.

The objectives set for the period until 2020 are:

- reducing energy intensity by 10% until 2020;
- reducing losses in the transmission and distribution networks: by up to 11% until 2020 (by up to 13% until 2015) for electricity; by 39% until 2020 (by 20% until 2015) for natural gas; and by 5% until 2020 (by 2% until 2015) for heating, respectively;
- reducing greenhouse gas emissions by 25% (compared to the baseline year 1990) until 2020;
- reducing energy consumption in buildings by 20% until 2020;
- insuring a 10% share of renovated public buildings until 2020;
- ensuring a 10% share of annual electric power production from renewable energy sources by 2020;
- stimulating the use of energy produced from renewable energy sources, relative to the total gross domestic consumption - 20% by 2020;
- ensuring a 10% share of biofuels in the total fuel used by 2020, with an intermediary objective of 4% by 2015.

Also, in compliance with the EU energy efficiency improvement objectives, the National Energy Efficiency Program for 2011-2020 establishes long term energy savings in proportion of 20% until 2020, which constitutes approximately 14,167.857 TJ and will contribute to greenhouse gas reduction by approximately 761,498.7 tons of CO_2 equivalent.

Electricity from Renewable Sources

The policy framework regulating electricity production from renewable sources is set in the *Law on Renewable Energy* now in the process of amendment with the aim to facilitate the implementation of such sources by introducing "feed-in" tariffs. It is expected that by 2020, the greenhouse gas emissions will decrease by approximately 240 Gg CO_2, as a result of putting approximately 400 MW of renewable capacity into operation. However, the accomplishment of this desideratum stumbles in the country capacity to insure the balancing power needed, for which reason another solution to meeting the energy demand is proposed.

Heating with Biomass

The policy framework regulating the promotion of biomass is set in the Law on Energy Efficiency, being more pragmatically formulated in the National Energy Efficiency Program for 2011-2020. Respective policies are carried out including through the Energy Efficiency Fund, established in 2012, as well as through the assistance received from foreign donors.

Co-generation Power Plants

The Law on Energy Efficiency establishes policies on the use of co-generation power plants. Due to the lack of thermal load, the development of such plants on country territory is viewed with reserves. Moreover, the continuous diminishing of thermal load at the existing cogeneration pour plants (CET-1, CET-2, and CET-Nord) makes the latter become less profitable.

S.4.2.2. Transport Sector

Greenhouse gas emissions are to be reduced in the transport sector through:

a) Reduction of carbon content in the fuels used by land vehicles by substituting the traditional fuel (gasoline and diesel oil) with compressed natural gas and liquefied petroleum gas, and by diluting the traditional fuels with biofuels;

b) Increase of auto fuel combustion efficiency by limiting the age of imported vehicles (the country is not a cars manufacturer);

c) Encouraging the use of environmentally clean vehicles and promoting public transport, as well as zero emissions transport modes (biking, walking); such encouragement has been promoted to a small extent until now;

d) Promoting global emissions trading schemes; the aviation sector is the first sector of Moldova to be mandatorily included in the EU emissions trading scheme, with an officially set emissions ceiling established;

e) Improving the infrastructure and taxation for using it; fuel consumption on bad roads increases by up to 20%; by 2020, the Republic of Moldova will have 38% of very good roads and 42% of good roads.

S.4.2.3. Buildings Sector

The buildings sector can contribute to making energy savings between 10% and 12% of the 20% national target by 2020. The policy on energy consumption reduction in buildings is outlined in the National Energy Efficiency Program for 2011-2020, Energy Strategy of the Republic of Moldova until 2030, as well as in the draft Law on Buildings Energy Performance.

S.4.2.4. Industrial Sector

In the industrial sector, environment related issues are reflected episodically and, as a rule, very generally, in a number of legislative acts. Along with these, the Republic of Moldova has signed the International Agreement on substances destroying the ozone layer, and approved a law in this regard as well. The reduction of greenhouse gas emissions by applying energy efficiency is provided for in a number of normative acts, with a significant contribution from foreign donors as well.

S.4.2.5. Agriculture Sector

Greenhouse gases in agricultural sector basically originate from three big sources: enteric fermentation, manure management and agricultural soils. To accomplish the objective of increasing the animal production, programs and strategies for improving the genetic fund of animals and poultry are being implemented. Along with these trends, the specific emissions will decrease. The use of animal manure increases every year, either for the purpose of producing biogas or for enhancing soil fertility, which fact will also contribute to reduction of greenhouse gas emissions. Promoting conservative tillage (no-till and min-till) technologies will also contribute to reducing GHG emissions from agriculture soils.

S.4.2.6. Forestry Sector

To date, forests cover approximately 12% of the country's territory, which is insufficient. To improve the situation, the authorities have traced the objective to increase the afforested areas up to 15% by 2020, concurrently improving the condition of existing forests. In this context, several policies were approved over the last decade to accomplish the set objective, while the key actions are outlined in the State Program for Regeneration and Afforestation of the Forestry Fund Land, planned for 2003-2020, and in the Program for Rational Land Use and Soil Fertility Enhancement for 2002-2010. Non-pollutant Development Mechanisms Projects "Soil Conservation in Moldova", and "Community Forestry Sector Development in Moldova" also contribute to the accomplishment of this objective.

S.4.2.7. Waste Sector

Mitigation policies in the waste sector are oriented towards discouraging the waste storage in municipal solid waste disposal sites and encouraging their recycling, providing sewerage services to the whole urban area, as well as to social objects from rural area. In this sense, the Government approved the Strategy for Waste Management in the Republic of Moldova for 2013-2027, the Law on Environment Pollution Fee, the Law on Industrial and Household Waste, the Law on Air Protection, etc. However, the actions taken until to date have not been sufficiently successful. The implementation of taxes and fees envisaged in this regard faced difficulties due to incoherence in the chain, from their setting to the effective payment. At the same time, even without palpable legal incentives for the rational use of biodegradable waste, the economic entities apply a policy of reusing such wastes, the very high price of fossil fuels constituting one of the main incentives in this respect, as it has increased more than 5 times over the last seven years. Two CDM projects currently underway, entitled "Biogas production from pressed sugar beet pulp at Südzucker Moldova" (Drochia, Republic Moldova) sugar refinery, and "Biogas capturing and electricity generation at the municipal solid waste landfill in Ţînţăreni", also contribute to reducing the greenhouse gas emissions originating from the waste sector.

S.5. Projections of Greenhouse Gas Emissions and Mitigation Policies and Measures Effect

S.5.1. Medium-Term Projections of Greenhouse Gas Emissions in the Republic of Moldova

The promotion of mitigation policies and measures reflected above, will lead to the following evolution of greenhouse gas emissions in the RM (Table S.5-1). As can be noted from the table, a continuous decrease of GHG emissions is expected during the years following 2010, reaching 27.6% of GHG emissions level recorded in the base year (1990) by 2020. In other words, the commitment of the RM under the Copenhagen Accord on reducing the emissions by at least 25% compared to the level recorded in 1990 will be over-fulfilled by 2020. In addition to the projection of GHG emissions reflected in Table S-4, which corresponds to With Measures Scenario (WM) related to the country's mitigation policies reflected in more details in Chapter 3 of the TNC, this report contains a projection of GHG emissions for Business-As-Usual (BAU) Scenario and for the With Additional Measures (WAM) Scenario.

S.5.2. Tools Used to Assess the Mitigation Potential

The mitigation potential has been assessed by applying the following tools:

- Energy Sector: WASP and IMPACT models from ENPEP software package; LEAP model; standard calculation tool (IPCC, 1997); as well as MS Excel based calculation tools developed by experts;
- Industrial Processes and Agriculture Sectors: software for the workbook of the Revised 1996 IPCC Guidelines (IPCC, 1997);
- LULUCF Sector: CO_2 FIX V2.0 model, developed by the European Forestry Instituted for CASFOR Project, as well as software for the workbook of the Revised 1996 IPCC Guidelines (IPCC, 1997);
- Waste Sector: calculation tool created by Swiss Company INFRAS for the First Order Decay Method; and the software for the workbook of the Revised 1996 IPCC Guidelines (IPCC, 1997).

S.5.3. Medium-Term Projections of Greenhouse Gas Emissions by Sector

S.5.3.1. Energy Sector

I. Electrical Power Sector

The BAU scenario envisages preserving the energy sources development and refurbishment trend established over the past years. The WM scenario involves the construction of 650 MW combined cycle power plants, the first group of 100 MW being put into operation in 2018, the second group of 175 MW – in 2019, while the rest 375 MW – in 2020. Renewable sources will be put into operation gradually, the wind sources starting with 2.5 MW in 2014 and finishing with 75 MW in 2020, accumulating in total 245 MW throughout this period; those of photovoltaic ones - starting with 1.5 MW in 2015, with a total of 4.5 MW constructed throu-

Table S-4: GHG emissions in the Republic of Moldova, Gg CO_2 equivalent

Greenhouse gas	BY	1990	1995	2000	2005	2010	2015	2020
		Historic data					Projections	
CO_2 (with LULUCF)		28175.8	10396.2	5607.0	8263.6	8911.3	6994.2	7102.5
CH_4 (with LULUCF)		4590.7	3816.9	3109.7	2870.6	2681.0	3022.9	2790.2
N_2O (with LULUCF)		3316.3	2007.9	1398.6	1662.3	1607.2	1669.4	1803.0
F-gases (HFC, PFC and SF_6)		0.0	1.9	13.4	39.5	103.0	151.8	226.3
Net emissions (with LULUCF)		36082.8	16222.8	10128.7	12836.0	13302.5	11838.2	11921.9
Total emissions (without LULUCF)	43259.8							
Compared to base year (without LULUCF), %			-62.5	-76.6	-70.3	-69.3	-72.6	-72.4
Level of emissions compared to base year, %			37.5	23.4	29.7	30.7	27.4	27.6

ghout the analysed period. To insure a balancing energy for these sources, approximately 250 MW gas turbines will be put into operation. The WAM repeats the BAU scenario, except the fact that in 2024, a 180 MW coal plant will be put into operation, while the import will reach a 25% level. By 2020, the WM scenario will ensure a reduction of direct GHG emissions by approximately 15%, while the WAM scenario would insure a reduction by approximately 23%.

Despite smaller GHG emissions reductions under WM scenario, the latter is also distinguished by a serious constraint. The average price of power produced under the WM scenario increases significantly starting with the years of putting the new electric power plants into operation, in 2020 exceeding the BAU scenario price by 44%, and that of the WAM by 48%. Such a significant discrepancy in the energy price is due to investments that are to be made, as well as the significant price for natural gas. Over two billion US dollars are to be used within approximately 6-7 years, which objective stirs reserves about its accomplishment. The WAM requires approximately 152.3 million US dollars for its implementation. The WM requires the availability of own sources for balancing the power of renewable sources when the wind or solar energy (SE) is missing. The cheapest source in this sense would be a combined cycle power plant (CCPP). However, it was demonstrated that the energy produced by the SE+CCPP tandem has a price by 25% higher than the energy coming from a coal power plant of the same capacity, even if the GHG emissions reduction would be purchased from the carbon market to insure the same emissions as in the SE+CCPP tandem. Another constraint in accomplishing the objectives of reducing the GHG emissions in the electricity subsector is the increasing price for natural gas applied at the heat and power plant in Dnestrovsk starting with 2013. As a result, the plant has started to use coal, which fact may significantly influence the level of emissions expected for the analysed scenarios.

II. Thermal Power Sector

Compared to 2005, by 2020 the total net emissions will decrease by 1.3% under the BAU, by 23.2% under the WM, and by 32.6% under the WAM scenarios. The GHG emissions reductions will be more visible than the power reduction, due to the implementation of energy efficiency measures and renewable energy sources. The most important constraints to accomplishing the proposed objectives are associated with the centralized heating system, which is very obsolete in the majority of country localities; thermal loads which are much lower than the designed ones, and tending to diminish, along with the limited payment capacity of the heating power consumers.

III. Transport Sector

Compared to BAU, by 2020 the WM promises a diminishing of total GHG emissions by approximately 13%, while the WAM – a reduction by circa 24%. It is worth mentioning that BAU scenario reaches the GHG emissions level characteristic to the base year only by 2030, while the emissions associated with the WM and WAM will be by 13% and 27% lower than those recorded in 1990. Among the most significant constraints to accomplishing the proposed objectives under the mitigation scenarios are: the low capacity of the country's economy to rehabilitate the road network which is rather deteriorated, as well as the existence of a commercial vehicle fleet unadjusted to the European quality and safety standards.

S.5.3.2. Industrial Processes Sector

Compared to the base year level, by 2030 the sector will record a GHG emissions level by 9.5% lower under the BAU, by 19.4 under the WM, and by 24.8% under the WAM scenarios. In relation with the BAU, the implementation of projected mitigation measures will allow reducing until 2030 the GHG emissions originating from the industrial processes sector by circa 11.0% under the WM and by 16.9% under the WAM, respectively. The main constraints to the efficient implementation of measures directed towards the GHG emissions mitigating under respective sector are: high degree of moral and physical depreciation of equipment at the industrial enterprises from the country and reduced financial possibilities for their restructuring; the lack of a real progress in attracting direct foreign investments; the lack of a sufficient political will in transposing EC Regulation 842/2006 on mitigation of fluorinated gas emissions.

S.5.3.3. Agriculture Sector

In agriculture sector, the BAU is distinguished by the lowest GHG emissions within the period until 2030. In 2020, GHG emissions generated under the WM will exceed the emission level generated under the BAU scenario by 12%, and the ones generated under the WAM scenario by 30%, respectively. In both WM and WAM scenarios, the GHG emissions constantly grow throughout the study period, the highest level of emissions being recorded under the WAM. This is explained by the need to develop the agriculture sector that has been in recession starting with 1990. The development of animal breeding sector will imminently lead to increasing the GHG emissions from enteric fermentation, while the increase of crops productivity would lead to increasing the GHG emissions as a result of intensified use of agricultural soils. Among the constraints of major impact on the accomplishment of mitigation scenarios the following can be highlighted: the plant production sector is dominated by low value added crops, while the share of high value added crops has reduced, including as a result of vineyard and orchard plantations aging, moral and physical depreciation of irrigation systems, lack of a modern market infrastructure, chronic lack of funds, as well as the lack of favourable conditions for attracting foreign investment; high fragmentation of approximately 50% of agricultural land in private ownership, etc.

S.5.3.4. LULUCF Sector

Compared to BAU, by 2020 the CO_2 emissions sequestration capacity will increase by six times under the WM, and by over 11 times under the WAM scenarios. Despite the increasing trend in CO_2 sequestration after 2010, characteristic to both the WM and the WAM scenarios, by 2030 the level of carbon sequestration recorded in 1990 will be no longer reached. The main constraints to reaching a high level of carbon sequestration in LULUCF sector are as follows: insufficient funds for afforestation activities; the increasingly unfavourable climate conditions during the last 30 years; essential extension of arboretums affected by forestry diseases and pests with the reduction of annual growth by circa 10-50%; the lack of a complex of economic and fiscal mechanisms for regulating and stimulating the actions for combating soil degradation, land desertification; excessive fragmentation of the agricultural land fund, etc.

S.5.3.5. Wastes Sector

Compared to BAU and WM scenarios, the WAM will be characterized by a stronger decrease of GHG emissions within the 2010-2030 periods. Thus, by 2030 the level of GHG emissions recorded under the BAU and WM scenarios will exceed the level of GHG emissions recorded in 1990 by 11.5 and 9.4%, respectively. Only under the WAM scenario there will be reached a decrease by circa 11.2%. The main constraints impeding the sustainable development of wastes sector are: the lack of regulations adequate to the current situation and EU legislation requirements; the lack of an infrastructure for planning, organizing, and implementing an integrated management system for waste and waste water at all levels; the lack of a sufficient funding capacity, etc.

S.5.4. Medium-Term Projections of Total Greenhouse Gas Emissions

Compared to the level of total GHG emissions (without LULUCF) recorded in 2010, by 2030 the total GHG emissions are expected to increase by circa 44% under the BAU, by 22% under the WM and by 14% under the WAN. In relation to the BAU, the implementation of planned mitigation measures will allow reducing by 2030 the total GHG emissions (without LULUCF) by 15% under the WM and by circa 20% under the WAM scenarios, respectively, while the net GHG emissions (with LULUCF) by circa 31% under the WM and by 48% under the WAM scenarios. The evolution of total GHG emissions within the 1990–2030 periods is provided in Figure S-5 and Table S-5.

S.6. Vulnerability and Adaptation Assessment

S.6.1. Use of Climate Vulnerability Index

Vulnerability is a key concept in climate change adaptation research. It is perceived as a function dependent on a number of biophysical and socio- economic factors. The approach used is attributed to the IPCC typology, otherwise speaking vulnerability was assessed as a function dependent on three determinants: *exposure, sensitivity and adaptive capacity*.

Assessment of vulnerability together with the adaptive capacity and its resilience component was needed to acquire the knowledge to prevent, moderate and adapt the Republic of Moldova to the future climate change impacts. Another purpose of the study was to gain knowledge about both the climate change impact and the country's capacity to respond to this challenge in order to prioritize, on a national level, the adaptation interventions and better target the climate change research.

The country's vulnerability profile was established by applying the Climate Vulnerability Index (CVI) at the national and sub- national levels. This approach was used as an express method to identify the strengths and weaknesses of the country, to identify structural causes of vulnerability and target the support sources.

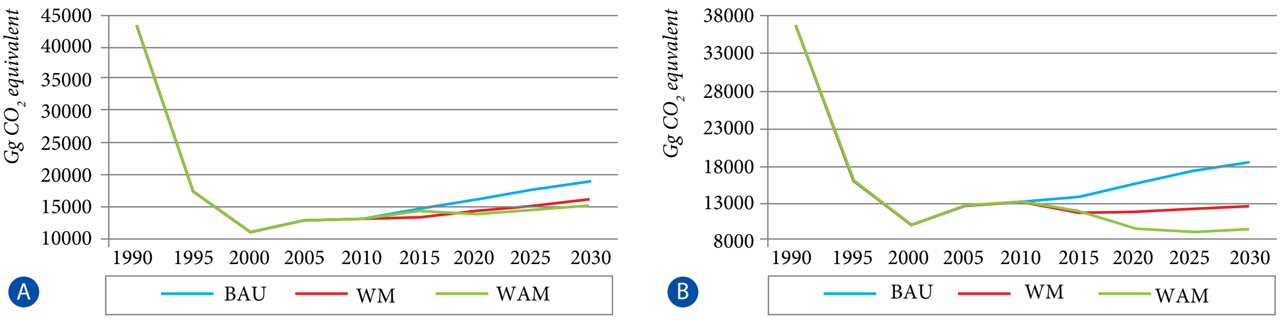


Figure S-5: Projections of total GHG emissions under the considered scenarios in the RM, for the period up to 2030: (a) without LULUCF; (b) with LULUCF

Table S-5: Projections of total GHG emissions and removals by sector, under the considered scenarios in the RM, for the period up to 2030, Gg CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
Energy	34520	11711	6662	8519	8947	9656	10827	12097	13192
Industrial Processes	1901	491	281	568	565	817	1104	1413	1721
Solvents and Other Products Used	91	38	32	68	54	53	53	53	53
Agriculture	5120	3359	2277	2373	2132	2154	2196	2271	2309
LULUCF	-7177	-1158	-782	-104	26	-560	-363	-337	-629
Waste	1627	1781	1659	1411	1578	1895	1866	1843	1814
Total (with LULUCF)	36083	16223	10129	12836	13302	14016	15682	17341	18461
Total (without LULUCF)	43260	17381	10911	12940	13276	14576	16045	17678	19089
	Historical data					WM			
Energy	34520	11711	6662	8519	8947	8461	8850	9399	9948
Industrial Processes	1901	491	281	568	565	792	1059	1306	1532
Solvents and Other Products Used	91	38	32	68	54	53	53	53	53
Agriculture	5120	3359	2277	2373	2132	2283	2459	2698	2930
LULUCF	-7177	-1158	-782	-104	26	-1613	-2330	-2923	-3577
Waste	1627	1781	1659	1411	1578	1863	1832	1802	1780
Total (with LULUCF)	36083	16223	10129	12836	13302	11838	11922	12334	12666
Total (without LULUCF)	43260	17381	10911	12940	13276	13451	14252	15257	16242
	Historical data					WAM			
Energy	34520	11711	6662	8519	8947	8890	8357	8638	8970
Industrial Processes	1901	491	281	568	565	771	1016	1220	1430
Solvents and Other Products Used	91	38	32	68	54	53	53	53	53
Agriculture	5120	3359	2277	2373	2132	2567	2855	3107	3301
LULUCF	-7177	-1158	-782	-104	26	-2183	-4133	-5315	-5528
Waste	1627	1781	1659	1411	1578	1883	1510	1482	1445
Total (with LULUCF)	36083	16223	10129	12836	13302	11982	9658	9185	9671
Total (without LULUCF)	43260	17381	10911	12940	13276	14164	13792	14500	15199

To assess climate change vulnerability, RM has developed a VRIM (Vulnerability and Resilience Index Model) based CVI. VRIM is a holistic method of assessing vulnerability, incorporating a large number of problems, allowing for a comparative analysis of the countries to identify their vulnerability degree and adaptive capacity, while international donors use this method to better target the financial resources. Attempts were made to reproduce VRIM as closely as possible keeping the set of original indicators; in some cases the type of indicators was adjusted to the national specifics (the original model comprises 18 indicators, after the adaptations on the national level -19).

VRIM is based on four hierarchical levels: vulnerability index (level I) consists of two determinants (level II) - sensitivity (the degree of the adverse climate impact on the system) and adaptive capacity (the ability of the society to maintain, to minimize losses or to increase the welfare gains); in turn, the determinants are composed of other components (categories) (Level III) for the sensitivity they represent the *housing infrastructure, food security, agricultural ecosystems, water supply, human health* and for adaptive capacity - *the economic, human, environmental capacity;* each sector includes 2-3 indices (level IV).

To map the climate vulnerability indices, GIS technologies were used. The map of the LVI mean value distribution across the administrative territorial units of RM (for the period under review 2006-2011) was drafted. The mapping technique allowed integrating information about the vulnerability aspects of administrative units in the country, and to visualize the distribution of vulnerability and identify the regions with higher vulnerability and better adaptive potential. The generated maps provide useful information for the population of districts and communities, local public authorities and decision-makers at all levels.

S.6.2. Current Climate: Observed Trends and Variability

The character of observed changes in the climate of the RM was identified through the evolution trends and variability of the basic climatic variables. The early 90's years of the 20th century are usually taken as a "benchmark" for global warming, therefore the seasonal and annual temperature and precipitation data at Chisinau meteorological station (where the longest series of instrumental observation of climate data is available: for temperature since *1887, for precipitation since 1891*) have been studied and compared for two periods: (i) from the beginning of the observation period to 1980 and (ii) from 1981 to 2010.

The results show only a slight growth in annual average air temperature before the 90's in the 20th century (*0.05 ^{0}C per decade and/or ~ 0.5^{0}C per century*). Starting with the 90's of the 20th century this indicator shows a sharp increase (*about 0.63^{0}C per decade and/or ~6.3^{0}C per century*). Moreover, compared to the first period (1887-1980), the temperature values trends in the last three decades (1981-2010) are quite significant statistically wise for summer temperatures, average annual temperatures, as well as spring and autumn temperatures.

The trends of annual average and seasonal precipitation values for the two periods under review are positive for all seasons, with the exception of spring (1891-1980) and summer (1981-2010), when the trends were negative. However, the slightly increasing trends of the average annual and seasonal precipitation values are not statistically significant with the exception of annual values for 1891-1980.

The comparison of the mean values of air temperatures and standard deviations for two baseline periods, have confirmed substantial changes in the temperature regime. It may be stated with high level confidence that the mean values of the seasonal (except autumn) and annual temperatures in last three decades are different from the previous time period while the variability of this indicator remains practically the same (except for the annual air temperature which showed a significant increase of the indicator variability over the last three decades). The analysis of the mean values of the annual amount of precipitation does not show any statistically significant difference. Also, no statistically significant differences in the variability of precipitation, with the exception of spring season were revealed.

S.6.3. Climate Change Scenarios

S.6.3.1. Development of climate scenarios

The model simulations for precipitation and temperature stem from 10 global coupled atmosphere ocean general circulation models made available by the World Climate Research Program: CSIROMk3, ECHAM5-OM, HadCM3, BCCR_BCM2.0, CCCma_CGCM3_T63, NIES_MIROC3.2_medres, NIES_MIROC3.2_hires, MRI_CGCM2.3.2, NCAR_CCSM3, GFDL_CM2.1. Experiments were modelled for the three emissions scenarios: SRES A2, A1B and B1 (downloaded from: (<http://www.ipcc-data.org/gcm/monthly/SRES_AR4/index.html>) which provides data on GHG concentrations determined on the basis of certain global socio-economic development scenarios.

Though it is unlikely than any of the emissions scenarios or global coupled atmosphere ocean general circulation model projections will occur exactly as described, an ensemble of global climate models simulations and GHG emissions scenarios profiles provides a range of possible climate outcomes that reflects the current level of expert knowledge. This approach to climate change scenarios is recommended in the by the 4th Assessment Report (IPCC 2007) and was used in the studies carried out under the Third National Communication.

An ensemble of projections from the 10 different GCMs (for SRES A1B, B1 emissions scenarios) and an ensemble of projections from 7 GCMs (for SRES A2 emission scenario) were considered as equally likely representations of the future climate of the 21st century for the three 30 year time slices, centred on the 2020' (2010-2039), 2050' (2040-2069) and 2080' (2070-2099). In terms of temporal aggregation, the following seasons have been considered: December–February (DJF), March–May (MAM), June–August (JJA) and September–November (SON).

For the purpose of building climate projections, as well as for the validation procedure, climate data for 1961-2010 recorded by the State Hydrometeorological Service from 5 meteorological stations (Briceni, Balti, Chisinau, Tiraspol, Cahul) was used, which included: daily and monthly amounts of precipitation, daily and monthly minimum, maximum mean temperatures and relative air humidity.

S.6.3.2. Description of Climate Scenarios

Temperature

By 2080', the anticipated rate of warming is higher under SRES A2 ensembles with averages reaching +4.3 ^{0}C; under SRES A1B +3.8 ^{0}C, and lower under SRES B1 scenario with averages of +2.7 ^{0}C. All the GCM models used agree that for the three future periods (2020s, 2050s and 2080s) there will be an increase of the winter temperature, relative to the 1961-1990 baseline periods. As it could be expected, the magnitude of the temperature growth is directly proportionate to the GHG concentrations, depending on emissions scenarios. The temperature will increase more in the northern and central parts of the country. According to the ensembles driven by the SRES A2 emission scenario, it is estimated that the Northern AEZ will experience the most significant warming during winter, with average temperatures rising up to 4.9^{0}C by 2080s. For the rest of the territory the winter temperature increase will be 0.5 to 1.0 degrees lower. The pattern of change derived from the SRES B1 is quite similar, but the magnitude of change is lower (increase about 2.6 to 3.0^{0}C across the entire territory of the country) with the maximum warming in Northern and Central AEZs. The summer warming was found to be even larger than winter, but the spatial distribution of the changes is quite different. The strongest temperature rise occurs over the Southern and Central AEZs. According to the SRES A2 scenario it is projected an increase of average summer temperatures by circa 5.1 - 5.2^{0}C in the Central and Southern AEZs, respectively by circa 4.5^{0}C in the Northern AEZ. The corresponding results from the SRES B2 scenario shows less intense differences in temperature increase, varying from 2.9^{0}C to 3.1^{0}C depending on the AEZ.

Precipitations

For 2080' precipitations, the SRES emissions scenarios of A2, A1B and B1 project general trends of decrease in annual average precipitation patterns from -13.5% in Southern AEZ to -5.7% in Northern AEZ (SRES A2), respectively from -4.4% in Southern AEZ to -1.5% in Northern AEZ (SRES A1B). According to the SRES B1 scenario, a slight decrease in precipitation, by -1.8% is projected only for Southern AEZ, while for the Central and Northern AEZs, relative to the reference time period 1961-1990, a slight increase by +0.6-1.7% is expected by the end of the 21st century. For all three SRES A2, A1B and B1 forcing scenarios show a general increase of precipitation during winter and spring. Spatially, this trend becomes progressively more intense towards the North. In details, the evaluated ensemble models simulate the largest increase in precipitation, from 5.3 % (SRES B1) to 7.5% (SRES A2) in winter and from 6.8% (SRES A2) to 10.9% (SRES B1) in spring in the Northern AEZ, and show a lower increase in precipitation, from 0.2% (SRES B1) to 1.5% (SRES A2) in winter and from -2.7% (SRES A2) to 7.3% (SRES B1) in spring for Southern AEZ, relative to the baseline period 1961-1990. The ensemble projections forced by SRES A2 emission scenario project the greatest summer rainfall reduction, by 26.4% in the Southern AEZ, and the lowest reduction, by 16.1% in the Northern AEZ. The pattern of the ensemble projections forced by SRES B1 is quite similar; however the magnitude of changes in precipitation decrease in summer is lower, from 8.4% in the Southern AEZ to 4.6% in the Northern AEZ, in comparison to the baseline period 1961-1990.

Level of Supply with Thermal Resources

In order to evaluate the level of supply with thermal resources, the sums of active and effective temperatures above 0°C, 5°C, 10°C and 15°C were calculated for baseline period (1961-1990), the current climate (1991-2010), as well as their projections of possible changes and deviations (°C) from the baseline period, for three future time periods 2020s, 2050s and 2080s according to the ensembles of the 10 GCMs for three SRES A2, A1B and B1 emission scenarios, separately for the Northern, Central and Southern AEZs. It is expected that due to the earlier onset of spring and autumn elongation the climate of the RM will feature a substantial increase in the duration of the warm period. The duration of the warm period with temperatures above 0°C during the baseline period varied from 260 days in the North of the country to 282 days in the South. As a result of climate change by the 2080s the duration of the period with temperatures above 0°C may increase significantly, in the Central and Southern AEZ from 44-56 days (SRES B1) to 71-75 days (SRES A2). The smallest growth is expected in the Northern AEZ, from 33 to 68 days.

The vegetation period with temperatures above 5°C during the baseline period varied from 220 days in the North of the country up to 236 days in the South. The analysis of the data shows that during the vegetation period with temperatures above 5°C will elongate in 2070-2099 from 14-21 days (SRES B1), to 30-32 days (SRES A2) in Southern and Northern AEZs. The tendency towards longer vegetation period with temperatures above 5°C will persist in the Central AEZ, with increases between 24 days (SRES B1) and 36-37 days (SRES A2 and A1B). This will happen, in particular, due to a later end of autumn (with 7-20[2] days later days in Northern AEZ; 14-23 days later in Central AEZ; and 14-20 days later in Southern AEZ), respectively earlier spring (7 to 12 days in the Northern AEZ; 9-13 days in Central AEZ; and 7-10 days in Southern AEZ).

The length of the vegetation period with temperatures above 10°C for the baseline period varied from 172 days in the North of the country up to 182 days in the South. In connection with climate change it is expected that the vegetation period with temperatures above 10°C will increase by 2070-2099 from 32-34 days (SRES B1) in Central and Southern AEZs, up to 41-42 days (SRES A2) in Southern and Central AEZ. The tendency towards increase of the vegetation period, with temperatures above 10°C in the Northern AEZ will persist, with increases between 25 days (SRES B1) and 37 days (SRES A2).

The sum of active $\Sigma T_{ac > 5°C}$ and effective $\Sigma T_{ef> 5°}$ temperatures (lower limit for the grain crops development) will increase consistently across the territory of the RM. According to all three scenarios in the 2070 - 2099 period the sum of active $\Sigma T_{ac>5°C}$ and effective $\Sigma T_{ef>5°}$ temperatures is expected to grow significantly relative to the baseline period under the high emission scenario SRES A2, by 34-37[3] and respectively 45-50%, varying from 4267 and 2996 °C for the Northern AEZ to 4911 and 3575 °C for the Southern AEZ; slightly lower growth is expected under the low emission scenario SRES B1, by 21-23 and respectively 28-30% varying from 3779 and 2599 °C for the Northern AEZ to 4434 and 3155 °C in the Southern AEZ.

For the majority of plant species cultivated in the Republic of Moldova the biologically active air temperatures mean the sum of air temperatures with values above 10°C. By the end of 2070-2099 time period the sum of biologically active $\Sigma T_{ac>10°C}$ and effective $\Sigma T_{ef>10°}$ temperatures will grow essentially in comparison with the reference period, by 42-43% and 79-67%[4] under high emission scenario SRES A2;

[2] Here and throughout the text the first number corresponds to scenario SRES B1, the second to scenario SRES A2.

[3] Here and throughout the text the first pair of numbers corresponds to $\Sigma T_{ac > 5°C}$, the second to $\Sigma T_{ef> 5°C}$.

[4] Here and throughout the text the first pair of numbers corresponds to $\Sigma T_{ac > 10°C}$, the second to $\Sigma T_{ef> 10°C}$.

varying from 3930 and 1834°C in Northern AEZ, to 4600 and 2347°C in Southern AEZ; a smaller increase is projected under the low emission scenario SRES B1 with an increase by 27-28% and 48-41%, with values varying from 3481 and 1514°C in Northern AEZ, to 4128 and 1983°C in Southern AEZ. It should be noted that during 1961-1990 the sum of active temperatures $\Sigma T_{ac > 10°C}$ varied in the RM from 2800 to la 3300°C; by the end of 2070-2099 time period, significant increase of the sum of active temperatures is projected, varying from 3500 to 4300°C (SRES B1), respectively from 4000 to 4700°C (SRES A2).

Level of supply with humidity

Ivanov's Aridity Index (K = P/PE, where P–sum of precipitations, mm, and PE–potential evaporation, mm) (Ivanov, 1962) was used to perform a more ample analysis of the temperature/humidity ratio development. This index allows assessing the development of the climate aridity rate throughout the year or during certain periods which are crucial for certain crops or species. The aridity rate was assessed using the following assessment scale: AI ≤ 0.05 – hyper-arid climate; K = (0.05-0.20) – arid climate; K = (0.21-0.50) – semi-arid climate; K = (0.51 – 0.65) – dry-sub-humid climate; and K ≥ 0.65 – sub-humid and humid climate. According to this classification, the major part of the RM's territory has dry or sub-humid climate conditions (0.50≥K≤0.65). Certain areas in the South-East have semi-arid climate (K≥0.48), and the Northern zone and the areas with altitudes above 350-400 meters above sea level have sub-humid and humid climate (K≥0.65). The climate of the RM becomes drier, moving from dry sub-humid towards semi-arid climate.

All three SRES emission scenarios (A2, A1B and B1) project worsening of the humidity conditions across the territory of the RM. Reduced rainfall in summer and autumn (that will not be compensated by a slight increase in winter and spring precipitation) on the background of rising temperatures will cause a strong moisture deficit and sequential increase of potential evaporation during the 21st century. In 2070-2099 most likely the potential evaporation will significantly increase during the vegetation period, relative to the baseline period of 1961-1990. For the SRES emission scenario B1 the increase will reach up to 22-27%, from 713 mm in Northern AEZ, to 942 mm in Southern AEZ[5]; while for SRES emission scenario A2 the increase will reach up to 40-45%, varying from 810 mm in Northern AEZ, to 1074 mm in Southern AEZ. Analysis of results shows that the climate aridization during the vegetation period may accelerate considerably in the future on the territory of the Republic of Moldova.

In the period during 2070-2099 climate aridization will be felt during the entire plant vegetation period (April to October); it will be much more pronounced and may result in the values characteristic of the semi-arid climate (K = 0.21-0.50). All the climatic scenarios applied for the assessment purposes have demonstrated that the aridity would be higher relative to the baseline period of 1961-1990, and in August (under the SRES A2, and also in July, August and September) the aridity levels can reach values characteristic of the arid climate (K = 0.05-0.20).

To identify the climate change patterns during crops vegetation period, the assessment of *Selianinov Hydro-Thermal Coefficient* (HTC) dynamics has been performed. HTC is a relative empirical index, which reflects the humidity rate and is calculated as the ratio between the sum of precipitation level (R) expressed in millimetres for the period with the average daily air temperatures above 10°C and the sum of daily average temperatures above 10°C (Σ T) for the same period of time divided by 10, i.e.: HTC = R/0.1 $\Sigma T_{>10°C}$. When the value of this index is 1.0 it means that the amount of precipitations is equal to the amount of the evaporated moisture. HTC is frequently used for monitoring drought conditions during the vegetation period.

In the current climate conditions of the RM the HTC ranges from 1.4 in the North to 0.7 in the South-East of the country, the values characteristic of the moderately dry climate in the former case and of the dry climate in the latter case. The assessment of that index has shown that the insufficiency of moisture would become more pronounced in the future as compared to the climate of the baseline period, clearly demonstrating the gradual aridization of the territory of the RM, including the northern areas, which today are still sufficiently wet.

Humidity conditions have been assessed on the basis of the following scale: *HTC > 1 - sufficient humidity; HTC ≤ 0.7 - drought conditions; HTC = 0.6 - medium drought; HTC ≤ 0.5 - strong drought*. The assessment results show that by 2070-2099 period the drought conditions (HTC ≤ 0.7) will be observed on the whole territory of RM including the Northern AEZ and moreover, in the Central and Southern AEZs under A2 high emission scenario in July, August, September, and October those levels can achieve the values characteristic of the medium drought (HTC = 0.6) and strong drought (HTC ≤ 0.5).

In addition to aridity index (K) another index proposed by Ivanov was used, and namely the Index of Biological Effectiveness of the Climate (IBEC). IBEC is a product of the sum of active temperatures above 10°C in hundreds of degrees: IBEC = $0.01\Sigma T_{>10°C}$K.

IBEC synthesizes the most important climatic variables: precipitation, temperature and relative humidity of the air, covered in their annual cycle, as well as the annual heat supply. It expresses very well the optimum general ecological background. It is estimated that the area of ecological

[5] For comparison, the average observed value of potential evaporation (PE) during the vegetation period during the baseline period (1961-1990) was: in Briceni – 562 mm; Chişinău – 770 mm; Cahul – 742 mm.

optimum corresponds to IBEC 22 value. The area with this IBEC value can be viewed as a kind of core natural habitat, outwards from which the natural conditions worsen, both towards the North (due to the general reduction of heat supply), and towards the south (due to reduced natural moisture availability on the one hand, and growing thermal discomfort due to excessive heat, on the other). IBEC clearly shows the zonal pattern of climate variability. The national projections clearly demonstrate the gradual worsening of optimal ecological-climatic characteristics for crops growing in the TM by the end of the 21st century, in comparison with the reference period.

S.6.3.3. Generating High Resolution Climate Change Scenario

A regional climate model PRECIS (Providing Regional Climates for Impacts Studies), developed by the UK Met Office Hadley Centre, was used to provide high resolution detailed maps (composed of a grid of elementary territorial units of approximately 25km x 25km) and statistics of future climate change across the RM in the 21st century. Three experiments were designed in close collaboration with PRECIS team: two experiments were aimed to simulate the reference period climate (1961-1990), the first experiment was driven by ERA-40_re-analyses, from ECMWF and the second one by ECHAM5 GCM. The last experiment designed for the 21st century future climate simulation, was driven based on limiting conditions imposed by A1B emissions.

Annual Mean Temperatures

Under the PRECIS/ECHAM5 regional climatic model, the mean annual temperatures on the territory of the RM in the 21st century are projected to increase from 4.1°C (Northern AEZ) up to 4.5°C (Southern AEZ). The highest increase is likely to occur in the Southern AEZ.

Annual Precipitation

The PRECIS/ECHAM5 regional climatic model projects reduced amounts of annual precipitation as a general trend with a well-defined zonal pattern (from the North towards the South), which will vary over the period under review from -2.5% (Northern AEZ) to -21.5% (Southern AEZ).

Seasonal Mean Temperatures

The PRECIS/ECHAM5 regional climatic model imposed by the SRES A1B emission scenario projects increase of the mean seasonal temperatures in the 2080' on the territory of the RM as follows: *in summer* from +3.8^{0}C (Northern AEZ) up to +4.5°C (Southern AEZ); respectively *in winter,* from +5.1^{0}C (Southern AEZ) up to +5.3°C (Northern AEZ).

Seasonal Precipitation

The PRECIS/ECHAM5 regional climatic model imposed by the SRES A1B emission scenario shows that the amount of precipitation during winter tends to generally decrease by the end of the 21st century on the territory of the RM, in particular for the Central AEZ (-14.0%) and Southern AEZ (-20.9%). Projections of average winter precipitation changes in the RM differ over time. So, the projected changes will vary quite significantly, from +0.7% (Northern AEZ) to 20.9% (Southern AEZ). Regionally, across the territory of the RM the decrease of precipitation amount *in summer* by the end of the 21st century is projected to be between 22.7 (Northern AEZ) and 34.2% (Southern AEZ). The *summer* precipitation changes are expected to be greater than in *winter* with variations between 22.7% (Northern AEZ) to -34.2% (Southern AEZ). It should be noted that the spatial distribution of changes of average amounts of precipitations is similar for all regions of the RM, the strongest seasonal decrease of precipitation amounts projected for the Central and Southern AEZs.

S.6.4. Climate Change Impacts by Sector

S.6.4.1. Agriculture Sector

The combination of long-term changes and the greater frequency of extreme weather events are likely to have adverse impacts on the agricultural sector, and these changes often have many knock-on effects at the macro-economic level. For example direct impacts on agricultural production and declining yields as a result of increased pest and disease problems could further lead to fluctuations in market prices and changes in crops. The combined effect of changes to the water regime could result in insufficient water for irrigation, and increased water competition, which could ultimately result in higher prices and regulatory pressure. Drought will lead to soil degradation, which is a major threat to the sustainability of land resources and may impair the ability of RM's agriculture to successfully adapt to climate change. Increased salinity may result in land abandonment as it becomes unsuitable for cropping.

Climate change is expected to bring both advantages and disadvantages for agricultural crops in the RM. Although warmer temperatures would increase the length of the growing season, they could also increase crop damage due to heat stress, changes in precipitation patterns, and pest problems. Impacts would vary regionally and with the type of crop being cultivated. There are some potential benefits. The longer growing season will potentially increase grass yields, while increased temperatures will increase the potential for growing forage legumes. The longer growing season should also reduce the costs of housing livestock. There may also be benefits for horticulture, both with respect to reducing costs of indoor production and increasing the range of horticultural crops that can be grown outdoors. Yields of vegetables and potatoes, both of which are frequently irrigated under current conditions, are likely to be reduced more than the yield of cereals. The summer growth of forage crops also appears likely to be reduced. An increased frequency of extreme weather events may also lead to crop damage or failure. There may also be problems arising from the introduction of new pests and diseases.

A large proportion of soils in RM's agro-climatic zones are black soils. These soils have large organic matter content and breakdown of Soil Organic Matter (SOM) is likely to increase with warmer temperatures. While this breakdown will increase soil fertility in the short term (via release of nutrients) in the longer-term soil fertility is likely to be reduced.

Changes in the frequency and intensity of extreme events (e.g., droughts, floods and heavy rains) have been identified as the greatest challenge that would face the agricultural industry as a result of climate change. Extreme events, difficult to both predict and prepare for, can devastate agricultural operations, as has been demonstrated several times in the past. Drought and extreme heat have also been shown to affect livestock operations. Model projections and observed trends suggest that warming would be greatest during the winter months. Although warmer winters would reduce cold stress, they would also increase the risk of damaging winter thaws and potentially reduce the amount of protective snow cover. Climate warming is also expected to increase the frequency of extremely hot days, which have been shown to directly damage agricultural crops. Future changes in moisture availability represent a key concern in the agricultural sector. Climate change is generally expected to decrease the supply of water during the growing season, while concurrently increasing the demand. In addition to the direct problems caused by water shortages, the benefits of potentially positive changes, including warmer temperatures and a longer growing season, would be limited if adequate water were not available. Water shortages are expected to be the main problem in certain regions of Moldova in the future.

Assessing the Magnitude of Risk and Opportunities of Climate Change on Agriculture

According to the vulnerability assessment of the magnitude of the risk/opportunities of the climate change on agricultural production, the most vulnerable regions in the RM due to possible climate change will be South (the Plain of Southern Moldova, terraces of the inferior Prut and Dniester Rivers) and partly Center (Sub-zone II-a, the Plain of Central Moldova and Codrii region, and Sub-zone II, Terraces of the Dniester, Prut, Raut, Prut, Bic, Botna etc. rivers) for which as a result of expert judgment revealed the greatest amount of risks with high probability related to climate change.

For agriculture in the RM, five of the identified risks are considered to be of high priority: increased risk of drought and water scarcity; increased irrigation requirements; soil erosion, salinization, desertification; increased risk of agricultural pests, diseases, weeds; and wheat and maize yield decrease. Three of these risks concern the consequences of potential changes in the precipitation pattern, with increased rainfall in winter and decreased water availability in summer.

Hence strategies need to be considered to conserve as much water as possible over winter to maintain supply during the summer. Much of the adaptation research in the agricultural sector should be focused on strategies for dealing with future water shortages. Such adaptations as water conservation measures and adjustment of planting and harvesting dates could play a critical role in reducing the losses associated with future moisture limitations. Other adaptation options being studied include the introduction of new species and hybrids, for example, those that are more resistant to drought and heat, and the development of policies and practices to increase the flexibility of agricultural systems. Better definitions of critical climate thresholds for agriculture will also be beneficial for adaptation planning. Of the two opportunities presented in the table, the potential for increased production of some crops, either as a result of the increased yield potentials under the new climatic regimes or an increase in the area over which new crops might be grown, was considered a high priority. Hence attention needs to be given to the promotion of crops that have the potential to flourish in the changed conditions.

Adaptation measures on water conservation for agricultural purposes could include:

- Achieving optimal irrigation methods (e.g. correct timing);
- Adapting plants to future climate conditions (e.g. growing less water-intensive crops);
- Modification of crop rotation according to the natural soil water regime (that is, introduction of a greater number of winter crops);
- Selection of proper drought-resistant crops, plant species and varieties;
- Awareness building in new technologies that address soil structure stability and soil treatment for expanding the active layer of the root zone for enhancing water uptake;
- Introduction of mulch technology for increasing infiltration into the soil and decreasing soil water loss by evaporation;
- Runoff reduction by agronomic practices (No till and mini till cropping systems can reduce water runoff);
- Runoff depending on soil characteristics can also be delayed by tillage methods combined with plants with a high root density and lush surface cover;
- Development of new complex agricultural water management programmes (combining irrigation, fishery and excess inland water management);

- Promotion of indigenous practices for sustainable water use.

S.6.4.2. Water Resources

Climate change is only one of many factors that will determine future patterns of water availability and use. Non-climatic factors could aggravate or attenuate the adverse effects of climate change on water availability and quality, as well as have a significant influence on water demand. Population growth and economic development will play a dominant role. According to the water-intensive target of national economic development, secure supply for all water users will be threatened by climate-related change in water resources already in the 2020s, when the intensity of surface water use will be close to 100 per cent. However, taking into consideration ground water supply as well, the point when water scarcity will become a brake to development is likely to set in after 2030. Non-climatic impacts could be generated through many realms - from policies and legislation to technologies and infrastructure to land-use patterns and agricultural activities/irrigation.

Assessing Risks/Opportunities of Climate Change on Water Resources

Although big rivers constitute the main source of water in RM, access is unequal. The greatest distance between a settlement and the closest water body in RM is about 6 km. Approximately one quarter of the population live in the 6 km buffer zone of the Dniester and Prut Rivers; this zone constitutes one fifth of the national territory and contains 23 per cent of the settlements. The rest of the country and population have to rely on various supply systems designed to transfer water from these rivers, or rely on local resources of poorer quality. The northern part of the country (and the central part to some extent) is, currently, more or less water secure, while the southern part suffers from a natural water deficit. At the same time, medium and long distance water transfer systems are almost non-existent in the south. This region is among the most exposed to water shortages.

Moreover, local surface water resources in the south (and, less frequently, in the central part of the country) are at high risk of depletion in drought years. In such a way, the geographical location of water users will play the most decisive role in the future in ensuring access to a secure water supply. The area of water scarcity, as it extends northwards, has already reached the most populated areas, which place the biggest load on water resources and are most intensive in water use. The most vulnerable regions in the RM will be South, Centre and Chisinau Municipality, for which the expert judgment revealed the highest level of risks very likely related to the anticipated climate change impacts.

For water resources in the RM, eight of the identified risks are considered to be of high priority: increased risk of drought and water scarcity; increased irrigation requirements; higher flood frequency and intensity; decrease in availability of water from surface sources or ground water; changes in water demand; water quality affected by higher water temperatures and variation in runoff; higher pollution with pesticides and fertilizers to water due to higher runoff; and changes in river flows both towards increase and decrease.

Adaptation measures for flood and drought impacts may include:

- Efficient operation of dams, dikes and open channels;
- Wetlands protection (one of the main positive functions of wetlands is to allow groundwater recharge and reduce peak discharges downstream);
- Measures for protection of the irrigation infrastructure from floods;
- Techniques to improve soil texture, aggregation, organic matter content and surface ground cover to manage water usage during dry periods;
- Improved flood forecasting;
- Installation of systems to provide dam break alerts;
- Technical assistance through agricultural extension in coordination with irrigation upgrades to assure dissemination to farmers of techniques to minimize their vulnerability to weather events; and
- Development of effective collaboration between Republic of Moldova, Ukraine, and Romania to monitor water discharges, improve weather/flood forecasting and early warning for all downstream countries.

S.6.4.3. Forestry Sector

Researchers expect that even small changes in temperature and precipitation could greatly affect future forest growth and survival, especially at ecosystem margins and threshold areas such as RM's forests. Climate change would impact future moisture conditions in forests through changes in both temperature and precipitation patterns. As the temperature increases, water loss through evapotranspiration increases, resulting in drier conditions. Higher temperatures also tend to decrease the efficiency of water use by plants. In some areas of RM, future decreases in precipitation will accentuate the moisture stress caused by warming. Changes in the seasonality of precipitation and the occurrence of extreme events, such as droughts and heavy rainfalls, will also be important. For example, tree ring analysis of oak and ash trees stems in the centre of RM revealed reduced ring growth to as little as 50% of the previous year and compared to the multiannual average of the past 10 years was associated with the 2007 drought.

Assessing Risks/Opportunities of Climate Change on Forest Resources

The potential lack of summer precipitation with consequent droughts is the main constraint factor on forest growth and productivity. Temperature increase and changes in precipitation are the main factors predisposing forests to various insect pests and fungal diseases. The demand of water during the growing season is normally larger than the amount of rainfall. This indicates that if temperature increase is not coinciding with increased rainfall, water could limit growth to an even larger extent than today. The effect of climate change on individual species can be either positive or negative, depending on the site conditions and regional climate changes. According to the vulnerability assessment of the magnitude of the impact with the probability of risk due to possible climate change on the forest sector, the most vulnerable regions in the RM will be: South (where there is already the lowest degree of forestation 7.7%), and partially Centre (where there is now the biggest surface coved with forest 209.4 thousands ha, or about 14.5% of the total geographic zone territory) for which as a result of expert judgment revealed the greatest amount of risks with high probability related to climate change.

For the forest sector in the RM, seven of the identified risks are considered to be high priority: negative consequences for species sensitive to temperature changes; changes in the regeneration rate; changes in species sensitivity to water shortages; changes in individual tree density; changes in the phytosanitary conditions; changes in species composition; possible increase in tree mortality. There is one opportunity associated with climate impacts on forest sector: increase in biomass production.

Adaptation measures in the temperate-continental bioclimatic zone, which also includes the RM's forests, are very versatile. On-going and planned research includes adapted seedlings, biotic and abiotic damages, biodiversity, especially genetic diversity, silviculture treatments, and protection functions of forests. Measures at stand level (forest regeneration, tending and thinning of stands, harvesting) are aimed at decreasing risks of abiotic disturbances, i.e. fire, wind, drought, as well as biotic disturbances, i.e. pests and pathogens. Building stable diversified forests is an on-going measure and it is planned to improve stand stability by selection of suitable species, provenances and genotypes.

Adaptation measures in forestry sector could be as follows:

- Review and development of (new) important components of the forestry regulatory basis, as integral parts of the forestry regime, focusing on the following areas: maintenance and conservation of forestry stations; conservation of forest genetic resources; ecological reconstruction of forests; certification of forests, forest products and management systems;
- Review of the regulatory framework for developing an appropriate financial mechanism in conservation and development of forestry resources, by imposing mandatory allocations from some extra budgetary funds (ecological, roads, etc.) and taxes (ecological tax on import of oil products, for landscaping, etc.) needed for expansion of lands covered with forestry vegetation, etc.;
- Development and approval of the regulation on implementation and assuring functionality of the principles of participatory management of public forest resources;
- Increasing the forest cover aimed at contributing to climate change mitigation and increasing the biodiversity;
- Development and implementation of projects aimed at planting protection forest belts (buffer zones) for agricultural lands protection, combating erosion, and for waters protection;
- Development and implementation of projects aimed at planting protection forest belts for agricultural land and water protection;
- Establishment of forest plantations for the needs of industry and energy; planting of energy forests to meet the needs of population in firewood for heating, wood for cooking, etc.;
- Agro technical analysis, selection and public production of plant types capable of adapting to different climatic conditions, research, development and application of production technologies for such plants, etc.

S.6.4.4. Energy Sector

As the climate of the world warms, the consumption of energy in climate-sensitive sectors is likely to change. Possible effects of warming, that could be relevant in the RM, include: decreases in the amount of energy consumed in residential, commercial, and industrial buildings for space heating and increases for space cooling; decreases in energy used directly in certain processes such as residential, commercial, and industrial water heating, and increases in energy used for residential and commercial refrigeration and industrial process cooling; increases in demand for energy used to supply other resources for climate-sensitive processes, such as pumping water for irrigated agriculture and municipal uses; changes in the balance of energy use among delivery forms and fuel types, as between electricity used for air conditioning and natural gas used for heating; and changes in energy consumption in key climate-sensitive sectors of the economy, such as transportation, construction, agriculture, and others. Changes in supply could also occur – extreme events extreme temperatures can cause damage to energy supply infrastructure, and development of renewable energy sources is very dependent on water, wind and biomass potential, all of which are expected to change under climate change. The main direct climate change impacts and their potential social economic consequences in RM are relevant to the energy sector.

Assessing the Magnitude of Risks/Opportunities of Climate Change on Energy Sector

Although RM mostly covers its energy needs through imports, the National Energy Strategy 2020 envisages strengthening local production capacities by modernizing and enhancing the existing Combined Heat and Power Plants as well as constructing new mini-CHPs. Another focus of effort will be boosting production from renewable sources, such as biomass, solar and wind energy. However, climate and water availability projections show that some of these plans may be put at risk under climate scenarios. Currently 65 to 70% of total water is used in industrial heating and cooling and hydro-energy production. However, as has been shown, water quantity in RM is quite sensitive to climate change effects. Thus, water scarcity will start adversely affecting national development goals by 2020 if only surface water is taken into account. If ground water is added then water scarcity will become a development obstacle by 2030. Furthermore, one of the climate change effects on water supply will be growing instability in annual water flows: growing short-term oversupply due to spring and flash floods and scarcity due to longer and more severe droughts. Hence, growing water scarcity may become the main obstacle to enhancing local hydro- and cogeneration power production. Furthermore, the climate projections show that the anticipated worsening of humidity conditions and growing aridisation may result in a deterioration of the ecological-climatic conditions for plant growing towards the end of the century. In the longer run it represents a serious threat to energy production from biomass.

At the same time, the anticipated rise in the number of days with temperature over 10°C will mean that building heating will be required for a smaller number of days (in Chisinau centralized heating season starts when daily temperature drops below 8°C). It is also anticipated that summers and autumns are expected to become hotter and drier. Therefore, the demand for the electricity required to ensure air cooling in the buildings is likely to surge. Even without taking climate change effects into consideration, electricity consumption is expected to grow by over 15 per cent over the period from 2006 to 2020. Taking into account the climate change effects on demand, it is very likely that the demand for electricity could be pushed still higher.

According to the vulnerability assessment of the magnitude of impacts with the probability of risk due to possible climate change on the energy sector, the most vulnerable regions in the RM will be: Chisinau municipality, the Northern and partially Southern part of the country, which are exposed to the highest climate change related risk.

For the energy sector in the RM, five of the identified risks are considered to be of high priority: increase in energy used for residential and commercial refrigeration and industrial process cooling; increase in damage to supply grids which present a threat to electricity transmission and distribution; changes in the balance of energy use among fuel types; increased water scarcity may become the main obstacle to enhancing hydro- and cogeneration power production; and decrease of biomass yield.

There are three opportunities associated with climate impacts on the energy sector: decrease in energy used in residential, commercial, and industrial water heating in Chisinau municipality, Central and Southern regions; wind speed and direction may increase wind generation potential and efficiency with high probability in the Southern and to a lesser degree in Central and Northern regions; and duration of sunshine, which may increase solar generation potential in Southern part of the country and in Chisinau municipality.

Adaptation measures in energy sector could include:

- Supply: (i) m*ined resources*(including oil and gas, thermal power)could include replace water cooling systems with air cooling, dry cooling, or re-circulating systems; improve design of gas turbines (inlet guide vanes, inlet air fogging, inlet air filters, compressor blade washing techniques, etc.); (re)locate in areas with lower risk of flooding/drought; build dikes to contain flooding, reinforce walls and roofs; adapt regulations so that a higher discharge temperature is allowed; consider water re-use ad integration technologies at refineries; (ii) h*ydropower* could include: build de-silting gates Increase dam height; construct small dams in the upper basins; adapt capacity to flow regime (if increased); adapt plant operations to changes in river flow patterns; operational complementarities with other sources (e.g. natural gas); (iii) w*ind*: (re)locate based on expected changes in wind-speeds; (iv) s*olar:* (re)locate based on expected changes in cloud cover; and (v) b*iomass*: introduce new crops with higher heat and water stress tolerance; substitute fuel sources; early warning systems (temperature and rainfall);support for emergency harvesting of biomass; adjust crop management and rotation schemes; adjust planting and harvesting dates; introduce soil moisture conservation practices.
- Demand: invest in high-efficiency infrastructures and equipment; invest in decentralized power generation such as rooftop PV generators; efficient use of energy through good operating practice.
- Transmission and Distribution**:** improve robustness of pipelines and other transmission and distribution infrastructure; burying or cable re-rating of the power grid; emergency planning; and regular inspection of vulnerable infrastructure such as wooden utility poles.

S.6.4.5. Transport Sector

The transport and roads infrastructure sector comprises road transport, railway transport, water and air borne transport, with very different types and ages of infrastructure. The transport sector is vulnerable to the predicted increase in frequency and intensity of storms (wind, rain, snow), which could result in raised costs related to the construction, maintenance, and operations of transportation infrastructure and vehicles. High humidity and problems caused by it entails damage of the asphalt flatness, shorten the roads life, increase the need of premature repairs of the asphalt coating and reduces the speed and comfort level of traffic, causing an increase of the vehicles maintenance cost and finally, a road safety decrease. Also, bridges and viaducts have serious problems because the water penetrates the concrete structural frame, causing an accelerated rusting of metal fittings. The only solution in this case is to replace the entire concrete based asphalt pavement, cover it with a water-resistant protective coating and reapply a new concrete based asphalt pavement. This solution is very costly and requires closing of circulation on bridges or viaducts for a long time. Furthermore, maintenance costs will increase for some types of infrastructure because they deteriorate more quickly at temperatures above 32°C. Construction costs could increase because of restrictions on days above 32°C, since work crews may be unable to be deployed during extreme heat events and concrete strength is affected by the temperature at which it sets. Increases in daily high temperatures would affect aircraft performance and runway length because runways need to be longer when daily temperatures are higher

Assessing the magnitude of risks/opportunities of climate change on the transport sector

Projected climate changes are likely to have a particularly significant impact on transportation infrastructure because the RM's transportation system was specified to typical weather conditions, and expected changes in climate extremes could push environmental conditions outside the range for which the system was designed. All modes of transportation are vulnerable to climate change. The impacts will vary depending on the location, mode, and condition of the transportation infrastructure. For example, Southern areas will be subject to a high magnitude of risks such as highway asphalt rutting, health and safety risks from heat stress to highway maintenance personnel and passengers, as well as overheating of diesel engines, whereas the Northern area may experience lower magnitude of risks.

Adaptation measures in transportation sector could include:

In the case of significantly changed temperatures and heat waves:

- Development of new, heat-resistant paving materials;
- Greater use of heat-tolerant streets and highway landscaping;
- Proper design/construction, milling out ruts;
- Shifting construction schedules to cooler parts of the day;
- Designing for higher maximum temperatures in replacement or new construction; and
- Adaptation through use of cooling systems.

In the case of increased number of intense precipitation events:

- Development of new, climate resistant road building materials;
- Overlay with more rut-resistant asphalt;
- Use of the most efficient technologies ensuring sealing and asphalt renewal (i.e., the ones that combine impregnation and surface treatment of concrete based asphalt, and respectively, ensure the revitalization and renewal of the bitumen binder quality, reducing the concrete based asphalt top layer fragility, enhancing elasticity and flexibility as well as its resistance to water and chemicals);
- Wider use of effective methods of road maintenance (*preventive maintenance*: include coatings, repairs, sealing by spraying cationic emulsions, sealing with crushed stone, sealing of cracks with suspensions etc., *correction maintenance*: patching, surface repairs and surface treatments with sealants;
- Conduct risk assessments for all new roads;
- Improve flood protection;
- Enhanced use of water flows sensor monitors;
- Upgrading of road drainage systems;
- Pavement grooving and sloping;
- Increases in the standard for drainage capacity for new transportation infrastructure and major rehabilitation projects; and
- Engineering solutions, increase warnings and updates to dispatch centers, crews and station.

S.6.4.6. Public Health

It is clear that climate change and extreme weather events have a direct impact on health. However, they can also affect forestry, agriculture and the economy resulting in problems related to food security and poor sanitary conditions that can, in turn, lead to serious mid- to long-term health effects. The health effects of drought could, for example, cause a decrease in food production and result in nutritional problems in the population, making them more vulnerable to disease.

Assessing the Risks and Opportunities of Climate Change Impacts on Health

Sub-populations that are most vulnerable to the health impacts of climate change depend on the region, the health outcome, and population characteristics, including human, institutional, social, and economic capacity. Individual vulnerability depends on genetic, developmental, acquired, and socio-economic factors. In general, the most vulnerable are children, older adults, those with chronic medical conditions, socially disadvantaged individuals, those living in water-stressed and flood prone areas, and populations highly dependent on natural resources.

The most vulnerable regions in the Republic of Moldova, due to possible climate change will be Chisinau Municipality, South, and partially Centre, showing the highest climate change related risks. Among the identified risks six are considered to be of high priority: increase in heat wave-related deaths; increase in air pollution-related diseases; increased risk of allergic disorders; increased risk of drought and water scarcity; and increase the burden of waterborne and food born diseases. Also, there is one opportunity associated with climate impacts on health – reduction of winter mortality from cold.

However, within these regions, the analysis should take into account that climate changes do not hit different population groups in the same manner: some groups are obviously more vulnerable than others. For example, the health care services infrastructure is much less accessible in rural areas, and the rural population has a much higher share of persons who are not registered with family physicians as well as a much higher share of those not holding obligatory medical insurance. Secondly, the rural population is much more dependent on the decentralized supply of water than the urban population, and the decline in the quality of water will affect the rural population. Another important vulnerability is the risk of malnutrition which appears when severe climate events, such as droughts, floods and hails may ruin crops, leaving small farmers with no food and no income meaning that rural populations will face serious nutrition risks

In the above context, priority action within the health system could include: strengthening health care; advocating health to other sectors; sharing good practices in inter-sector action; building capacity in the health workforce; ensuring access to information.

Adaptation measures in health sector may include:

- Develop integrated assessments of environmental, economic and health impacts of climate change.
- Discuss and design adaptation strategies for use by the health sector in identifying climate-related health risks in the country;
- Agree on a lead body to coordinate the public health preparedness for and response to climate change; define roles and responsibilities;
- Review and strengthen existing disease surveillance systems with a view to including further climate-related health outcomes, such as heat-related morbidity and mortality;
- Identify, monitor and target risk groups and vulnerable populations; develop treatment protocols for climate-related health problems;
- Raise the awareness of healthcare professionals, the public and the most vulnerable groups;
- Insure improved access of remote communities and vulnerable groups (e.g., elderly, obese, and disabled) to healthcare services;
- Provide training and guidance for medical professionals and advice for the public on measures to be taken during extreme weather events, such as heat-waves, floods and drought;
- Upgrade current education and communication programmes;
- Set up a monitoring system and evaluation mechanism to assess the effectiveness of preparedness and response measures;
- Apply new technology for scientific measurements (e.g. vector borne disease, water quality, climate change, etc.);
- Enhance understanding of risk for the emergence of new, unfamiliar diseases and health impacts;
- Consider the cost (and volumes) of energy and CO_2 emissions used by air-conditioning and advocate for alternative cooling methods to the public;
- Maintain international and regional cooperation.

S.6.5. Case Studies on Potential Impacts of Climate Change at sector level

S.6.5.1. Plant Production

The assessment of the climate change impact on agricultural sector (plant production) was made based on projections of changes in temperature and precipitation received by regionalization of global experiments the most reliable in the Republic of Moldova 10 GCM for the three SRES A2, A1B and B1 greenhouse gases emission scenarios.

To assess the vulnerability of main agricultural crops to climate change the empirical-statistical approach was used, linking fluctuations of crops productivity to climate conditions during the growing season. The analysis of the obtained results revealed that if no adaptation measures are taken, by 2080's *a significant decrease in productivity*, compared to 1981-2010 time period, can be expected: in maize for grain from 49% (SRES B1) up to 74% (SRES A1B); in winter wheat from 38% (SRES B1) up to 71% (SRES A2); respectively, a *moderate decrease of productivity* in sunflower, from 11% (SRES B1) up to 33% (SRES A2); sugar beets from 10% (SRES B1) up to 20% (SRES A2); and tobacco from 9% (SRES B1) up to 19% (SRES A2).

A *sharp decline in the productivity* of winter wheat in the 21st century can be explained by a shift of vegetation phases in a more unfavourable period due to temperature increase. By the 2070-2099 period, the vegetation period of winter wheat will start earlier by 7-9 days (under the SRES B1) and/or by 10-13 days (under the SRES A2), in dependence of the assessed emission scenario, with a maximum expected shift in the Central Agro-Ecological Zone (AEZ).

Change of phonologic phases duration is an essential factor with potential factor for reducing the winter wheat productivity. The index 'sum of effective temperatures above 5^0C' was used to calculate the average date of initiation of the main development phases in the spring-summer period for winter wheat, according to an ensemble of 10 GCMs for three SRES A2, A1B and B1 emission scenarios. The analysis of data for the most vulnerable Central AEZ revealed that in comparison with the baseline period (1961-1990), in 2070-2099 period the tiller initiating phenological phase in winter wheat may shift on average with 4 days (SRES A2) up to 6 days (SRES B1); the jointing may come earlier by 12 days (SRES A1B), respectively by 15-17 days earlier (SRES A2 and A1B); the humidity conditions in this period will be close to optimal (HTC = 1.0). However, by 2080s this shift can already draw from 12 days (SRES B1) up to 15-17 days (SRES A2 and A1B); the humidity conditions for this period would be sufficient only in accordance with the SRES B1 low emission scenario (HTC = 1.0), while according the other two emission scenarios (SRES A2 and A1B) the humidity conditions would be adverse (HTC = 0.8-0.9), thus the critical period for jointing in winter wheat will take place in dryer conditions, which will result in significant drop in productivity.

The index 'sum of effective temperatures above 10^0C' was used to calculate the possible average initiation date of the main development phases for maize (for hybrids of different maturity groups) in the spring-summer period, according to an ensemble of 10 GCMs for three SRES A2, A1B and B1 emission scenarios. In comparison with the baseline period (1961-1990), by 2080's according to the global climate models under the SRES B1 and A2 emissions scenarios the onset of the germination - tasseling phase in maize varieties can start 17-22 days earlier (for intermediate and late maturing hybrids); and 20-26 days earlier (for the late maturity hybrids); while the onset of the sowing – milky grain phase may start earlier by 21-30 days for the early maturity hybrids and by 23-32 days for late maturity groups. During this period the humidity conditions will be close to optimal (HTC = 1.2) during the sowing – tasseling phenological in the global climatic model ensembles under the SRES A1B and B1 emissions scenarios and insufficient (CHT = 0.8) in the global climatic model ensembles under the SRES A2 emissions scenario. The critical phenological phases, such as „sowing – tasseling" – "appearance of stigmata and pollination " – "early grain filling " – „milky ripening", in maize hybrids, irrespective of maturity group, will take place in drier conditions in case of the global climatic model ensembles under the SRES A2 (HTC = 0.6) and SRES A1B (HTC = 0.8); respectively in insufficient humidity conditions (HTC = 0.9) in the global climatic model ensembles under the SRES B1, what will contribute to a dramatic decrease of this crop productivity.

In the above context it can be concluded that due to the anticipated climate change if no adaptation measures are taken (if current cultivation technologies and varieties and hybrids which are used at present, will persist) by the end of the 21st century, cultivation of cereal crops, such as winter wheat and maize in the RM could become practically impossible, according to the global climate models ensemble set under the SRES A2 emissions scenario, or economically inefficient in the case of global climate models and ensembles under the SRES B1 and A1B emissions scenarios.

S.6.5.2. Livestock

The assessment of the climate change impact on livestock sector was made based on projections of changes in temperature received by regionalization of global experiments for the RM of the most reliable 10 GCMs for the three SRES A2, A1B and B1 emission scenarios and projections of productivity variation in the main cereal crops (winter wheat and grain maize). To assess the livestock production vulnerability to climate change, the empirical-statistical approach was used, linking fluctuations of livestock production to climate conditions during the most recent time period (1981-2010).

The impact assessment performed allow conclude that the negative effect of increased average summer temperatures and the sharp decline in the crop productivity of the main cereal crops, according to an ensemble of 10 GCMs for SRES A2, A1B and B1 emission scenarios, will lead by the 2080s, according to the *optimistic scenario* (assuming the absence of future declines in productivity of major cereal crops), to a *significant* drop in the livestock production, from 57% (SRES B1) to 87% (SRES A1B) for beef, from 38% (SRES B1) to 76% (SRES A2) for pork, and from 32% (SRES B1) to 63% (SRES A2) for milk; a *medium* decrease, from 23% (SRES B1) to 46% (SRES A2) for poultry, from 21% (SRES B1) to 44% (SRES A2) for eggs, and from 17% (SRES B1) to 33% for mutton; respectively to a *slight* decrease in the wool production from 5% (SRES B1) to 10% (SRES A2). In comparison with the 1981-2010 period, as per the *pessimistic scenario* (assuming a possible reduction in the productivity of the main cereal crops winter wheat and grain maize by 2080') a *significant* drop in milk production is anticipated, from 61% (SRES B1) to 93% (SRES A1B); respectively, from 52% (SRES B1) to 79% (SRES A1B) for poultry; from 34% (SRES B1) to 70% (SRES A2) for eggs; from 44% (SRES B1) to 87% for mutton (SRES A2); respectively a *medium* decrease in the wool production, from 19% (SRES B1) to 37% (SRES A2). In addition, according to the *pessimistic scenario*, if in the second part of the 21st century no adaptation measures are undertaken in the livestock sector, production of the main animal products (milk, beef, pork and poultry) will become impossible on the territory of the RM.

S.6.5.3. Forest Ecosystems

The impact of climate changes on forest ecosystems has been assessed by using JABOWA III dynamic method that describes the evolution of species composition and productivity (biomass and base area) depending on the local conditions, species characteristics and climate parameters. For this purpose, the base areas (model) were chosen for which the annual increases are determined for each sample separately, adding the newly appeared samples and eliminating the ones that will die. JABOWA III uses 3 sub-models: (1) GROW, which provides data about the annual increases for each sample; (2) BIRTH, which shows the possibility of appearance of new samples, and (3) KILL, forecasts which sample will die. As a dynamic model, JABOWA needs an intermediated climate scenario that would characterize the evolution in time of the climate variables. For this purpose, an ensemble of 10 global coupled atmosphere ocean general circulation models under the SRES A1B[6] emission scenario was used.

Using JABOWA III and the climate data generated for the 21st century compared with the climate data characteristic for the baseline period (1961-1990), simulations have been done for three geographic areas of the RM: (i) North – with a prevailing composition of pedunculate oak (*Quercus robur*), cherry (*Cerasus avium*), white locust (*Robinia pseudacacia*), ash (*Fraxinus excelsior*), maple (*Acer platanoides*), red oak (*Quercus rubra*); in this area, the penduncculate oak and cherry ecosystems at present cover an area of about 11.6 thousand ha; (ii) Centre – with prevailing composition of pedunculate oak (*Quercus robur*), sessile oak (*Quercus petraea*), white locust (*Robinia pseudacacia*), ash (*Fraxinus excelsior*), common beech (*Fagus sylvatica*), small-leaved lime (*Tilia cordata*), silver lime (Tilia tomentosa); in this area, sessile oak, pedunculate oak and common beech ecosystems at present cover an area of about 160 thousand ha; (iii) South – with prevailing composition of white locust (*Robinia pseudacacia*), pubescent oak (*Quercus pubescens*), pedunculate oak (*Quercus robur*), red oak (*Quercus rubra*), ash (*Fraxinus excelsior*), walnut (*Juglans regia*); in this region, the pubescent oak (*Quercus pubescens*) at present covers an area of about 7 thousand ha.

The study was conducted to find out the vulnerability of the forest ecosystems in these areas to the new climate conditions characteristic of the 21st century. Based on the prospects of the changes in annual and seasonal average air temperatures (ΔT, °C), precipitations (ΔP, mm), and heat and humidity level in the RM during the 21st century, as compared to the 1961-1990 baseline period, the conclusion reached was that essential changes are likely to occur in the forest ecosystems as well as in the environmental group range. An increase in the percentage of xerophytes and mezoherophytes on the account of a decrease in mezohigrophytes and higrophytes is possible. The spreading area of southern and south-eastern elements is likely to expand on the account of decreased northern and western elements. There are no premises and arguments that the forest (ruderalisation) degradation and weediness process will stop.

The analysis of the obtained results, in the perspective of the regional climate main components evolution towards a pronounced dryness by the end of the 21st century, shows the following possible changes in the space distribution of forest ecosystems on the territory of the Republic of Moldova: (i) common beech (*Fagus sylvatica*) that at present covers about 400 ha of the summits of planes in Central Moldova, could disappear; (ii) the freed areas could be taken over by plant formations of sessile oaks (*Quercus petraea*), linden (*Tilia cordata* and *Tilia tomentosa*), and ash (*Fraxinus excelsior*) that in their turn will withdraw to the summits, conceding immense spaces to the archaeological oak (*Quercus sp.*) with common hornbeam (*Carpinus betulus*); (iii) semiarid forests of pubescent oaks (*Quercus pubescens*) with smoke trees (*Cotinus coggygria*) will move towards the North, covering the lowest lands of the relief, as well as will move to the spaces freed of forests on the plane of Northern Moldova; (iv) as a whole, the areal of thermophilic species may be available to extend while the areal of mezophilic species (Northern, Central-European, Euro-Asian) may disappear from the territory of the Republic of Moldova.

S.6.5.4. Wildlife

The preferences of rodents to the temperature vary significantly from one season to another and among different geographic areas. For the common vole (*Microtus arvalis*), the preferred temperature in wintertime is about 17-18°C, spring 24-28°C, and in summer 30-32°C, respectively. The research conducted in agrocoenoses during nearly four decades allowed to conclude that this species does not show a strict cycle of the population dynamics, and the top phases, with the highest density, largely coincide with those in other areas of the areal. The common vole considerably grows in number and harms the agricultural crops (autumn crops, perennial plants) during the vegetation period that follows a mild winter. Being an animal that feeds on succulent vegetation, it prefers climate conditions with optimal temperatures and humidity.

Based on the information collected about the trends in the density of *Microtusarvalis* population in natural ecosystems and agrocoenoses, attempts were made to establish how the climate factors influenced the trends of this species in the previous period. Prospects for the future have also been made by using three GCMs (CSIROMK3, ECHAM5 and HadCM3) imposed by SRES A2, A1B and B1 emission scenarios.

[6] Taranu L., Bercu I., Deveatii D. (2012), *Regional Climate Change Scenarios for the Republic of Moldova: Future Temperature and Precipitation Projections from Ensembles of 10 Global Climate Models. Mediul Ambiant*. Nr.3 (63), P. 33-42.

In order to assess the correlation between the density per hectare of *Microtus arvalis* colonies and temperature and humidity parameters, the Seleaninov Hydro-Thermal Coefficient (HTC) was used. The temperature and humidity data were supplied by the State Hydrometeorological Service of the RM, and the future temperature and precipitation prospects are available in Ţăranu et al, 2012. The climate data and data related to the density of *Microtus arvalis* colonies were statistically processed. Also, a regression analysis was made, which showed the correlation between the CHT and the change in the density of *Microtus arvalis* colonies in the period from 1973 to 2010. An increase in the density of the number of *Microtus arvalis* colonies per hectare with the increase in the Hydro-Thermal Coefficient was revealed.

As compared to the 1973-1990 reference periods, between 1991 and 2010 an unessential increase in the density of the rodent species *Microtus arvalis* was revealed. At the same time, according to the three global climate models (CSIROMK3, ECHAM5 and HadCM3) under the SRES A2, A1B and B1 emission scenarios, a decline in the density of the population of this rodent species is anticipated in the 21st century, as a result of the drop in the HTC on the territory of the RM. In all the assessed emissions scenarios (SRES A2, A1B and B1), the global climate models CSIRO MK3, ECHAM5 and HadCM3 forecast a varied reduction in the density of *Microtus arvalis* rodent colonies in the time periods 2010-2039, 2040-2069 and 2070-2099. The highest indicators of *Microtus arvalis* colonies density are predicted by the ECHAM5 and CSIROMK3 models and the lowest indicators – by the HadCM3 climatic model.

S.6.5.4. Soil Resources

The impact of the climate changes on the soils is either direct (resulted from the increase in temperatures, amount and intensity of precipitations and concentration of carbon dioxide), or indirect, resulted from the changes caused to the vegetal carpet or soil biota by the climate changes. The climate changes produce: an increase in the hydric erosion of the soil and washing off/leaching of nutrients due to the change in the amount and intensity of precipitations; a change in the structure and texture of the soil due to the increased disaggregation/alteration tendency under the influence of the excessive climate factors; an amplification of the Aeolian erosion due to the increase in temperatures and reduction of precipitations in summertime; a reduction of the amount and quality of the organic substance in the soil due to the reduction of the photosynthesis in C3 plants (with first enzyme involved in fixing the CO_2, rubisco, inhibited at temperatures higher than 35ºC); a reduction of the biodiversity of the soil biota due to the temperature increase and reduction of water in the soil; an increased amount of salt in the soils due to intensified irrigation.

The WEPP (Water Erosion Prediction Project) model was used to project future changes in soil erosion dynamics. WEPP represents a system of soil erosion forecast based on fundamental technologies that take into account the storing of sediments during flows, the theory of infiltrations, hydrology aspects, and the science of plants, hydraulics and mechanical erosion. The model broadly applies the information about slope structures and soil profiles. The most notable advantages of this model include capacities for space estimation and distribution of soil losses (the net loss of the soil for the entire slope or for each point of a profile slope that can be estimated for one day, one month or one year). The modelling process is based on a broad range of conditions that play a practical role in the test area.

The area selected for the case study has about 31 ha (width - 553 m and length - 560 m) and a rather complicated relief. The altitude varies between 135 min the Eastern part and 137 m - in the Western part, with the altitude in the Centre on average reaching 114 m. Soil erosion modelling was produced for the reference period (1961-1990), as well as for the 21st century. The information about the climate in the 21st century was generated by using the regional climate model PRECIS (Providing Regional Climates for Impacts Studies), developed by the Hadley Centre of the Meteorological Office of the United Kingdom of the Great Britain and Northern Ireland. PRECIS is largely used to generate high resolution maps and statistics about the future changes in the climate conditions of the 21st century. During the study, the climate of the baseline period (1961-1990) and the future climate of the 21st century were simulated based on the limiting conditions under the A1B emissions scenario for the global climate model ECHAM5, including daily average temperatures, minimal and maximal, as well as the daily precipitations.

The obtained results allowed to conclude that in comparison with the baseline period (1961-1990), for the location selected, a reduction in the amount of precipitations by about 14.0% in 2020s, by 8.4% in 2050s, and by 23.0% in 2080s, is anticipated. At the same time, the climate changes will influence an increase in soil erosion, of about 20.4 t soil/ha or by 2.4% more in the period 2010–2039; about 52.9 t soil/ha or by 6.3% more in the period 2040–2069, about 23.6 t soil/ha or by 2.8% more in the period 2070–2099 as compared to the level of erosion characteristic for the baseline period (1961-1990).

Using the current modelling capacities and technical possibilities, the consequences of the climate changes on RM's soil resources can be forecasted at a larger scale. In accordance with the results obtained, soil processing technologies may be used to decrease soil losses as a result of the climate changes anticipated in the 21st century.

S.6.5.5. Water Resources

The specifics of the geographical position of the Republic of Moldova, located almost entirely between two main rivers – Dniester and Prut – determines the specifics of the structure of surface water resources. About 91% of the their total amount accounts to Dniester's and Prut's transit resources, which are formed on the territory of Ukraine and partially in Romania (Prut), and only 9% - to local water resources that are determined by small river flows and intermittent courses. The average multiannual climate flow layer of rivers was used as a criterion for assessing the impact of climate change on surface waters. To forecast the average annual flow, the water balance method was used.

Based on the processed information, sets of maps have been drawn representing the results of the calculations and mapping of the climate induced annual average climate water flows for three time periods (2020s, 2050s and 2080s) based on the set of models for three emission scenarios SRES A2, A1B and B1, as compared to the baseline period 1961-1990, for three AEZs in the RM (North, South and Centre). According to the obtained results, for the 2080s, the changes in the climate induced average annual flow as generated by the assessed models ensembles, consistently show the same trend, and their value increases from the low emissions scenario (SRES B1) to high emissions scenario (SRES A2). The most significant decrease in the climate induced average annual flow, from -30.2% (SRES B1) to -64.0% (SRES A2) will occur in the Southern AEZ.

In the context of the study conducted, the following conclusions have been made: (1) the difference towards decreasing the average climate flow and the measured one requires an additional study to clarify the non-zonal character of the flow in the researched area; (2) the high level of correlation between the average climate flow and the measured flow grants a high level of optimism in forecasting the water resources for the future, with reference to determining the climate flow based on the global and regional climate models available, under various emissions scenarios; (3) a comparative analysis of the average climate flow values shows that both at present and in the future this will tend to decrease from north-west to south-east within the limits of the territory under research.

S.7. Other Information

S.7.1. Activities Related to Technology Transfer

IPCC identifies three major dimensions needed to ensure efficient technology transfer: capacity building, enabling business environment, technology transfer mechanisms.

S.7.1.1. Capacity Building

Aiming at building capacities in innovation and technology transfer targeted towards reduction of GHG emissions, the following activities have been undertaken:

- Innovation and Technology Transfer Agency (ITTA) was created in 2004;
- Organization for Small and Medium Enterprises Sector Development (ODIMM) is active in the RM;
- Establishment of industrial parks is scaling up: three science and technology parks and three innovation incubators have been created already;
- RM is a partner to „Enterprise Europe Network" since September 22, 2011.

Recognizing the contribution of the structures mentioned above to building the country's capacity in technology transfer, it should be noted that their contribution to the promotion of technologies leading to climate change mitigation is relatively modest. A much more significant impact on such technologies transfer has been produced after the establishment of the Energy Efficiency Agency (EEA) in 2010 and the Energy Efficiency Fund (EEF) in 2012. MoSEFF and MoREFF credit lines launched by the EBRD in 2010 to promote energy efficiency projects and construction of renewable energy sources, as well as the EU – RM bilateral program also contribute to building capacities. In 2011 the latter included a 42.6 million euro package for the implementation of renewable energy sources and energy efficiency; the energy package launched by the World Bank is also worth to be mentioned.

S.7.1.2. Enabling Business Environment

Business environment in the Republic of Moldova features unjustified financial and time costs that significantly exceed the costs level in developed countries, which is discouraging to fair competition focused on productivity and innovation. Development of business environment is viewed as a priority in the National Development Strategy "Moldova 2020" (2012).

S.7.1.3. Technology Transfer Mechanisms

According to the IPCC Report „Methodological and Technological Issues in Technology Transfer", the mechanisms for technology transfer comprise: *National System of Innovation, Official Development Assistance (ODA), Global Environment Facility (GEF), Multilateral Development Banks, Kyoto Protocol Mechanisms*. The RM's innovation system is in its early development stage and for now is lacking the essential elements of a modern innovation system. The ODA offered to the RM has stabilized at the level of circa US$ 450 million annually (level of 2011 year). Of this amount, only a small part has been geared towards climate change mitigating. Since joining the GEF and applying for the GEF grants the RM has obtained non-refundable financial support worth US $ 28.8 million and US $ 57.1 million as co-financing for 18 projects, including six projects in biodiversity, six projects related to climate change and two projects aimed at protecting trans-boundary rivers, one project on combating soil degradation, two projects targeted towards elimination of persistent organic pollutants and two projects in multifocal areas. In the last phase of applying for GEF funding (GEF-5) intended for the period July 2010 - June 2014, the RM was supposed to get US $ 9 million. Among the multilateral development banks present in the RM, the World Bank (WB) and the European Bank for Reconstruction and Development (EBRD) were particularly active in promoting sustainable development and environmental projects. WB projects with an impact on climate change mitigating in the RM are worth about US $ 114.5 million, and the EBRD financed projects are worth about US $ 389 million, respectively. Until now, 11 CDM projects have been submitted for approval to the Designated National Authority (DNA), 8 projects having been already registered. In order to facilitate CDM projects aiming at reducing electricity produced from fossil fuels, in 2011, a tool to calculate the Greed Emission Factor (GrEF) of the national power system was developed with financial support of the WB; GrEF specific values for the lending periods that started in in 2010 were calculated.

S.7.2. Systematic Observations and Research Activities

S.7.2.1. Institutions Involved in Systematic Observations

The State Hydrometeorological Service (SHS) is a public institution subordinated to the Ministry of Environment of the Republic of Moldova comprising three main fields of activity: meteorology, hydrology and environmental quality monitoring. The main tasks of the SHS are: (1) To monitor the state and evolution of the hydro-meteorological conditions and environment quality with the purpose to protect the population and national economy against dangerous hydro-meteorological phenomena and high levels of environmental pollution; (2) Develop meteorological, agro-meteorological, hydrological forecasts, as well as environmental pollution forecasts; (3) To issue warnings on imminence of hydro-meteorological hazardous phenomena, as well as on high levels of environmental pollution; (4) To provide hydro-meteorological and environmental quality information to the population, central and local public authorities, businesses, national defence; (5) Establishment and operation of the National Hydrometeorological Data Fund to support hydrometeorological justification for design, construction and exploitation of various socio-economic objects; (6) Participate in the international data exchange within the global observing system and to fulfil the commitments under the conventions and international agreements signed by the Republic of Moldova.

S.7.2.2. National Systematic Observation System and Monitoring Network

SHS carries out systematic observations of the climate and the environment condition under the influence of natural and anthropogenic factors. The national meteorological system reproduces, on a country-wide level, the global meteorological system. It is of a complex nature and ensures recording, transmission and processing of meteorological information, according to internal needs, directives and agreements of the World Meteorological Organization (WMO) and other bilateral treaties and conventions to which RM is a part. Systematic climate observation is the main source of activity data for scientific analysis of climate and climate change. The SHS terrestrial monitoring network includes approximately 90 hydro-meteorological stations and posts and checkpoints to monitor air, water and soil pollution. Observation of meteorological, hydrological and agro-meteorological parameters and ecologic monitoring is carried out in non-stop regime at stations and posts. The information obtained from monitoring is used to develop meteorological and agro-meteorological forecasts, assess the air, water and soil pollution, warnings on natural hydro-meteorological phenomena, for global and regional of hydro-meteorological data exchange network, also to assess climate change in RM and to complement the National Hydrometeorological Data Base.

S.7.2.3. National Monitoring System

SHS meteorological observation network includes 18 meteorological stations and 60 observation posts (11 meteorological posts, 20 agro-meteorological posts and 29 hydrological posts). The network functions in accordance with the WMO's regulations and requirements, and disseminate the information used in international meteorological and climatologic research. With the help of SAIM "Pogoda" automatic continuous measurements of the air temperature and humidity, atmospheric pressure, wind speed and direction, soil temperature up to 20 cm depth are done and operational data is transmitted promptly. Other meteorological parameters are measured by using classical equipment. Every three hours the basic meteorological information, encoded in SYNOP telegrams, is collected by the Telecommunications Centre. These data are submitted to the Regional Meteorological Centre (Moscow, Russian Federation) to be distributed within global and regional exchange among WMO member countries. Monthly meteorological information obtained from four stations and encoded in "Climate" telegrams is transmitted to the Regional Meteorological Centre (Moscow, Russian Federation), DWD (Germany), World Climate Data Centre (Asheville, North Carolina, USA). These data are then used by the WMO to prepare monthly climatologic reports and climate modelling in scientific research in the field.

The Global Observations Network (GCOS) includes Chisinau weather station, its data being used for global information exchange. At regional level data from all stations of the national network are involved.

Data on adverse meteorological phenomena observed across the country each year are transmitted and placed in the WMO's Bulletin for Region VI. In November 2010, as part of the Regional EUMETSAT Project, the National Meteorological Forecasting Centre has been equipped with the DAWBEE station receiving and visualizing satellite data, which allows to monitor the state of the atmosphere, evolution of cloud systems, parameter of moisture fields, meteorological phenomena, etc. in quasi real time. In 2013 year the Doppler weather radar system with dual polarization has been installed and put into operation.

S.7.2.4. Climate Database

SHS continuously builds its climate database. National Hydrometeorological Data Fund also stores historical data of meteorological observations (since 1886). These data are used to analyse weather patterns across the country and to estimate climate evolution over the period of instrumental observations. Meteorological data is processed by „PERSONA MIS" and „PERSONA MIP" software that allow to process information in accordance with the WMO's recommendations and requirements. Climate database is built by using the "CLICOM" climate data processing system. National Hydrometeorological Data Fund is systematized and permanently supplemented with hydrometeorological data and scientific research materials in the field.

S.7.2.5. Data Collection System

The following three types of communication are used to collect data from the observation network and receive synoptic information: (1) internet (data from meteorological stations), at 14 out of 18 stations 3G modems ensuring a speed of 4.7 Mb/s are installed; (2) telegraph (data from stations) –"Telex Alpha" telegraph modem and the corresponding software is installed at Telecommunication Centre; this set fully replaces the telegraph and allows to receive the telegram directly to personal computer, with subsequent possibility to edit it; (3) telephone (in case of other communication means failure); (4) a complex meteorological multi-satellite "MITRA", connected to a satellite communication channel that allows to receive satellite images, maps, data, distributed in the form of meteo-message, and operational information; (5) information from weather radars located in the RM (the radar is located on the territory of Chisinau International Airport) and Romania (complex radar maps within the Doppler radars scheme of the National Meteorological Administration of Romania); (6) a direct channel to the Regional Meteorological Centre of the World Meteorological Organization (Moscow), using the designed "UniMas" hardware and software complex intended to perform the message switching function; "UniMas" receives – transmits meteorological data through a direct link channel.

S.7.2.6. Hydrological Monitoring System

SHS carries out hydrological monitoring of surface waters. Currently the National Hydrological Monitoring Network (NHMN) of surface water consists of two stations (Ungheni station and Dubasari station) and 54 hydrological posts, 30 in the Dniester River basin, 24 in the Prut River, the Danube and the Black Sea basins. Daily observations on water level, rainfall, water and air temperature, water turbidity, seasonal observations of ice formation phenomena, ice thickness, measurements of water flow, are carried out at hydrological posts. Regional characteristics of the hydrologic regime of water bodies are studied under special programs, zonal factors and economic activity impact is identified, development and spreading of the natural hydrological hazardous phenomena is taken into account for the purpose of insuring national economic organizations. Hydrological data obtained at observation points serve as basis for further data processing and analysis in order to study the occurrence rate of the processes and forecast the environment condition. During 2006-2008, five automatic hydrologic stations on the Raut River were installed, and during 2010-2012 eleven automatic hydrologic stations were installed on the Prut River. In 2011, the SHS installed a web server that receives data from automatic hydrologic stations using GPRS and satellite communications. In 2013 year, an automated system of monitoring water resources in the Dniester River basin was created and eight automatic hydrologic stations were installed. Hydrological information is shared on a regional level between the Danube River basin (DANUBE - HYCOS) and Black Sea (BLACKSEA - HYCOS) states. Under the long-term intergovernmental agreements and programs with neighbouring countries (Ukraine and Romania), hydrologic operational information is shared and the state of water resources of the border Rivers Dniester and Prut is monitored.

S.7.2.7. Environmental Quality Monitoring System

Environmental Quality Monitoring Department of the SHS carries out ecological monitoring of the environment components quality (surface water, air, soil, sediments, rainfall, ambiental dose rate of γ-radiation, etc.) through the monitoring network covering the entire territory of the RM. The national environmental quality monitoring system was established in the '60 of the XX century and systematic observations started in the '80 of the XX century, now having the following priority objectives: monitoring of the environmental quality and determining the pollution level; detection of extremely high pollution of surface water, air and soil; prevention and mitigation of adverse effects on the environment and population by using emergency warning systems; emergency warning of decision makers about level of environmental pollution; systematic public awareness on the environmental quality.

S.7.2.8. Agro-Climatic Monitoring System

Agro-meteorological monitoring is carried out by SHS. At present observation of agricultural crops conditions, development and yield formation phases, is carried out at 17 meteorological stations and 20 agro-meteorological posts. Observation of complex meteorological elements is carried out at the same stations and posts. In addition, reserves of available soil moisture on land covered by crops are measured during the vegetation period, and temperature at the depth of the twinning node is monitored in winter, and two times in winter - winter crop growth is checked to determine the their viability. To determine the height of the snow layer special measurements are made. The SHS carries out also agro-climatic aridity monitoring.

S.7.2.9. Other Types of Monitoring

Countrywide monitoring of groundwater is carried out by the State Enterprise "Hydro-Geological Expedition" which subordinates to the Ministry of Environment. Monitoring includes measurement of groundwater level, temperature, and water quality. Institute of Geology and Seismology of the ASM also implements research projects in geology, and groundwater monitoring component is present in some of them. Groundwater monitoring results are published in the annual scientific bulletins, in which the analysis of information on changing the groundwater level and quality as a result of human activities and natural processes, is provided. The results of groundwater quality monitoring are also transmitted to the State Geological Fund. A national forest monitoring network of the Republic of Moldova was created within "Moldsilva" Agency. The Institute of Pedology, Agrochemistry and Soil Protection "N. Dimo" deals with research into soil genesis, geographical distribution of soils, soil classification across the country, development of soil mapping and land value assessment methods, development of soils monitoring and inventory database, as well as research of soil erosion processes, development of erosion control technologies to reduce the degree of soil degradation, and other environmental aspects. National Scientific and Practice Centre for Preventive Medicine of the Ministry of Health is in charge of monitoring drinking water quality and air quality in the sanitary areas of settlements in the Republic of Moldova. "Apele Moldovei" Agency collects and process statistical data on water use. Ministry of Health monitors air quality in urban areas. Measurements of maximum admissible concentrations in the air by six key parameters are made on a monthly basis. Several institutes of the Academy of Sciences (e.g. Institute of Zoology, Botanical Garden (Institute), Institute of Genetics and Plant Physiology), State University of Moldova and Moldova State Agrarian University, study the wild flora and fauna of the country at species level.

S.7.2.10. Research Activities

Systematic hydrometeorological observations made in the RM over the past 60-110 years, allowed to summarize the climate data, to publish it as climate and agro-climatic guidebooks, monographs, such as "Climate of the Moldavian Soviet Socialist Republic", "Climate of Chisinau Municipality", "Agro-Climatic Resources of the Moldavian Soviet Socialist Republic", "Agro-Climatic Guidelines for the Moldavian Soviet Socialist Republic", "Natural Meteorological Phenomena in Ukraine and Moldova" and other information which is used for planning and controlling harmful effects of dangerous natural phenomena, and environmental protection. The results of hydrologic observations are published in: "Annual Data on the Regime and Surface Water Resources", "State Water Cadastre of the Republic of Moldova", "Multi-Annual Characteristics Guide", etc. Scientific research is also conducted in the framework of regional hydro-meteorological programs. Based on regional climate information, monitoring researches are carried out being focused on the natural and anthropogenic influence on the climate in RM. Such researches fosters climate change forecasts for the country, make it possible to calculate changes in the basic features of air temperature and precipitations. Risks and vulnerability for agricultural sector, in the context of climate change, are assessed, and adaptation measures for agriculture are identified. Climate change modelling relevant for the territory of the country is carried out by the Climate Change Office of the Ministry of Environment. Other institutions involved in climate researches, including modelling of future climate events, are the SHS and the Institute of Ecology and Geography of the ASM. Researches with reference to the influence of climate change on different sectors of the national economy are made periodically by Climate Change Office of the Ministry of Environment and by Institutes of the Academy of Science of Moldova. To be noted that by the end of 2013, the Institute of Ecology and Geography of the ASM, will have published the "Atlas of Climatic Resources of the Republic of Moldova" developed based on Geographical Information Systems (GIS).

S.7.2.11. International Cooperation

SHS gears its international activities towards the following directions: participation in UN specialized agencies: (1) World Meteorological Organization (WMO), UN Convention to Combat Desertification (UNCCD), the Convention on the Trans-boundary Effects of Industrial Accidents of the United Nations Economic Commission for Europe (UNECE); (2) Partnership in the Commonwealth of Independent States (CIS); (3) achieving bilateral agreements with other national meteorological hydrological and environment quality monitoring services; (4) participation in scientific programs under international conventions and projects. Collaboration with state hydrometeorological services takes place in the framework of bilateral agreements. Relationships with hydrometeorological services of the neighbouring countries become more intense. Intergovernmental long-term cooperation programs with Ukraine and Romania are of special importance collaboration strengthening. These agreements and programs foster operational hydrometeorological information exchange, monitoring of the water resources of the state border Rivers Dniester and Prut. In the past years, in collaboration with international partners, SHS implemented the following projects: „Disaster and Climate Risk Management" project (2010-2013) (supported by the World Bank); „Surface Water Monitoring and

Flood Prevention in the River Prut Basin" project (2010-2012) (supported by the Government of Czech Republic); EUMETSAT Project „Data Access for Western Balkan and Eastern European Countries (DAWBEE)" (2010); „Surface Water Monitoring and Flood Prevention in the River Raut Basin" project (2006-2008) (supported by the Government of Czech Republic).

S.7.3. Education, Training and Raising the Public Awareness

S.7.3.1. Ecologic Education of Population

The objectives of ecologic education are similar in most countries and focused on informing and enhancing the population's knowledge about the environment, the need to improve the quality of the environment, and on identifying ways to prevent environmental problems. People are informed about global warming, environment pollution, about how the planet "works" as an integral system, about the consequences of environmental degradation, and, accordingly they learn about the role of the humanity in generating environmental problems, in solving and preventing them.

S.7.3.2. Education System

Moldovan education system is based on the principle of equitable education for everyone, which is set out in the Law on Education No.547 of 21 July 1995. The national and sector policies in education are reflected in the Government Activity Program "European Integration: Freedom, Democracy, Welfare" (2011-2014) (Chapter "Education and Research); Strengthened Education Development Strategy for 2011-2015, approved by Order of the Minister of Education No. 849 of 29 November 2010; Vocational/Technical Education Strategy for 2013-2020 and the Action Plan for implementing the Strategy, approved by the Government Decision No. 97 of 1 February 2013; and the Inclusive Education Development Program in the Republic of Moldova for 2011-2020, approved by Government Decision No. 523 of 11 July 2011, as well as the draft Sector Development Strategy for 2014-2020 "Education 2020" (as from 13 September 2013 in public consultation process). Moldovan education system includes several stages, among which preschool education, primary education, gymnasium education, lyceum education, vocational education, pre-university and university education.

S.7.3.3. Preschool Education

The preschool education is the first level of the education system and includes children aged 3-7. It aims at preparing multilaterally the children for life and subsequent enrolment in school. In this period of life children are acquainted with the concept of "environment". In this process children get acquainted and learn to use elementary concepts about their own body, nature and the environment.

S.7.3.4. Primary and Secondary General Education

The education process is based on the framework curriculum, a normative document that regulates the organization of the education process, especially in primary, gymnasium and lyceum education. According to the 2013-2013 curriculums, the framework curriculum for grades 1-9 (primary and gymnasium stages), stipulates the following: teaching of *Sciences* to students of grades 2-5 (1 hour per week); teaching of Biology to students of grade 6 (1 hour per week) and to students of grades 7-9 (2 hours per week). The biology curriculum for grades 6-9 has one of its main objectives to create beneficial convictions and attitudes in students to their own health and environmental protection. The curriculum contains the topic of environmental protection that teaches (in grade 9) subjects related to human influence on biodiversity and the impact of human action on one's own existence. In this subject, children are taught how to develop recommendations/measures to prevent reduction of the ozone layer, acid rains, and global warming. The curriculum also contains optional courses for grades 1-9, which include the subject of *ecologic education.* As to the framework curriculum for *lyceum* education (grades 10-12), the subject of *biology*, humanitarian profile, is taught 1 hour per week for grades 10-12; grade 10 - 2 hours per week; grades 11-12 - 3 hours per week. According to the lyceum *biology* curriculum for grades 10-12 (part of the topical block *math and sciences*), e*cology and environmental protection* is taught only in grade 12 (real sciences profile - 18 hours; humanitarian profile - 6 hours). In addition to the required courses, the lyceum cycle also includes optional classes in *environment protection*, with 0-1 hours for grades 10-12, humanitarian profile, and 0-2 hours for grades 10-12, real sciences profile. The optional subjects focus on forming in students competences that cannot be formed only through one subject. They are meant to contribute to enhancing and deepening the students' knowledge within the scope of the school program but also to their professional orientation.

S.7.3.5. Secondary Vocational Education

The vocational secondary education is an integral part of the national educational system and is focused on training and developing skills, competences and professional abilities that are specific to training qualified workers for the national economy branches in RM. The vocational secondary education ensures learning an occupation (profession) and improving/re-training qualified workers and laid-off workers. The objectives of vocational secondary education provide for the interaction of the qualified worker with the economic environment. At present in RM there are 67 units of secondary vocational education open, including: 49 vocational schools; 21 occupational schools; 2 vocational lyceums. In the school year 2012/2013, the vocational secondary education institutions had 19.6 thousand students enrolled. At such institutions the students are trained in the areas of agriculture, forestry, horticulture, etc. As part of such professions, the students also acquire ecology-related knowledge. Ecologic education is taught in general culture subjects as part of biology modules ("Ecology and Environment Protection"), chemistry ("Solving ecologic problems based on chemical knowledge"), geography ("Environmental geography") and physics ("Thermal devices and pollution", "Biological effect of radiations; Protection against radiations"). Every year, in April, vocational secondary schools organize conferences on environmental topics (Human excesses as related to the nature; Excessive hunting and poaching; Waste piling and land and water residues). There is organized a by-monthly ecologic event "One tree for our perpetuation", cleaning works, round tables, essay contests, etc.

S.7.3.6. Specialized Secondary Education

Moldova provides professional training of specialists of average level of qualification in 47 colleges that, in the school year 2012/2013, had 30.7 thousand students enrolled. The *Ecologic College* is the specialized secondary education institution that trains specialists in ecology, according to the following majors: 2701 Ecology and environmental protection; 2806 Forestry and public gardens; and 2506 Water management and environment protection. For pedagogical colleges, the framework curriculum provides course units/modules in the area of ecology for the future specialists in the following majors: 1203 Primary education pedagogy; 1202 Preschool pedagogy; 1404 Musical training; 1301 Physical education and sports. The course units/optional modules in ecology contain topics for a number of majors, including: 2551 Cadastre and territorial organization; 2512 Anti-fire protection; 2301 Design and technology of fabric manufacturing; 2304 Design and textile technology; 2052 Railway transportation; 2051 Ground transportation; 2902 Tourism and 2901 Hotel services. As part of extra-curricular activities, ecologic education takes different forms: monthly ecology-related events; specialized teacher classes; trainings; debates; conferences; essay and poem contests; round tables, etc.

S.7.3.7. Higher Education

There are 34 higher education institutions in RM, including 19 state institutions (of which two provide only master programs) and 15 – private institutions. At these institutions, students acquire knowledge in chemistry, biology, soil science, environmental protection, hydrology, agriculture, forestry, plant protection, agricultural biotechnology, geography, meteorology, geology, environmental law, water management and protection, environment engineering and protection, etc. In accordance with the Law on Approving the Classifier of Professional Training Areas and Majors for Training in Higher Education Institutions, Cycle I – bachelor higher education, initial training in ecology takes places both in public and private institutions, in several areas, including as part of general educational areas 42 "Natural sciences," 61 "Agricultural sciences," and 85 "Environmental protection." At present, initial training through bachelor higher education takes place in the following areas of professional training: 424 "Ecology" – Moldova State University (Chisinau), Tiraspol State University (Chisinau), "Alecu Russo" State University (Bălți), Moldova Free International University (Chisinau), Moldova State Agricultural University (Chisinau), Moldova Academy of Sciences University (Chisinau); 612 "Plant protection" – Comrat State University, Moldova State Agricultural University; 851 "Environmental protection" – Moldova State University. Starting with the school year 2011/12, education is provided for the major: 852.1 "Ecological security". The course units/modules in the area of ecology contain curriculum for a number of majors, including: 423.1 "Geology" – Moldova State University; 425.1 „Geography" – Moldova State University, Tiraspol State University, Moldova Academy of Sciences University; 426.1 "Meteorology" – Moldova State University; 613.1 "Agriculture" – "Alecu Russo" State University, Comrat State University, Moldova State Agricultural University. Starting with 2008, in the context of the national reforms for implementing the objectives of the Bologna process, enrolment has been done for cycle II - higher master level education. In view of completing the university training, higher education institutions have developed master programs, focused on deepening the bachelor higher education. At present, the following master programs with an ecologic profile, authorized by the Ministry of Education, are being implemented: *Ecology and Environmental Protection* (Moldova State University); *Biodiversity and Protection of Natural Resources* (Moldova State University); *Environmental Sciences* (Moldova State University); *Meteorological Studies and Analyses* (Moldova State University); *Ecologic Chemistry and Environmental Protection* (Moldova State University); *Ecological Chemistry* (Tiraspol State University); *Agrarian Ecology* (Comrat State University); *Environmental Geography* (Tiraspol State University); *Agro-ecology* (Moldova State Agricultural University); *Ecology, Environmental Protection and Ecological Security* (Moldova Free International University).

S.7.3.8. Post-University Education

The post-doctoral program is a form of deepening the theoretical knowledge and scientific research for persons having a scientific degree of doctor and a manner of preparing the habilitated doctoral thesis, and is organized for a timeframe of up to two years. Post-doctoral programs can enrol persons having the scientific level of doctor, who have scientific works (licenses) containing pioneering results for the science and practice – solutions, facts, generalizations, conclusions generating new directions, value implementations - performed after presenting the doctoral thesis (different and at a higher level), and that represent at least two-thirds of the results that can serve as basis for a habilitated doctoral thesis. The decision for admission to the post-doctoral program is made by the senate of the line university, with the subsequent approval of the National Council for Accreditation and Certification.

S.7.3.9. Ecologic Training

In the context of improving education and ecologic training of the population, the Ministry of Environment undertakes various actions. For example, every year it organizes the "Ecologic Hour", which is teaching material developed for pre-university education institutions. Each year this initiative reveals a certain environmental topic – biodiversity, water protection, climate changes, waste management, access to environmental information, etc. Ministry of Environment organizes various ecologic contests on various environmental topics, e.g. in April-May 2012 it launched the photo and drawing contest "Environment and Sustainable Development." This contest was started in the context of the UN Conference on Sustainable Development RIO+20 that was held in the period from 15 to 22 June 2012. Students of various pre-university institutions participated in the drawing context, while the photo contest was open to everyone. The contest results have been exhibited in the Ministry's building.

Ministry of Environment has financially supported the publishing of a number of textbooks with an ecologic content, a total of 17 book titles, each having been published in about 1500 copies. The books have been distributed to education institutions throughout the country. This activity has been organized jointly with the Ministry of Education. The book titles have a scientific and popularization character, and are meant for school and university students, teachers as well as to the public at large interested in environmental protection. These books aim at deepening and integrating the knowledge in sciences, biology, geography and ecology, and also at achieving inter-disciplinary objectives.

Every year, the Ministry of Environment organizes activities related to the celebration of international environmental days. In this context, the Ministry's specialists organize and participate in seminars, round tables, radio and TV programs, public debates etc. that are attended by the public at large. Also, different projects are being implemented under the aegis of the Ministry of Environment, which aim at improving the situation of environmental components, improving the environmental legislation, and educating the population in environmental issues.

The Ministry of Environment also organizes other actions aimed at informing the population about the importance of environmental protection, such as: *European Mobility Week entitled "Clean Air for Everyone"*, action organized every year that aims at bringing in spotlight air pollution, especially from the ground transportation. The main goal of this action is to sensitize local public authorities and the population about certain aspects of air pollution with noxious substances, which has reached critical levels in the past years and has severe economic, social and ecologic consequences. As part of this actions are also tackled the issues of climate change in the context of reducing GHG emissions from the broad use of fossil fuels and combustibles. *Global Action "Earth's Hour"* – this is a global event during which millions of people on the globe simultaneously disconnect the electricity for 1 hour. The purpose of this action is to stimulate the interest in saving the natural resources and preventing climate change. This action is organized every year and involves business operators, environmental NGOs, and the interested population. In 2013 the event included a number of actions aimed to draw public attention to environmental issues and the importance of solving them. In view of sensitizing and enhancing the level of awareness of the population, there were broadcast films on the following topics: climate change, sustainable development in market economy conditions, protection of the ozone layer, combating desertification and prevention of water resources pollution. In parallel to the broadcasting the documentary films there was organized a traditional asphalt drawing contest for children and school students "*Smile - the Planet Loves You*". *Action "A Tree for Our Perpetuation"* - is a national action that provides, alongside the proper planting of trees and bushes, recovery of green spaces, arrangement and cleaning of communities, cleaning and recovery of river protection strips.

Business operators have had an increasingly broad involvement in such actions. For example, in 2009, the foreign capitals company "RED UNION FENOSA" S.A. launched the "Energy Efficiency" Project. The goal of the project was to promote energy efficiency culture, stimulate and encourage company's clients to use the electric energy in a responsible and efficient manner. The project aimed to stimulate the clients to reasonably use the energy, reduce the negative impact of energy systems on the environment, identify new directions for the development of energy efficiency programs and of the necessary framework for developing coordination and cooperation actions, increasing the level of energy security and encouraging cooperation in the energy efficiency area. At the same time, "GAZ NATURAL FENOSA" S.A. takes a number of actions aimed at preventing environmental pollution, informing the population about the importance of reasonable use of natural resources and energy, which can be found on the company's website (<http://gasnaturalfenosa.md>) such as the environmental protection campaign "GO Green"; "A Tree for Our Perpetuation"; "A Tree for the Youth"; organization of fairy tale contest on the topic of resource conservation; Earth's Hour, etc. To note that for the first time in RM there was created a web platform for reporting community problems <www.alerte.md>. The purpose of this project is to identify and solve a number of social problems by having them marked on the map by the citizens. All the problems reported on the site later reach the Chişinău Mayor's Office and the responsible persons deal with them. The special interest in the above-said platform is represented by the columns: "Green Spaces" and "Solid Waste," that are directly related to the environment protection and give the possibility to the Chisinau residents to participate actively in identifying and solving environmental problems; as a result, awareness-raising is efficient because it reaches each individual.

In the period from 20 May–25 June 2013, the Climate Change Office of the Ministry of Environment organized the national competition "Act on the CO_2" in which participated 16 youth initiatives, civic associations and local public authorities, selected in a rigorous process, to which 33 projects applied. The purpose of the contest was to: raise the awareness of the youth and have them protect the environment in the context of the climate change phenomenon; undertake responsibility and develop skills of reducing GHG emissions and mitigating climate changes; identify solutions for solving environmental problems in the climate change context at local and national levels. The prize award fund of the national competition "Act on the CO_2" was as follows: first prize and the title "National Champion of the Competition "Act on the CO_2" – 3000 MDL, "Together, for a clean environment", coordinator: Rodica Frecauţeanu, CAROMA Nord, Bălţi; second prize – 2000 MDL, "A vacation day for a cleaner world", coordinator: Inga Platon, Regina PACIS Foundation, Chişinău; third prize – 1000 MDL, "The eye forgets, the lens remembers", coordinator: Iacoban Irina, town Cimişlia, Cimişlia; special prizes – 500 MDL each: "Best rural project" – "Think globally, act locally", coordinator: Natalia Lubaş-Verdeş, Izbişte, Criuleni; and "Discovery of the competition" – "Flowers speak more in the interest of our health", coordinator: Elena Ipati, Ustia, Dubăsari.

S.7.3.10. Information and Public Awareness

Information and Public awareness about environmental issues takes place continuously through the media, radio and TV programs, seminars and topical trainings organized in this connection, public debates, flash mobs as well as environmental campaigns, implemented together with the community partners and central and local authorities, own electronic information tools (<www.mediu.gov.md>, <www.clima.md>), as well as of environmental NGOs (Ecologic Movement of Moldova, REC Moldova, Eco-Tiras, Bios, Biotica, Eco-Terra, Ecotox, Gutta Club, Cutezătorul, Environment and Health, Ormax, etc.). This process is coordinated by the Ministry of Environment, institutions subordinated to the Ministry, and environmental NGOs.

In view of informing the population about the activities carried out, the Ministry of Environment periodically publishes a Report on the State of Environmental in the Republic of Moldova that can be found in electronic format on the Ministry's website (<www.mediu.gov.md>). Also, the State Ecologic Inspectorate annually prepares and publishes the report "Environmental Protection in the Republic of Moldova" (<http://inseco.gov.md/monitorizare/>) and the State Hydrometeorology Service publishes the "State Cadastre of Waters" as well as the "Activity Report of the State Hydrometeorology Service" (<www.meteo.md>).

With the financial support of the National Environmental Fund the following environmental publications are periodically developed: "Natura" (Nature), "Mediul ambiant" (Environment), "Buletinul ecologic" (Environmental Newsletter) and "Revista apelor" (Waters Magazine). Environment protection issues are broadly and periodically covered in such radio and TV programs as "Eco-Terra" and "Terra-Vita", especially by the National Public Broadcaster "Teleradio Moldova".

To note that the level of awareness of the public at large in the Republic of Moldova in regard to the climate change has been recently studied through the national survey *"Republic Moldova: What the Population Knows About Climate Changes,"* conducted in the period 29 May–16 June 2012, on the order of the Climate Change Office, Moldovan Ministry of Environment, under the Project "Ensuring support to the Republic of Moldova for preparing the TNC in compliance with its commitments to the UNFCCC" (the study is available on the website of the Climate Change Office in Romanian and English).

The public opinion survey had a pool of 804 respondents, aged between 15 and 65, from 12 administrative-territorial units, living in urban and rural areas. This sample is representative for the adult population of RM (without Transnistria), with a maximum error margin of ±3.5%. The results of the survey reveal that the perceived level of information about the global warming or its consequences for the time being is very low in Moldova: 5%-6% consider themselves very informed about the climate system or measures that can be taken to reduce the effects of global warming; and only 3% state to be very happy about the level of information available to them. These perceptions are very well highlighted in the respondent answers where many knowledge-related questions show significant gaps for the vast majority of the Moldovan population. The point of view of the scientific community does not reach the population; the representations about the scientific truth are shared, including as effect of the lack of contact with the scientific truth.

S.7.4. International and Regional Cooperation

S.7.4.1. Legal and Institutional Frameworks for International Cooperation

The Foreign Policy Concept (1995) remains the main document that identifies the country's priorities in the area of international cooperation. Honouring the commitments made is one of the main principles set forth in the Concept. According to this, foreign policy is focused on bilateral and multilateral cooperation. The country considers the G7 countries as important strategic partners and the cooperation with the United Nations and other international or regional organizations as an essential activity. The Environment Policy Concept of Moldova (2001) stresses the following: political orientation to European integration, with emphasis on approximating the national law to the EU Directives; signing bilateral protocols of cooperation with the CIS and EU countries; signing and ratifying regional agreements; international cooperation in view of attracting investments for environment protection. The cross-border cooperation concept has been developed in view of supporting the dialog with the neighbouring countries and international and European organizations. By the Parliament Decision "On Developing Cross-Border Cooperation within the Euroregions" (2003), there was established the Committee for Cross-Border Cooperation that is responsible of the following: establish mechanisms of cross-border cooperation within the Euroregions as fundamental elements of the European integration process; approximate the provisions of national legal acts on cross-border cooperation to the European standards; and create a system for implementing the conventions and agreements to which the country is party. The laws on joining conventions or protocols are an inherent part of the national legislation. The signing of international treaties by RM takes place under two main legal acts: the Law on International Agreements (1999) and the Regulation on the Mechanism for Concluding International Agreements (2001).

The main role in concluding environment agreements or joining environment conventions belongs to the Ministry of Environment. Until now, RM has joined 18 conventions, 9 protocols and 2 international environment agreements. A national focal point has been appointed for coordinating the implementation of the requirements for each international treaty. Special units (Offices) have been established under the Ministry of Environment for carrying out the activities under some of the conventions (most of them have been created through the Order of the Central Environment Authority). The teams of such Offices, in addition to developing, promoting and implementing projects, have the task to participate in developing, promoting and implementing the national policies and strategies in accordance with RM's obligations to the international conventions and treaties to which our country is signatory.

S.7.4.2. Political Framework of Cooperation with the European Union

According to the Activity Program of the Government "European Integration: Freedom, Democracy, Welfare" (2011-2014), the European integration is a fundamental desideratum of RM's internal and external policy. The plenary realization of this objective will allow the country anchor in a system of security, stability and prosperity, governed by democratic values and respect for fundamental human freedoms. At the same time, assuming and responsibly implementing the commitments resulted from the European path is the most efficient manner of modernizing the country politically, economically, and socially. European integration first of all means internal positive transformations of the country. The government sets to make efforts to promote the reforms requested both by the society and the international community in view of ensuring freedom of the media, independence of the judiciary, and liberalization of the economy, which are vital areas for the European integration of the country. By coherently promoting policies for making all the country's social-political and economic aspects more European and signing the association agreement with the EU, we will manage in a predictable period to transform RM into a country eligible to join the EU. As a result of implementing the Government's Activity Program, RM will become a trustworthy partner and a welcomed country into the international community, which successfully conducted the negotiations of the Association Agreement (at the Third Eastern Partnership Summit in Vilnius, Lithuania, 28-29 November 2013), including the Deep and Comprehensive Free Trade Agreement with the EU, and will launch the process of negotiation of the EU membership status.

To note that the relations between RM and the European Union were formally launched within the signing of the Cooperation and Partnership Agreement (CPA) on 28 November 1994, that became effective on 1 July 1998 for an initial period of 10 years. The CPA represents the legal basis of the relations between RM and the EU. This arrangement ensures the basis of cooperation with the EU in the political, commercial, economic, legal and cultural-scientific areas. At the same time, the political dialog between RM and the EU is ensured through reunions in the format EU-Moldova Political Dialog (COEST, COPS, Political Directors) that discuss the path of the reforms in RM, the RM – EU relations, and the subjects of common interest on foreign policy and security. In May 2004, RM was included in the ENP of the EU. The RM–EU Action Plan was signed on 22 Feb 2005. On 4 May 2006, RM was accepted as full member in the South-East European Cooperation Process, which once again confirms RM's belonging to the South-East European space and opens new perspectives in the RM – EU relations framework.

On 6 October 2005, the Delegation of the European Union to RM was established to enhance the Moldovan-European relations. In June 2008 the RM – EU Mobility Partnership was launched. Staring with 7 May 2009 RM has been participating in the Eastern Partnership Initiatives, actively contributing to developing the bilateral and multilateral dimension. Starting with 1 January 2010, RM has become full member of the Energy Community Treaty, and from 15 June 2010 the RM–EU Visa Liberalization Dialog was launched. In January 2011, RM received the Visa Liberalization

Action Plan that contains two sets of conditions that, once implemented will contribute to instituting a visa-free regime between RM and EU (since 2014). On 1 May 2011, the Protocol on the General Principles for RM's participation in the EU programs was defined. The first EU program in which RM participates is the Framework Program 7 (FP7) of the European Community for Research, Technological Development and Demos (2007-2013) (Memorandum of Understanding between the EU and RM on Moldova's joining the FP7, was ratified by the Moldovan Parliament by Law No. 279-XIX of 27 December 2011). Also, on 26 June 2012, RM signed an agreement for joining the EU Common Air Space.

The EU has been developing an increasingly close relation with RM, which goes beyond cooperation, up to gradual economic integration and deepening of political cooperation. To note that at present RM is in the process of negotiating the draft Association Agreement. The *"Environment"* section in the Agreement stipulates the specific commitments and activities to be implemented in the area of environmental protection by the RM's Government, and namely: develop legislation, norms and regulations aligned to the EU standards, strengthening the institutional capacities and establishing new structures as necessary; develop a new environmental strategy that would include the planned institutional reforms (with pre-established timeframes) for ensuring the enforcement and observance of the environmental law; develop sector strategies on water, air, waste management, biodiversity conservation, etc.; strict and clear division of competences among national, regional local environmental bodies; integrate the environment in other sector policies, promote green economy development and eco-innovations etc. The Annex to the "Environment" section of the Association Agreement contains 25 EU environment directives according to which RM must transpose and implement a broad set of requirements that also involve significant costs. There is close cooperation also within the working group "Environment and Climate Change" of the 2nd platform "Economic Integration and Convergence with the EU Policies" of the Eastern Partnership.

S.7.4.3. Bilateral Cooperation

In the period from 2010 to 2013 RM initiated a number of bilateral cooperation agreements and memoranda and also has joined programs on environment protection and sustainable use of natural resources, including the following: (1) Memorandum of Understanding between the Moldovan Ministry of Environment and the Romanian Ministry of Environment and Forests on the Cooperation in Environment Protection, 27 April 2010, Bucharest; (2) Agreement between the Moldovan Government and the Romanian Government on Cooperation for the Protection and Sustainable Use of Prut and Danube, 28 June 2010, Chișinău; (3) Mutual Memorandum of Understanding between the Estonian Ministry of Agriculture and the Moldovan Ministry of Agriculture and Food Industry in the area of research and economic cooperation in agriculture (in force from 16 Aug 2010); (4) Agreement between the Moldovan Ministry of Environment and the Estonian Ministry of Environment on cooperation in environment protection, 19 October 2011, Tallinn; (5) Framework Program 7 of the European Community for Research, Technological Development and Demos (2007-2013), ratified by the Moldovan Parliament by Law No. 279-XIX of 27 December 2011; (6) Nagoya Protocol on Genetic Resources and Correct Distribution of Benefits resulted from their use in the Biodiversity Convention, 25 January 2012; (7) Nagoya-Kuala Lumpur Additional Protocol on the Response and Repair of Damages to the Cartagena Protocol on Biosecurity, 25 January 2012; (8) Agreement between the Moldovan Government and the Israeli Government in Environment Protection, signed in Jerusalem on 14 May 2012; (9) Memorandum of Understanding between the Moldovan Government and the Turkish Government in Environment Protection, signed in Ankara on 1 November 2012 (Parties will cooperate in integrated waste management, water management, air quality management, industrial pollution prevention, climate change, assessment of impact on the environment, protection of biodiversity etc.); (10) Agreement between the Moldovan Government and the Ukrainian Cabinet of Ministries for Cooperation in the Protection and Sustainable Development of the Dniester River Basin, 29 November 2012, Rome.

In accordance with the provisions of the Moldovan Government Decision No. 790 of 22 October 2012 there has been established a Moldova Office for Science and Technology (MOST) under the EU in view of ensuring the plenary implementation of RM's status as associated country to the Framework Program 7 of the European Community for Research, Technological Development and Demonstration (2007-2013).

To note also the Program of Cooperation in Science and Technologies between the Moldova Academy of Sciences and the State Agency for Science, Innovation and Information of Ukraine (2013-2017), signed on 18 July 2013. According to this Program, the priority areas of research are the environment, information and communication technologies, new materials, biotechnology, nanotechnology, energy and energy efficiency, medicine and pharmaceutics. In the period from 2010 to 2013, the extension of international cooperation in environment protection has continued and the relations with the development partners have been renewed: Swiss Office for Cooperation, the Swedish International Development Agency (SIDA), Germany's International Cooperation Agency (GIZ), Austrian Development Agency (ADA), UN European Commission for Economy (UNECE), European Bank for Reconstruction and Development (EBRD), World Bank (WB), United Nations Development Program (UNDP), United Nations Environment

Program (UNEP), United Nations Program for Industrial Development (UNIDO), Global Environment Fund (GEF), Organization for Economic Cooperation and Development (OECD), etc.

S.7.4.4. Cross-Border Cooperation

On a cross-border level, in the period from 2010 to 2012 RM started and carried out activities on environment protection within common operational programs. On 28 June 2010, an Agreement was signed between the Moldovan Government and the Romanian Government on the Cooperation for the Protection and Sustainable Use of Prut and Danube Waters, that aims at the protection and sustainable use of water resources, exploitation of the Hydro-Technical Joint Costești (Moldova) – Stînca (Romania) on the Prut River, construction and exploitation of other hydro-technical objects.

On 29 November 2012, an Agreement between the Moldovan Government and the Ukrainian Cabinet of Ministers on the Cooperation for the Protection and Sustainable Development of the Nistru River was signed in Rome. The goal of the Agreement is to create a legal and organizational basis for cooperation and reasonable use of water resources and of other related resources, and of the ecosystems of the Nistru basin in the interests of the population and sustainable development of the Contracting Parties.

The cross-border cooperation is also ensured through the Romania–Ukraine–RM Joint Operations Program, one of the new funding instruments (ENPI) of the EU, implemented at the external borders of the extended Europe in the period 2007-2013. The program aims at creating a “connecting bridge” between the three partner countries in view of supporting the communities in the border areas in view of finding common solutions to the similar problems they face. Through this program, the local authorities and other organizations from the border area are encouraged to cooperate in view of developing the local economy, solving certain problems related to the environment and for strengthening the preparedness for emergency situations.

S.7.4.5. External Assistance Received under the Bilateral and Multilateral Cooperation for Development

According to the OECD data, RM ranks among the first ten countries of Europe that benefit from external assistance. According to the situation of 2011, the share of official assistance for development in the Gross National Income for RM accounted for 5.95%. When the European Integration Alliance (EIA) came to govern in September 2009, the Government addressed the donor community with the request for support in implementing the priority reforms for the country’s economic growth, specified in the “Re-launch Moldova” paper.

As a result, during the reunion of the Advisory Group “Partnership for Moldova Forum” held in Brussels on 24 March 2010, the donors community committed to allocate to RM 1.84 billion Euros (0.96 billion in the form of a grant or 52% of the total; respectively, 0.88 billion in the form of credits or 48% of the total) for the period 2011-2013. As a whole, the USA (through the Compact Program of the Millennium Challenge Corporation, signed in 2010 in the amount of USD 260 million) has become one of RM’s main bilateral development partners.

The EU commitment and of the EU member states on future allocations have accounted for 40% of the resources promised during the reunion. Towards the end of 2012, over 70% of the resources provided in the 2010 Brussels reunion had been contracted, through specific projects started in various national economy sectors. In addition, external funds of about 800 million euro have been attracted. So, we can establish a total amount of 2.6 billion euro provided to RM by the donor community in the period 2010-2012 (by 40% more than as compared to the financial commitments made during the Brussels reunion).

In 2012 the donor funds were estimated at about 474 million euro. According to the data of the State Chancellery of Moldova, the budget of the projects contracted in the reporting period account for about 206 million euro and the disbursements reported by the donors – about 465 million euro (about 98% of the estimated amount). For comparison, in 2007 the disbursements amounted to 266 million euro; in 2008 – 298 million euro; in 2009 – 244 million euro; in 2010 – 470 million euro; in 2011 – 451 million euro. For 2013 and 2014 there are provided 322 million and 213 million euro, respectively.

The manner of cooperation between RM and the development partners have taken various forms. Here can be mentioned technical assistance, support for implementing various investment or social projects, the support provided to the budget for implementing sector policies or the support provided for supporting the state’s payment balance. The objectives of the cooperation between the Moldovan Government and its partners are agreed upon and stipulated in the medium-term framework cooperation agreements. According to the data available for external development assistance, the highest share is held by the assistance with project implementation (75%), followed by sector budget assistance (about 17%), technical assistance, and assistance with maintaining the state payment balance. Given the budgetary constraints and of state debt servicing, the manner of attraction of external resources that is preferred by the Moldovan Government are grants and/or concessional credits.

The amount of on-going external assistance in 2012, according to the information from the database of the State Chancellery accounted for about 1.1 billion euro in the form of grants and 682.8 million euro in the form of loans. Accordingly, in 2012, the contracted resources were distributed as follows: about 109.4 million euro in the form of grants and 97.1 million euro in loans (EBRD, EIB, WB). The share of active grants in the total amount of external assistance has represented about 62%. For 2012, the grant-credit parity represented 53%, accordingly, 47% of the total amount of external assistance contracted during the year.

The community of active development partners in RM brings together about 30 countries and organizations and includes both multilateral (IFI) and bilateral cooperation. The top ten partners by the amount of financial assistance on-going in 2012 include EU, followed by the US Government, WB, EIB, EBRD, Romanian Government, UN, Swedish Government, Japanese Government and the Swiss Government. For the resources contracted during 2012, the EU further remains the biggest provider of assistance for development, followed by the WB, financial institutions of the EU, UN, US Government, Austrian Government, Swedish Government and the Chinese Government (of the bilateral).

According to the principles on enhancing the development assistance, aligning the assistance to the national priorities is a key factor in reaching economic development results and improvement of population's living standards. In this sense, the past years communication between the Government and the development partners has been constructive, and as proof of this come also the results of the surveys for two consecutive years, which show that over 90% of the on-going projects are aligned to the national development priorities. The efforts of both parties have been also focused on reducing project fragmentation and ensure balanced presence of the partners in various sectors.

The evaluation of donor presence in the sectors described in the Government's Action Plan shows the following distribution thereof: economic and financial policies (14), environment (11), health and social problems (9 each), education, efficient public services and rule of law (8 each), foreign policy and reintegration (5 each) and youth, culture and minority integration (4 each). At the same time, the donors are also dispersed in a number of sectors (UN - 9, EU - 8, WB, Germany - 6), which creates difficulties in coordinating the activities and reaching concrete results for some more difficult sector reforms. With reference to the presence of foreign assistance by sectors: "Transport and storage," "Government and civil society," "Other social infrastructure," "Agriculture" and "Business environment and other services", are in the top five of those accounting for about 78% of the on-going foreign assistance. For the assistance contracted in 2012 (circa 206 million euro) the respective sectors are "Business environment and other services," "Energy," "Transportation," "Government and civil society" and "Agriculture", with a share of 81% of the total amount. This denotes that the external assistance is directed to implementing investment projects for the economic sectors and for implementing important structural reforms.

The projects contracted in 2012 are related to the Competitiveness Growth Program (WB - 23 million euro); rehabilitation of electric transport networks (EBRD, EIB – 32.6 million euro); competitive agriculture (WB - 14 million euro); building dwellings for socially vulnerable layers (CEDB – 13.4 million euro); supporting measures for building trust between the Dniester River banks (EU - 12 million euro) and road rehabilitation in Chișinău (EBRD, EIB - 20 million euro). By the end of 2012, RM was implementing 384 projects in various sectors, including 116 projects in governance and civil society, 58 projects in infrastructure and social services, 49 projects in education, 31 projects in agriculture, 29 multi-sectoral projects, 24 projects for private sector development, 19 projects in environment and 16 projects related to energy generation and supply. As a total, in 2012, there were launched 98 projects, with new commitments in the amount of 206.6 million euro in various sectors. For 2013, the estimated amount of external assistance is 314 million euro.

S.8. Financial, Technical and Capacity Needs and Constraints

S.8.1. Mitigation Constraints by Sector

S.8.1.1. Energy Sector

Reduced payment capacity of consumers and relatively high cost of capital in the RM are either difficult to be achieved, or unaffordable expensive. Most measures aimed at reducing GHG emissions require investments that entail increase in energy prices, what does not ensure the economy's sustainability. Lack of interest for rehabilitation or construction of new power plants in a free electricity generation market is another important barrier. The availability of electricity generation sources (Ukraine, MTPP) providing electricity at lower prices than a new plant is limiting investors' interest for construction of new power plants in the country. Lack of "feed-in" tariffs limits the willingness of investors for implementation of renewable energy sources.

S.8.1.2. Transport

One of the barriers associated with demand for energy efficiency improvements to vehicles is the perceived commercial risk of investing in the development of efficient technologies, which partly result from the lack of clear regulatory signals in the form of vehicle efficiency standards. Use of bio-fuels, given the demand for arable land and water resources for irrigation, compete with more pressing domestic policy objectives looking at ensuring food security.

S.8.1.3. Buildings

Many energy efficiency projects in buildings are too small to attract the attention of investors and financial institutions. Thermal insulation of apartments in multi-storey blocks encounter different kinds of difficulties, or lack of economic interest because of the connection to the district heating system, or due to the decreasing heat load with a negative impact on the CHPs operation.

S.8.1.4. Industry

The existing machinery and equipment in a good part of industrial enterprises in RM have a high degree of obsolescence and physical tear and wear. Lack of enabling business environment is also a barrier to technology transfer.

S.8.1.5. Agriculture

Agricultural activity in the RM is a volatile and highly vulnerable to risks, particularly susceptible to climatic factors (such as droughts, frosts, floods, hail, erosion). Reducing dependence on such phenomena is a major challenge for the sector. Other barriers to low carbon development are associated with: insufficient financial coverage, excessive fragmentation of agricultural land, insufficient development of conservation agriculture, lack of investments for recovery of the livestock breeding sector and implementation of sustainable of manure management systems.

S.8.1.6. Forestry

The current system of monitoring and control of production processes in the forestry sector is applied to forest areas managed by the "Moldsilva" only. Thus, a broad range of monitoring, practical use and forestry management efforts are needed to address the deforestation issues currently faced by the RM.

S.8.1.7. Waste

The legal aspect of waste management in the RM is still underdeveloped and requires restructuring of both the legal and institutional framework, as well as development of an integrated recycling and waste recovery system. Reduction of the biodegradable fraction in municipal waste requires significant investment and specialized treatment facilities that have significant operating costs and are based on advanced technologies. It is worth mentioning also that the current statistical system in waste management pursues a different approach compared to the European Union.

S.8.2. Capacity Building Needs

The capacity building needs in the area of climate change mitigation are relevant and are supposed to be available in four dimensions:

- to carry out studies, researches and assessments in climate change mitigation and adaptation;
- to develop sector climate change mitigation and adaptation strategies and policies;
- to support the implementation of climate change mitigation and adaptation strategies and policies;
- to facilitate participation in negotiation of future international climate agreements.

The initial capacities are available in the respective areas in the RM; however these have to be further developed, inclusive with external donors support.

S.8.3. Financial Needs in the Context of Low Emissions Development

Implementation of the mitigation targets in the low emissions development context requires the availability of two funding categories. The first concerns the need to achieve the appropriate level of capacity in climate change mitigation. The second related to the amount of investments needed to implement measures and technologies that would lead to anticipated GHG reductions.

The estimates have shown that circa US$ 1.2 million would be required for the period 2013-2017, to strengthen the country's capacity in addressing the climate change action related problems, of which US $ 0.3 million would be required annually, on a permanent basis, and the rest - as one time assistance, mainly donors driven.

With reference to the investments needed to implement the mitigation measures and technologies, identified by the RM and which will also ensure the national economy sustainability, these have been calculated based on investments planned to implement the nationally appropriate mitigation actions (NAMA) included in the draft *Low Emissions Development Strategy of the Republic of Moldova until 2020*. The investment required for this purpose is about US $ 6.5 billion.

INTRODUCTION

On March 16, 1995, the Republic of Moldova (RM) ratified the United Nations Framework Convention on Climate Change (UNFCCC), followed by the Kyoto Protocol, ratified on February 13, 2003, recognizing thus, the complex influence of climate change on humankind evolution.

As a developing country, Party to this Convention, the Republic of Moldova has committed to promote sustainable development, to contribute to the achievement of the Convention's ultimate objective and to assist Annex I Parties to fulfil their commitments to limit and reduce greenhouse gas emissions.

In this context should be considered the concerns related to such areas as: GHG inventories; assessment of various sectors vulnerability to climate change; identifying and implementing GHG emissions mitigation actions, including through the Clean Development Mechanism (CDM) of the Kyoto Protocol under the UNFCCC; identifying and implementing climate change adaptation actions; transfer of environmentally friendly technologies; improvement of the national system of observation and environment monitoring networks; improving information systems for collecting, processing and data storage; developing, maintaining and updating databases related to climate change; as well as various capacity building activities, education, training and public awareness raising actions within the civil society and youth regarding the climate change issue.

This National Communication represents the third voluntary report of the RM to UNFCCC which reflects the degree of compliance with the Convention provisions nominated nationwide.

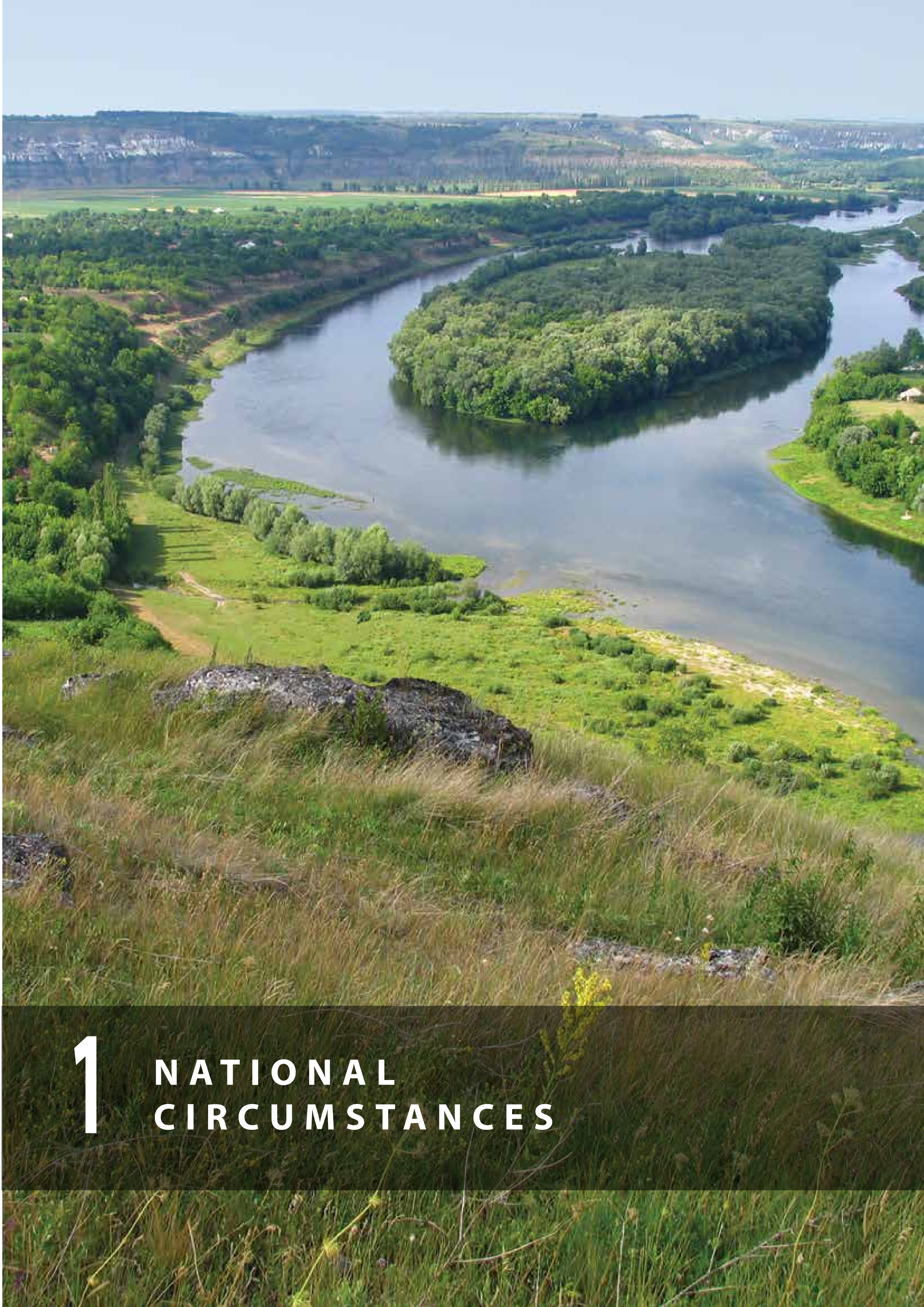
This Report has been developed within the „Republic of Moldova: Enabling Activities for the Preparation of the Third National Communication under the United Nations Framework Convention on Climate Change" Project, implemented by the Ministry of Environment (MoEN) and United Nations Environment Programme (UNEP), with financial support of the Global Environment Facility (GEF), which outlines a series of actions in the areas indicated above, revealing directions for future work and establishing effective partnerships.

As a signatory Party of the Convention and a country that has ratified the Kyoto Protocol, the Republic of Moldova is concerned with analysing opportunities arising from the fullest implementation of the flexible mechanisms available under the Kyoto Protocol, while actively taking part in post-Kyoto international negotiations, which are currently in progress.

Extensive information dissemination related to climate change phenomenon has contributed to a broader awareness raising within the society, scientific community and decision makers in the RM. Thus, one can say that the process of completing the Third National Communication and the Communication itself strengthened the country's potential, both for assessing climate change impact, as well as to promote and implement strategies, politics, action plans, programmes and technologies focused on mitigation the effects caused by such changes and adapt to new climate conditions.

It should also be noted the need for continuity in this direction, which would both make it possible for the RM to engage in global efforts to mitigate climate change, but would also involve the country's scientific and technical potential, qualified professionals in the adaptation process of national economic, social and environmental components to new climate conditions.

This Report underlies the *Low Emission Development Strategy of the Republic of Moldova until 2020* and the *Climate Change Adaptation Strategy of the Republic of Moldova until 2020*, expected to be approved by the Government in the first quarter of 2014 year.



1 NATIONAL CIRCUMSTANCES

CHAPTER 1. NATIONAL CIRCUMSTANCES

1.1. Physical Context

1.1.1. Geographical Location

The Republic of Moldova (RM), covering an area of 33,846 square km, is located in Central Europe, in the north-western Balkans. The RM's capital city is the municipality of Chisinau (mentioned in the historical records for the first time in 1436) with a population of approximately 794.8 thousand people (NBS, 2012). The RM borders on Ukraine in the North, East and South and on Romania in the West, with the Western border line going along the river Prut (Figure 1-1). The total length of the RM's national border is 1389 km, including 939 km of the border with Ukraine and 450 km of the border with Romania.

The RM is situated at longitude 28˚50' east and latitude 47˚ north. The exact location of the extreme points on the RM's territory is as follows: the northernmost point is Naslavcea (latitude 48^0 21' north and longitude 27^0 35' east); the southernmost point is Giurgiulesti (latitude 45^0 28' north and longitude 28^0 12' east) which is also RM's sole location on the bank of the Danube; the westernmost point is Criva (latitude 48^0 16' north and longitude 26^0 30' east); the easternmost point is Palanca (latitude 46^0 25' north and longitude 30^0 05' east). The distance between the extreme points is about 350 km from Naslavcea to Giurgiulesti and only 120 km from the West to the East at the latitude of the municipality of Chisinau.

The RM is a Black Sea region country. Its southern border extends almost as far as the Black Sea coast, and the access to the Black Sea is open for RM through the Dniester estuary and the Danube.

1.1.2. Relief

The region between the Prut and the Dniester is a part of the Moldovan Plateau, which starts at the foothills of the Bukovina Mountain Crest and Moldova's Sub-Carpathians in the West and reaches as far as the Dniester in the East. The south-western part of the Podol Upland extends along the left bank of the Dniester. Hills and flatland areas can be observed next to the upland relief within the framework of those major relief-forming units. The absolute altitudes are within the range of 429 m (Balanesti Hills) and 4 m above the sea level in the Dniester flood land (Palanca).

The relief has contributed to the formation and development of geographic landscapes and ecosystems - next to the other geo-ecological, biotic and socio-human factors. The current geo-ecological complex took shape at the end of the Late Pleistocene Epoch and in the first half of the Holocene (Recent) Epoch. The current biotic complex (flora, fauna, soil) and soils appeared in the second half of the Holocene epoch.

Figure 1-1: Map of the Republic of Moldova

1.1.3. Climate

The climate of the Republic of Moldova is moderately continental, characterized by relatively mild winters with little snow, long warm summers and low humidity. The country is located in the area where the air masses coming from the Atlantic Ocean via Western Europe interact and mix with the air from the extreme continental north-eastern regions and the Mediterranean air from the south-west. Two distinctive patterns can be observed regarding the territorial distribution of the climatic features in RM: (i) distinct zoning of the annual rainfall averages which show a decreasing trend from the North to the South; and (ii) the increase by approximately 100 mm of the multiannual rainfall averages in the upland regions depending on the neighbouring flatland areas. The average annual air temperatures vary between 6.3ºC (1980) in the North and 12.3ºC (2007) in the South. Between 1990-2011 time series, the average monthly air temperatures varied from a minimum of -8.5°C in January (1996) and a maximum of +33.3°C in July (2011). The warm period of the year is approximately 190 days long (Table 1-1).

Table 1-1: The Average Annual Air Temperatures and Precipitations Reported at the Stations Briceni (North), Chisinau (Centre) and Cahul (South) in the Republic of Moldova, 1960 – 2011

	Average annual air temperature, ºC			Average annual precipitations, mm		
	Briceni	Chisinau	Cahul	Briceni	Chisinau	Cahul
1960	8.4	10.6	11.2	661	537	435
1970	7.9	10.1	10.3	747	672	537
1975	9.0	10.8	11.0	535	483	519
1980	6.3	8.3	8.5	700	712	617
1985	6.5	8.0	8.2	672	593	564
1986	7.9	9.6	9.7	463	400	379
1987	6.5	8.1	8.5	619	593	525
1988	7.5	9.0	9.3	740	652	569
1989	9.3	10.9	10.9	653	460	441
1990	9.5	11.3	11.4	471	360	359
1991	8.0	9.4	9.3	655	673	661
1992	8.5	10.1	10.2	518	417	369
1993	7.8	9.4	9.3	557	533	537
1994	9.5	11.3	11.3	456	403	383
1995	8.4	10.0	10.0	609	702	401
1996	7.1	9.1	9.1	835	711	603
1997	7.7	9.4	9.1	587	607	813
1998	8.2	10.3	10.1	891	666	584
1999	9.2	11.0	10.9	564	484	674
2000	9.7	11.2	11.2	451	437	342
2001	8.8	10.3	10.4	711	618	600
2002	9.5	10.8	11.0	578	604	568
2003	8.6	9.8	10.3	618	459	307
2004	9.0	10.3	10.9	515	591	470
2005	8.7	10.5	10.8	800	638	513
2006	8.4	10.2	10.8	683	564	367
2007	10.1	12.1	12.3	618	480	517
2008	9.7	11.3	11.8	773	466	444
2009	9.6	11.4	11.8	445	446	405
2010	8.9	10.6	11.2	960	734	699
2011	9.1	10.5	10.6	439	428	371

The annual precipitation intensity decreases from the North-West to South-East. During 1960-2011 the annual rainfall averages varied between 439 mm (2011) and 960 mm (2010) in the Northern part of Moldova and 307 mm (2003) and 813 mm (1997) in the South of the country. The total number of rainy days (with no less than 0.1 mm of rainfall) varied between 120 (2011) and 174 days (1987) in a year in the northern regions and respectively between 68 (2011) and 152 days (1991) in a year in the southern regions.

1.2. Natural Resources

1.2.1. Land Resources

Moldova has unique land resources characterized by: predominant black earth soils (chernozems) with high productivity potential; very high utilization rate (>75 per cent); and rugged topography (above 80 per cent of the total arable land are located on hill slopes).

According to the General Land Cadastre of the Republic of Moldova, as of January 1, 2012, RM's total available land amounted to 3,384.6 thousand hectares (ha), including 2,497.9 thousand ha (or 73.8 per cent) of agricultural land; of which 1,810.5 thousand ha (53.5 per cent) – arable land, 298.7 thousand ha – perennial plantations; 352.3 thousand ha (10.4 per cent) – hayfields and pastures, 36.5 thousand ha (1.1 per cent) – fallow land; 462.7 thousand ha (13.7 per cent) – forest land and areas covered with woody vegetation; 99.5 thousand ha (2.9 per cent) – rivers, lakes, water basins and ponds and 324.4 thousand ha (9.6 per cent) – other lands (Table 1-2).

Of the total land of the country – 2,497.9 thousand ha, the owners of agricultural lands manage 2,008.9 thousand ha (59.3 per cent of the total or 80.4 per cent of the agricultural lands), including 1,651.1 thousand ha (66.2 per cent) of arable land, 244.3 thousand ha (9.8 per cent) – perennial plantations, of which 120.2 thousand ha of orchards and 113.6 thousand ha of vineyards, 33.1 thousand ha (1.3 per cent) – hayfields and pastures from the appropriate land use categories.

The current situation regarding the use of agricultural land by various landowners is as follows: 140 agricultural cooperatives accounting for a total area of 117.6 thousand ha (6.3 per cent); 146 joint stock companies – a total area of 39.9 thousand ha (2.0 per cent); 37.6 thousand limited liability companies – 688.9 thousand ha (34.0 per cent); 384.5 thousand peasant farms – 547.2 thousand ha (27.6 per cent); agricultural land attached to individual houses and gardens – 316.7 thousand ha (14.2 per cent); land associations for growing orchards and vegetable – 6 thousand ha (0.3 per cent); the reserve fund and other land – 292.6 thousand ha (15.6 per cent). Large and medium farm areas account for 846.4 thousand ha (42.3 per cent).

Table 1-2: Available Land by Category in the Republic of Moldova in 1992-2012, thousand ha

	1992	1994	1996	1998	2000	2002	2004	2006	2008	2010	2012
Land – total, including:	**3376.0**	**3384.0**	**3385.1**	**3384.4**	**3384.4**	**3384.4**	**3384.6**	**3384.6**	**3384.6**	**3384.6**	**3384.6**
Agricultural land:	2565.9	2557.3	2556.7	2556.6	2550.3	2533.8	2528.3	2518.2	2506.2	2501.1	2497.9
Arable land	1736.3	1744.5	1758.7	1809.9	1813.8	1842.6	1845.4	1833.2	1821.7	1816.7	1810.5
Perennial plantations:	474.8	448.2	430.7	370.7	352.3	300.8	298.0	299.0	302.8	301.0	298.7
orchards	224.5	216.6	208.3	179.8	170.8	137.5	134.8	131.1	132.7	132.5	134.5
vineyards	215.8	205.5	202.6	176.9	168.9	152.8	153.0	157.3	157.5	153.5	147.3
Pastures	350.5	362.0	365.2	373.7	373.9	379.7	374.1	368.1	357.9	352.1	350.3
Hayfields	4.3	2.6	2.1	2.3	2.5	2.4	2.8	2.1	2.1	2.2	2.0
Fallow land	0.0	0.0	0.0	0.0	7.8	8.3	8.0	15.8	21.7	29.1	36.5
Forest land and areas covered with woody vegetation	421.7	420.7	425.3	422.9	422.7	426.6	433.5	443.3	456.2	462.8	462.7
Rivers, lakes, water basins and ponds	88.7	90.4	92.6	93.5	95.5	97.5	96.3	96.1	96.3	96.4	99.5
Other lands	299.7	315.6	310.5	311.4	315.9	326.5	326.5	327.0	325.9	324.3	324.4

Source: Statistical Yearbooks of the RM for 2012, 2008, 2003, 1999 and 1994.

RM's soil cover is very diverse and comprised of above 745 soil types. Chernozems accounts for approximately 73.7 per cent of the country's total territory; grey forest soil (found mainly on elevations with altitudes above 200 m on the Northern Plateau, on hills along the Dniester and in the Codrii Zone) accounts for about 9.4 per cent, and brown forest soil (found on hilltops at altitudes exceeding 300 m, covered currently or previously with beech, hornbeam and oak tree forests) - respectively for about 0.6 per cent; alluvial soils (found in river floodplains and water meadows on recent alluvial deposits) account for approximately 10.2 per cent; and deluvial soils (formed on hill slopes and in valleys from soil particles brought by the land erosion processes) - respectively about 3.7 per cent; rendzine (soddy-calcareous) soils (formed on limestone under the influence of the steppe and forest grass aggregations) – about 1.0 per cent; chernozem-like, swamp and humus-peaty soils (found in fragments in forest-steppe zones) – about 0.7 per cent; vertisol soils (formed predominantly in the steppe and forest-steppe environment, under grass canopy on the bed of hard clay rock) – about 0.4 per cent; and alkaline (solonetzic) and saline soils account for about 0.2 per cent of the Republic of Moldova's total territory. The extremely high land utilization rate in agriculture dictates the necessity of rational use, resource conservation, amelioration and protection of soils from erosion, landslides and other types of ill-considered human intervention.

1.2.2. Water Resources

Rivers. There are 3621 rivers and water-springs in the Republic of Moldova. All of them form part of the Black Sea basin and can be categorized as follows: the Dniester Basin Rivers, the Prut Basin Rivers and the southern region rivers falling into either the Danube estuary or in the Black Sea coastal salt lakes. The majority of rivers are small in size. The largest rivers include: the Dniester (1,352 km long, including 657 km in Moldova, with the annual water debit of approximately 10.0 cubic km), the Prut (976 km long, including 695 km in Moldova, with the annual water debit of about 2.4 cubic km), the Raut (286 km long), the Cogilnic (243 km long, including 125 km in Moldova), the Bic (155 km long), the Botna (152 km long). The RM's drainage network density is 0.48 km per square kilometre on the average, varying between 0.84 km/km^2 in the northern regions and 0.12 km/km^2 in the regions on the left bank of the Dniester. The main water sources feeding the rivers are snowfalls and rainfalls, whereas the groundwater plays only a minor role. The majority of precipitations occur in the form of rainfall, whereas snow accounts for as little as 10 per cent of the total precipitations. High water levels are observed in spring due to the melting snow (40-50 per cent of the annual flow). In summer the water levels in rivers - and in particular in small rivers – can rise considerably after storm rainfall, sometimes causing disastrous floods.

Lakes. There are approximately 60 natural lakes in the Republic of Moldova. Most of them are lakes located in the high-water beds of the rivers Prut (Beleu, Rotunda, Fontan) and Dniester (Old Dniester, Cuciurgan). In addition, there are above 3,500 water storage ponds created and maintained for diverse economic purposes (such as: irrigation, fishing, recreation, industrial and household needs, protection from floods). Large water-storage reservoirs have been created for hydro-power plants: Costesti–Stinca (735.0 mln.m^3) on the river Prut jointly with Romania; and Dubasari (277.4 mln.m^3) on the Dniester river.

Groundwater. Groundwater has a special role in the surface water balance in the RM. They participate actively in the hydrological cycle as a component of the ground water debit. The distribution of the available ground waters is not even across the country, because their major portion is concentrated in the high-water beds of the Dniester and the Prut. The water supply capacity of the ground water-bearing horizons decreases with the increasing distance to those rivers.

Groundwater reserves are about 0.5 billion m^3/yr[7]. According to the SE „EHGeoM", at 01.01.2011, the confirmed

[7] <http://www.apelemoldovei.gov.md/category.php?l=ro&idc=120>.

groundwater reserves represented 3,478.3 thousand m^3/day[8]. Groundwater accounts for about 65 per cent of the total water consumed in the Republic of Moldova. About 4,842 artesian wells and circa 179,574 fountains fed from groundwater wells[9] supply 95 per cent of rural population and 35 per cent of urban population, or a total of 65 per cent of country's population.

The water resources are exploited from 10 horizons and water systems: (1-2) the alluvial horizon dating back to the Quaternary and Middle Pliocene Epochs is in use in the valley of the Dniester and the Prut; (3) the Pontian horizon is exploited in certain localities in the south-west of Moldova; (4-5) the Late Sarmatian – Meotian system is used in the southern regions of the country; (6-7) water from the Middle Sarmatian horizon can be found in the central, southern and south-eastern regions (8) the Badenian (Middle Miocene) – Early Sarmatian water system forms the basis for centralized water supply to the capital city and settlements in the central regions; (9) the Cretaceous-Silurian water system is used in the northern parts of the country; (10) the water-bearing layers in the Vendian and Late Riphean deposits are exploited in the north-east of the country.

Mineral Waters. Currently, in the RM, about 50 types of mineral waters in circa 170 mineral water springs are approved for use and certified, but about half of them are not operating[10]. Of these, circa 25 mineral water springs (Varnita–III, Branesti, Purcari, Edinet-II, Micauti, Cotiujeni, Orhei, Balti-III, Ialoveni, etc.), including therapeutic mineral water springs (Source no. 3 from Gura Cainarului village) are new springs, appreciated as a result of the last years prospections. Water mineralization levels vary between 1.0 and 10.0 g/dm^3. Mineral water springs are typical for the southern and north-eastern regions of the country, containing hydrocarbonates and hydrocarbonates-sulfates prevailing the sodium and calcium cations. Their water contains hydrogen sulphide (30.0-80.0 mg/dm^3), iodine (17.0-26.0 mg/dm^3), bromine (132.0-139.0 mg/dm^3) and other chemical elements (lithium, radon, strontium, boron).

Industrial Waters. The industrial ground water available in the Republic of Moldova contains less-common extractable chemical elements, with the waters containing iodine, bromine, strontium, caesium, rubidium, boron and helium being the most widespread. The highest concentration of chemical elements in the water with mineralization levels of 70-100 g/dm^3 is: 60 mg/dm^3 for iodine; 360 mg/dm^3 for bromine; 380 mg/dm^3 for strontium; 1.0 mg/dm^3 for caesium; 3 mg/dm^3 for rubidium; and 15.0 ml/dm^3 for helium.

Thermal Waters. Thermal water is common in the high-water bed of the Prut and in the southern regions of the RM. The water temperature is 20.0-80.0^{0}C, and the water debit of the wells is 10-100 m^3 per day.

1.2.3. Biological Resources

Flora. The RM's geographic location, climate and relief have pre-conditioned the development of extremely various vegetation with a large number of species; currently the country's flora comprises about 5,558 plant species (with 2,044 superior plants and 3,524 inferior plants). The ecosystems which have the richest flora composition include: the forest (above 850 species), steppe (above 600 species), high-water basin (about 650 species), petrophyte (circa 250 species), water and swamp (about 160 species) systems.

In terms of landscape, the RM's territory is located in two natural zones – wooded steppe and steppe. The steppe zone comprises the fields and elevations in the regions to the south of the Codrii Upland and to the south and east of the Tigheci Hills. In addition to the above, the steppe flora can be found also in the North - in the Cubolta Upland, in the Ciulucuri Hills and in the Middle Prut Upland.

Most of the steppe regions are used currently in agriculture; and therefore the typical steppe flora represented by mat-grass, feather grass, fescue and diverse other grass types has persisted solely on small hill slope areas with old landslides or on more inclined erodible slopes. Of the total number of steppe plant species, 18 have been included in the Red Book of Moldova, including 9 species (*Astragalus dasyanthus Pall.*, *Belevallia sarmatica (Georgi) Woronow*, *Bulbocodium versicolor (Ker.-Gawl.) Spreng.*, *Colchicum triphyllum G.Kunze*, *C. Fominii Bordz.*, *Galanthus elwesii Hook. fil.*, *Ornithogalum amphibolum Zahar.*, *O. oreoides Zahar.*, *Sternbergia colchiciflora Waldst. et Kit.*) which are also included in the Red Book of Ukraine (1996) and in Romania's Red List of superior plants (1994).

The forest flora can be found - in addition to the steppe regions - in the wooded steppe zone, on higher hills more frequent in the Codrii Region. The deciduous forests typical of the Central Europe prevail and account for 97.9 per cent (Quercus spp. – 39.6 per cent, Robinia spp. – 36.1 per cent, Fraxinus spp. – 4.6 per cent, Carpinus spp. – 2.6 per cent, Populus spp. – 1.6 per cent), whereas resinaceous forests account for as little as 2.1 per cent.

The country's forest ecosystems include 45 native species of trees, 81 native species of shrubs and 3 native species of forest vines (lianas). The most common native woody plant species found in our forests include: English Oak *(Quercus robur)*, Durmast Oak *(Quercus petraea)*, Pubescent Oak *(Quercus pubescens)*, Common Ash *(Fraxinus excelsior)*, European Hornbeam *(Carpinus betulus)*, European White Elm *(Ulmus laevis)*, Sycamore Maple *(Acer pseudoplatanus)*, Small-Lea-

[8] <http://mediu.gov.md/images/documente/starea_mediului/rapoarte/nationale/p1_Raport_RO-IEG_2007-2010.pdf>.
[9] <http://inseco.gov.md/wp-content/uploads/2010/06/Anuarul-IES-2011_R2-1.pdf>.
[10] <http://mediu.gov.md/images/documente/starea_mediului/rapoarte/nationale/p1_Raport_RO-IEG_2007-2010.pdf>.

ved Linden *(Tilia cordata)*, European Weeping Birch *(Betula pendula)* and European Beech *(Fagus sylvatica)*.

Fauna. The RM's fauna is relatively rich and manifold. There are above 15.5 thousand species of animals in Moldova, including 461 species of vertebrates and above 15 thousand species of non-vertebrates. The vertebrates include 70 species of mammals, 281 bird species, 14 reptile species, 14 amphibian species and 82 fish species. Birds are highest in number among the vertebrates (281 species and subspecies), and insects - among non-vertebrates (above 12 thousand species).

The most widespread native species of mammals include: brown long-eared bat *(Plecotus auritus)*, hedgehog *(Erinaceus europaeus)*, European mole *(Talpa europaea)*, common shrew *(Sorex araneus)*, noctule bat *(Nyctalus noctula)*, red squirrel *(Sciurus vulgaris)*, brown hare *(Lepus europaeus)*, European ground squirrel *(Citellus citellus)*, spotted squirrel *(Citellus suslicus)*, house mouse *(Mus musculus)*, Norway rat *(Rattus norvegicus)*, wood mouse *(Apodemus sylvaticus)*, yellow-necked mouth *(Apodemus flavicollis)*, red fox *(Vulpes vulpes)*, European roe deer *(Capreolus capreolus)*, wild boar *(Sus scrofa)*, Eurasian badger *(Meles meles)*, beech marten *(Martes foina)*, European polecat *(Mustela putorius),* and least weasel *(Mustela nivalis)*. Rare and endangered species are protected by the law; 116 animal species have been entered in the Red Book of Moldova (the edition of 2001), including 14 mammal species, 39 bird species, 8 reptile species, 1 amphibian species, 12 fish species, 1 Cyclostomata species, 37 insect species, 1 Crustacean species and 3 Mollusc species.

The mammals populate mostly the forest ecosystems – 47 species, meadows – 33 species and agricultural ecosystems – 25 species, while the birds populate mostly the water ecosystems – 109 species, the forest – 106 species, agricultural ecosystems – 76 species, steppe – 45 species and petrophyte ecosystems – 23 species.

There are five natural reservation established for scientific research purposes with the total area of 19.4 thousand ha in the Republic of Moldova. Two natural forest reservations – "Codrii" and "Plaiul Fagului" – are located in the central regions of Moldova; two more reservations – "Prutul de Jos" and "Padurea Domneasca" – in the Prut valley; and the fifth reservation – "Iagorlic" (Dubasari district) – has been established to protect and study the unique water ecosystem of the Dniester river.

1.2.4. Mineral Resources

As of 01.01.2010, mineral resources in the Republic of Moldova were extracted from 415 deposits, of which: 130 operate, 37 are being prepared for use, and 230 represent exploitable reserves while 21 are not intended for exploitation[11]. Most of the minerals are extracted from open mines, and only certain limestone varieties are mined from stone quarries (underground galleries).

The most popular minerals are: (1) carbonate strata rocks dating back to the Early Sarmatian and Badenian Era (used in construction of industrial facilities and housing, cement production, sugar refining, road construction, as additives to animal feed, etc.; (2) clint rocks (siliceous limestone, diatomite/kieselgur, fossil meal/tripoli) (used in food industry, production of artificial leather, paper, thermal and electrothermal materials, etc.); (3) clay rocks (slate clay, bentonite clay, ordinary clay) (used in production of cement, claydite, ceramite, bricks, tiles and ceramic pipes); (4) sand and broken stone (gravel) (used in the manufacture of glass, concrete, in the various construction sectors including road construction); (5) sulphate rocks (gypsum) (used in construction, medicine, pharmaceutics); (6) crystal rocks (gabbro, granite, gabbro-norite) (used in production of ferro concrete, in road construction); (7) caustobioliths (petrol, gas, brown coal) available in insignificant quantities in the South (Valeni, Victorovca, Vladiceni).

1.3. Administrative-Territorial Organisation, Population and Human Context

1.3.1. Administrative-Territorial Organisation

According to Law No. 764 as of 27.12.2001 on the administrative territorial organisation, the Republic of Moldova is divided into 32 districts (rayons), 5 municipalities and 2 administrative-territorial units (Figure 1-2).

In most districts (Anenii Noi, Basarabeasca, Briceni, Cahul, Cantemir, Calarasi, Causeni, Cimislia, Criuleni, Donduseni, Drochia, Edinet, Falesti, Floresti, Glodeni, Hincesti, Ialoveni, Leova, Nisporeni, Ocnita, Orhei, Rezina, Riscani, Singerei, Soroca, Straseni, Soldanesti, Stefan Voda, Taraclia, Telenesti, Ungheni) the administrative centre is located in a town, and only the district of Dubasari has the commune of Cocieri as its centre. By January 1, 2013, the number of population in the districts varied between a minimum of 28.4 thousand people (Basarabeasca district) to a maximum of 119.4 thousand people (Cahul district).

In the Republic of Moldova municipalities are urbanized areas which play a significant role in the nation's economic, social-cultural, scientific, political and administrative life, with relevant industrial, commercial, health care and cultural facilities as well as educational establishments.

In most cases municipalities are an agglomeration of several settlements. For example, the municipality of Chisinau, which is the capital city of the Republic of Moldova, comprises 35 settlements, which include 5 city districts, 6 towns

[11] <http://mediu.gov.md/images/documente/starea_mediului/rapoarte/nationale/p1_Raport_RO-IEG_2007-2010.pdf>.

Figure 1-2: Administrative-Territorial Map of the Republic of Moldova

and 12 communes (the latter comprising the total of 26 settlements). The other 4 municipalities are: Balti, Comrat, Tiraspol and Bender.

The purpose of dividing the territory of the country into a number of administrative territorial units is to ensure the execution of the principles of local autonomy, decentralise public services, electiveness of the local public administration authorities, and the access for the citizens to the elected authorities and to the advice on the local problems and issues of particular interest. All local problems and issues fall within the authority and powers of the local administrative councils, which are elected. The prefects and mayors for the districts and municipalities are nominated by the local administrative councils and appointed by the President of the Republic of Moldova.

There are two administrative-territorial units in the Republic of Moldova: the Autonomous Territorial Unit Gagauzia (ATU Gagauzia) and the administrative-territorial units on the left bank of the Dniester (ATULBD). The area of ATU Gagauzia is approximately 3,000 km^2 (157.2 thousand people)[12], and the area of ATULBD is respectively about 4,163 km^2 (513.4 thousand people) [13]. Since the collapse of the Soviet Union (USSR), the administrative-territorial units on the left bank of the Dniester started promoting the separatist policy in respect of the RM's centralized public administration authorities. Currently, the official authorities of the Republic of Moldova monitor that area only partially.

1.3.2. Population

As of 01.01.2012 the population of the RM was 4,073.8 thousand people, with the density of approximately 120.4 persons per square kilometre. Thus, numerically the Republic of Moldova outruns such European countries as Lithuania, Ireland and Slovenia.

During 1990-2012, the number of population decreased by about 6.6 per cent or 287.8 thousand people. That decrease was caused by the negative natural balance as well as the negative external migration flow balance. The above dynamics resulted in the decrease in the average population density from 129.2 persons per square kilometre in 1990 down to 120.4 persons per square kilometre at the beginning of 2012. However, even in such conditions the density of population in the Republic of Moldova significantly exceeds the average population density in Europe and the world average.

Females prevail with 52.2 per cent in the nation's population, as opposed to 47.8 per cent of males in the total population. This clear misbalance with prevalence of females in the population structure by gender has rated the Republic of Moldova among the top 10 states worldwide according to that indicator, thus impacting adversely the nation's demographic development.

The majority of the population is concentrated in the rural areas. The existing 1614 rural settlements have 2237.7 thousand residents or 54.9 per cent of the total population, averaging about 1400 residents per settlement. The urban population is 1836.1 thousand or 45.1 per cent of the total. The urbanization rate is among the lowest in Europe. Urban settlements are small in size, with about 27 thousand residents on the average, and only 8 thereof can boast the population exceeding 35 thousand residents: Chisinau (794.8 thousand people), Balti (149.2 thousand people), Tiraspol (135.7 thousand people), Bender (93.0 thousand people), Ribnita (48.8 thousand people), Ungheni (40.8 thousand people), Cahul (39.8 thousand people) and Soroca (37.5 thousand people).

According to the data of the 2004 population census held separately in the areas on the right bank of the Dniester and in the administrative-territorial units on the left bank of the Dniester, Moldavians accounted for about 69.6 per cent of the country's population (64.5 per cent in 1989), Ukrainians – 11.2 per cent (13.8 per cent in 1989), Russians – 9.4 per cent (13.0 per cent in 1989), Gagauz – 3.8 per cent (3.5 per cent in 1989), Bulgarians – 2.0 per cent (2.2 per cent in 1989), Romanians – 1.9 per cent (0.1 per cent in 1989), Gypsies – 0.3 per cent (0.3 per cent in 1989), Jews – 0.1 per cent (1.5 per cent in 1989), other nationalities – 1.6 per cent (1.3 per cent in 1989), etc. (Table 1-3).

Table 1-3: Resident Population by the Main Nationalities in the Republic of Moldova (According to the 2004 Population Census Data)

Ethnic origin	RM (Right Bank of Dniester)	%	ATULBD (Left Bank of Dniester)	%	Republic of Moldova (total)	%
Moldovans	2564.8	75.8	177.1	31.9	2741.9	69.6
Ukrainians	282.4	8.3	159.8	28.8	442.2	11.2
Russians	201.2	5.9	168.4	30.4	369.6	9.4
Gagauz	147.5	4.4	4.1	0.7	151.6	3.8
Romanians	73.3	2.2	1.0	0.2	74.3	1.9
Bulgarians	65.7	1.9	13.8	2.5	79.5	2.0
Gypsies	12.3	0.4	0.1	0.0	12.4	0.3
Jews	3.6	0.1	1.2	0.2	4.8	0.1
Other	32.5	1.0	28.9	5.2	61.4	1.6
TOTAL	3383.3	100.0	554.4	100.0	3937.7	100.0

1.3.3. Demographic Situation

Between 1990 and 2011 the demographic processes registered a distinctive negative development pattern, which showed itself in the general instability of demographic indicators and phenomena as well as falling birth rate, growing mortality, depopulation, demographic ageing, etc.

For example, the 2011 birth rate - 11.0‰ (registering a significant decrease in comparison with the 1990 rate of 17.7‰), was equal to the mortality rate (the mortality rate recorded in 2011 was higher than the 1990 rate of 9.7‰).

The infant mortality rates remained among the highest in Europe (10.9‰,) but were lower than the 1990 figures (19.0‰). Between 1999 and 2010, the natural balance of the population was negative (0.0‰ in 2011; for comparison, the 1990 figure showed the natural population growth of 8.0‰).

[12] <http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=POP0110&ti=Populatia+prezenta+pe+raioane+si+orase%2C+la+ inceputul+anului%2C+2004-2012&path=../Database/RO/02%20POP/POP01/&lang=1>.

[13] <http://www.mepmr.org/pechatnye-izdaniya/statisticheskij-ezhegodnik-pmr>.

That dynamics has resulted, among other things, in the demographic ageing of the population which shows itself as the reduced portion of the young and the increased portion of the elderly. During 1990-2011, the share of the population aged below 15 years decreased from 27.9 per cent in 1990 down to 17.7 per cent in 2011, and the age group of persons above 60 increased respectively from 12.6 per cent in 1990 up to 15.7 per cent in 2011.

During 1990-2011 the 'average life expectancy at birth' indicator somewhat increased - from 69.0 years in 1990 to 71.1 years in 2011 (the respective indicator increased from 65.5 years to 67.1 years for males and from 72.3 years to 75.0 years for females). The values of this particular indicator are relatively modest - as opposed to other countries, thus rating the RM among the last in Europe on the force of those levels.

1.3.4. Public Health

It is believed that the state of public health is determined by four major groups of factors: life style (accounting for 50-55 per cent), the environmental situation (20-25 per cent), genetics (15-20 per cent) and the effectiveness of the health care and preventive health care facilities (8-10 per cent). The nature of the environmental factors affecting public health may be chemical, physical, biological, psychological, genetic, cultural, or behavioural.

The current environmental situation in the Republic of Moldova cannot be characterized as the one contributing to healthy and long life. The main problems are caused by the negative impact of polluted air, water, soil and food on human health. The neglect of the public health problems - in particular in the rural areas, which are caused by the environmental factors, threatens with severe consequences for the public as well as for the national economy.

During 2000-2011, the overall mortality rates tended to increase (Table 1-4). The mortality breakdown analysis has demonstrated that respiratory diseases are the main cause of death (19.6 per cent), followed by diseases of the circulatory system (17.5 per cent), intestinal diseases (12.8 per cent), diseases of the nervous system and sense organs (7.1 per cent), followed by diseases of the genitourinary system (6.7 per cent), complications of pregnancy, childbirth and the puerperium (6.5 per cent), mental and behavioural disorders (6.1 per cent), endocrine, nutritional and metabolic diseases (5.3 per cent), infectious and parasitic diseases (4.7 per cent), osteoarthrities, muscle and connective tissue diseases (4.6 per cent), traumas, intoxication and other consequences of external causes (4.6 per cent) and tumours (3.4 per cent).

The situation regarding infectious diseases remains severe. According to the data provided by the Ministry of Health for 2012, the number of bacterial dysentery and hepatitis C cases increased compared to 2011. Also, during 2012, the number of acute intestinal infections cases increased (18.6 thousand). Thus, in 2012, per 100 thousand people, on average there were 523 cases of acute intestinal infections, 89 cases of tuberculosis of the respiratory organs, 5 cases of viral hepatitis and 267 cases of "socially constructed" diseases. However, over the last five years it was recorded a significant decrease in bacterial dysentery cases, from 744 cases in 2008

Table 1-4: The mortality rates in the RM during 2000-2011, by disease classes (per 1,000 residents)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Disease classes - total	**631.9**	**609.4**	**634.6**	**647.1**	**665.0**	**678.5**	**655.3**	**664.9**	**685.5**	**736.3**	**736.3**	**759.2**
Infectious and parasitic diseases	55.8	51.6	49.7	44.6	39.9	39.0	36.9	37.4	46.5	37.9	38.1	35.8
Tumours	17.6	16.5	17.5	18.5	21.1	20.6	20.7	21.4	22.3	23.7	26.3	25.9
Endocrine, nutritional and metabolic diseases	17.8	18.0	20.4	21.5	23.5	26.7	27.6	28.6	29.6	30.8	35.6	40.0
Diseases of the blood and blood forming organs and certain disorders involving the immune mechanism	9.4	10.3	11.5	12.4	13.0	14.0	13.8	14.0	13.7	13.8	14.0	14.9
Mental and behavioural disorders	43.0	42.1	43.9	45.0	48.0	44.4	45.5	44.6	48.5	46.7	43.5	46.4
Diseases of the nervous system and sense organs	52.3	50.8	51.9	52.3	58.3	54.3	49.7	48.1	47.8	49.2	50.9	53.6
Diseases of the circulatory system	83.3	56.7	60.0	64.8	78.0	92.3	98.8	110.2	116.2	123.4	125.0	132.5
Respiratory diseases	148.5	125.6	130.9	135.4	125.9	132.0	121.0	119.8	111.4	155.7	130.9	149.1
Intestinal diseases	71.1	75.1	77.3	76.3	76.7	80.9	78.3	80.8	82.3	88.0	93.2	97.3
Diseases of the genitourinary system	43.3	44.2	45.5	48.1	48.6	51.1	47.0	46.6	47.1	48.3	48.9	51.2
Complications of pregnancy, childbirth and the puerperium	36.3	46.5	52.1	37.2	40.6	42.1	36.7	36.0	41.6	43.5	49.1	49.2
Diseases of the skin and subcutaneous tissue	32.7	32.7	32.4	32.4	34.2	30.1	27.3	26.3	24.4	23.4	24.1	22.5
Osteoarthrities, muscle and connective tissue diseases	26.6	26.7	28.4	30.8	33.0	29.9	29.9	30.6	31.2	31.8	33.9	35.2
Congenital malformations, deformations and chromosomal abnormalities	3.6	3.4	3.7	3.5	3.4	3.7	3.7	3.5	3.6	3.4	3.8	4.0
Traumas, intoxications and other consequences of external causes	41.8	39.3	43.2	46.1	45.2	42.7	40.6	38.6	45.9	44.9	52.5	34.9

Source: <http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=SAN0202&ti=Morbiditatea+populatiei+pe+principalele+clase+de +boli%2C +2001 -2011&path=../Database/RO/08%20SAN/SAN02/&lang=1>.

(21 cases per 100 thousand people), to 467 in 2012 (about 13 cases per 100 thousand people), while the viral hepatitis cases decreased to 165 in 2012 (about 5 cases per 100 thousand people). The same trend was recorded regarding the number of tuberculosis cases which decreased from 3.4 thousand cases in 2008 (95 per 100 thousand people), to 3.1 thousand cases in 2012 (89 per 100 thousand people).

Prophylactic vaccination and appropriate preventive measures helped to reduce the mortality rate caused by epidemic parotiditis: from 823 cases per 100 thousand persons in 2008, to 3.4 cases per 100 thousand persons in 2012. At the same time, it can be noted decrease morbidity related to "socially constructed" diseases, in particular due to pediculosis. In 2012, per 100 thousand people, on average there were 85 cases of pediculosis and 32 cases of gonorrhea infection, compared to 140, respectively 46 cases recorded five years earlier. In the same year, there were recorded 478 HIV cases, with 16 less than in 2011. Also, 152 AIDS cases were recorded, while the overall HIV incidence is 13.4 per 100 thousand people.

To be noted that between 2000 and 2011, the overall mortality rate varied significantly. The overall mortality rate is an integral indicator among those defining the state of public health. The mortality breakdown analysis has demonstrated that in 2011, the cardiovascular pathologies was still the main cause of death (57.5 per cent) - followed by tumours (14.4 per cent), intestinal diseases (9.1 per cent), traumas, intoxication and other consequences of external causes (7.8 per cent) and respiratory diseases (4.8 per cent) (Table 1-5). It should be noted that during 2000-2011 the rates of mortality, caused by the first two pathology types tended to increase.

The mortality rates by region are not uniform, registering dramatic differences between the regions. In 2011, the lowest mortality rates were reported in the municipality of Chisinau and in Balti, whereas the highest rates in Donduseni, Briceni, Rascani, Drochia, Soldanesti and Glodeni districts. In the recent years, the Republic of Moldova has made considerable efforts to improve the national public health situation.

Table 1-5: The mortality rates in the RM during 2000-2011, by the main cause of death (per 100 thousand residents)

Year	Tumours	Diseases of the circulatory system	Respiratory diseases	Intestinal diseases	Traumas and intoxication	Total
2000	125.0	632.0	69.4	103.4	92.9	1132.8
2001	128.2	618.2	64.6	109.5	98.4	1103.8
2002	134.7	654.8	74.4	110.0	98.4	1155.4
2003	138.5	679.6	79.0	114.1	103.2	1192.6
2004	141.5	653.7	69.3	116.3	101.6	1156.4
2005	145.8	700.1	79.2	128.6	108.4	1243.2
2006	153.4	671.4	72.9	122.5	105.0	1203.2
2007	150.6	675.9	72.1	119.4	101.9	1203.6
2008	155.2	657.4	68.9	112.3	99.4	1175.0
2009	158.7	663.2	64.7	115.5	97.0	1181.8
2010	157.6	688.1	68.3	121.9	103.6	1224.9
2011	158.3	633.4	53.4	100.2	86.3	1102.5

Source: Statistical Yearbooks of the RM for 2012 (page 52), 2011 (page 52), 2010 (page 52), 2009 (page 52), 2008 (page 56), 2006 (page 65), 2005 (page 54), 2003 (page 67), 2001 (page 53).

1.3.5. Education

The Ministry of Education and Youth, the Municipal Education Departments, Regional General Departments of Education and educational establishments are responsible for the delivery of the primary, secondary general, secondary professional, secondary vocational and university (higher) education. The legal framework for the education system is the Concept Paper on education development in the Republic of Moldova and the Curriculum by disciplines.

Primary and secondary general education. At the beginning of the 2012/2013 school year, the Republic of Moldova had 1397 operating primary and secondary general educational establishments, by 4.3 per cent less than in the school year 2011/2012 (Figure 1-3).

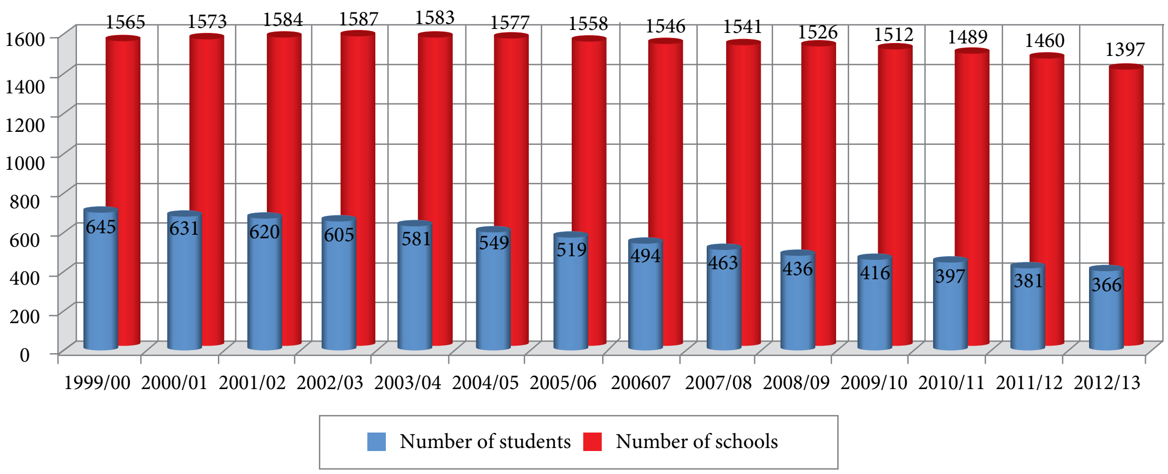


Figure 1-3: Number of Schools, Gymnasiums and Lyceums (units) and Number of Students (thousand) in the Republic of Moldova

Depending on the educational forms, we can distinguish 1394 educational institutions with day classes and 3 institutions providing evening classes. Educational institutions providing day classes include 108 primary schools, 767 gymnasiums, 491 lyceums and 28 specialized schools for handicapped children with mental or physical development deficiencies. As a result of the optimization process related to the secondary general educational establishments, the new configuration of the primary and secondary general education network is as follows: 7.7 per cent – primary schools, 55 per cent – gymnasiums, 35.2 per cent – lyceums and 2.0 per cent - specialized schools for handicapped children with mental or physical development deficiencies. At the same time, compared to the school year 2011/2012, both the number of gymnasiums and lyceums was reduced by 62 respectively 6 units, and only the number of primary schools increased by 25 units.

At the beginning of the 2012/2013 school year, the total number of students enrolled in primary and secondary general educational establishments was 366.0 thousand, by 3.7% lower than in the preceding year. The students structure on educational levels show that students enrolled in primary and secondary schools prevail. In recent years, the number of students enrolled in primary schools is growing, while the number of students enrolled in gymnasiums is decreasing.

In the school year 2012/2013, the average number of students in a class was 20, while the ratio of students per one teacher represented 11 students/teacher in primary schools, 9 students/teacher in gymnasiums; and 11 students/teacher in lyceums. The number of students starting the first grade who were enrolled in preschool programs represented 34.5 thousand or 97.5 per cent. The number of students enrolled in specialized schools for the school year 2012/2013 represented 2.3 thousand or 0.6 per cent of the total. Most of such students had mental development deficiencies - 79.3 per cent, hearing impairment - 8.7 per cent and impaired eyesight – 4.5 per cent.

Secondary professional education. During the school year 2012/2013, the number of secondary professional educational establishments was 67 (21 industrial schools, 49 professional schools, including 2 professional lyceums), by 3 units less than in the preceding year. The number of students enrolled in the secondary professional education is decreasing continuously, recording 19.6 thousand students at the beginning of the school year 2012/2013, compared to 20.3 thousand during the preceding school year (Figure 1-4).

In the school year 2012/2013, 11.9 thousand students were enrolled in professional secondary education establishments, by 8.5 per cent less as compared to the preceding school year. Most of the students were enrolled based on gymnasium education (82.4 per cent of the total). The most demanded professions/occupations are: cook (11.8 per cent of the total number of enrolled students), car mechanic (11.0 per cent), plasterer (9.0 per cent), tailor/dressmaker (7.7 per cent), welder-fitter (electric and gas welding) (6.1 per cent), computer operator (5.3 per cent), tractor driver (3.3 per cent), carpenter (3.1 per cent).

Secondary vocational education. In 2012/2013 school year, the secondary vocational education was organized in 47 colleges (Figure 1-5), including 41 state colleges and 6 private colleges. The number of students was 30.7 thousand, by 2.2 per cent less than in the preceding school year.

In the school year 2012/2013, 8.8 thousand students were enrolled in colleges, by 2.2 per cent less than in the preceding school year. The most demanded sectors were: medicine (12.7 per cent of the total first-year students), economy (11.9 per cent), transport (9.4 per cent), teaching (7.3 per cent), services (6.5 per cent), constructions (5.3 per cent), mechanics (5.2 per cent), computer sciences (5.0 per cent), etc.

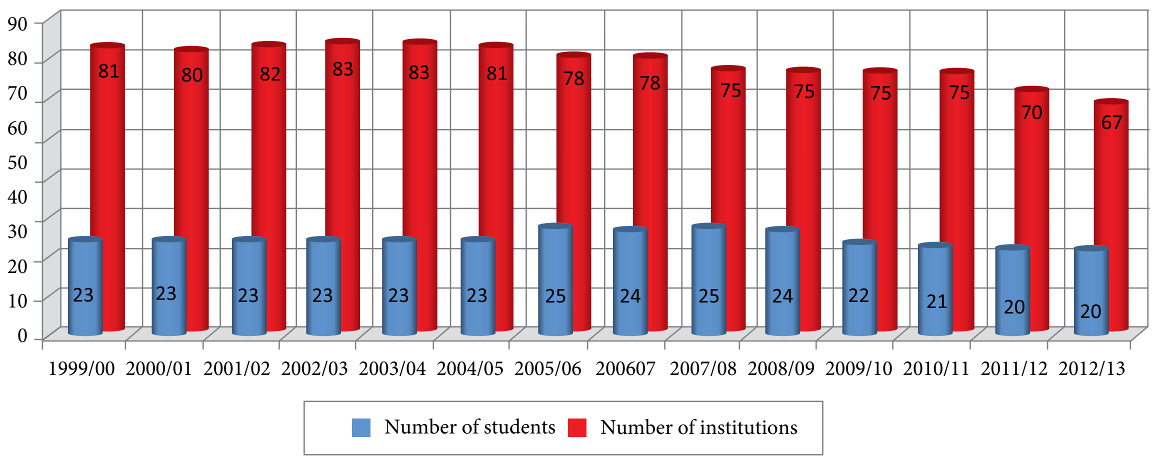


Figure 1-4: Number of Secondary Professional Educational Establishments (units) and Number of Students (thousand) in the Republic of Moldova

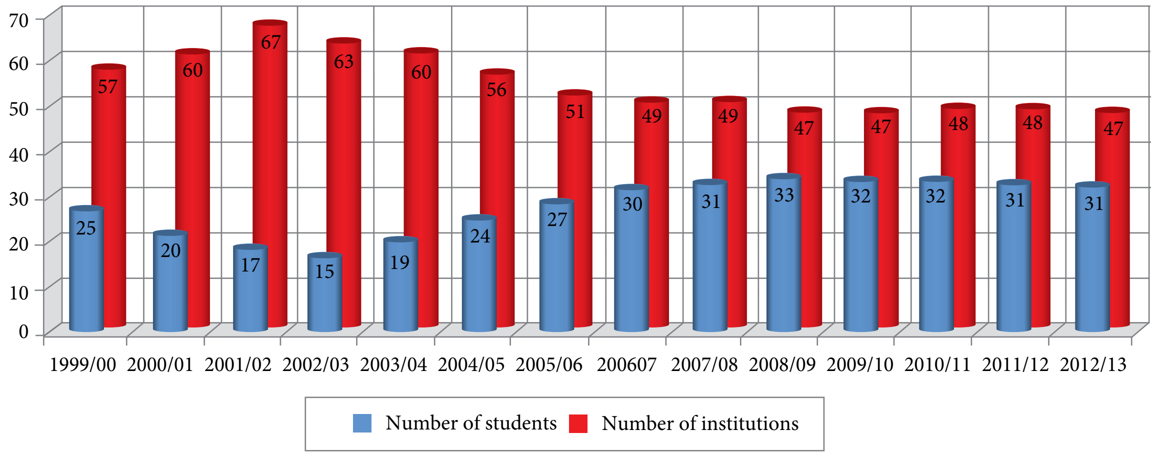


Figure 1-5: Number of Secondary Vocational Educational Establishments (units) and Number of Students (thousand) in the Republic of Moldova

Higher education. In the 2012/2013 academic year, the total number of higher education establishments (universities) in the Republic of Moldova was 34 (Figure 1-6), including 19 state-owned of which 2 provide only master degree programs. In recent years, the number of students is continuously decreasing, accounting at the beginning of 2012/2013 academic year 102.5 thousand. Most students were enrolled in state-owned universities – 83.0 thousand (81.0 per cent), of which 34 per cent were receiving training free of charge, funded from the budget.

At the beginning of the academic year 2012/2013, 82.8 thousand students were enrolled for a university programme, for the first cycle (80.8 per cent of the total), 15.5 thousand students were enrolled for a master degree programme, the second cycle (15.1 per cent), while 4.2 thousand students were enrolled for a medical and pharmaceutical programme (4.1 per cent). Compared to the academic year 2011/2012, the number of students enrolled for the second cycle increased by 1.2 per cent. In the 2012/2013 academic year, the universities had 20.4 thousand first-year students enrolled for the first cycle (by 1.9 per cent less than in the preceding year) and 7.7 thousand enrolled for the second cycle (a 4.0 per cent increase). Among the speciality areas the biggest share of first-year students chose: economy - 19.9 per cent of the total first year students, education – 18.1 per cent, engineering – 14.1 per cent; law – 7.7 per cent. As for the second cycle, the students enrolled for a master degree programme had the following preferences: economy – 28.6 per cent of the total, law – 18.5 per cent and education – 14.0 per cent.

Post-graduate education. Among the total of 67 research (R&D) institutions operating in the Republic of Moldova as at the beginning of 2012, 46 institutions offered post-graduate studies (doctoral degree). The total number of post graduate students was 1556, recording a significant increase by 30.2 per cent as compared to 1999 (Figure 1-7).

As at the beginning of 2011, the total number of the institutes offering post-doctoral studies was 21 (Figure 1-8). The total number of post-doctoral students was 40. Compared to 1999, in 2007 the total number of post-doctoral students grew by 2.9 times.

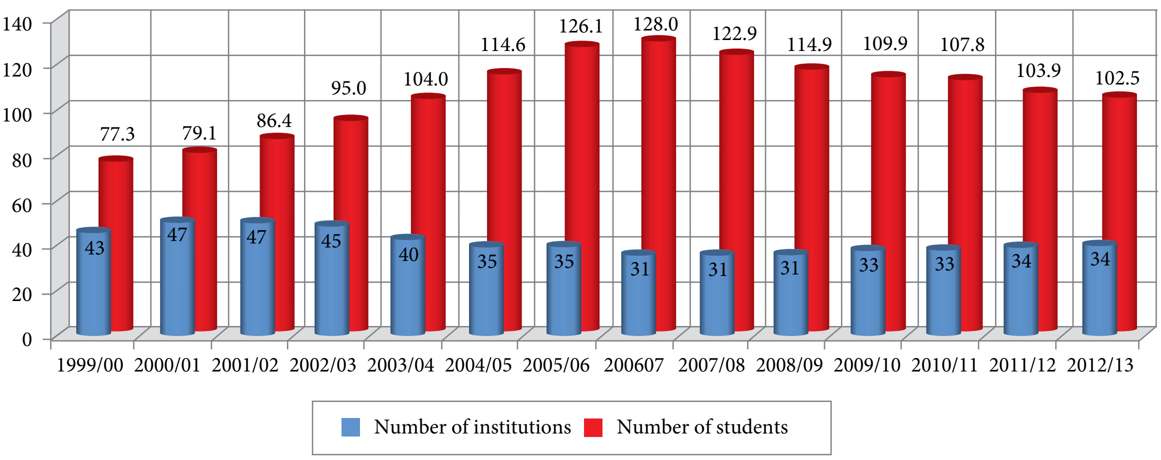


Figure 1-6: Number of Higher Education Establishments (units) and Number of Students (thousand) in the Republic of Moldova

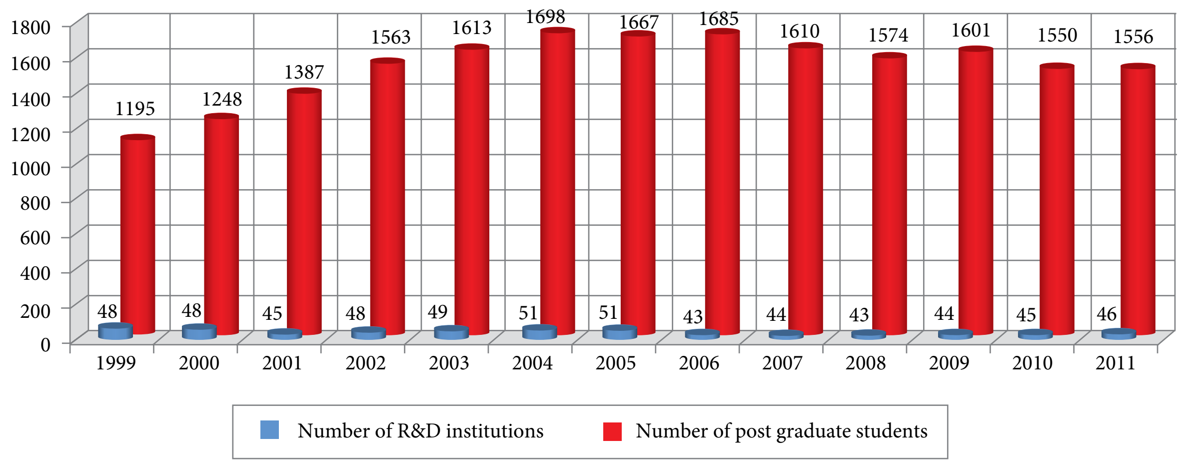


Figure 1-7: Number of Institutions (units) Providing Post Graduate Education and Number of Post Graduate Students (persons) in the Republic of Moldova

1.4. Institutional Arrangements

1.4.1. Institutions

The Republic of Moldova proclaimed its independence on August 27, 1991; it remained however a part of the Soviet Union until the latter's formal dissolution in December of 1991. The RM's new constitution was approved in the national referendum and ratified by the Parliament on July 28, 1994. According to the Constitution, the RM is a neutral country. The Constitution guarantees the voting right to all its citizens who have reached the age of 18 and provides for the various civil rights and liberties.

The President is the head of the state. Prior to the amendments to the Constitution introduced in 2000 presidential elections used to be direct. Currently the President is elected by the Parliament for the term of 4 years and may hold the presidential office no more than two consecutive terms. The President has the power to dissolve the Parliament. The Constitution provides for the possibility to accuse the President of a penal or constitutional infringement.

The President appoints the Prime Minister and (upon the latter's recommendations) the Cabinet of Ministers. The Prime Minister and the Cabinet require the approval of the Parliament. The current Government, invested on May 31, 2013 is comprised of 16 ministries:

1. Ministry of Economy (MEC) (www.mec.gov.md)
2. Ministry of Finance (MF) (www.mf.gov.md)
3. Ministry of Justice (MJ) (www.justice.gov.md)
4. Ministry of Internal Affairs (MIA) (www.mai.gov.md)
5. Ministry of Foreign Affairs and European Integration (MFAEI) (www.mfa.gov.md)
6. Ministry of Defence (MD) (www.army.gov.md)
7. Ministry of Regional Development and Constructions (MRDC) (www.mdrc.gov.md)
8. Ministry of Agriculture and Food Industry (MAFI) (www.maia.gov.md)

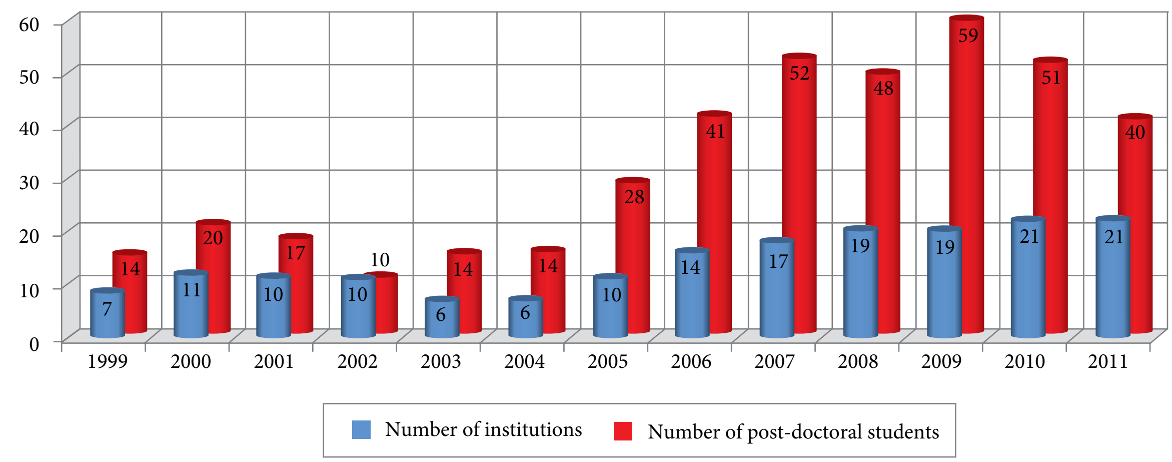


Figure 1-8: Number of Institutions (units) Providing Post-Doctoral Education and Number of Post-Doctoral Students (persons) in the Republic of Moldova

9. Ministry of Transport and Road Infrastructure (MTRI) (www.mtid.gov.md)
10. Ministry of Environment (MoEN) (www.mediu.gov.md)
11. Ministry of Education (MED) (www.edu.gov.md)
12. Ministry of Culture (MC) (www.mc.gov.md)
13. Ministry of Labour, Family and Social Protection (MLFSP) (www.mmpsf.gov.md)
14. Ministry of Health (MH) (www.ms.gov.md)
15. Ministry of Information Technology and Communication (MITC) (www.mtic.gov.md)
16. Ministry of Youth and Sport (MYS) (www.mts.gov.md)

The nation's supreme legislative authority is the one-chamber Parliament. It is composed of 101 deputies (MPs) elected directly for the term of four years. The Parliament has two ordinary sessions per year; furthermore, it is possible to convene an extraordinary parliamentary session. In addition to adoption of laws and exercising other basic legislative functions, the Parliament may declare the state of national emergency, martial law or war.

The judiciary system includes three supreme courts: the Supreme Court of Justice, the Court of Appeals and the Constitutional Court – the supreme authority on constitutional issues issuing final decisions which cannot be appealed against. Tribunals and courts exercise judicial procedures at the local level. The President appoints judges for the Supreme Court of Justice and the Court of Appeals from the nominees submitted by the Supreme Council of Magistrates.

The Supreme Council of Magistrates composed of 11 magistrates and elected for a five-year term is in charge of appointments, transfers and promotions of judges. The Council includes the Minister of Justice, the Chairman of the Supreme Court of Justice, the Chairman of the Court of Appeals, the Chairman of the Economic Court and the Attorney General, three members elected from among the members of the Supreme Court of Justice and another three members elected by the Parliament from among the accredited university professors.

1.4.2. Institutional arrangements relevant for NCs preparation

The Ministry of Environment (MoEN) of the Republic of Moldova is the state authority vested with the power to:

- develop and promote policies and strategies addressing environment protection, rational use of natural resources and biodiversity conservation;
- identify priorities, develop and promote national programs and action plans which address such priorities, coordinate relevant actions and monitor their implementation in the best way;
- integrate environment protection policies in the social-economic processes and corresponding parts of sector policies based on principles of sustainable development and harmonization of relevant legislation with the EU legislation;
- promote the state policy and determine the priority directions of the environmental research and development, make possible and coordinate implementation of research and development programs, promote implementation of new technologies, equipment and machinery;
- ensure international collaboration for the environment protection;
- gather, systematize and manage own information data base to support own activities, ensure maintenance and optimization of the sector information system;
- undertake regulatory and control actions to ensure ecological and biological security of the country;
- ensure state ecological expertise and exercise state control in the environment protection area, use of natural resources, implementation of forest extension programs and activities aimed at forests regeneration and exploitation, ecological reconstruction;
- manage the National Environmental Fund (NEF), coordinate the activity of local ecological funds;
- carry out integrated ecological monitoring, develop and broadcast synoptic, aeronautical, agro-meteorological and hydrological forecasts, forecast the dangerous meteorological phenomena and appropriately warn the public authorities, population and economic agents about their features and scale;
- involve mass-media, non-governmental organizations and population in implementation of environmental protection, promote educational activities with all categories of population.

On behalf of the Government of the Republic of Moldova, MoEN is responsible for implementation of international environment treaties to which the Republic of Moldova is a Part (including the United Nations Framework Convention on Climate Change, signed by the Republic of Moldova on June 12, 1992, ratified by the Parliament on March 16, 1995, as well as the Kyoto Protocol, ratified by the Republic of Moldova on February 13, 2003).

Representatives of MoEN also perform the function of the GEF Political and Operational Focal Points, as well as UNFCCC Focal Point.

Through the Government Resolution No. 1574 as of 26.12.2003 it was established the „National Commission for Implementing Provisions of the United Nations Framework Convention on Climate Change and Provisions and Mechanisms of Kyoto Protocol" (Designated National Authority).

In conformity with Article 2 of its working regulations, the „National Commission" (DNA) is the supreme authority in the Republic of Moldova responsible for implementation of the UNFCCC provisions, as well as the mechanisms and provisions of Kyoto Protocol (the National Commission was vested with the authority to develop and promote policies and strategies under the Clean Development Mechanism of the Kyoto Protocol). The activity of the National Commission and execution of its decisions is coordinated and monitored by the Commission's Secretary, who is also the Manager of the Climate Change Office under the MoEN.

The Climate Change Office was established through the Order No. 21 as of February 11, 2004 of the Ministry of Ecology, Constructions and Territory Development of the Republic of Moldova (reorganized into Ministry of Environment and Natural Resources (MENR) based on Government Resolution No. 357 as of April 23, 2005 'On reorganization of ministries and central administration authorities of the Republic of Moldova'; based on Law No. 21-XVIII as of September 18, 2009, MERN was reorganized into the Ministry of Environment).

The main tasks of the Climate Change Office are:

- providing logistical support to the Government, central and local public administration authorities, non-government and academic organizations, in activities implemented and promoted by the Republic of Moldova under the United Nations Framework Convention on Climate Change and the Kyoto Protocol;
- implementing climate change related projects and programs providing for such activities as:
  - national greenhouse gas emissions assessment and development the National Inventory Reports (NIRs);
  - development and implementation of greenhouse gas emissions mitigation activities and projects;
  - development and implementation of measures and projects aimed at adapting to climate change;
  - assessment of the climate change impacts on biologic and socio-economic components;
  - cooperation, promotion and implementation of activities and projects under the Clean Development Mechanism of the Kyoto Protocol;
  - implementation and facilitation of activities aimed at building awareness and information among civil society, relevant experts and decision makers on issues related to climate change, etc.

In the above mentioned context, it is worth noted that the Climate Change Office under the Ministry of Environment is totally responsible for the activities related to preparation of National Communications (Figure 1-9) and since 2014, also of the Biennial Update Reports of the Republic of Moldova under the UNFCCC.

The Climate Change Office comprises six working groups (teams): National GHG Inventory Team, Climate Change Mitigation Assessment Team, Vulnerability and Adaptation Assessment Team, Climate Change Modelling Team and Education and Public Awareness Team.

Below is a brief description of functional responsibilities of the participants in the process:

- National experts (hired on a contract basis) are responsible for the process of activity data gathering, selecting suitable assessment methods, assessment at sectoral level, taking correction measures as a response to quality assurance and quality control activities as well as developing some component parts of the National Communications.
- Team leaders are responsible for the coordination of the process of compilation of the key parts of the National Communications. They supervise the process at sectoral level, are responsible for interpreting the results obtained by national experts, coordination of quality assessment and quality control activities, documentation and archiving the materials used and aggregating the reports submitted by national experts.

The activity data needed for the National Communications and National GHG Inventories compilation are available in Annual Yearbooks, Energy Balances and others sector statistic publications of the National Bureau of Statistics of the Republic of Moldova.

Additional statistical data (non-published) may be provided at request, in conformity with provisions of the *Law nr. 412 as of 09.12.2004 on Official Statistics, Article 9 (2), item a) and b),* according to which *"the official statistics authorities must disseminate statistical data to users in the amount, manner and terms specified in the statistical works programme"*, as well as to *"to ensure access of all users to non-confidential statistic on equal conditions in terms of amount and terms of dissemination"*.

Based on the provisions of the *Law on Access to Information*, adopted by the Parliament Resolution No. 982-XIV as of 11.05.2000, other relevant activity data are collected at request (a written request from the Ministry of Environment), from various partner organizations, such as:

- Central Public Authorities and Subordinated Institutions:
  - Ministry of Transport and Road Infrastructure,
  - Ministry of Information Technology and Communication,
  - Ministry of Regional Development and Constructions,
  - Ministry of Agriculture and Food Industry,
  - Ministry of Internal Affairs,
  - Ministry of Economy,

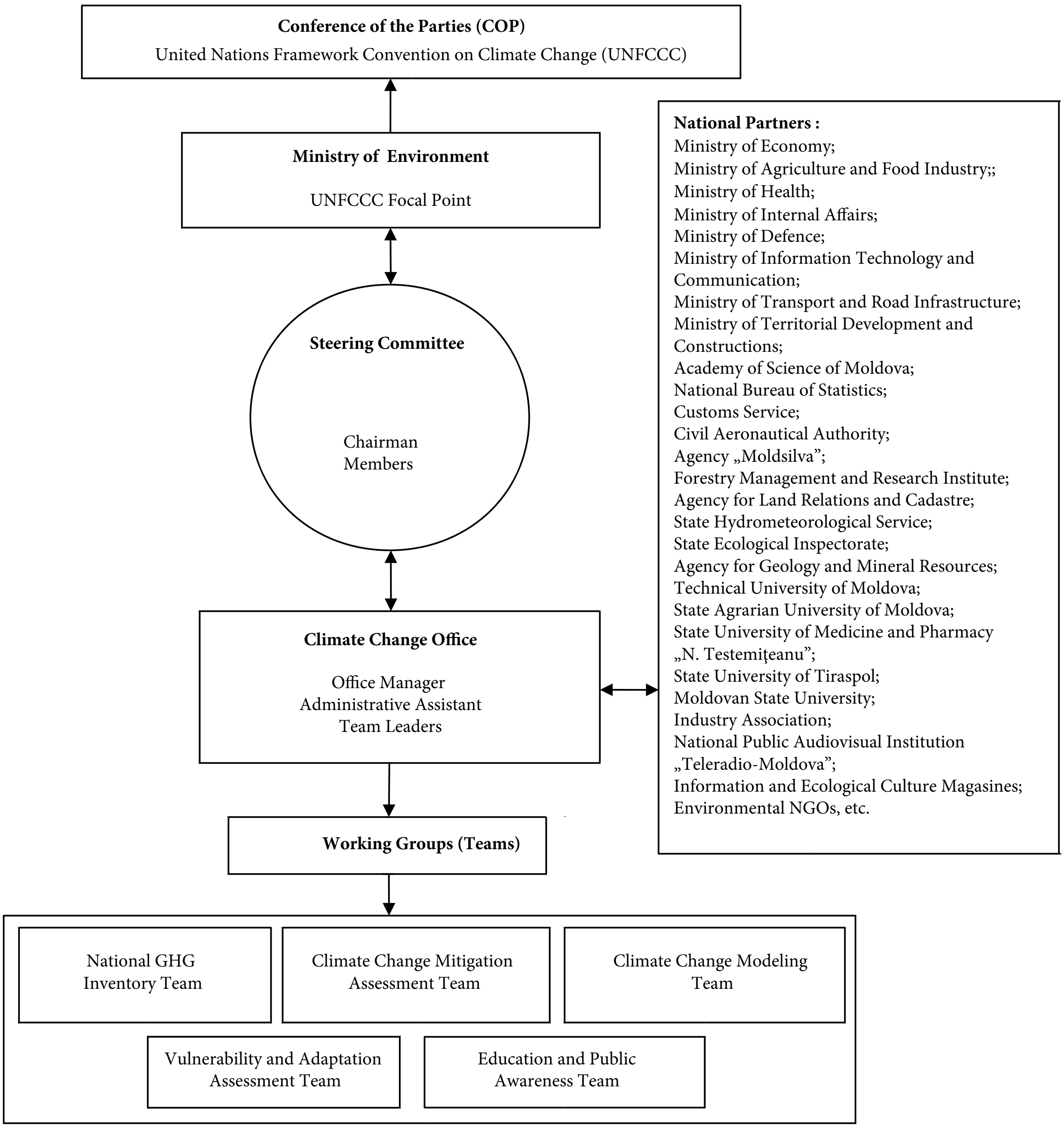


Figure 1-9: Institutional Arrangements Relevant for the Preparation of the National Communications in the Republic of Moldova.

- Ministry of Health,
- Ministry of Defence,
- Customs Service,
- Energy Efficiency Agency,
- Civil Aeronautical Authority,
- National Agency for Energy Regulation,
- Agency for Geology and Mineral Resources,
- State Hidrometeorological Service,
- State Ecological Inspectorate,
- Environmental Pollution Prevention Office,
- Biodiversity Office,
- Ozone Office

• Central Administrative Authorities:
  - Agency „Moldsilva",
  - National Bureau of Statistics,
  - Land Relations and Cadastre Agency

• Academy of Sciences of Moldova with its institutional members:
  - Institute of Zoology,
  - Institute of Power Engineering,

- Botanical Garden (Institute),
- Institute of Ecology and Geography,
- Institute of Genetics and Plant Physiology,
- Institute of Plant Protection and Ecological Agriculture,
- Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo",
- Institute of Scientific and Practical Animal Husbandry and Veterinary Medicine in Biotechnology
- Universities:
  - State University of Moldova
  - State University of Tiraspol,
  - Technical University of Moldova,
  - State Agrarian University of Moldova,
  - State University of Medicine and Pharmacy „Nicolae Testemiteanu"
- Economic Agents:
  - S.E. „Moldavian Railways",
  - M.E. „Autosalubritate",
  - J.S.C. „Moldova-Gaz",
  - J.S.C. "Moldelectrica",
  - J.S.C. Red Union Fenosa S.A. from Gas Natural Fenosa Group,
  - S.E. „Glass Factory in Chisinau",
  - M.E. „Glass Container Company" J.S.C.,
  - M.E. „Cristal-Flor" S.A.,
  - J.S.C. „Lafarge-Ciment",
  - J.S.C. „Macon"
- Industry Associations:
  - Public Association of Refrigerating Engineers in the Republic of Moldova,
  - Union of Moldovan Sugar Producers

So, Article 1 of the *Law on Access to Information* regulates the relationships between information providers and individual/legal entity in the process of ensuring and implementing the constitutional right of access to information; principles, conditions, ways and manner of accomplishing access to official data owned by information providers; aspects of access to and protection of personal information within the scope of access to such data; rights of data solicitants, including petitioners of personal data; obligations of information providers in the process of ensuring access to official information; ways to protect the right to access to information. Article 4 (1) stipulates that *"anyone, under this law's conditions, has the right to look for, receive and make public official information"*.

According to Article 6 (1), *"official information are deemed to be all information owned and available to information providers, developed, selected, processed, consolidated and / or adopted by authorities or official persons or made available to them by other legal entities"*. This Article is a review of information bearing documents as stipulated by the provisions of this law. Article 7 refers to cases of limited access to official information. Rights of data solicitants are reflected in Article 10, while Article 11 refers to the obligations of information provider.

According to Article 13 (1), ways of access to information are the following: hearing of information which can be provided verbally; document review on the premises of the institution; issuing a copy of the requested document or information; issuing a copy of the document, information translated into a different language than the language of the original, for an additional charge; sending by mail (including e-mail) of a copy of the document, information, a copy of the translated document, information into a different language, at the solicitant's request, for a payment. Article 13 (2) stipulate that extracts from registers, documents, information, as per solicitant's request, can be made available to the solicitant in a reasonable and acceptable to the solicitant form.

Article 16 of the Law refers to the requirements that have to be met to ensure access to information: the requested information or documents shall be made available to the solicitant from the moment it becomes available for issuing, but not later than 15 working days from the date the application for access to information is registered; the leadership of the public institution may extend the term of providing the information, or document by 5 working days if : (i) the request refers to a very big volume of information requiring their selection; (ii) additional consultations are needed to satisfy the request. The solicitant will be informed about any extension of the information delivery term and about the reasons for such extension 5 days prior to the expiry of the initial term. The Law also refers to cases when access to information is denied, to payments for official information provision, to modalities of protecting the right for access to information and prosecution in court of information providers' actions.

Also, a series of other laws contain provisions pertaining to wide public to environment protection related information. Thus, Article 29 (3) of the *Law on Natural Resources*, adopted by the Parliament Resolution No. 1102-XIII as of 06.02.1997, stipulates that *„Government, local public administration authorities, state bodies assigned with natural resources management and environment protection, as well as businesses, shall make public valid and accessible information regarding natural resources use and environment protection activities"*.

Article 23 of the *Forestry Code*, adopted by the Parliament Decision no. 887 as of 21.06.1996, stipulates that citizens and NGO-s are entitled to receive information from the state forestry authorities and environment protection bodies about forestry and hunting resources, planned and accomplished conservation measures and use of such resources.

The *Regulation regarding trading and regulated use of halogenated hydrocarbons that deplete the ozone layer*, approved by the *Law of the Republic of Moldova No. 852-XV as of 14.02.2002*, stipulates the procedure of presenting by the MENR of information regarding production, import, export, trading and use (recycled and reclaimed quantities of controlled substances) of halogenated hydrocarbons that deplete the ozone layer, regulated by Montreal Protocol.

1.5. Economical Context

After the breakup of the Soviet Union and declaration of the Republic of Moldova's independence, the nation had to face a particularly severe crisis in view of both the size of the country and the scope of the crisis as compared to the other economies in transit. The RM rated among the medium income countries in 1991, and it has turned currently to one of the poorest countries in Europe, with its per capita GDP below the average for both the Commonwealth of Independent States (CIS) and the Central European countries. In terms of its structure, the RM's economy is closer to that of the Central Asia countries than that of the other Western former Soviet Union Republics.

1.5.1. Gross Domestic Product

The separatist actions of the industrialized Transnistrian region (i.e., the current administrative-territorial units on the left bank of the Dniester) have left the RM with an undiversified economic base, dependent in practical terms solely on the agricultural production and food industry.

In 1993 the agricultural sector accounted for 31.2 per cent of GDP, and the manufacturing industry – for 39.0 per cent of GDP. In 2012 the share of GDP accounted for by the agriculture decreased to 10.0 per cent, and that of the manufacturing industry to 13.9 per cent (Table 1-6).

Nevertheless, the agriculture is still a dominating GDP driver, whereas the industrial sector is based to a considerable extent on food procession. According to the 2012 Statistical Yearbook of the RM, the manufacturing industry accounts for as little as 13.1 per cent of the total employment – as opposed to the agriculture accounting for 27.5 per cent of the total employment.

It should be noted that certain economic decline patterns had been registered prior to 1991, but the separation from the USSR has considerably accelerated that process. GDP level was decreasing continuously during the period from 1990 to 1999 inclusive, when it fell down to as little as 34 per cent

Table 1-6: GDP Structure in the Republic of Moldova, 1993-2012, %

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
GDP structure, %	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Gross Value Added	99.0	93.4	88.6	87.5	86.0	84.6	89.3	87.5	88.0	87.3
Production, Total	70.2	58.6	54.3	50.6	46.2	42.5	41.9	41.7	41.1	38.3
Agriculture	31.2	27.3	29.3	27.5	26.0	25.8	24.9	25.4	22.4	21.0
Industry	39.0	31.4	25.0	23.1	20.2	16.7	17.0	16.3	18.7	17.3
Services, Total	32.9	38.6	36.6	41.7	43.5	46.9	53.0	48.2	49.2	51.0
Wholesale and Retail Trade	7.9	7.8	8.0	8.3	8.2	10.3	15.3	12.5	12.0	11.0
Transports and Communications	4.4	6.3	5.1	5.6	6.5	7.4	8.2	9.5	10.4	10.0
Construction Sector	3.3	4.5	3.5	3.8	4.7	3.2	3.3	2.7	3.1	2.9
Financial Sector	4.8	5.2	3.7	6.6	6.0	7.4	8.2	5.3	4.5	4.3
Other	12.5	15.0	16.3	17.4	18.2	18.7	18.0	18.2	19.2	22.7
Agent (Intermediary) Services	-4.1	-3.9	-2.2	-4.7	-3.8	-4.8	-5.6	-2.4	-2.3	-2.1
Product and Import Taxes, Net	1.0	6.6	11.4	12.5	14.0	15.4	10.7	12.5	12.0	12.7
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
GDP structure, %	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Gross Value Added	85.2	85.9	84.0	83.4	83.1	82.3	84.1	83.4	83.0	82.4
Production, Total	35.9	34.7	32.2	29.2	24.2	22.7	21.8	25.3	26.0	23.9
Agriculture	18.3	17.6	16.4	14.5	10.0	8.8	8.5	12.0	12.3	10.0
Industry	17.6	17.1	15.8	14.7	14.3	13.9	13.3	13.3	13.7	13.9
Services, Total	51.6	53.5	53.8	56.7	61.2	61.7	63.9	60.1	59.1	60.7
Wholesale and Retail Trade	10.7	10.6	10.4	11.5	12.6	13.0	13.2	12.8	13.3	12.9
Transports and Communications	10.8	11.8	12.2	11.8	12.3	12.1	12.0	11.3	10.7	10.5
Construction Sector	2.9	3.4	3.3	4.0	4.8	5.0	3.5	3.4	3.4	3.7
Financial Sector	4.5	4.7	4.6	5.0	6.0	6.0	6.4	5.7	5.6	5.8
Other	22.6	23.0	23.2	24.5	25.4	25.7	28.9	26.9	26.1	27.8
Agent (Intermediary) Services	-2.3	-2.3	-2.0	-2.5	-2.3	-2.1	-1.6	-2.1	-2.1	-2.2
Product and Import Taxes, Net	14.8	14.1	16.0	16.6	16.9	17.7	15.9	16.6	17.0	17.6

Source: Ministry of Economy of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (November 2012).

of the 1990 level. The only exception was 1997 year, when a slight increase by 1.6 per cent versus the previous year was registered due to the excellent agricultural yields as result of the very favourable weather (Tables 1-7, 1-8 and 1-9).

The reasons for the economic collapse were multiple. First, the RM had been integrated completely in the USSR economic system, and the independence resulted, among other things, in the cessation of any subsidies or cash transfers from the centralized government. Second, the end of the Soviet Era with its well established commercial links has resulted in the emergence of multiple obstacles for free movement of products, and in access restrictions introduced by the emerging markets. Third, the lack of domestic energy resources and raw materials in the RM has contributed considerably to the nation's strong dependence on other former Soviet Republics. That dependence has caused a shock in the sphere of imports due to the increased prices of the energy resources imported from the Russian Federation.

Certain internal reasons should be mentioned as well, such as: transition from a centralized economy to a market economy; loss of the industries located in Transnistrian region on the left bank of Dniester; frequent droughts; and the civil conflict. Despite these problems, the considerable GDP growth achieved since 2000 seems to indicate that the economy is finally developing in the correct direction (excluding 2009, when the country was affected by the global economic crisis), although it should be remembered that, according to the latest data available, in 2011 the GDP reached only 61.0 per cent of the 1990 level. Also, the substantial cash inflows from the Moldavians working abroad have

Table 1-7: GDP in the RM in 1990-2011, billion MDL

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
GDP, billion MDL (real)	13.00	25.90	191.90	1.82	4.74	6.48	7.80	8.92	9.12	12.32	16.02
% compared to the preceding year	97.6	82.5	71.0	98.8	69.1	98.6	94.1	101.6	93.5	96.6	102.1
% compared to 1990	100.0	82.5	58.6	57.9	40.0	39.4	37.1	37.7	35.2	34.0	34.8
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
GDP, billion MDL (real)	19.05	22.56	27.62	32.03	37.65	44.75	53.43	62.92	60.43	71.89	82.17
% compared to the preceding year	106.1	107.8	106.6	107.4	107.5	104.8	103.0	107.8	94.0	107.1	106.4
% compared to 1990	36.9	39.8	42.4	45.5	49.0	51.3	52.8	57.0	53.6	57.4	61.0

Source: Ministry of Economy of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (November 2012).

Table 1-8: GDP in the RM in 1990-2011, billion 2005 US $

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
GDP, billion 2005 US $	5.961	5.008	3.550	3.508	2.424	2.390	2.266	2.302	2.152	2.079	2.123
% compared to the preceding year	97.6	84.0	70.9	98.8	69.1	98.6	94.8	101.6	93.5	96.6	102.1
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
GDP, billion 2005 US $	2.252	2.428	2.588	2.780	2.989	3.132	3.228	3.478	3.270	3.497	3.721
% compared to the preceding year	106.1	107.8	106.6	107.4	107.5	104.8	103.1	107.8	94.0	106.9	106.4

Source: Economic Research Service, US Department of Agriculture, 11/03/2012, <http://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx#.UXFRlKJTCQo>.

Table 1-9: GDP in the RM in 1993-2012, billion US $

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
GDP, billion US $ (real)	1.358	1.165	1.441	1.694	1.929	1.699	1.174	1.289	1.480	1.662
% compared to the preceding year		85.7	123.8	117.5	113.8	88.1	69.1	109.8	114.9	112.3
GDP, billion US $ (PPP)	10.830	10.948	7.586	7.659	8.064	7.622	7.413	7.687	8.351	9.176
% compared to the preceding year		101.1	69.3	101.0	105.3	94.5	97.3	103.7	108.6	109.9
GDP per capita, thousand MDL	0.493	1.287	1.798	2.167	2.440	2.498	3.379	4.402	5.247	6.227
% compared to the preceding year	96.2	69.3	100.7	94.2	100.1	93.5	96.8	102.3	106.4	108.1
thousand US $	0.368	0.317	0.400	0.471	0.528	0.465	0.322	0.354	0.408	0.459
thousand US $ (PPP)	2.935	2.975	2.105	2.128	2.207	2.087	2.033	2.112	2.300	2.533
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
GDP, billion US $ (real)	1.981	2.598	2.988	3.409	4.401	6.056	5.438	5.813	7.002	7.255
% compared to the preceding year	119.2	131.1	115.0	114.1	129.1	137.6	89.8	106.9	120.5	103.6
GDP, billion US $ (PPP)	9.988	7.307	8.490	9.189	9.740	10.725	10.201	10.999	11.883	11.884
% compared to the preceding year	108.9	73.2	116.2	108.2	106.0	110.1	95.1	107.8	108.0	100.0
GDP per capita, thousand MDL	7.646	8.890	10.475	12.483	14.937	17.625	16.948	20.181	23.083	24.747
% compared to the preceding year	106.9	107.6	107.8	105.1	103.2	108.0	94.1	107.2	106.5	100.4
thousand US $	0.548	0.721	0.831	0.951	1.230	1.696	1.525	1.632	1.967	2.042
thousand US $ (PPP)	2.765	2.028	2.362	2.563	2.723	3.004	2.861	3.088	3.338	3.345

Source: Ministry of Economy of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (November 2012).

significantly reduced the negative impact of the declining economic activity.

1.5.2. Inflation

The inflation rate grew dramatically up to approximately 788.5 per cent in 1993 and slowed down to 7.7 per cent in 1998 (Table 1-10). The 1998 year depreciation of the Russian Rubble caused rapid growth of the inflation up to 39.3 per cent. Later, the RM achieved a significant progress in terms of controlling its inflation rate, and the inflation rate decreased to 5.2 per cent in 2002; however, the 2003 average inflation rate for the year increased up to 11.7 per cent driven by the growing prices for agricultural products (as result of a severe drought), and the above growth pattern persisted in the subsequent years; the inflation reached 12.4 per cent in 2004, but decreased to 11.9 per cent in 2005 – only to grow up to 12.7 per cent in 2006, in particular due to the increased prices for the natural gas imported from Russian Federation, for fuel and medications. The average inflation rate for the year was about 12.4 per cent in 2007, and the nature of inflation was mainly non-monetary, because it was driven by the growing global prices for oil, increase of the government-regulated tariffs for certain services (utilities) and the growing purchasing power of the population owing to the increased salaries and old-age pensions as well as hard-currency flows to the Republic of Moldova from the Moldavians working abroad. The 2008 inflation rate remained relatively high (the inflation rate was 12.7 per cent from January to December), driven by the growing prices for public utilities, increasing food demand and the growth of the purchasing power. In 2009, the inflation rate represented about 0.006 per cent, increasing up to 7.4 per cent in 2010 and to 7.6 per cent in 2011, in particular, due to the more evident growth of food and fuel prices, and partly being influenced by developments in the foreign exchange market. In 2012, the inflation risk balance continued to be influenced by external and internal factors, with a slight emphasis on post-inflationary factors. The main factors that influenced the average rate of consumption index increase were oil prices on the international markets and increased food prices due to severe droughts in the summer of 2012. The main disinflation factors this year were represented by lower economic activity and weak domestic and foreign demand.

1.5.3. National Currency Exchange Rate

The national currency (MDL – Moldovan Lei) has been put into circulation in November 1993. During 1994-2011, the average MDL exchange rate for the year (in nominal terms) registered a significant depreciation against United States Dollars (USD) (Table 1-11).

Table 1-11: The Average Annual Exchange Rate of the Republic of Moldova's National Currency (MDL) against United States Dollars (USD) in Nominal Terms, 1993-2012

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Exchange rate, MDL /US $	3.66	4.07	4.50	4.60	4.62	5.37	10.50	12.43	12.87	13.57
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Exchange rate, MDL /US $	13.94	12.33	12.60	13.13	12.14	10.39	11.11	12.37	11.74	12.12

Source: National Bank of Moldova, <http://www.bnm.md/md/rates_evolution>.

From the beginning of 2012, the national currency exchange rate recorded 5.7 per cent depreciation in nominal terms against United States Dollars, as well as 6.6 per cent depreciation against Euro. The main drivers of the above changes in the exchange rate were: inflows of currency from abroad and US dollar fluctuation on the international monetary markets, determined, in particular by the economic issues related to the growth of the external debt in the USA and in some Euro zone countries. Due to the continuing depreciation of the US dollar on the international monetary markets, the number of transactions with that currency has decreased considerably. Against that background, the period of 2003-2013 featured a growing number of transactions in Euro (Table 1-12).

Table 1-12: Structure of Transactions on the Currency Market, 2000-2013, %

	12/2000	12/2001	12/2002	12/2003	12/2004	12/2005	12/2006
USD	89.8	85.1	85.3	81.7	80.4	77.4	70.2
Euro	3.4	5.7	8.9	12.7	15.2	16.6	26.5
Russian Rubble	6.6	8.8	4.7	4.9	3.6	4.6	3.0
Other	0.3	0.4	1.1	0.7	0.7	1.4	0.3
	12/2007	12/2008	12/2009	12/2010	12/2011	12/2012	03/2013
USD	66.3	64.9	68.8	58.0	63.1	56.5	52.4
Euro	29.3	31.4	27.5	36.9	33.6	41.0	45.3
Russian Rubble	3.6	2.8	2.7	4.5	2.9	2.1	1.8
Other	0.9	0.9	0.9	0.7	0.4	0.5	0.5

Source: National Bank of Moldova, <http://bnm.md/md/fm_valute_market>.

The National Bank of Moldova owned as of 31.01.2013 foreign currency provisions which totalled USD 2.5199 billi-

Table 1-10: Consumer Price Index for Goods and Services in the RM in 1993-2012, %

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Inflation, average rate of consumption index increase, %	788.5	329.6	30.2	23.5	11.8	7.7	39.3	31.2	9.6	5.2
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Inflation, average rate of consumption index increase, %	11.7	12.4	11.9	12.7	12.4	12.7	0.0	7.4	7.6	4.5

Source: <http://www.indexmundi.com/moldova/inflation_rate_(consumer_prices).html>.

on, increasing by 0.2 per cent compared to the level recorded at the end of 2012 and by 24.1 per cent compared to the level recorded at the end of 2011.

1.5.4. Trade Balance Deficit

The RM's import expenses exceed considerably the nation's proceeds from its exports, thus indicating a severe problem in terms of the nation's trade balance deficit. That deficit reached 24 per cent of the GDP in 2000 and exceeded 41.1 per cent of the GDP in 2012 (Table 1-13).

The above reflects the nation's dependence on the imports of energy resources and the growing demand for the imported products. The imports growth is driven by the massive inflow of cash transfers from abroad, which are channelled in domestic consumption. The range of RM's exports is relatively narrow, thus complicating the nation's efforts to penetrate the western markets.

Food and alcoholic drinks, textiles and textile articles, vegetable products, base metals and products thereof, machinery and mechanical appliances, electrical equipment, etc. prevail in the exports. In 2011, food and alcoholic drinks, textiles and textile articles accounted jointly with machinery, mechanical appliances and electrical equipment for approximately 64.9 per cent of the total exports (Table 1-14).

Table 1-13: Trade Balance Deficit of the Republic of Moldova, 1993-2012

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
GDP, billion US $	1.358	1.165	1.441	1.694	1.929	1.699	1.174	1.289	1.480	1.662
Exports (CIF), billion US $	0.483	0.565	0.746	0.795	0.874	0.632	0.463	0.471	0.565	0.644
% compared to the preceding year	102.8	117.1	131.9	106.6	109.9	72.3	73.3	101.7	119.9	113.8
Imports (FOB), billion US $	0.628	0.659	0.841	1.072	1.171	1.024	0.586	0.776	0.892	1.038
% compared to the preceding year	98.1	105.0	127.5	127.5	109.2	87.4	57.3	132.4	114.9	116.3
Trade balance deficit, billion US $	-0.145	-0.094	-0.095	-0.277	-0.297	-0.392	-0.123	-0.305	-0.327	-0.394
Coverage of IMP with EXP, %	76.9	85.8	88.7	74.1	74.6	61.7	79.0	60.7	63.4	62.0
% of GDP: exports	26.5	48.5	51.7	46.9	45.3	37.2	39.5	36.6	38.2	38.7
imports	34.5	56.6	58.3	63.3	60.7	60.3	50.0	60.2	60.3	62.4
balance	-8.0	-8.1	-6.6	-16.4	-15.4	-23.1	-10.5	-23.7	-22.1	-23.7
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
GDP, billion US $	1.981	2.598	2.988	3.409	4.401	6.056	5.438	5.813	7.002	7.255
Exports (CIF), billion US $	0.790	0.985	1.091	1.050	1.340	1.591	1.283	1.542	2.217	2.220
% compared to the preceding year	122.7	124.7	110.7	96.3	127.6	118.7	80.6	120.1	143.8	100.1
Imports (FOB), billion US $	1.402	1.769	2.292	2.693	3.690	4.899	3.278	3.855	5.191	5.200
% compared to the preceding year	135.1	126.1	129.6	117.5	137.0	132.8	66.9	117.6	134.7	100.2
Trade balance deficit, billion US $	-0.612	-0.783	-1.201	-1.643	-2.350	-3.308	-1.995	-2.314	-2.974	-2.980
Coverage of IMP with EXP, %	56.3	55.7	47.6	39.0	36.3	32.5	39.1	40.0	42.7	42.7
% of GDP: exports	39.9	37.9	36.5	30.8	30.4	26.3	23.6	26.5	31.7	30.6
imports	70.8	68.1	76.7	79.0	83.8	80.9	60.3	66.3	74.1	71.7
balance	-30.9	-30.2	-40.2	-48.2	-53.4	-54.6	-36.7	-39.8	-42.5	-41.1

Source: Ministry of Economy, Department of Macroeconomic Analysis and Forecasts (November 2012).

Table 1-14: Exports by Sections According Harmonized System in 2000-2011, %

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total exports, including:	100	100	100	100	100	100	100	100	100	100	100	100
Live animals and animal products	4.8	3.2	2.4	3.6	2.0	1.6	1.5	1.0	0.6	0.7	1.7	1.7
Vegetable products	14.0	13.9	16.5	11.6	12.2	12.1	13.0	12.1	13.2	20.6	22.1	21.2
Animal or vegetable fats and oils	0.8	1.5	2.6	3.7	4.2	3.5	3.3	4.1	4.0	4.0	3.1	3.5
Food, drinks and tobacco	42.1	44.5	41.5	39.8	35.1	36.3	26.3	20.5	19.6	21.9	20.6	14.9
Mineral products	0.6	1.1	1.8	2.6	3.1	1.8	2.6	4.3	4.0	1.1	1.1	1.7
Chemical products	1.7	1.4	1.1	1.1	0.9	1.4	2.0	2.0	2.1	4.5	4.8	5.0
Plastics, rubber and articles thereof	0.4	0.5	0.4	0.7	0.8	1.1	1.5	2.5	2.4	2.1	1.7	2.8
Raw hides and skins, leather, fur skins and articles thereof	2.8	2.0	3.6	5.7	7.9	6.6	2.3	2.2	2.1	1.9	1.6	1.6
Wood and articles of wood (excluding furniture)	0.2	0.3	0.2	0.2	0.4	0.2	0.4	0.3	0.3	0.3	0.4	0.5
Paper, paper-board and articles thereof	0.4	0.6	0.8	1.3	0.8	1.1	1.8	2.0	1.0	0.6	0.8	1.1
Textiles and textile articles	17.7	18.4	16.7	16.4	17.3	17.8	21.7	20.6	19.7	20.1	17.4	16.0
Footwear, headgear, umbrellas and similar articles	0.8	0.9	1.5	1.9	2.2	2.4	2.9	3.0	3.0	2.1	2.0	2.3
Articles of stone, gypsum, cement, ceramic, glass or similar materials	3.1	2.4	2.2	2.0	1.7	1.7	3.1	3.8	3.3	2.0	2.3	2.1
Base metals and articles of base metals	2.5	0.5	1.1	2.5	3.0	4.5	7.2	8.2	7.5	2.3	3.8	5.1
Machinery and mechanical appliances, electrical equipment	5.1	5.4	3.9	3.8	4.0	4.2	5.1	6.8	10.5	10.9	11.1	12.8
Vehicles and associated transport equipment	1.1	1.3	2.1	1.4	2.3	1.4	1.6	1.4	1.0	1.2	1.4	2.1
Instruments and apparatus	0.7	1.1	1.0	0.9	0.8	0.7	1.2	1.7	1.8	0.9	0.8	1.0
Miscellaneous manufactured articles	1.1	0.7	0.7	0.8	1.1	1.6	2.6	3.3	3.8	3.0	3.4	4.4

Source: National Bureau of Statistics. Social-economic development of the Republic of Moldova in 2012, Chisinau, 2013.

The majority of the exports have as their destination the European Union member countries (EU-27) (about 46.9 per cent of the 2012 total, respectively 48.8 per cent of the 2011 total) and the CIS countries (about 42.9 per cent of the 2012 total, respectively 41.5 per cent of the 2011 total). The top 14 destination countries for Republic of Moldova's exports, which accounted for about 90 per cent of the total exports were: Russian Federation (30.3 per cent in 2012, respectively 28.2 per cent in 2011), Romania (16.5 and 17.0 per cent), Italy (9.4 and 9.7 per cent), Ukraine (5.7 and 6.9 per cent), United Kingdom (3.9 and 4.6 per cent), Belarus (3.7 and 3.4 per cent), Poland (3.4 and 3.9 per cent), Germany (3.2 and 4.8 per cent), Turkey (2.6 and 3.3 per cent), Kazakhstan (2.3 and 2.1 per cent), Bulgaria (1.6 and 1.5 per cent), France (1.4 and 1.1 per cent), USA (1.4 and 1.1 per cent), Hungary (1.3 and 1.1 per cent), New Zeeland (1.2 and 0.2 per cent), Iraq (1.1 and 0.4 per cent), etc.

1.5.5. Cash Transfers and Remittances

Cash transfers from outside the country, and in particular cash inflows from the Moldovans working abroad are of major importance for the economy of the RM. Globally, the country is among the leaders regarding the share of remittances into the GDP[14]. In 2011, the total net inflow of foreign currency from the Moldovans working abroad accounted for USD 1,600.4 million or about 22.9 per cent of the GDP (Table 1-15).

[14] <http://data.worldbank.org/indicator/BX.TRF.PWKR.CD.DT/countries/1W?order=wbapi_data_value_2008%20wbapi_data_value%20wbapi_data_ value-first&sort=asc&display=default>.

Notwithstanding the trade balance deficit for products and services increasingly higher cash inflows from the Moldovans employed outside the country have contributed to the decrease of the current account deficit of the RM. The country's evident dependence on cash transfers from its citizens employed abroad presents a potential threat and indicates the lack of sustainability because the inflow of funds from outside the country creates incentives to increase consumption rather than production, thus leading to growth of imports and inflation, and a direct negative economic shock may ensure, should the volume of such transfers decrease rapidly. It is possible that the flows of money transferred from abroad will decrease in the long term, as some of the immigrants settle for permanent residence in other countries.

1.5.6. Investments

Investments are of major importance for the growth of the RM's economy. In recent years, investments registered a significant increase as compared to the preceding years' levels. In 2012, the investments attracted by the national economy represented about 18.0 billion MDL, equivalent to about USD 1.5 billion (20.5 per cent of the GDP) (Table 1-16).

At the same time, in 2011, the direct net foreign investments (DFI) attracted to the national economy represented USD 294.2 million (4.2 per cent of GDP) (Table 1-17).

That increase was driven in particular by the growing equity investments and income re-investments in the diverse sectors of the national economy (the investments were directed in particular to the power industry, transports, communications and food industry). The top investor countries for the

Table 1-15: Remittances from Moldovans Working Abroad in 1996-2011

	1996	1997	1998	1999	2000	2001	2002	2003
GDP, million US $	1694.3	1928.7	1699.0	1173.5	1288.8	1480.3	1662.3	1981.3
Remittances, million US $	87.2	114.4	124.3	111.9	178.6	243.3	323.7	486.6
% compared to the preceding year	8546.1	131.2	108.7	90.0	159.7	136.2	133.1	150.3
% of the GDP	5.1	5.9	7.3	9.5	13.9	16.4	19.5	24.6
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
GDP, million US $	2597.9	2988.2	3408.6	4401.1	6056.3	5437.6	5813.0	7002.5
Remittances, million US $	705.2	915.1	1175.8	1491.3	1888.0	1198.6	1351.4	1600.4
% compared to the preceding year	144.9	129.8	128.5	126.8	126.6	63.5	112.7	118.4
% of the GDP	27.1	30.6	34.5	33.9	31.2	22.0	23.2	22.9

Source: World Bank, 2012.

Table 1-16: Investments in the National Economy of the Republic of Moldova in 1993-2012

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Investments, billion MDL	0.171	0.712	0.845	0.987	1.202	1.444	1.592	1.759	2.315	2.804
Investments, billion US $	0.128	0.175	0.188	0.215	0.260	0.269	0.152	0.142	0.180	0.207
% of the GDP	9.4	15.0	13.0	12.7	13.5	15.8	12.9	11.0	12.2	12.4
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Investments, billion MDL	3.622	5.140	7.797	11.012	15.336	18.225	11.124	13.805	16.338	18.008
Investments, billion US $	0.260	0.417	0.619	0.839	1.263	1.754	1.001	1.116	1.392	1.486
% of the GDP	13.1	16.0	20.7	24.6	28.7	29.0	18.4	19.2	19.9	20.5

Source: Ministry of Economy, Department of Macroeconomic Analysis and Forecasts (November 2012).

Table 1-17: Direct Net Foreign Investments attracted to the National Economy in 1994-2011

	1994	1995	1996	1997	1998	1999	2000	2001	2002
GDP, million US $	1164.8	1441.4	1694.3	1928.7	1699.0	1173.5	1288.8	1480.3	1662.3
Direct foreign investments, million US $	11.6	25.9	23.7	78.7	75.5	37.9	127.5	54.5	84.1
% compared to the preceding year	82.6	224.0	91.6	331.7	95.9	50.2	336.6	42.8	154.1
% of the GDP	1.0	1.8	1.4	4.1	4.4	3.2	9.9	3.7	5.1
	2003	2004	2005	2006	2007	2008	2009	2010	2011
GDP, million US $	1981.3	2597.9	2988.2	3408.6	4401.1	6056.3	5437.6	5813.0	7002.5
Direct foreign investments, million US $	73.8	87.7	190.7	258.7	536.0	726.6	135.2	201.5	294.2
% compared to the preceding year	87.7	118.9	217.5	135.6	207.2	135.6	18.6	149.1	146.0
% of the GDP	3.7	3.4	6.4	7.6	12.2	12.0	2.5	3.5	4.2

Source: World Bank, <http://data.worldbank.org/indicator/BX.KLT.DINV.CD.WD/countries/1W?display=default>.

RM include: the Netherlands, Russian Federation, Spain, USA, Germany, Romania, France, UK and Turkey.

The total foreign investments were at the end of 2012 – 3.22 billion USD, in 2011 – 3.17 billion USD, 2010 – 2.65 billion USD, 2008 – 1.81 billion USD, 2006 – 2.09 billion USD, 2005 – 1.72 billion USD, 2004 – 1.64 billion USD, and 2003 – 1.69 billion USD.

1.5.7. Social Sphere

The average monthly salary of an employee in the national economy was 3,477.7 lei in 2012, increasing by 8.9 per cent compared to 2011. The real salary increased by 4.1 per cent (Table 1-18). In December 2012 the average monthly salary was 3,888.8 lei (by 4.9 per cent higher than in December 2011). The average monthly salary was 3,269.5 lei in the public sector (by 11.3 per cent higher than in December 2011) and 4,184.8 lei in the economic (real) sector (by 2.8 per cent higher than in December, the preceding year).

The following national economy sectors have salaries below the national average: agriculture, hunting and forestry – 2,818.3 lei, recreation, culture and sports – 2,822.1 lei, hotel and restaurant sector – 2,842.7 lei, education – 2,852.5 lei, fishery – 3,169.2 lei, other public, social and personal services – 3,193.9 lei, wholesale and retail; repairing of cars, motorcycles, personal and household goods – 3,240.3 lei and mining and quarrying industry – 3,382.1 lei.

The average monthly old-age pension was MDL 957.6 as of January 1, 2013, increasing by 9.6 per cent as compared to its level as of January 1, 2012. According to data provided by the National Office of Social Insurance, the number of pensioners registered by the social security authorities as of January 1, 2013, represented 649.9 thousand people, with 11.3 thousand more compared to January 1, 2012. The 2012 unemployment, estimated according to the standards of the International Labour Organization (ILO), was 62.2 thousand (Table 1-19), compared to 81.5 thousand in 2010. The

Table 1-18: Average Monthly Salary and Average Monthly Old Age Pension in 1993-2012

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Nominal salary, MDL	31.2	108.4	143.2	187.1	219.8	250.4	304.6	407.9	543.7	691.5
Nominal salary growth, %	897.3	347.4	132.1	130.7	117.5	113.9	121.6	133.9	133.3	127.2
Real salary growth, %	69.9	59.2	101.6	105.4	104.9	105.5	87.3	102.1	121.6	120.9
Nominal salary, US $	23.3	26.7	31.9	40.7	47.5	46.6	29.0	32.8	42.2	51.0
Real salary growth, %		114.5	119.5	127.6	116.9	98.1	62.2	113.1	128.7	120.6
Nominal salary, US $ (CPI)	185.6	250.5	167.7	183.8	198.8	209.2	183.3	195.7	238.3	281.3
Real salary growth (%)		135.0	66.9	109.6	108.2	105.3	87.6	106.8	121.8	118.0
Old age pension, MDL	18.8	55.2	64.3	78.7	82.8	83.9	82.8	85.1	135.8	161.0
Old age pension, US $	14.0	12.9	14.3	16.7	17.6	10.1	7.1	6.9	10.4	11.6
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Nominal salary, MDL	890.8	1103.1	1318.7	1697.1	2065.0	2530.0	2748.4	2972.2	3193.9	3477.7
Nominal salary growth, %	128.8	123.8	119.5	128.7	121.7	122.5	108.6	108.1	116.0	108.9
Real salary growth, %	115.4	110.2	106.8	114.2	108.4	108.7	108.6	100.7	107.8	104.1
Nominal salary, US $	63.9	89.5	104.7	129.3	170.1	243.5	247.3	240.3	272.2	288.8
Real salary growth, %	125.4	140.0	117.0	123.5	131.6	143.2	101.6	97.2	113.2	106.1
Nominal salary, US $ (CPI)	322.1	251.7	297.4	348.4	376.4	431.2	464.0	454.8	461.9	473.1
Real salary growth (%)	114.5	78.1	118.2	117.2	108.0	114.6	107.6	98.0	101.6	102.4
Old age pension, MDL	210.6	326.0	383.4	442.3	548.3	646.4	775.5	810.9	874.1	977.2
Old age pension, US $	15.9	26.1	30.4	33.7	45.2	62.2	69.8	65.6	74.5	80.6

Source: Ministry of Economy, Department of Macroeconomic Analysis and Forecasts (November 2012).

Table 1-19: Economically Active Population, Number of Unemployed and Unemployment Rate in the Republic of Moldova in1993-2012

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Economically active population, thousand people	1615.0	1474.0	1432.0	1422.0	1357.0	1314.0	1303.0	1265.0	1235.0	1258.0	1287.0
Number of unemployed, thousand people	63.3	62.3	59.6	59.9	51.8	48.4	46.2	79.2	81.5	67.3	62.2
Unemployment rate, %	3.9	4.2	4.2	4.2	3.8	3.7	3.5	6.3	6.6	5.3	4.8

Source: National Bureau of Statistics, Statistical Yearbooks of the RM for 2006 (page 102), 2007 (page 96), 2008 (page 97), 2012 (page 70).

unemployment rate (unemployed persons as a percentage of the total economically active population) recorded at the country level represents 4.8 per cent (5.9 per cent for males and 3.7 for females). There are still significant differences between the unemployment rate in urban areas (7.3 per cent) and the rural areas (2.8 per cent).

According to data provided by the National Employment Agency, as of January 1, 2013, 26.3 thousand registered unemployed were looking for a job, while the business units dismissed every ninth. Of the total number of unemployed, 54 per cent are females. Over 11 per cent of the registered unemployed receive unemployment allowance. In December 2012, the average unemployment allowance represented 1,137.9 MDL. On average, the rate was 8 unemployed per one job.

1.6. Current State of National Economy

1.6.1. Industrial Production

The 2012 industrial production reached approximately MDL 35.975 billion (in current prices). Compared to the 2011 level, the industrial production level index represented 96.9 per cent (under comparable conditions) (Table 1-20, Figure 1-10).

During 1990-2012, the industrial sector featured certain fluctuations, showing the best performance in 2001 and 2003 and the worst performance in 1992, 1994 and 2009.

Processing Industry. The situation in the Industry Sector was determined mainly by the processing industry which accounted in 2012 for 84.7 per cent of the total production of the large enterprises whose main business was manufacturing. The production of those enterprises decreased by 3.0 per cent in comparison with 2011. Food and drinks industry accounted for the highest portion in the processing industry performance (Table 1-21).

In 2012, food and drinks industry reported a decrease of production by 1.7 per cent, in particular in the following sectors: bakery food manufacturing – by 25.4 per cent; fruit and vegetables processing and canning – by 24.4 per cent; bread and confectionary manufacturing – by 3.4 per cent; wine making – by 1.0 per cent. A similar decreasing trend was registered in some other processing sectors, such as: clothing manufacturing – by 23.9 per cent; manufacture of tobacco products – by 20.4 per cent; production of paper and paper-board – by 19.3 per cent; metal industry – by 13.9 per cent; manufacture of finished metal products, exclusively for machinery and equipment production – by 13.3 per cent; machinery and equipment – by 12.4 per cent; leather, leather products and footwear manufacturing – by 11.5 per cent; wood and wood products processing – by 9.3 per cent, furniture manufacture – by 4.4 per cent, etc.

At the same time, certain progress was achieved in the following sectors due to increased production: machinery and electrical equipment – by 36.7 per cent; processing and

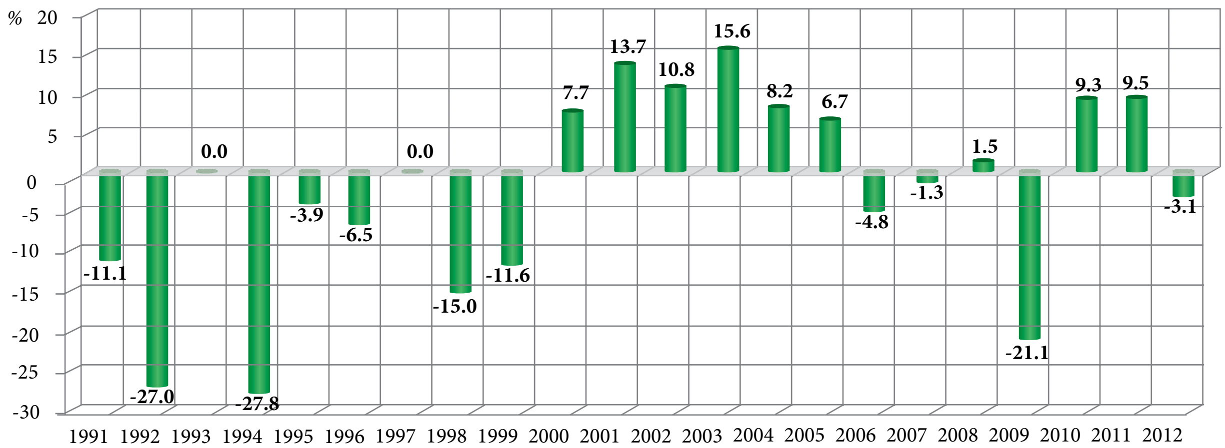


Figure 1-10: Evolution of Industry Sector in the Republic of Moldova, 1991-2012, in % compared to the preceding year

Table 1-20: Evolution of Industry Sector in the Republic of Moldova, 1990-2011

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Industry, billion MDL	11.500	22.200	129.800	1.186	3.747	4.265	4.690	5.889	5.982	7.191	8.168
% compared to 1990	100.0	88.9	64.9	64.9	46.9	45.0	42.1	42.1	35.8	31.6	34.1
Industry, billion US $	-	-	-	0.885	0.921	0.949	1.019	1.274	1.114	0.685	0.657
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Industry, billion MDL	10.428	12.624	15.963	17.591	20.770	22.371	26.174	29.988	22.644	28.140	34.194
% compared to 1990	38.7	42.9	49.6	53.7	57.3	54.5	53.8	54.6	43.1	47.1	51.6
Industry, billion US $	0.810	0.930	1.145	1.427	1.648	1.704	2.156	2.886	2.038	2.276	2.914

Source: Ministry of Economy, Department of Macroeconomic Analysis and Forecasts (November 2012).

Table 1-21: Production of Main Industrial Products by RM's Manufacturing Industry, 2003-2011

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Meat, kt	14.2	9.0	5.9	9.0	14.3	12.1	15.3	23.7	26.4
..poultry, kt	1.7	2.3	2.3	4.8	5.8	7.6	10.4	12.5	13.9
Sausages, kt	12.5	13.0	14.2	14.6	17.0	18.9	14.1	13.2	14.5
Canned meat, kt	2.7	2.2	0.6	1.0	1.1	1.3	1.0	1.5	1.3
Canned fruits and vegetables, kt	98.5	78.2	81.3	91.4	94.0	98.1	58.2	68.8	67.0
..Fruit and vegetable juices, kt	56.9	36.9	30.0	29.7	53.8	38.4	27.9	30.9	33.9
....unconcentrated juices	18.2	16.2	11.5	18.0	27.9	17.7	11.9	18.2	17.5
....concentrated juices	38.7	20.7	18.5	11.7	25.9	20.7	16.0	12.7	16.9
..Canned vegetables, kt	25.5	22.7	33.0	44.4	23.7	41.9	26.5	29.9	26.3
..Processed and canned fruits, kt	16.1	18.6	18.3	17.3	16.5	17.8	3.7	8.0	6.8
Margarine, tonnes	3301.0	3515.0	3390.0	2624.0	2225.0	1944.0	1658.0	1274.0	1119.0
Milk and cream with fat content <6%, kt	16.9	16.0	20.8	50.3	55.3	66.6	61.4	65.1	62.9
Solid milk and cream, tonnes	3709.0	5059.0	4565.0	3806.0	2676.0	2693.0	1821.0	1217.0	625.0
Butter, tonnes	2763.0	3640.0	3393.0	3321.0	3387.0	4338.0	3819.0	4199.0	3878.0
Fat cheese and young sheep cheese, tonnes	1836.0	1904.0	2380.0	2008.0	2035.0	2519.0	1309.0	1779.0	2087.0
Curd, curd cream, yogurt, kefir, sour cream and other fermented products, tonnes	16662.0	17258.0	21032.0	21378.0	23851.0	23934.0	24464.0	25615.0	27314.0
Ice-cream and other ice-forms with or without cocoa, tonnes	8073.0	7287.0	8105.0	8609.0	8228.0	7500.0	6942.0	12491.0	12372.0
Flour, kt	116.7	118.2	144.0	133.5	113.3	122.6	115.6	108.0	116.9
Cereals, kt	3.7	3.6	3.0	4.3	4.7	6.4	7.2	5.6	4.8
Ready-made forage for animals, kt	25.7	43.9	48.8	60.6	42.9	49.1	56.8	71.6	73.3
Bread and bakery foods, kt	105.2	109.7	108.4	112.3	122.8	137.5	130.6	129.0	130.0
..Fresh bread	102.7	107.2	105.7	108.8	119.4	133.7	126.7	124.3	125.8
..Other bakery products	2.5	2.5	2.7	3.5	3.4	3.8	3.9	4.8	4.2
Flour confectionary, kt	17.0	16.9	19.8	20.8	21.4	22.0	22.9	26.9	28.3
Sugar, kt	107.1	110.9	133.5	149.0	74.0	134.0	38.4	103.2	88.4
Molasses, kt	29.8	42.9	42.2	42.3	24.9	34.5	23.3	36.2	35.2
Sugar confectionery, kt	11.9	11.1	12.3	12.2	13.2	13.8	12.6	12.9	13.0
Macaroni, kt	7.7	8.8	7.8	7.2	6.9	5.7	6.1	6.3	6.5
Mayonnaise and other emulsified sauces, tonnes	2876.0	2647.0	2578.0	2141.0	1768.0	1066.0	827.0	540.0	466.0
Cognac (Divine), thous. dal	661.1	812.0	1189.8	560.4	504.6	701.3	443.9	438.8	595.2
Vodka and liqueurs, thous. dal	1845.9	2016.1	2251.6	1791.5	1477.6	1066.1	904.0	966.1	979.6
Sparkling wine, thous. dal	739.0	938.0	1051.0	402.0	541.0	572.0	500.0	556.0	686.0
Natural grape wine, mill. dal	19.1	33.1	36.3	19.3	12.3	15.4	12.5	12.7	12.5
Porto, Madeira, Sheary, Tokay wine and other, thous. dal	2899.1	3017.8	3237.9	1336.9	752.6	921.8	692.5	1051.1	1111.6
Mineral and carbonated waters, mill. dal	6.2	7.5	9.6	10.6	12.9	12.3	11.1	11.6	10.8
Soft beverages, mill. dal	6.0	6.5	6.4	7.5	9.4	7.7	6.0	6.5	7.2
Fermented tobacco, kt	8.4	7.6	8.2	5.2	4.3	6.3	4.9	7.3	6.5
Fabrics, thous. m^2	162.0	123.0	116.0	107.0	201.0	174.0	111.0	55.0	20.0
Hosiery, thous. pairs	1190.0	988.0	1082.0	1518.0	1428.0	1558.0	1463.0	1288.0	1463.0
Knitwear, mln. pcs	11.4	18.5	17.0	16.5	16.9	19.3	17.6	20.2	17.2
Clothing for work, thous. pcs	1353.5	3343.1	3848.2	4528.0	5659.6	5580.9	4034.3	6190.7	6507.4
Overcoats, raincoats, capes, cloaks, anoraks, thous. pcs	573.8	754.0	938.3	859.9	938.8	791.4	776.0	649.8	616.3
Suits and assemblies, thous. pcs	337.0	394.9	344.4	214.9	435.3	270.0	126.6	97.7	136.8
Coats, jackets and blazers, thous. pcs	623.6	591.6	513.5	709.1	509.0	601.4	565.4	458.4	502.9
Trousers, shorts and overalls, thous. pcs	1649.1	1970.2	2452.3	2840.5	2258.4	1650.6	1529.7	1775.5	1594.6
Dresses and sarafans, thous. pcs	207.0	225.3	121.1	343.1	670.5	1013.1	734.7	798.9	1033.7
Skirts and divided skirts, thous. pcs	622.6	580.4	733.2	636.3	526.4	367.4	377.3	250.4	335.9
Blouses and shirts for women and girls, thous. pcs	524.7	606.3	1983.8	2548.8	1823.8	1939.4	1920.2	1915.7	1822.2
Coffers, suitcases, trunks and similar containers of any material, thous. pcs	293.3	304.6	317.1	312.0	279.2	339.8	137.9	129.2	136.9
Bags for women of any material, thous. pcs	62.9	94.6	98.9	80.3	101.0	154.5	116.9	95.1	131.3
Footwear, thous. pairs	2738.0	3033.0	3650.0	3673.0	3796.0	3832.0	2221.0	2717.0	2845.0
Saw-timber, thous. cubic meters	16.1	23.0	21.7	25.9	29.3	45.3	32.9	24.8	17.2

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Wooden blocks for doors and windows, thous. m^2	39.8	37.1	32.6	33.0	33.7	47.3	40.5	35.8	25.0
Wooden block parquet, thous. m^2	43.9	37.3	98.4	119.1	104.4	60.5	37.0	26.3	23.6
Paper and corrugated paper-board, mill m^2	61.2	60.2	52.3	35.2	30.1	36.2	32.5	35.7	29.3
Books, brochures publishing and similar printed items, thous. pcs	...	37628.5	12363.4	10158.1	18742.0	29906.4	26138.6	9609.7	7760.8
Printing services for newspapers and periodicals, appearing at least four times/week, mill. copies	24.1	36.1	29.9	31.0	32.3	28.9	19.2	16.7	15.5
Copy-books, mill. pcs	7.5	11.1	11.9	11.9	14.3	13.8	9.0	12.7	12.4
Oxygen, thous. cubic meters	1478.0	1546.0	1454.1	1495.5	1459.5	1417.3	1140.5	1788.5	1996.7
Carbon dioxide, tonnes	3471.0	3409.0	3198.0	3227.0	2599.0	2346.0	1691.0	1306.0	1385.0
Paints and varnishes, tonnes	3443.0	5136.0	6269.0	8295.0	10815.0	11557.0	11822.0	12864.0	18011.0
Soap, tonnes	338.6	385.9	317.1	526.0	562.0	399.2	380.3	537.5	485.6
Washing and cleaning products, tonnes	243.0	493.0	533.0	769.0	1034.0	451.0	482.0	618.0	752.0
Natural essential oil, tonnes	11.3	45.4	62.5	66.9	41.5	72.4	46.0	67.9	50.9
Plastic tubes and pipes, tonnes	389.0	494.1	714.0	2338.7	2135.3	1553.1	1577.5	1679.4	2044.8
Boxes, cases, crates and similar plastic products, tonnes	392.3	284.9	944.7	1218.7	667.7	554.5	469.6	298.3	160.3
Plastic windows, doors, stained windows and their frames, thous. m^2	50.5	94.3	129.8	176.6	255.3	289.1	211.4	291.9	269.3
Glass windows, thous. m^2	9.9	10.1	9.8	11.0	12.9	12.5	11.3	10.8	11.7
Canning jars for sterilization, mill. pcs	107.4	98.9	103.1	121.3	98.7	80.7	92.2	99.7	48.2
Glass Bottles and vials, mill. pcs	281.4	308.0	354.6	321.4	302.7	284.7	201.3	246.2	326.3
Ceramic building bricks for construction, mill. conventional pcs	52.2	54.9	55.7	52.8	55.9	53.0	39.2	38.8	42.5
Dry gypsous mixtures, kt	95.7	90.2	131.5	188.2	331.3	380.4	136.0	142.3	157.9
Prefabricated structural components from cement, concrete or artificial stone for constructions, thous. cubic meters	79.6	100.7	117.2	129.0	137.6	144.3	111.9	122.9	111.4
Grey iron castings, tonnes	2054.7	2114.3	2213.5	1914.0	1877.9	1294.2	783.9	874.7	1008.8
Steel castings, tonnes	160.8	190.6	173.3	222.2	124.6	108.5	30.6	59.1	73.3
Light non-ferrous metal castings, tonnes	102.2	40.7	7.8	8.0	7.6	7.6	5.7	6.1	11.8
Doors, windows and their frames, thresholds, windowsills from ferrous metal, tonnes	237.6	386.4	191.1	240.2	386.1	380.3	300.5	295.8	436.0
Doors, windows and their frames, thresholds, windowsills from aluminium, tonnes	564.8	1197.0	1667.1	1461.0	1057.0	1560.5	3930.6	5132.1	4908.2

Source: National Bureau of Statistics, <http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=IND0301&ti=Productia+principalelor+produse+industriale%2C+1997-2011&path=../Database/RO/14%20IND/IND03/&lang=1>.

canning of meet and meat products – by 14.7 per cent; dairy products – by 7.2 per cent; production of medical equipment and instruments, precision and optical equipment – by 6.8 per cent; textiles – by 4.4 per cent; spirits production – by 3.4 per cent; chemical industry – by 2.6 per cent; production of other non-ferrous mineral products – by 2.0 per cent.

Energy Industry. In 2011, the energy sector enterprises accounted for approximately 15.7 per cent of the total production of the large enterprises where industrial manufacture was the main business. These enterprises generated the sales of circa 5.374 billion MDL (in current prices), 9.9 per cent more than in 2010. In 2012, the production decreased by 4.4 per cent compared to the level recorded in the preceding year, including in such sectors as: steam and hot water supply – by 5.3 per cent, electricity generation and distribution – by 3.7 per cent, which motivated the decrease of the overall production index within the industry sector.

Brief Description of the Energy System of the Republic of Moldova

In the Republic of Moldova electricity generation capacity include: Moldovan Thermal Power Plant (MTPP) from Dnestrovsk (on the left bank of the Dniester) with an installed capacity of 2,520 MW, operating on natural gas, residual fuel oil and coal, built between 1964-1982; CHP-2 Chisinau, with an installed capacity of 240 MW (available 210 MW) and 1,200 Gcal/h heat capacity, built between 1976-1980; CHP-1 Chisinau, with an installed capacity of 66 MW (available 40 MW) and 254 Gcal/h heat capacity, built between 1951-1961; CHP-North Balti, with an installed capacity of 28.5 MW (available 24 MW) and 200 Gcal/h heat capacity built in during 1956-1970; HPP Dubasari on the river Dniester with an installed capacity of 48 MW (30 MW available), 75 per cent overused degree, built between 1954-1966; HPP Costesti on the river Prut, with an installed capacity of 16 MW (10 MW available), 67 per cent overused degree, built in 1978; other power plants, including nine CHP owned by sugar plants with an installed capacity of 97.5 MW operating on natural gas and residual fuel oil, built during 1956-1981.

Of relatively high total nominal capacity (2,996.5 MW) it can be used only about 346 MW in cogeneration regime in Chisinau and Balti and in the hydro base, respectively, it is used only about half of the MTPP capacity (in particular, due to difficult trading conditions). Most (stabilized at around 76-79% during 2007-2010) of the electricity consumption of the country is covered by MTPP and imports from Ukraine.

It should be noted, however that between 1990-2011 electricity generation registered a decrease of 63.1 per cent in terms of physical volumes, while electricity consumption decreased by 53.3 per cent (Table 1-22).

The power transmission system operator Moldelectrica SOE manages the internal transport network on the right bank of the Dniester River, including 5,977.5 km transmission lines of 400, 330, 110kV, and 25,877.4 km radial lines of 35 and 6-10 kV. Interconnections include 7 lines of 330kV and 11 lines of 110kV with Ukraine, 3 lines of 110kV and just one line of 400kV with Romania and from there, with Bulgaria.

The RM's electricity system operates synchronously with the IPS / UPS system and in island mode only with Romania. While currently, the connection with Ukraine is entirely used, a large volume of the use is the maximum security transit, operation of the connection with Romania offers a reduced transborder exchange, as well as a low supply security.

In 2000, the Republic of Moldova privatized a large part of the distribution sector (approximately 70%), that including three of the five power distribution units, which, subsequently, merged in the ICS RED "Union Fenosa" J.S.C., while the other two remained state-owned enterprises: J.S.C "RED North" and "RED North-West" J.S.C. On the left bank of the Dniester River the service is provided by "RED East" J.S.C. and "RED South-East".

Public Electricity Generation

The energy system of the Republic of Moldova owns only one Thermal Power Plant (TPP) situated in Dnestrovsk on the left bank of the Dniester. The TPP is equipped with eight energy groups on coal, with an electric power of 200 MW (in service from 1964-1971, of which only five are currently operational energy groups; during 1999-2007 none was working), 2 energy groups on residual fuel oil and natural gas with an electric power of 210 MW (in service since 1973-1974, both operational) and two energy groups on natural gas, operating on gas-steam combined cycle, with an installed capacity of 250 MW each (in service since 1980, both operational).

The technological processes used by MTPP are based on the classical cycle of steam turbines with condensation and involve combusting fossil fuels for electricity generation, heat production representing only a secondary process. Electricity generation decreased by 3 times between 1990-2010 years at MTPP (Table 1-23).

When the Russian Federation increased the price for imported natural gas, MTPP changed its tariff policy, increasing the price of electricity supplied to the Republic of Moldova.

In this context, from November 2005 through September 2009, the Republic of Moldova has stopped buying electricity from MTPP, opting for cheaper electricity imports from Ukraine. The lack of demand during 09.11.2005-11.01.2007 forced the MTPP to use just one energy unit that operated by gas-steam combined cycle based on natural gas consumption.

Between 1996-2011 years the annual production of electricity on the left bank of the Dniester (MTPP from Dnestrovsk and HPP Dubasari) varied between 1.6-5.2 billion kWh,

Table 1-22: Electricity Balance within the National Economy in 1990-2011, billion kWh

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Generation	15.690	13.154	11.248	10.376	8.308	6.168	6.240	5.375	4.841	4.110	3.624
Imports	4.489	4.457	4.609	5.029	4.582	4.324	3.937	3.523	3.376	2.665	2.482
Consumption	11.426	10.839	10.022	8.569	4.350	7.022	6.686	6.133	5.351	4.715	4.620
Exports	7.532	5.600	4.636	5.777	0.265	2.235	2.254	1.587	1.665	0.878	1.172
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Generation	4.912	4.408	4.062	4.179	4.225	2.835	3.857	4.035	6.196	6.012	5.785
Imports	2.138	2.899	4.512	4.180	3.633	3.163	2.934	2.969	2.946	3.038	3.145
Consumption	4.705	5.309	6.452	6.025	5.838	5.485	5.684	5.732	5.302	5.257	5.334
Exports	1.467	1.615	1.826	1.844	1.547	0.052	0.636	0.793	3.358	3.391	3.023

Source: Statistical Yearbooks of the RM for 1994 (page 272), 1999 (page 311), 2003 (page 400), 2006 (page 319), 2009 (page 313), 2012 (page 317); Statistical Yearbooks of the ATULBD for 2000 (page 99), 2006 (page 93), 2009 (page 92), 2010 (page 93), 2011 (page 94), 2012 (page 98).

Table 1-23: Electricity Generation at MTPP in 1990-2011, billion kWh

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Electricity Generation	13.569	11.223	9.468	8.626	6.836	4.747	4.560	3.629	3.296	2.687	2.463
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Electricity Generation	3.366	2.942	2.793	2.891	2.701	1.374	2.489	2.631	4.863	4.619	4.494

Source: S.O.E. „Moldelectrica".

of which about 40-60% was exported to Moldova and the southern regions of Ukraine (Table 1-24).

At the beginning of 2007, MTPP exported electricity to Belarus and the Russian Federation, but as a consequence of the increased fees adopted by Ukraine for electricity transit on its territory, the export of electricity was reoriented to Romania. Exports of energy take place through interconnection power transmission lines of 110 kW and 400 kW: MTPP (ATULBD)-Vulcanesti (RM) and Vulcanesti (RM)-Isaccea (Romania). The long-term strategy of the Russian company Inter RAO EES is to create operating conditions for the plant to a capacity of at least 1500 MW, providing energy exports to the Balkans countries, over 6.0 billion kWh annually. In order to achieve modernization plans, during 2005-2011, the Russian company has invested about 100 million USD in upgrading MTPP.

Public Combined Heat and Power Generation

Currently, on the right bank of the Dniester there are three Combined Heat and Power Plants (CHP): in Chisinau municipality the CHP-1 and the CHP-2, and in Balti municipality: the CHP–North. Also, there are some small power plants with cogeneration at sugar plants.

The installed capacity of cogeneration power plants on the right bank of the Dniester River is only about 14 per cent of the total installed capacity of power plants in the Republic of Moldova. Unlike the overall territory of the country, the right bank of Dniester River is deficient in terms of installed capacity for electricity generation. Of the total nominal installed capacity on the right bank of Dniester River, the largest share has CHP-2 in Chisinau, about 55 per cent of the total, followed by CHP-1 in Chisinau, with a share of about 14% and CHP-North in Balti, with a share of about 7%. Total nominal installed capacity in this region covers only around 30 per cent of the electricity needs.

Total production of electricity on the right bank of Dniester River decreased from approximately 1.901 billion kWh in 1990 to about 1.016 billion kWh in 2011 (Table 1-25), which indicates that the installed capacity of power generation in this region is used inefficiently. In the context of increasing trend of electricity consumption in the last period, this is a negative factor, inclusive from the energy security point of view.

Public Heat Generation

There are several Heat Plants (HPs) in the Republic of Moldova, mainly operating on natural gases and residual fuel oil, less on coal and biomass. The amount of fuel consumption is accounted in the Energy Balances of the Republic of Moldova. Between 1990-2011, the total amount of heat produced in the Republic of Moldova decreased by circa 80.3 per cent, from 22.212 million Gcal in 1990 to 4.376 million Gcal in 2011 (Table 1-26).

Table 1-24: Electricity Generation in ATULBD in 1996-2011

	1996	1997	1998	1999	2000	2001	2002	2003
Electricity Generation, bill. kWh, including at:	4.840	3.924	3.593	2.973	2.720	3.649	3.228	3.016
HPP Dubasari, bill. kWh	0.279	0.295	0.297	0.286	0.257	0.283	0.286	0.223
MTPP Dnestrovsk, bil. kWh	4.560	3.629	3.296	2.687	2.463	3.366	2.942	2.793
Electricity Imports in ATULBD, bill. kWh	0.000	0.000	0.000	0.003	0.000	0.000	0.285	0.921
Electricity consumption in ATULBD, bill. kWh	2.589	2.364	1.929	2.098	2.100	2.183	1.899	2.112
Electricity exports from ATULBD, bill. kWh	2.250	1.560	1.665	0.878	0.620	1.467	1.615	1.826
	2004	2005	2006	2007	2008	2009	2010	2011
Electricity Generation, bill. kWh, including at:	3.157	2.996	1.643	2.757	2.939	5.165	4.947	4.770
HPP Dubasari, bill. kWh	0.266	0.295	0.269	0.268	0.307	0.303	0.328	0.276
MTPP Dnestrovsk, bil. kWh	2.891	2.701	1.374	2.489	2.631	4.863	4.619	4.494
Electricity Imports in ATULBD, bill. kWh	0.812	0.659	0.276	0.000	0.000	0.002	0.000	0.000
Electricity consumption in ATULBD, bill. kWh	2.124	2.108	1.899	2.134	2.151	1.815	1.670	1.763
Electricity exports from ATULBD, bill. kWh	1.844	1.547	0.052	0.636	0.793	3.358	3.391	3.023

Source: Statistical Yearbooks of the ATULBD 2000 (pages 99, 101, 175, 183), 2006 (pages 93, 95, 173, 179), 2009 (pages 92, 94, 169, 175), 2010 (pages 93, 96, 167, 173), 2011 (pages 94, 97, 171, 177), 2012 (pages 98, 101, 175, 181).

Table 1-25: Electricity Generation on the Right Bank of Dniester River in 1990-2011, billion kWh

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Electricity Generation	1.901	1.655	1.581	1.442	1.240	1.181	1.400	1.451	1.248	1.137	0.904
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Electricity Generation	1.263	1.180	1.046	1.022	1.229	1.192	1.100	1.097	1.031	1.064	1.016

Source: National Bureau of Statistics, Statistical Yearbooks for 1994 (page 272), 1999 (page 311), 2003 (page 400), 2006 (page 319), 2009 (page 313), 2012 (page 317).

Table 1-26: Heat Generation in the Republic of Moldova, 1990-2011, million Gcal

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Heat Generation	22.212	16.896	12.423	10.208	7.507	7.278	7.665	7.126	7.371	5.650	3.846
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Heat Generation	4.375	4.417	4.605	4.347	4.830	5.043	4.508	4.683	4.075	4.488	4.376

Source: Energy Balances of the Republic of Moldova, 1990-2011; Statistical Yearbooks of the ATULBD: 2000 (page 99), 2006 (page 93), 2009 (page 92), 2010 (page 93), 2011 (page 94), 2012 (page 98).

Table 1-27 provides data regarding heat generation on the right bank of Dniester. As can be noted, about 65.4 per cent of the total heat generated was produced by combined heat and power plants (CHP), while 34.5 per cent was produced by heat plants (HP).

For the right bank of the Dniester River it is characteristic a decreasing tendency of heat generation – during 1997-2011, the decrease represented about 51.0 per cent (from 6.590 million Gcal in 1997 to 2.721 million Gcal in 2011), while for the left bank of the Dniester River it was revealed a reversed tendency, compared to the production level recorded in 1997 (0.536 million Gcal), in 2011 it was produced by 3.1 times more heat (1.655 million Gcal).

Mining and Quarrying. In 2011, the extractive industry enterprises account for about 1.7 per cent of the total production of large enterprises whose main business is manufacturing. These enterprises generated the sales of circa 574.9 million MDL (in current prices), 23.2 per cent more than in 2010, while in 2012, the production exceeded by 0.8 per cent the level recorded in the preceding year.

1.6.2. Agricultural Production

The 2012 agricultural production data show a decrease by 22.4 per cent as compared to 2011 (Table 1-29, Figure 1-11), driven by the extremely unfavourable weather conditions in

Table 1-27: Heat Generation on the Right Bank of Dniester River, thousand Gcal

	1990	1993	1994	1995	1996	1997	1998	1999	2000	2001
Heat, including:	22.212	10.208	7.507	7.097	7.077	6.590	6.120	4.647	3.057	3.298
From CHP	7.220	4.657	3.641	3.528	3.659	3.294	3.127	2.534	1.847	2.113
From HP	14.802	5.542	3.862	3.568	3.417	3.296	2.991	2.113	1.207	1.183
From Other Plants	0.190	0.009	0.003	0.001	0.001	0.000	0.002	0.000	0.003	0.002
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Heat, including:	3.217	3.347	3.347	3.591	3.552	3.094	3.074	2.638	2.874	2.721
From CHP	2.128	1.922	1.922	2.140	2.165	1.855	1.939	1.647	1.874	1.780
From HP	1.087	1.423	1.423	1.451	1.358	1.386	1.133	0.990	1.000	0.940
From Other Plants	0.002	0.002	0.002	-	0.001	0.001	0.002	0.001	-	0.001

Source: Energy Balances of the Republic of Moldova, 1990-2011.

Table 1-28: Production of Main Industrial Products by the RM's Mining and Quarrying Industry in 2003-2011

	2003	2004	2005	2006	2007	2008	2009	2010	2011
Calcareous monumental or building stone, alabaster, thousand m³	270.3	261.7	271.7	293.3	323.8	300.0	226.5	196.9	198.6
Other monumental or building stone, thousand m³	137.8	137.7	190.5	211.0	191.8	187.5	181.3	150.2	231.4
Sand, thousand m³	559.7	832.2	790.3	721.4	1076.9	1110.7	782.4	881.4	927.0
Road-metal, gravel, boulders and silex, thousand m³	770.4	938.7	1085.1	1406.4	1421.1	1597.4	1048.2	1265.8	1620.1
Sand-gravel mixture, thousand m³	52.3	47.8	101.2	196.6	187.5	138.7	98.9	179.0	447.5

Source: National Bureau of Statistics,< http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=IND0301&ti=Productia+principalelor+produse+industriale%2C+1997-2011&path=../Database/RO/14%20IND/IND03/&lang=1>.

Table 1-29: RM's Agricultural Production in1990-2011

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Production, bill. MDL	6.100	11.300	97.300	1.067	3.212	4.243	4.639	5.100	4.775	6.396	8.268
% compared to 1990	100.0	88.9	76.0	83.9	63.3	64.5	56.8	63.3	55.9	51.2	49.5
Production, bill. US $				0.796	0.790	0.944	1.008	1.103	0.889	0.609	0.665
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Production, bill. MDL	8.646	9.474	10.354	11.819	12.688	13.734	12.825	16.503	13.300	19.873	22.619
% compared to 1990	52.7	54.5	47.1	56.9	57.3	56.7	43.6	57.6	52.1	56.2	59.0
Production, bill. US $	0.672	0.698	0.743	0.959	1.007	1.046	1.056	1.588	1.197	1.607	1.927

Source: Ministry of Economy, Department of Macroeconomic Analysis and Forecasts (November 2012).

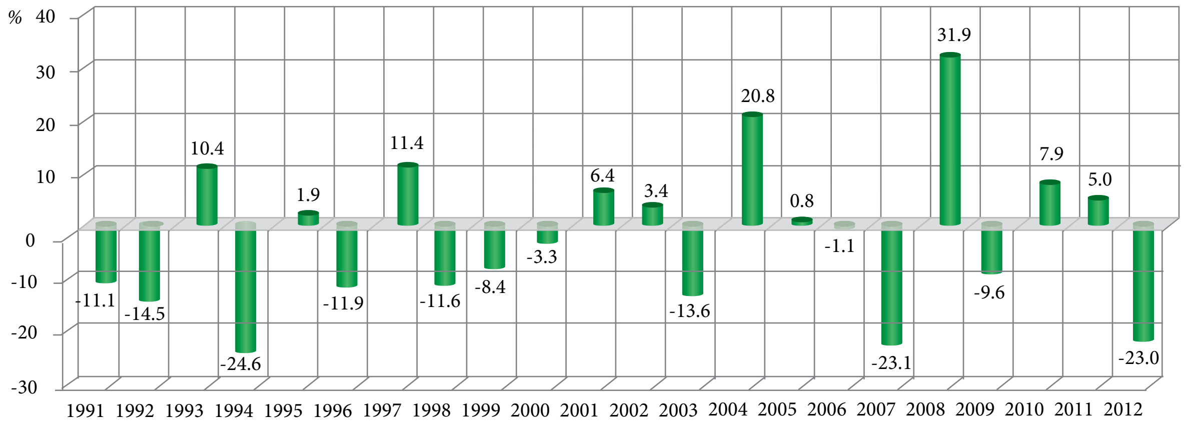


Figure 1-11: Dynamics of Agricultural Production over 1991-2012, % compared to the preceding year

the year under review (one of the most disastrous droughts in the nation's history).

The agricultural production over 1991-2011 was characterized by fluctuations, with the best performance reported in 1993, 1997, 2004 and 2008, and with poor results – respectively in 1992, 1994, 1996, 1998, 2003, 2007 and 2012.

The 2012 agricultural production by all categories of producers totalled 12.263 billion MDL in current prices, representing 77.6 per cent compared to 2011 level and only 45.4 per cent of the 1990 level. The decrease of global agricultural production was determined by the sharp decline in crop production (by 32.6 per cent) and livestock (by 1.1 per cent), due to severe weather conditions (drought).

To be noted that over the period from 1990 through 2011, the gross harvest of some agricultural crops significantly decreased in the Republic of Moldova, including: winter and spring wheat – by 17.5 per cent, winter and spring barley – by 50.2 per cent, leguminous crops – by 66.0 per cent, sugar beet – by 71.9 per cent, tobacco – by 89.6 per cent, vegetables – by 66.2 per cent, forage roots – by 94.6 per cent, maize for silo and green fodder – by 98.2 per cent, fruits, berries and walnuts – by 57.6 per cent, grapes – by 34.7 per cent (Table 1-30).

Table 1-30: Gross Harvest of Agricultural Crops in the RM in 1990-2011, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cereals and leguminous crops – total	2538.6	3105.9	2099.8	3340.2	1753.8	2638.6	1981.2	3512.3	2751.9	2375.0	2070.2
...Wheat	1129.0	1056.5	925.7	1392.5	658.8	1277.2	784.2	1344.7	1104.7	922.4	813.0
...Barley	417.9	427.0	405.0	481.0	324.9	311.3	136.7	256.9	241.9	203.1	152.3
...Leguminous crops	97.1	105.7	121.8	121.6	70.2	55.5	31.6	63.2	76.9	61.6	30.9
...Grain maize	885.5	1501.2	635.4	1324.5	629.3	949.2	1008.6	1791.2	1272.7	1151.3	1050.4
Technical crops											
...Sugar beet	2374.5	1988.6	1784.0	1845.4	1526.7	1916.6	1749.4	1842.4	1524.6	1164.3	1115.1
...Sun flower	252.2	151.4	176.2	173.7	149.2	326.8	343.1	263.6	237.9	287.8	307.6
...Soybeans	23.8	33.4	7.9	9.3	4.0	28.9	37.9	25.3	28.7	47.2	48.1
...Tobacco	66.2	62.8	45.0	50.2	41.5	27.0	19.5	23.6	24.5	22.4	25.3
...Grain rapeseed	-	-	-	-	-	12.7	31.8	145.0	145.0	175.4	96.3
Potatoes, vegetables and melons & gourds											
...Potatoes	295.3	290.6	310.8	725.9	474.7	426.3	386.7	430.0	436.6	372.5	361.0
...Vegetables	1177.3	989.2	787.5	777.2	598.5	566.4	362.4	393.6	565.6	531.8	395.0
...Melons and gourds	34.4	35.6	9.3	18.6	12.6	24.3	24.2	31.8	25.8	33.1	30.3
Forage crops											
...Forage roots	1171.8	1416.4	922.5	988.6	547.0	545.6	336.5	310.2	255.2	157.6	117.1
...Maize for silo and green fodder	4509.0	4979.1	3025.8	3358.7	2286.0	1766.2	1212.3	1064.9	653.0	299.5	211.6
Fruits, berries and walnuts	901.1	698.0	511.0	1190.3	707.0	588.7	556.9	1050.2	398.9	138.1	263.7
Grapes	939.7	774.0	824.0	933.4	674.4	861.9	776.1	301.8	344.3	468.9	712.0

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cereals and leguminous crops – total	2823.6	2791.2	1654.4	3178.0	2954.3	2371.2	932.5	3261.6	2277.4	2617.5	2737.2
...Wheat	1314.0	1254.4	103.4	943.9	1120.4	721.0	430.5	1345.8	807.1	871.4	931.7
...Barley	246.9	241.7	74.4	284.1	226.7	214.6	125.7	362.3	272.9	226.2	208.1
...Leguminous crops	79.1	50.2	30.2	51.0	66.4	68.4	14.4	38.0	30.3	39.7	33.0
...Grain maize	1134.3	1206.3	1440.2	1845.1	1502.7	1327.6	363.2	1484.1	1145.4	1453.7	1535.3
Technical crops											
...Sugar beet	1228.5	1238.0	721.3	930.9	1013.3	1193.9	616.5	981.3	353.9	903.1	666.4
...Sun flower	287.3	345.5	393.5	335.2	336.1	379.9	155.5	371.9	284.3	382.3	427.4
...Soybeans	30.6	36.0	50.8	59.8	82.2	96.0	43.0	73.4	58.9	157.4	136.0
...Tobacco	16.1	11.8	6.9	7.9	7.2	5.2	3.8	4.5	5.2	9.7	6.9
...Grain rapeseed	90.6	57.9	30.1	1.0	3.0	7.0	34.2	95.4	69.1	36.7	52.0
Potatoes, vegetables and melons & gourds											
...Potatoes	409.0	337.1	313.7	331.2	394.8	392.3	204.1	284.1	271.5	297.1	378.4
...Vegetables	473.3	409.8	373.2	333.2	417.0	498.3	228.3	392.1	319.9	364.5	398.1
...Melons and gourds	38.8	29.2	72.0	61.0	59.0	99.1	42.5	72.5	103.1	108.3	92.6
Forage crops											
...Forage roots	180.4	195.0	149.2	120.0	94.8	74.6	32.6	50.1	38.2	77.6	63.1
...Maize for silo and green fodder	306.7	322.8	327.9	219.9	178.9	153.8	104.6	113.0	95.7	95.2	83.2
Fruits, berries and walnuts	332.4	245.6	655.2	438.9	390.1	332.3	280.4	372.8	308.7	323.7	381.6
Grapes	508.8	645.7	681.6	689.1	519.4	467.3	601.1	643.2	694.0	486.9	613.5

Source: National Bureau of Statistics, <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>. Statistical Yearbooks for ATULBD: 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 98), 2010 (page 100), 2011 (page 101), 2012 (page 105).

At the same time, in several sectors the production increased, including: grain maize – by 69.5 per cent, soybeans – by 471.5 per cent, potatoes – by 28.1 per cent and melons & gourds – by 169.2 per cent. However, these positive results are due, in particular, to the expansion of sown areas and less to the crop yields increase (Table 1-31).

Phytotechny. The study regarding the influence of production type on the rhythm of crop yields decrease for 2012, compared to the preceding year, reveals that a significant negative influence was due to the decrease of production of cereals and leguminous crops – by 51 per cent (including wheat – by 38 per cent, grain maize – by 61 per cent), potatoes – by 48 per cent, vegetables – by 37 per cent, sun flower – by 31 per cent, grain rapeseed – by 89 per cent, rapes – by 15 per cent, etc.

In 2012, the share of crop yields in total agricultural production represented 59 per cent (68 per cent in 2011), of which: cereals and leguminous crops – 11.6 per cent (18.4 per cent in 2011), technical crops – 10.3 per cent (12.0 per cent in 2011), potatoes, vegetables and melon & gourds – 10.0 per cent (13.6 in 2011), fruits, berries and walnuts – 5.0 per cent (4.3 per cent in 2011), grapes – 15.8 per cent (14.4 per cent

Table 1-31: Average Yield per Hectare of Agricultural Crops in the RM in 1990-2011, t/ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cereals and leguminous crops – total	3.4	3.7	2.8	3.7	2.1	2.9	2.2	3.3	2.6	2.3	1.9
...Wheat	3.9	3.5	3.3	4.0	2.2	3.2	2.1	3.3	2.7	2.4	1.9
...Barley	3.5	3.2	3.3	3.5	2.2	2.3	1.3	2.0	1.8	1.6	1.2
...Leguminous crops	1.3	1.4	1.7	1.7	1.1	1.0	0.7	1.4	1.3	1.0	0.6
...Grain maize	3.4	4.8	2.4	3.9	2.2	3.0	2.9	4.0	3.1	2.8	2.3
Industrial crops											
...Sugar beet	29.1	24.9	21.6	22.2	18.4	18.7	16.9	19.3	15.0	12.9	12.1
...Sun flower	1.9	1.2	1.3	1.4	1.1	2.3	1.7	1.5	1.2	1.3	1.4
...Soybeans	0.9	1.4	0.5	1.0	0.7	8.5	15.8	10.5	4.4	2.7	4.1
...Tobacco	2.1	1.9	1.6	1.6	1.5	1.4	1.2	1.4	1.1	1.2	1.1
...Grain rapeseed	2.0	2.0	1.6	1.2	1.0	0.8	0.7	1.0	0.9	1.7	1.0
Potatoes, vegetables and melons & gourds											
...Potatoes	7.2	6.2	5.6	10.2	7.6	7.5	6.5	6.9	7.0	5.6	5.5
...Vegetables	16.6	12.7	10.7	10.6	8.8	9.4	7.0	7.3	11.5	11.1	7.9
...Melons and gourds	3.7	4.5	1.3	3.1	2.5	0.4	0.4	0.6	0.5	0.6	0.6
Forage crops											
...Forage roots	44.4	47.2	31.8	35.3	22.8	20.4	16.1	17.0	14.4	7.9	7.3
...Maize for silo and green fodder	15.4	16.5	10.1	15.6	8.6	9.7	6.7	10.8	6.7	4.8	4.3
Fruits, berries and walnuts	3.9	2.9	2.1	4.3	2.8	2.8	2.8	5.6	2.3	0.8	1.7
Grapes	4.7	3.9	4.3	4.7	3.5	4.5	4.2	1.7	2.0	3.0	4.7
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cereals and leguminous crops – total	2.4	2.4	1.8	2.8	2.7	2.5	0.9	3.2	2.3	2.6	2.8
...Wheat	2.7	2.5	0.5	2.8	2.6	2.3	1.3	3.1	2.1	2.4	2.7
...Barley	2.2	1.8	0.8	2.0	1.7	1.7	0.9	2.6	1.6	1.5	1.8
...Leguminous crops	1.5	0.8	0.6	1.3	1.6	1.6	0.4	1.3	0.9	1.0	1.1
...Grain maize	2.3	2.7	2.5	3.1	3.3	2.9	0.8	3.5	2.8	3.4	3.3
Industrial crops											
...Sugar beet	14.4	16.8	10.8	16.2	20.5	21.8	14.8	27.4	11.0	16.9	11.5
...Sun flower	1.4	1.3	1.1	1.2	1.2	1.3	0.7	1.6	1.2	1.5	1.5
...Soybeans	3.2	3.5	2.8	2.1	2.3	1.7	0.9	2.4	1.2	2.7	2.3
...Tobacco	1.0	1.3	1.2	1.4	1.5	1.4	1.0	0.9	0.8	0.8	0.4
...Grain rapeseed	0.9	1.0	1.0	1.0	1.5	1.0	0.8	1.9	1.2	0.9	1.1
Potatoes, vegetables and melons & gourds											
...Potatoes	9.5	7.4	8.1	9.5	11.0	11.4	5.8	9.1	9.6	10.7	12.9
...Vegetables	7.6	7.5	8.9	9.1	11.1	11.6	6.0	9.8	9.1	9.6	11.5
...Melons and gourds	0.9	0.7	1.8	2.1	2.8	4.7	2.8	4.6	6.2	5.8	5.9
Forage crops											
...Forage roots	25.1	25.3	18.4	22.2	28.7	19.1	12.7	16.1	18.1	19.9	37.7
...Maize for silo and green fodder	7.8	9.2	7.4	8.9	11.2	9.9	4.2	11.0	9.5	9.5	8.6
Fruits, berries and walnuts	2.4	1.8	5.2	3.6	3.3	2.8	2.3	3.1	2.5	2.6	3.1
Grapes	3.2	4.2	4.5	4.7	3.5	3.1	4.0	4.3	4.6	3.3	4.3

Source: National Bureau of Statistics, <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>; Statistical Yearbooks of the ATULBD 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 99), 2010 (page 101), 2011 (page 102), 2012 (page 106).

in 2011). In 2012, the agricultural enterprises have the main share in the production of sugar beet – 89 per cent, grain rapeseed – 87 per cent, tobacco – 70 per cent, cereals and leguminous crops (only maize) – 74 per cent, soybeans – 72 per cent and sun flower – 70 per cent from the total. Farm households have the main share in the production of vegetables – 76 per cent, potatoes – 67 per cent, maize – 46 per cent and grapes – 42 per cent from the total, while peasant (family) farms have the main share in the production of melon & gourds – 58 per cent and fruits and berries – 43 per cent from the total.

Over the 1990-2011 time periods, there was a significant reduction, by circa 86.7 per cent and respectively by 99.7 per cent, of the amount of synthetic and organic fertilizers applied to soils in the RM (Table 1-32). On average, about 20 kg of synthetic fertilizer were applied per one hectare of sown fields, recalculated to 100 per cent nutrients (active substance – a.s.), compared to 134 kg applied in 1990 (by 85.4 per cent less). As for the organic fertilizers, about 20 kg were applied per one hectare, compared to 5.6 tonnes in 1990.

The 2012 in agricultural enterprises and farm households there were introduced about 43.7 kg of synthetic fertilizers (recalculated to 100 per cent a.s.), respectively 30 kg of organic fertilizers per one hectare of sown fields. During the year under review, per one hectare of sown fields were used: 1.70 kg of insecticides, 3.42 kg of fungicides, 2.45 kg of herbicide, 1.94 kg of organic products and 2.68 kg of other phytosanitary products.

Livestock. In 2012, the share of livestock production represented 41 per cent of the total agricultural production (32 per cent in 2011), of which: livestock and poultry – 24.8 per cent (18.7 per cent in 2011), milk – 11.2 per cent (9.2 per cent in 2011), eggs – 4.2 per cent (3.6 per cent in 2011). Compared to the preceding year, milk and egg production decreased for all categories of producers by 5.7 per cent and by 10.2 per cent respectively (in farm households milk production decreased by 6.1 per cent, while egg production – by 16.0 per cent). Over the 1990-2011 time periods, the livestock production significantly decreased in the RM, including cattle and poultry sold for slaughter (in live weight) – by 69.5 per cent, milk yield – by 64.5 per cent, egg production – by 37.5 per cent and wool production – by 32.8 per cent (Table 1-33). The largest share of livestock products are produced in farm households (milk – 97.0 per cent, cattle and poultry breeding – 71.6 per cent, eggs – 61.5 per cent). As of January 1, 2013, these farms accounted for: 98.0 per cent of the total sheep and goats, 94.1 per cent of cattle (including 96.6 per cent of cows), and 67.5 per cent of pigs.

Table 1-32: Applied Synthetic and Organic Fertilizers in the RM in 1990-2011, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Synthetic fertilizer (a.s.), kt	**232.4**	**191.4**	**127.6**	**44.9**	**20.0**	**12.5**	**14.3**	**12.1**	**10.3**	**6.1**	**10.3**
nitrogen	92.1	82.7	61.8	26.4	14.1	10.5	13.2	11.4	10.2	5.9	10.2
phosphorus	85.7	75.2	43.4	12.7	8.0	1.4	0.7	0.5	0.1	0.1	0.1
potassium	54.6	33.5	22.4	5.8	1.6	0.6	0.3	0.2	0.0	0.0	0.0
On average kg/1 sown ha	134	111	75	25	12	7	8	7	6	4	6
Organic fertilizer, kt	**9740.0**	**8600.0**	**5300.0**	**4200.0**	**1620.0**	**1779.2**	**905.7**	**352.9**	**227.3**	**122.1**	**83.3**
On average kg/1 sown ha	5620	5009	3097	2360	944	1031	527	204	132	73	49
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Synthetic fertilizer (a.s.), kt	**12.8**	**18.4**	**15.4**	**17.5**	**18.1**	**16.6**	**22.4**	**24.7**	**19.9**	**25.5**	**30.9**
nitrogen	12.7	18.0	14.6	16.1	16.1	13.8	18.8	21.9	17.0	20.6	25.0
phosphorus	0.1	0.3	0.6	1.0	1.5	2.0	2.4	1.7	2.0	3.3	4.0
potassium	0.0	0.1	0.2	0.4	0.5	0.8	1.1	1.1	0.9	1.6	1.8
On average kg/1 sown ha	7	11	10	10	11	11	14	16	13	16	20
Organic fertilizer, kt	**98.2**	**54.2**	**47.3**	**42.2**	**44.2**	**10.5**	**7.9**	**8.0**	**6.9**	**17.7**	**31.5**
On average kg/1 sown ha	57	31	30	25	27	7	5	5	5	11	20

Source: Statistical Yearbooks of the RM for 1988 (page 280), 1994 (page 239), 1999 (page 330), 2003 (page 442), 2006 (page 352), 2011 (page 345) and 2012 (page 348); Statistical Yearbooks of the ATULBD for 1998 (page 230), 2000 (page 107), 2002 (page 111), 2006 (page 108), 2009 (page 107), 2010 (page 109), 2011 (page 110), 2012 (page 114).

Table 1-33: The Main Livestock Products Produced in the RM in1990-2011

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cattle and poultry sold for slaughter (in live weight), kt	530.0	433.0	334.0	228.0	193.0	183.6	173.0	165.6	151.0	151.7	126.0
Milk yield, kt	1503.0	1284.0	1128.0	867.0	805.0	811.1	717.8	630.7	626.3	602.7	576.6
Eggs, million pcs	1129.0	1061.0	813.0	530.0	418.0	515.1	556.3	528.5	547.8	566.2	578.5
Wool, tonnes	3043.0	2869.0	2616.0	2598.0	2812.0	2921.8	2833.2	2731.5	2449.4	2295.9	2079.9
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Cattle and poultry sold for slaughter (in live weight), kt	117.6	122.1	121.4	120.7	122.3	135.3	150.9	108.9	125.3	152.6	161.9
Milk yield, kt	580.6	603.3	585.5	613.3	636.1	603.3	576.8	514.3	543.3	598.4	532.9
Eggs, million pcs	620.2	675.0	622.8	668.7	762.7	765.7	704.4	562.6	640.3	718.6	705.3
Wool, tonnes	2087.1	2083.6	2066.7	2035.0	2085.4	2173.9	2148.2	2022.9	1997.8	2069.5	2045.2

Source: National Bureau of Statistics, <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR03/AGR03.asp>. Statistical Yearbooks of the ATULBD for 2000 (page 116), 2002 (page 120), 2006 (page 111), 2009 (page 110), 2012 (page 117)

Between 1990-2011 time periods, the livestock population related to particular species decreased sharply: cattle – by 78.8 per cent (dairy cows – by 60.3 per cent, other cattle – by 89.8 per cent), sheep – by 42.0 per cent, swine – by 74.5 per cent. At the same time, during the period under review it was reported an increase regarding other species such as: goats – by 235.9 per cent, poultry of all categories – by 40.4 per cent, asses and mules – by 25.0 per cent and horses – by 8.7 per cent (Table 1-34).

1.6.3. Transport and Communication

RM's transport sector is comprised of the following segments: road transportation, railway transport, air transportation and naval transportation.

Road Transportation. The national network of roads has a total length of 10,826 km (including 9,352 km – on the right bank of Dniester, 1,474 km – on the left bank of Dniester; hard-surface roads: 8,827 km – on the right bank of Dniester and 1,430 km - on the left bank of Dniester) (Table 1-35) has the municipality of Chisinau as its principal hub, intersection of the principal national and international roads crossing the country. The roads network is sufficiently developed (the public roads density represents about 320 km/1,000 km^2, while the hard-surface roads - circa 303 km/1,000 km^2), but the state of the roads and the infrastructure in general is deplorable, though in the last five years repairs and restoration of the national road network are being widely performed.

Table 1-34: Total Livestock and Poultry in all Households Categories in the Republic of Moldova in 1990-2011 (as of the end of the year), thousand heads

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cattle	1060.7	1000.5	970.1	882.6	832.0	729.5	646.3	549.7	532.4	482.4	445.4
Cows	395.2	397.1	403.2	401.8	402.6	380.8	355.4	323.7	318.4	306.9	298.5
Other cattle	665.5	603.4	566.9	480.7	429.4	348.7	290.9	226.0	214.0	175.5	146.9
Sheep and goats	1281.9	1288.8	1357.2	1437.0	1501.9	1423.0	1372.4	1235.3	1147.2	1055.5	962.1
Sheep	1244.8	1239.3	1294.3	1362.5	1410.4	1328.2	1273.7	1139.3	1050.5	953.2	850.7
Goats	37.1	49.5	62.9	74.7	91.5	94.7	98.7	95.9	96.7	102.4	111.4
Horses	47.2	48.4	51.4	54.5	58.2	61.6	63.3	65.4	68.5	72.0	76.0
Asses and mules	1.7	1.8	2.1	2.2	2.9	3.2	3.1	3.0	3.2	3.4	3.8
Swine	1850.1	1753.0	1487.4	1082.3	1046.8	1014.6	950.1	797.5	928.0	751.3	492.7
Poultry	24625.0	23715.0	17128.0	12809.2	13448.3	13744.9	12364.9	12363.9	13046.0	13730.1	13624.9
House Rabbits	283.0	250.8	298.5	262.4	237.2	209.3	189.8	176.8	185.9	182.6	161.3
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cattle	453.6	454.7	409.1	359.5	339.8	326.9	253.7	238.4	243.0	236.4	224.4
Cows	300.1	304.8	277.7	249.0	233.1	222.0	180.8	171.8	173.2	166.2	156.6
Other cattle	153.5	149.9	131.5	110.5	106.7	104.9	72.9	66.6	69.8	70.2	67.8
Sheep and goats	971.7	978.4	958.4	959.8	954.3	962.5	866.4	879.5	929.7	921.1	845.8
Sheep	857.0	849.1	834.8	838.1	832.8	848.7	765.5	774.0	816.7	801.1	721.9
Goats	114.6	129.2	123.6	121.7	121.5	113.8	100.9	105.6	112.9	119.5	124.3
Horses	81.6	82.6	81.4	75.8	72.0	69.3	60.5	57.4	56.1	53.8	51.1
Asses and mules	4.3	4.0	4.3	4.0	3.7	3.6	3.1	3.2	2.9	2.8	2.5
Swine	489.2	550.1	476.4	422.3	493.0	568.3	320.8	302.9	403.6	511.7	472.0
Poultry	14730.4	15535.4	16195.5	17883.9	22773.6	23017.2	17544.1	18830.5	22986.6	23811.3	34563.9
House Rabbits	191.4	190.7	205.4	239.1	278.9	326.0	263.4	248.5	274.5	277.0	278.4

Sources: NBS, Statistical Annual Report Nr. 24-agr „Animal Breeding Sector", the number of livestock and poultry in all Households Categories as of 1st of January (annually for 1990-2011 time periods); Statistical Yearbooks of the ATULBD 1998 (page. 224), 2000 (page 114), 2002 (page 118), 2006 (page 109), 2010 (page 110), 2011 (page 111), 2012 (page 115).

Table 1-35: Length and Density of Road Communication Lines by the end of the year in the RM per 1,000 km^2 in1996-2011 time periods

	1996	1997	1998	1999	2000	2001	2002	2003
Public Roads – total, km	10665	10680	10679	10678	10655	10711	10739	10740
On the Right Bank of Dniester, km	9388	9403	9402	9401	9378	9433	9461	9462
On the Left Bank of Dniester, km	1277	1277	1277	1277	1277	1278	1278	1278
With hard surface, km	10152	10143	10142	10141	10003	10059	10101	10102
On the Right Bank of Dniester, km	8929	8920	8919	8918	8780	8835	8877	8878
On the Left Bank of Dniester, km	1223	1223	1223	1223	1223	1224	1224	1224
Density of Public Roads, km/1000 km^2	315.1	315.6	315.5	315.5	314.8	316.5	317.3	317.3
On the Right Bank of Dniester, km	316.2	316.8	316.8	316.7	316.0	317.8	318.8	318.8
On the Left Bank of Dniester, km	306.7	306.7	306.7	306.7	306.7	307.0	307.0	307.0
With hard surface, km/1000 km^2	299.9	299.7	299.7	299.6	295.6	297.2	298.5	298.5
On the Right Bank of Dniester, km	300.8	300.5	300.5	300.5	295.8	297.7	299.1	299.1
On the Left Bank of Dniester, km	293.8	293.8	293.8	293.8	293.8	294.0	294.0	294.0

	2004	2005	2006	2007	2008	2009	2010	2011
Public Roads – total, km	10743	10746	10746	10615	10621	10817	10818	10826
On the Right Bank of Dniester, km	9464	9467	9467	9337	9343	9344	9344	9352
On the Left Bank of Dniester, km	1279	1279	1279	1278	1278	1473	1474	1474
With hard surface, km	10105	10108	10112	10015	10034	10234	10239	10257
On the Right Bank of Dniester, km	8880	8883	8887	8791	8810	8811	8811	8827
On the Left Bank of Dniester, km	1225	1225	1225	1224	1224	1423	1428	1430
Density of Public Roads, km/1000 km^2	317.4	317.5	317.5	313.6	313.8	319.6	319.6	319.9
On the Right Bank of Dniester, km	318.8	318.9	318.9	314.6	314.8	314.8	314.8	315.1
On the Left Bank of Dniester, km	307.2	307.2	307.2	307.0	307.0	353.8	354.1	354.1
With hard surface, km/1000 km^2	298.6	298.6	298.8	295.9	296.5	302.4	302.5	303.0
On the Right Bank of Dniester, km	299.2	299.3	299.4	296.2	296.8	296.8	296.8	297.4
On the Left Bank of Dniester, km	294.3	294.3	294.3	294.0	294.0	341.8	343.0	343.5

Source: Statistical Yearbooks of the RM for 2003 (page 500), 2006 (page 405), 2012 (page 400). Statistical Yearbooks of the ATULBD for 2000 (page 127), 2006 (page 121), 2009 (page 119), 2010 (page 123), 2012 (page 128)

In the RM road transportation is represented by a wide range of transport means: cars, buses and minibuses, trucks, special destination vehicles (ambulances, fire fighting vehicles, hook-and-ladder trucks, mobile cranes and other) (Table 1-36). To be noted that during the period under review the number of special destination vehicles decreased significantly, by 69.2 per cent, while the number of cars increased by 105.6 per cent, buses and minibuses – by 82.2 per cent, and trucks – by 79.1 per cent. The main types of fuels consumed by road transportation are Gasoline, Diesel Oil, Liquefied Petroleum Gases – LPG and Liquefied Natural Gases – LNG.

In 2011, the total volume of freight transportation with motor vehicles represented 26.0 million tonnes, which is a decrease by 90.1 per cent as compared to the 1990 level, but an increase of 9.3 per cent as compared to 2010 (Table 1-39).

At the same time, in 2012, the total volume increased by 3.1 per cent compared to the preceding year. Buses and minibuses transported 114.7 million passengers, by 74.3 per cent less than in 1990 and by 8.2 per cent less than in 2010 (Table 1-40). In 2012, the number of passengers transported by buses and minibuses increased by 1.6 per cent compared to the preceding year.

Railways. The history of railway transportation dates back 140 years. The total length of railway lines is 1,157 km, while the density per 1,000 km^2 is 34.2 km (Table 1-37).

Table 1-36: Road Transportation Means Existent by the end of the year in the RM in 1990-2011, units

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Trucks	79192	77941	61595	63235	62171	61433	58597	58206	58558	53439	47501
Buses and Minibuses	12033	11226	8924	9101	9139	9697	10282	11623	13345	14005	13176
Cars	261204	218059	166259	166440	169387	232866	245515	289105	306825	323264	329431
Special Destination Vehicles	23029	19632	16155	15241	15228	17255	16314	14981	14076	12455	11024
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Trucks	47099	47442	47873	74684	82545	84682	95587	116804	120639	131585	141851
Buses and Minibuses	15094	16132	16069	20063	20123	21336	21672	22062	21939	21973	21919
Cars	347574	360488	356752	359248	386034	414315	441991	470926	492481	512386	537145
Special Destination Vehicles	10437	9918	9311	9058	8951	8510	8186	7983	7631	7373	7098

Source: Statistical Yearbooks for 1994 (page 325), 1999 (page 390), 2006 (page 407), 2007 (page 403), 2008 (page 399), 2009 (page 398), 2010 (page 399), 2011 (page 399), 2012 (page 402). Statistical Yearbooks of the ATULBD for 2000 (page 127), 2006 (page 121), 2009 (page 119), 2010 (page 123), 2012 (page 128)

Table 1-37: Length (km) and Density (km per 1,000 km^2) of Railways by the end of the year in the Republic of Moldova in 1990-2011

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Railways, km	1150	1150	1150	1150	1150	1150	1150	1140	1137	1140	1139
on Right Bank of Dniester, km	977	977	977	977	977	977	977	967	964	967	999
on Left Bank of Dniester, km	173	173	173	173	173	173	173	173	173	173	140
Railways density, km per 1000 km^2	34.1	34.0	34.0	34.0	34.0	34.0	34.0	33.7	33.6	33.7	33.7
on Right Bank of Dniester, km	33.0	32.9	32.9	32.9	32.9	32.9	32.9	32.6	32.5	32.6	33.7
on Left Bank of Dniester, km	41.6	41.6	41.6	41.6	41.6	41.6	41.6	41.6	41.6	41.6	33.6
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Railways, km	1121	1120	1111	1075	1139	1154	1154	1157	1157	1157	1157
on Right Bank of Dniester, km	981	980	971	970	1034	1049	1049	1052	1052	1052	1052
on Left Bank of Dniester, km	140	140	140	105	105	105	105	105	105	105	105
Railways density, km per 1000 km^2	33.1	33.1	32.8	31.8	33.7	34.1	34.1	34.2	34.2	34.2	34.2
on Right Bank of Dniester, km	33.1	33.0	32.7	32.7	34.8	35.3	35.3	35.4	35.4	35.4	35.4
on Left Bank of Dniester, km	33.6	33.6	33.6	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2

Source: Statistical Yearbooks of the RM for 1994 (page 319), 1999 (page 382), 2006 (page 405) and 2012 (page 400); Statistical Yearbooks of the ATULBD 2000 (page 127), 2006 (page 121), 2009 (page 119), 2010 (page 123), 2012 (page 128).

The railway transport in the RM is assured by Diesel Locomotives (400-4000 kW), Manoeuvring Locomotives (200-2000 kW), Diesel Trains, Cargo and Passenger Trains. To be noted that during the period under review the rolling stock has decreased significantly: Diesel Locomotives (by 82.4 per cent); Manoeuvring Locomotives (by 71.9 per cent); Diesel Trains (by 65.9 per cent); Cargo Wagons (by 49.2 per cent) and Passenger Coaches (by 17.9 per cent) (Table 1-38). The main type of fuel used in railways is Diesel Oil. Other types of fuels, such as: Coal, Residual Fuel Oil, Gasoline, Natural Gas and Lubricants are also used for auxiliary needs.

The railway transport employs around 15 thousand persons. An important railway segment 45 km long was constructed and commissioned in 2005 to connect Revaca and Cainari and to enable the transportation of freights and passengers to the south of the RM without the necessity to go through the town of Bender in ATULBD. Furthermore, the construction of the railway section Cahul - Giurgiulesti 50 km was completed in 2008 to connect the railway network with the port Giurgiulesti, ensuring a direct link to the Danube transport system.

In 2011, railways accounted for 4.554 million tonnes of the total freight transportation, registering an decrease of 93 per cent as compared to 1990, but also an increase of 18.2 per cent as compared to 2010 (Table 1-39). In 2012, the total volume of freight transportation decreased by 9.5 per cent compared to the preceding year. Around 4.711 million passengers used railway transportation services, which is 77.7 per cent less than in 1990, and 5.1 per cent less than in 2010 (Table 1-40). In 2012, the number of passengers trans-

Table 1-38: Railway Transport Means Existent by the end of the year in the RM, units

	1990	1995	1996	1997	1998	1999	2000	2001	2002
Diesel Locomotives	324	113	103	97	82	78	76	78	89
Manoeuvring Locomotives	139	114	100	75	72	50	42	44	48
Diesel Trains (Sections)	44	29	28	26	26	24	22	22	22
Cargo Wagons	14960	14097	13316	12838	12233	11010	10577	10033	9303
Passenger Coaches	486	482	480	470	458	461	460	440	460
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Diesel Locomotives	100	95	100	100	100	90	57	57	57
Manoeuvring Locomotives	54	50	56	56	56	53	39	39	39
Diesel Trains (Sections)	22	18	20	20	20	18	15	15	15
Cargo Wagons	8723	8492	8318	8177	7940	7921	7919	7835	7606
Passenger Coaches	452	452	440	436	416	398	423	411	399

Source: Statistical Yearbooks of the RM for 1994 (page 325), 1999 (page 390), 2006 (page 407), 2007 (page 403), 2008 (page 399), 2009 (page 398), 2010 (page 399), 2011 (page 399), 2012 (page 402).

Table 1-39: Goods Transportation, by Types of Public Transport in the RM in 1990-2011

	1990	1995	1996	1997	1998	1999	2000	2001	2002
Transported goods, million t									
Transport – total, of which by:	**331.1**	**54.2**	**45.5**	**45.5**	**38.7**	**28.0**	**28.9**	**27.8**	**31.8**
Railway transport, mill. tonnes	65.4	13.2	12.5	12.8	11.1	6.6	8.2	10.6	12.6
Road transportation, mill. tonnes	262.8	41.0	33.0	32.7	27.6	21.4	20.7	17.2	19.1
River navigation, kt	2885.5	19.7	19.7	39.1	13.1	15.9	30.8	103.7	107.5
Air transportation, kt	12.2	1.6	1.2	1.2	1.5	1.3	1.4	1.7	0.9
Turnover of goods, million t-km									
Transport – total, of which by:	**21648**	**4296**	**3891**	**3968**	**3597**	**2267**	**2605**	**3044**	**4007**
Railway transport	15007	3134	2897	2937	2575	1191	1513	1980	2748
Road transportation	6305	1159	992	1028	1018	1073	1088	1060	1257
River navigation	317	0.20	0.15	0.32	0.01	0.18	0.06	2.60	0.30
Air transportation	19.0	3.0	1.5	2.4	3.6	3.3	4.1	2.0	1.3
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Transported goods, million t									
Transport – total, of which by:	**34.319**	**34.701**	**36.410**	**38.250**	**40.794**	**39.794**	**25.989**	**27.781**	**30.718**
Railway transport, mill. tonnes	14.739	13.310	11.704	11.093	11.847	11.006	4.415	3.852	4.554
Road transportation, mill. tonnes	19.459	21.271	24.593	27.015	28.780	28.585	21.391	23.801	26.013
River navigation, kt	120.0	119.7	111.8	141.5	166.5	202.0	182.0	127.2	149.1
Air transportation, kt	0.75	0.72	0.77	0.97	1.00	0.83	0.83	1.30	1.60
Turnover of goods, million t-km									
Transport – total, of which by:	**4597.5**	**5168.7**	**5459.6**	**6242.2**	**5864.6**	**5840.6**	**3773.6**	**4193.1**	**4795.2**
Railway transport	3019.2	3005.9	3052.9	3673.2	3120.2	2872.7	1058.2	958.6	1195.7
Road transportation	1577.0	2161.4	2405.3	2567.1	2742.5	2965.9	2713.7	3232.4	3597.3
River navigation	0.35	0.37	0.43	0.55	0.60	0.80	0.60	0.40	0.50
Air transportation	0.90	1.00	1.00	1.30	1.30	1.20	1.10	1.70	1.70

Source: Statistical Yearbooks of the RM for 2012 (page 393), 2009 (page 387), 2007 (page 395) and 1999 (page 385).

ported using the railway transportation services decreased again by 7.9 per cent compared to the preceding year.

River Navigation. RM's river navigation is in the process of development after a long period of stagnation (freight transportation along the Dniester, suspended for above 10 years, was resumed starting in 2000). Currently, operating ports are located in Bender, Dnestrovsk, Malovata, Ungheni, Ribnita and in Giurgiulesti, the latter providing access to the Black Sea via the Danube.

The current length of navigable waterways of public use in the RM is around 624 km (558 km on the right bank of the Dniester and 66 km on the left bank of the Dniester). The number of river transport means used in the RM for both passenger and cargo transportation on Danube, Dniester and Prut, especially in the warm season, is relatively small (Tables 1-41 and 1-42).

In 2011 the river ships transported 149.1 thousand tonnes of freight, which is 94.8 per cent less than in 1990, but 17.2 per cent more than in 2010 (Table 1-39). In 2012, the volume decreased by 3.3 per cent compared to the preceding year. The number of passengers transported by river transport means was 0.123 million persons, which is 95.1 per cent less than in 1990, and by 3.2 less than in 2010 (Table 1-40). In 2012, this number decreased by 5.6 per cent compared to the preceding year.

Air Transportation. Currently above 30 entities and about 15 air-carrier companies have operations in the air transport segment, of which 3 air carriers offer regular scheduled flights, the other 11 offer charter flights, and 5 companies offer specialized services. The National Register of Planes has entries for 202 air transport units. This segment employs above 2,000 persons.

There are 4 airports in Moldova: in Chisinau, Balti, Cahul and Marculesti, of which only the Chisinau airport offers regular scheduled flights. The airports in Cahul and Marculesti are still in the process of obtaining the required statutory approvals and certificates. The Balti Airport is certified, but it offers only charter flights.

In recent years, the aircraft fleet of the Republic of Moldova significantly changed its structure. If before 2000, about 80 per cent of flights were operated by aircrafts produced in CIS countries, by 2011 the situation was opposite. Most air-

Table 1-40: Passenger Transportation by Types of Public Transport in the RM in 1990-2011

	1990	1995	1996	1997	1998	1999	2000	2001	2002
Passengers transported, million passengers									
Transport – total, of which by:	**757.7**	**410.9**	**373.5**	**337.5**	**384.7**	**406.1**	**326.6**	**211.5**	**280.6**
Railway transport	21.1	11.7	10.4	10.3	9.4	5.4	4.8	4.8	5.1
Buses	446.9	84	77.8	65.6	71.7	65.5	72.4	72.7	83.9
Taxi	13.7	0.7	0.5	0.4	0.3	0.3	0.7	0.7	0.6
Trolley-buses	272.6	314.2	284.6	261	303.1	334.7	248.5	133.0	190.7
River transport	2.5	–	–	–	–	–	0.03	0.1	0.1
Air transport	0.90	0.24	0.23	0.24	0.22	0.20	0.22	0.23	0.24
Passenger turnover, million passenger-km									
Transport – total, of which by:	**10102**	**3605**	**3296**	**3059**	**3013**	**2676**	**2415**	**2131**	**2624**
Railway transport	1626	1019	882	789	656	343	315	325	355
Buses	4878	1163	1195	1071	1067	1013	1021	1069	1298
Taxi	164	15	11	7	6	5	12	12	11
Trolley-buses	1063	1103	914	838	969	1074	814	435	636
River transport	19	–	–	–	–	–	0.1	0.2	0.2
Air transport	2352	305	294	354	315	240	253	290	324
	2003	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Passengers transported, million passengers									
Transport – total, of which by:	**296.250**	**306.868**	**316.439**	**318.141**	**319.061**	**326.060**	**291.843**	**232.455**	**235.728**
Railway transport	5.282	5.111	5.024	5.284	5.591	5.763	5.187	4.964	4.711
Buses	93.396	99.295	105.656	109.405	103.184	110.286	105.806	105.985	114.677
Taxi	0.698	1.057	1.007	1.098	3.414	4.259	3.836	4.262	3.308
Trolley-buses	196.522	200.963	204.255	201.855	206.338	205.172	176.436	116.477	112.209
River transport	0.104	0.134	0.135	0.103	0.119	0.105	0.119	0.119	0.123
Air transport	0.249	0.308	0.362	0.397	0.415	0.474	0.460	0.649	0.700
Passenger turnover, million passenger-km									
Transport – total, of which by:	**2963.2**	**3347.4**	**3548.9**	**3793.7**	**4187.1**	**4429.7**	**3932.7**	**3993.4**	**4286.3**
Railway transport	351.9	346.1	355.0	471.4	468.2	485.6	422.8	398.8	363.1
Buses	1640.1	1949.2	2058.7	2206.1	2475.5	2598.9	2300.1	2416.7	2685.4
Taxi	12.6	19.8	19.2	20.3	65.9	84.3	72.5	80.1	65.2
Trolley-buses	654.0	666.8	676.0	614.8	627.7	623.2	533.3	346.8	335.1
River transport	0.33	0.42	0.33	0.21	0.24	0.21	0.24	0.24	0.24
Air transport	304.3	365.1	439.7	480.9	549.6	637.5	603.8	750.8	837.3

Source: Statistical Yearbooks of the RM for 2012 (page 398), 2009 (page 392), 2007 (page 401) and 1999 (page 389).

Table 1-41: River Transport Means Existent by the end of the year on the Right Bank of Dniester River, units

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Goods Self-Propelled Ships	14	9	5	5	5	5	5	4	4	3	-
Goods Non-Self-Propelled Ships	72	67	67	67	20	20	15	15	15	15	15
Towboats, Stamps & Stamp-Towboats	49	48	47	47	12	12	11	11	11	11	11
Passenger Self-Propelled Ships	36	37	32	32	3	3	3	4	3	3	3
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Goods Self-Propelled Ships	-	-	-	-	-	-	-	-	-	-	-
Goods Non-Self-Propelled Ships	15	15	15	15	15	13	12	9	9	9	9
Towboats, Stamps & Stamp-Towboats	10	10	10	10	10	8	8	8	8	8	8
Passenger Self-Propelled Ships	3	3	3	3	3	2	1	1	1	1	1

Source: Statistical Yearbooks of the RM for 1993 (page 330), 1994 (page 325), 1999 (page 390), 2006 (page 407), 2007 (page 403), 2008 (page 399), 2009 (page 398), 2010 (page 399), 2011 (page 399) and 2012 (page 402).

Table 1-42: River Transport Means Existent by the end of the year on the Left Bank of Dniester River, units

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Goods Ships including Towboats, Stamps & Stamp-Towboats	73	71	69	67	65	63	59	59	58	57	54
Passenger Ships	33	32	31	30	29	28	25	25	25	25	24
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Goods Ships including Towboats, Stamps & Stamp-Towboats	52	52	52	52	50	45	42	42	42	42	42
Passenger Ships	23	23	23	23	14	8	8	8	8	8	8

Source: Statistical Yearbooks of the ATULBD 2000 (page 128), 2006 (page 121), 2009 (page 119), 2010 (page 124), 2012 (page 128).

crafts used today are modern, low GHG emission, produced mainly in western countries. Table 1-43 provides information on the number of aircraft in use at the end of each year during 1996-2011.

Table 1-43: Air Transport Means Existing in the RM by the end of the year, units

	1996	1997	1998	1999	2000	2001	2002	2003
Civil aircrafts for passenger transportation	40	40	32	20	26	21	19	19
Civil aircrafts for goods transportation	9	6	6	5	6	6	7	9
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Civil aircrafts for passenger transportation	20	32	35	20	23	24	22	22
Civil aircrafts for goods transportation	8	7	16	3	3	4	3	4

Source: Statistical Yearbooks of the RM for 2004 (page 562), 2006 (page 407), 2007 (page 403), 2008 (page 399), 2009 (page 398), 2010 (page 399), 2011 (page 399), 2012 (page 399).

In 2011 the air transport transported 1.6 thousand tonnes of freights, which is by 86.9 per cent less than in 1990, but by 23.1 per cent more than in 2010 (Table 1-39). In 2012, this volume decreased by 1.9 per cent compared to the preceding year. The number of passengers using air transport services in 2011 was 0.7 million persons, or by 22.2 per cent less than in 1990, but by 7.9 per cent higher than in 2010 (Table 1-40). In 2012, this number decreased by 3.9 per cent compared to the preceding year.

Communications. In 2012, the number of phone calls using the fixed phone network increased by 12.8 per cent compared to the preceding year, due to the increase number of long-distance phone calls (+16.2 per cent). Also, it was recorded an increase of postal correspondence (by 6.5 per cent), pensions, subsidies and allowances paid through post offices (by 0.3 per cent). At the same time, there was a decrease in the number of newspapers and magazines delivered (by 5.8 per cent), telegrams (by 4.7 per cent), telegraph money order (by 3.5 per cent), delivered parcels (by 1.0 per cent). In the public telephone network, as of December 31, 2011 the number of main phone sets exceeded 1,194.7 thousand units, of which 1,048.1 thousand were home phone lines (Table 1-44).

1.6.4. Tourism

Currently, tourism accounts for a relatively insignificant portion in the national economy. The modest infrastructure in the tourism and low incomes generated by the tourist businesses rates the RM among the countries where tourism is poorly developed. In 2011 the total tourist accommodation capacity of the collective accommodation facilities was 27.5 thousand beds, registering a decrease of 3.0 per cent as compared to the preceding year (Table 1-45).

In the total tourist accommodation capacity, hotels and motels account for 34.4 per cent, summer camps for children – 28.7 per cent, holiday villages and other holiday facilities – for 25.5 per cent, tourist and agro-tourist boarding houses – for 6.1 per cent, health homes – for 2.8 per cent, hostels for visitors – for 2.4 per cent.

The services of the collective tourist accommodation facilities were used in 2012 by 268.2 thousand tourists, or 8.0

Table 1-44: Main Indicators for Post Communications and Telecommunications in the RM in 2000-2011

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Number of mailings:												
Written correspondence, million	11.862	16.998	25.179	30.630	34.262	37.293	38.478	38.314	40.764	41.174	41.879	44.788
Newspapers and magazines, million	18.963	21.210	22.022	22.750	29.500	28.721	28.520	28.714	26.837	25.104	23.758	21.762
Parcels, thousand	18.000	18.000	21.000	33.000	29.000	23.000	26.000	27.118	28.284	29.500	30.769	32.092
Money orders by post and telegraph, million	11.313	9.665	8.836	8.028	8.140	8.133	8.191	8.168	8.186	8.414	8.835	9.043
Number of telephone conversations ensured by means of fixed telephone service:												
Interurban (long-distance), million	117.4	163.0	195.9	246.7	293.8	340.8	373.3	348.1	294.0	246.1	212.9	194.3
International, million	17.5	18.6	21.4	25.3	30.7	33.1	37.4	49.4	46.2	31.6	26.3	22.7
Number of main phone sets in the public telephone network:												
Total, thousand	603.6	655.3	719.3	791.1	863.4	942.2	1018.1	1081.4	1115.8	1139.9	1162.3	1194.7
Of which home lines, thousand	513.3	564.6	625.7	695.5	761.5	838.5	957.6	1002.2	1030.6	1025.2	1042.5	1048.1
Number of phone sets per 100 residents:												
Public telephone network	16.6	18.1	19.9	21.9	24.0	26.3	28.4	30.3	31.3	32.0	32.6	33.6
Mobile telephone network	3.0	6.2	9.4	13.2	21.9	30.4	37.9	52.7	67.9	78.1	88.9	104.4
Number of stations, at the end of the year:												
Television	47.0	50.0	50.0	50.0	76.0	76.0	76.0	94.0	130.0	178.0	…	…
Broadcasting	…	…	…	28.0	30.0	36.0	51.0	55.0	48.0	67.0	…	…

Source: Statistical Yearbooks of the RM for 2012 (pages 411-412), 2009 (pages 407- 409) and 2007 (pages 414-417).

per cent more than in 2011, of which 89.0 thousand tourists were foreign nationals, by 18.6 per cent more than in the preceding year.

In 2012, the countries accounting for the highest share in the total number of foreign tourists using the services of the accommodation facilities were: Romania (19.7 per cent), Russian Federation (10.4 per cent), Ukraine (9.2 per cent), USA (7.1 per cent), Turkey (6.5 per cent), Germany (6.2 per cent), Italy (5.6 per cent), United Kingdom (3.7 per cent), Poland (2.6 per cent), France (2.4 per cent), Israel (1.9 per cent), Bulgaria (1.5 per cent), Sweden (1.3 per cent), Belarus (1.3 per cent), Austria (1.3 per cent), Netherlands (1.1 per cent), etc.

The total number of man-nights spent by the tourists in the collective accommodation facilities in 2012 was 1,462.4 thousand, an increase by 2.7 per cent as compared to 2011. The total net utilization rate of the operating tourist accommodation facilities was 30.7 per cent, including for health homes – 66.8 per cent, hostels for visitors – 53.5 per cent, summer camps for schoolchildren – 35.7 per cent, tourist and agro-tourist boarding houses – 16.6 per cent, hotels and motels – 15.8 per cent, tourist villas, holiday villages and other holiday facilities – 14.7 per cent.

Compared to 2010, in 2011 the number of existing hotels and other similar facilities increased by 11.6 per cent, thus increasing the accommodation capacity by 6.7 per cent, while the accommodation capacity utilization rate decreased by 9.5 per cent (Table 1-46).

Over the 2009-2010 period, the number of foreign tourists visiting the RM decreased (Table 1-47), but this pattern did not persisted and soon exceeded the numbers recorded before the beginning of the economic crisis in 2009, because both the infrastructure and the offered tourist destinations are developing rapidly.

In 2012, travel agencies and tour operators provided their services to 194.0 thousand of tourists and excursionists, by

Table 1-45: Main Indicators for Collective Tourist Accommodation in the RM in 2004-2011

	2004	2005	2006	2007	2008	2009	2010	2011
Accommodation facilities– total, including:	184	191	211	222	229	249	250	247
Hotels and motels	53	54	55	58	62	72	75	85
Tourist and agro-tourist boarding houses	5	7	12	13	11	15	13	15
Hostels for visitors	11	10	9	7	6	6	7	6
Health homes	7	7	6	7	6	6	6	7
Holiday villages and other holiday facilities	55	57	60	60	62	71	72	63
Summer camps for children	53	56	69	77	82	79	77	71
Rooms - total	7296	7374	7970	7960	8149	8349	8417	8172
Beds - total	23827	23992	27269	27608	28265	28448	28370	27511
Tourist serviced - total	286731	301656	311966	314619	280550	227888	229893	248309
including foreign tourists	68829	67235	62771	70302	73288	59563	63593	75000
Man-nights spent during the year - total,	1487585	1618558	1752963	1745178	1726885	1400063	1412166	1424441
including foreign tourists	174439	186590	213982	201006	201624	147762	162755	173893
Accommodation capacity utilization rate, %	37.9	43.0	44.5	44.3	46.7	36.8	32.7	32.2

Source: Statistical Yearbooks of the RM for 2012 (pages 240-245).

Table 1-46: Hotels and Similar Facilities in the RM, as of December 31 in 2004-2011

	2004	2005	2006	2007	2008	2009	2010	2011
Hotels and similar facilities - total, including:	69	71	76	78	79	93	95	106
4-5 stars	6	6	10	11	10	13	14	21
3 stars	4	5	11	11	12	20	22	21
2 stars	6	7	7	6	8	9	9	9
Rooms - total	2576	2475	2457	2297	2350	2517	2695	2864
Accommodation capacity - total beds	4850	4581	4519	4271	4415	4727	5112	5454
Man-nights spent during the year - total, thousand	404.1	434.8	483.7	428.0	416.9	330.2	371.7	368.4
Accommodation capacity utilization rate, %	25.2	26.6	30.9	28.3	28.6	20.8	22.1	20.0

Source: Statistical Yearbooks of the RM for 2012 (page 240).

Table 1-47: Tourist Activities of the Travel Agencies and Tour Operators in the RM in 2004-2012

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of foreign tourists arrived - total	26045	25073	14239	14722	8710	9189	8956	10788	12797
Number of Moldovan tourists travelled abroad - total	67846	57231	67826	81790	85085	93294	117204	136095	146791

Source: Statistical Yearbooks of the RM for 2012 (page 245).

5.0 per cent more than in the preceding year. The total number of foreign tourists and excursionists, who visited the RM and used the services of the Moldovan travel agencies and tour operators in 2012, was 12.8 thousand (of which 54.9 per cent arrived aiming to rest, for recreation and leisure, 40.6 per cent – for business and professional purpose, 4.5 per cent – for a treatment), by 18.6 per cent more than in 2011.

The total number of Moldovan tourists and excursionists, who travelled abroad using the services of the Moldovan travel agencies and tour operators was 146.8 thousand (97.4 per cent travelled abroad for rest, recreation and leisure), by 7.9 per cent more than in 2011. The above statistics reflects only the trips arranged by the Moldovan travel agencies and tour operators and do not include trips arranged by the travellers personally.

The RM's current national policy in the sphere of tourism is reflected in the Strategy on the long-term development of the tourism for 2003-2015 periods. The strategy provides for the expansion of tourist areas, establishment and maintenance of special tourist routes, etc.

1.6.5. Retail Trade and Sales of Personal Services

The 2011 retail sales registered a growing pattern. The population purchased consumer goods to the total amount of 50.9 billion lei, or by 10.7 per cent more than in 2010 (Table 1-48).

In December 2012, the trading volume for retail trade decreased by 0.5 per cent (in comparable prices) as compared to the preceding year. During this month, the sales of the retails companies recorded a decrease by 1.2 per cent (in current prices) compared to the preceding month and a decrease by 14.6 per cent compared to December 2011. In 2012, the trading volume for retail trade decreased by 2.5 per cent (in current prices) compared to the preceding year.

The 2011 sales of personal services totalled 19.0 billion MDL or by 5.0 per cent more in real terms than in 2010 (Table 1-49).

In December 2012, the trading volume for personal service sales recorded a positive trend, increasing by 9.2 per cent (in comparable prices) as compared to the preceding month, but a negative trend compared to December 2011, decreasing by 1.2 per cent. In 2012, the trading volume for personal service sales increased by 3.1 per cent (in comparable prices) compared to the preceding year.

In December 2012, the trading volume for personal service sales, in particular regarding companies, recorded a positive trend, increasing by 11.1 per cent (in current prices) as compared to the preceding month, but a negative trend compared to December 2011, decreasing by 13.0 per cent. In 2012, the trading volume for personal service sales companies decreased by 1.3 per cent (in current prices) compared to the preceding year.

Table 1-48: Retail Trade in the RM in 1990-2011

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Retail sales, billion MDL	6.400	11.000	47.300	0.432	1.363	2.757	3.840	3.971	3.679	3.602	6.012
% compared to the previous year		82.0	53.0	75.0	58.0	111.7	118.0	96.2	87.7	72.6	104.0
billion US$				0.322	0.335	0.613	0.834	0.859	0.685	0.343	0.484
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Retail sales, billion MDL	7.612	10.753	14.537	16.576	19.488	23.357	28.220	34.684	32.143	38.766	50.930
% compared to the previous year	114.8	134.2	118.2	105.6	105.3	106.9	107.6	108.8	95.1	104.5	110.7
billion US$	0.591	0.792	1.043	1.344	1.547	1.779	2.325	3.338	2.892	3.135	4.340

Source: Ministry of Economy, Department of Macroeconomic Analysis and Forecasts (November 2012).

Table 1-49: Sales of Personal Services in the RM in 1990-2011

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Sales of personal services, billion MDL	0.900	1.200	5.800	0.070	0.424	0.652	0.820	1.237	1.299	1.897	2.600
% compared to the previous year		81.0	55.0	67.0	52.0	100.1	78.1	110.2	88.3	89.8	100.1
Sales of personal services, billion US$				0.052	0.104	0.145	0.178	0.268	0.242	0.181	0.209
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Sales of personal services, billion MDL	3.404	4.222	5.299	6.970	8.210	9.964	11.569	13.153	14.590	16.670	19.044
% compared to the previous year	121.2	111.8	113.3	105.3	109.2	105.6	101.1	97.8	102.5	103.9	105.0
Sales of personal services, billion US$	0.265	0.311	0.380	0.565	0.652	0.759	0.953	1.266	1.313	1.348	1.623

Source: Ministry of Economy, Department of Macroeconomic Analysis and Forecasts (November 2012).

1.6.5. Capital Investments

The 2012 data on the volumes of capital investments show a decrease of 4.1 per cent as compared to 2011. During 1990-2012 the development of that indicator was characterized by certain fluctuations, positive results were recorded only in 1998 and, more recently, during 2001-2008 and 2010-2011 time series (Table 1-50, Figure 1-12).

In 2012 capital investments totalled MDL 16.457 billion MDL in current prices (of which 8.482 billion MDL – in construction-assembling works, 7.249 billion MDL – in machinery and equipment, transportation vehicles and 0.726 billion MDL – other), which amounts to approximately 23.0 per cent of the 1990 level. Compared to the preceding year, in 2012 the share of construction-assembling works increased by 3.6 per cent while the investments in machinery, equipment, transportation vehicles and other decreased by 1.3 per cent and 2.3 per cent respectively.

The analysis of the investment structure by ownership revealed that increased investment activity was recorded mainly at the expense of the private sector of the economy. Economic agents and physical persons within that sector invested 6.604 billion MDL, representing 40.1 per cent of the total investments. Compared to 2011, the level of those investments decreased by 16.7 per cent (in comparable prices). Enterprises from the public sector ensured 37.1 per cent of total national investments, or 6.111 billion MDL, increasing by 22.3 per cent compared to the preceding year. Joint ventures and foreign-owned companies invested 21.2 per cent of the total national investments, or by 1.9 per cent less than in 2011.

In order to ensure the investment process in 2012, there were mainly used investments from the internal sources of companies and individuals, representing 9.646 billion MDL or 58.6 per cent of the total, or by 8.7 per cent less compared to the preceding year. In 2012, to ensure investment needs at the expense of budgetary resources were used 1.921 billi-

Table 1-50: Capital Investments in the RM in 1990-2011

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Investments, billion MDL	2.500	3.300	28.300	0.171	0.712	0.845	0.987	1.202	1.444	1.592	1.759
% compared to 1990		91.0	67.3	37.0	18.1	15.2	14.0	12.9	14.2	11.1	9.4
Investments, billion US$				0.128	0.175	0.188	0.215	0.260	0.269	0.152	0.142
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Investments, billion MDL	2.315	2.804	3.622	5.140	7.797	11.012	15.336	18.225	11.124	13.805	16.338
% compared to 1990	10.4	11.6	12.4	13.4	16.3	20.2	24.6	25.2	16.7	20.5	22.9
Investments, billion US$	0.180	0.207	0.260	0.417	0.619	0.839	1.263	1.754	1.001	1.116	1.392

Source: Ministry of Economy, Department of Macroeconomic Analysis and Forecasts (November 2012).

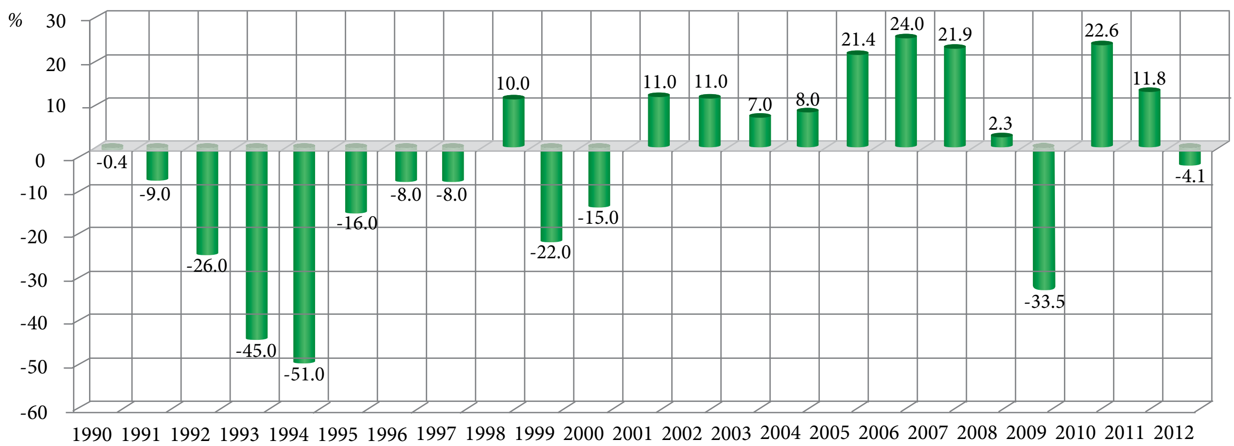


Figure 1-12: Capital Investments in the RM in 1991-2012 (% compared to the preceding year)

on MDL or 11.6 per cent of total investment, increasing by 25.8 per cent compared to 2011 (in comparable prices). The share of capital investments from foreign investors – 1.210 billion MDL, decreased by 1.5 per cent compared to 2011, representing 7.4 per cent of total investment.

In terms of the structure of capital investments, most of the investments were channelled into the machinery, equipment and transportation vehicles sector (44.0 per cent compared to 45.3 per cent in 2011). The share of investments into the construction of buildings and structures represented 31.7 per cent of total investments (of which, 11.6 per cent – housing and 20.1 per cent – other buildings and structures), or by 3.0 per cent less than in 2011. In 2012, the construction of housing attracted 1.910 billion MDL or 11.6 per cent of total investments, decreasing by 17.2 per cent compared to the preceding year.

1.6.6. Waste Management

Increased consumption over the past decades contributed to global increase of solid wastes. Though no statistical evidence on average daily waste generation rate is being performed in the RM, this indicator was inferred from data on waste disposal on land reported by sanitation services, varying from circa 0.25 kg/day in towns such as Nisporeni and Cimislia, up to circa 1.1 – 1.3 kg/day in municipalities such as Balti and Chisinau. Specialized services in waste collection and disposal exist in municipalities, in all district centres, municipal waste management is carried out in an organized manner through these services, working on a contract basis with private clients, but the problem is that the system covers only 60-90 per cent of total municipal waste generators in urban areas.

In rural areas, in most settlements, there are virtually no organized waste management services, transport to the disposal sites is being made individually by each waste generator, except for the waste collecting services created in some rural settlements.

The number of people connected to such services in rural areas is relatively low, due to lack of financial resources. Only a small part of rural settlements, in particular those in immediate proximity to district centres are served by organized waste management services (Chisinau, Falesti, Ungheni, etc.)

Annually, through urban sanitation services, about 1.1-2.4 million m^3 of waste is being transported to solid waste disposal sites (1 m^3 is equivalent to circa 0.4 tonnes of solid waste) (Table 1-51).

Current situation with the management of 'Municipal Solid Waste' (MSW) in the Republic of Moldova is similar to the situation in other developing countries; it is in the budding stage and includes two basic elements: municipal solid waste generating sources and the landfills. The most widely used method of MSW management is their disposal on the site.

The total area of SWDS in urban and rural areas varies between 1,300 and 1,400 ha, the total number of such sites being approximately 1,700. According the official statistical data, in 2012, the area of authorized SWD sites represented circa 210.7 ha, therefore, it can be inferred that circa 1,100-1,200 ha are occupied by the so called "dump sites" (unauthorized landfills) situated especially in the rural areas of the RM. Most landfills, 3/4 of those existing in the Republic of Moldova do not comply with sanitary and environment protection requirements.

No statistical records on disposed waste volume is being made, there are only some visual estimates of environment inspectors, who appreciate the total volume of SWD disposed at approximately 30-35 million tons.

By the way the landfills are organized and managed in the RM, they are far from meeting environmental requirements. It is acknowledged that only the landfill situated in Cretoaia village, Anenii Noi district was built in conformity with the designed project and is managed in conformity with in strata waste disposal technology, with compacting and using intermediary cover material. Though some other landfills are authorized to operate as well, they are not properly organized and managed, and inappropriate management entails soil and phreatic water contamination and emissions of GHG and other toxic gases, directly affecting the human health and the environment.

Information available on landfill characteristics allows draw the conclusion that the Republic of Moldova does not have sites built and managed in conformity with the environmental requirements, except the landfill situated in Cretoaia village, Anenii Noi district, where more than ½ of CH_4 emissions originated from municipal solid waste per country are emitted.

Circa 3/4 of district town's landfills are being explored for circa 25-40 years at 80-100 per cent of their capacity, and currently need to be closed down and recovered. In most

Table 1-51: Municipal Solid Waste in the RM, transported to SWDS in 1990-2011, thousand m^3

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total, including	3399.3	3444.7	3593.8	1568.9	1471.2	1373.5	1399.7	1305.8	1306.2	1211.4	1144.6
Chisinau municipality	1126.0	1127.4	879.4	869.3	830.0	833.1	806.9	822.9	815.8	844.0	734.2
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Total, including	1101.9	1148.4	1143.5	1200.0	1268.5	1353.6	1790.6	2130.8	2210.2	2302.6	2350.0
Chisinau municipality	713.0	741.0	752.0	773.0	1021.0	1089.0	1192.0	1460.0	1475.0	1494.0	1513.4

Source: NBS, Statistical Yearbooks of the RM for 2012 (page 25), 2007 (page 26), 2003 (page 34), 1999 (page 24), 1993 (page 53).

district towns the dump sites are overfilled, the disposed waste layer being 7-8 m deep (ex., in Ungheni, Cahul, Ocnita, etc.), at some landfills the layer is circa 10-15 m deep (ex., in Briceni, Balti, Ialoveni, etc.) and even 25-30 m deep (Cretoaia and Orhei).

Sometimes, the existent landfills were set into operation without any execution project and proper arrangements, with no dam or fence. Mechanical compacting and isolation are occasional operations, and a part of waste is disposed beyond the authorized and specially arranged boundaries.

Data on waste generation and disposal to the SWDS of the ATULBD were provided by the "*The State Programme on Management the Household and Industrial Waste in the ATULBD*". In this sector the situation is similar with the rest of the country; household and industrial waste being disposed to the SWDS. According to the *Programme*, each year about 135 thousand tonnes, respectively 252 thousand tonnes of industrial waste are disposed to 8 authorized landfills and about 90 unauthorized landfills. In fact, all active landfills were built between 1960 and 1990, do not comply with sanitary and environment protection requirements and should be considered unauthorized.

Data provided by Table 1-52 refer to managed SWDL (for Chisinau municipality), unmanaged SWDS (for urban area on the right as well as on the left bank of Dniester River, where sanitation services are available and they report information on their activities to regional and central statistical authorities), as well as to the industrial waste disposed (for the entire territory).

Over the 1990-2010 period, the total amount of solid waste disposed at SWDS in the Republic of Moldova decreased by 18.7 per cent, while starting with 2003, it has been noted an increasing trend regarding the disposal of solid waste on landfills.

In 2012, the experts from the Central Environmental Laboratory within the State Ecological Inspectorate of the Republic of Moldova assessed the morphological composition of household waste disposed in the landfills of the SWDS in Chisinau and Balti municipalities, respectively in Leova and Causeni districts (Table 1-53).

Table 1-52: The Amount of Solid Waste Disposed on Land in the RM (total) in 1990-2010, kt

Year	Managed SWDL	Unmanaged SW Sites	Industrial Waste	Total SWDL
1990	909.3	450.4	679.9	2039.6
1991	926.9	451.0	688.9	2066.8
1992	1085.8	351.8	718.8	2156.3
1993	279.8	416.9	565.8	1262.5
1994	256.5	392.1	546.2	1194.9
1995	216.2	350.5	526.7	1093.3
1996	237.1	370.1	531.9	1139.2
1997	193.2	324.8	513.2	1031.1
1998	196.2	326.5	513.2	1035.9
1999	337.6	301.4	507.0	1146.0
2000	293.7	291.3	526.7	1111.7
2001	285.2	289.6	521.7	1096.6
2002	296.4	305.3	527.6	1129.4
2003	300.8	299.1	527.9	1127.9
2004	309.2	297.2	541.5	1147.9
2005	408.4	315.6	613.0	1336.9
2006	435.6	334.7	641.7	1412.0
2007	476.8	365.3	685.6	1527.7
2008	584.0	375.7	672.7	1632.5
2009	590.0	411.0	605.1	1606.1
2010	597.6	440.4	620.2	1658.3
1990-2010, %	-34.3	-2.2	-8.8	-18.7

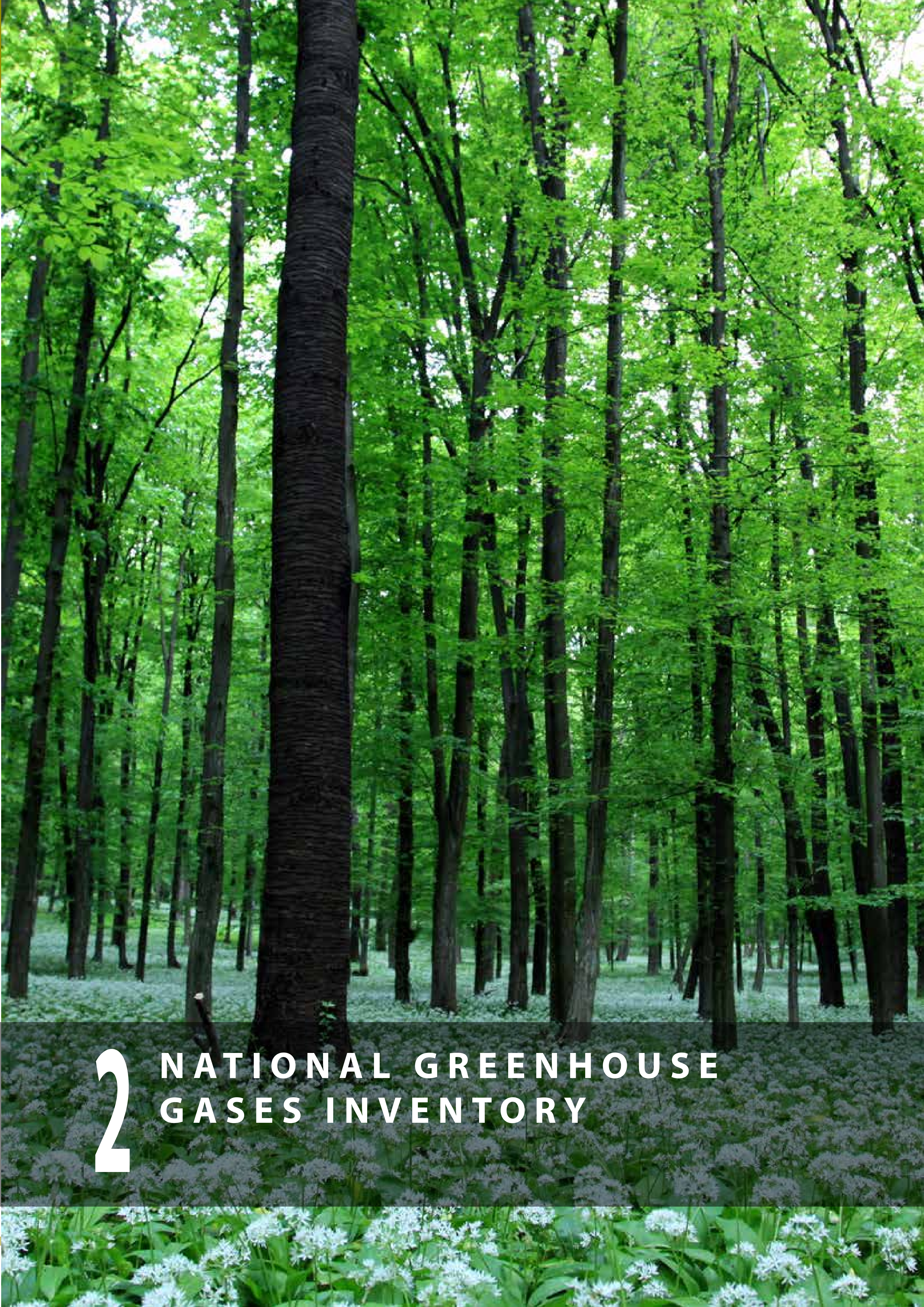
As can be seen from the table, recyclable waste fraction is relatively high, despite the initiatives launched in recent years by local authorities on separate collection of recyclable waste in order to reuse it subsequently.

In country's municipalities, the organic waste fraction is also relatively high, as opposed to smaller urban areas, where the fraction is much lower (there, the organic waste is often used for animal feeding or for composting).

Between 1993 and 2012, the share of biodegradable waste in the Republic of Moldova recorded a decreasing trend, varying from 71 per cent in 1993, to 46 per cent in 2012.

Table 1-53: Morphological Composition of Solid Waste in Urban Areas of the RM in 2012

Waste categories		Morphological composition of waste, %			
		Chisinau	Balti	Leova/Causeni	National average
Recyclable waste	Paper, paper-board	7.98	2.83	5.02	5.28
	Glass	8.06	5.17	5.13	6.12
	Plastics	7.30	3.76	2.92	4.66
	Metals and non-metals	1.98	1.99	1.04	1.67
Organic waste	Food waste	46.24	63.14	28.79	46.06
	Phytotechnical waste	4.30	5.01	23.00	10.77
	Textiles	3.28	2.66	1.84	2.59
	Footwear	0.57	0.20	0.29	0.35
Large waste	Furniture	1.39	3.88	0.59	1.95
	Electric and Electronic Equipment (EEE) Wastes	1.66	1.01	0.97	1.21
Construction and demolition waste	Wood	1.87	1.85	1.55	1.76
	Other construction waste	15.37	8.50	28.86	17.58



2 NATIONAL GREENHOUSE GASES INVENTORY

CHAPTER 2. NATIONAL GREENHOUSE GASES INVENTORY

2.1. Introduction

2.1.1. Convention, Kyoto Protocol and Party's Commitments

The overall objective of the United Nations Framework Convention on Climate Change (UNFCCC) is aimed at stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. To-date 196 countries are Parties to the Convention. The Republic of Moldova signed the UNFCCC on June 12, 1992 and it was ratified by the Parliament on March 16, 1995.

Article 4, paragraph 1(a) and Article 12, paragraph 1(a), of the UNFCCC stipulate that each Party has to make available to the Conference of the Parties (COP), "*national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, to the extent its capacities permit, using comparable methodologies to be agreed upon by the Conference of the Parties; also a general description of steps taken or envisaged by the Party to implement the Convention; and any other information that the Party considers relevant to the achievement of the objective of the Convention and suitable for inclusion in its Communication, including, if feasible, material relevant for calculations of global emission trends*".

The main mechanism for making this information available is national communications. COP 2 (Geneva, 1996) adopted the Guidelines on national communications by non-Annex I Parties (Decision 10/CP 2). In conformity with the Guidelines, in 1998-2000, under the UNDP-GEF Project "Republic of Moldova: Enabling Activities for the Preparation of the FNC under the UNFCCC", the Republic of Moldova developed the First National Communication to the UNFCCC (including a national greenhouse gas emissions inventory for the time series 1990 through 1998), made available at the COP 6 (Hague, 2000).

COP 8 (New Delhi, 2002) adopted a new Guidelines on national communications from non- Annex I Parties to the Convention (Decision 17/CP 8). In conformity with this document, in 2005-2009 the Republic of Moldova developed its Second National Communication under the UNFCCC and, within 2010-2013 time period its Third National Communication under the UNFCCC.

The COP 3 (Kyoto, 1997) adopted the Kyoto Protocol, representing an instrument setting binding targets for the Convention Parties, by committing industrialized countries and economies in transition included in Annex I to Convention, to reduce total emissions of direct GHG by at least 5 per cent, against 1990 levels over the five-year period 2008-2012.

The Republic of Moldova ratified the Kyoto Protocol on February 13, 2003. It should be noted however, that as a non-Annex I Party, the Republic of Moldova had no commitments to reduce GHG emissions under the Protocol during the first commitment period (2008-2012).

According to the Bali Action Plan, adopted at the 13th Conference of Parties to the UNFCCC (2007), developing countries agreed for the first time to develop and implement *national appropriate mitigation actions* in the context of sustainable development, supported by technology transfer, adequate financing and capacity-building actions.

The 15th Conference of the Parties held in Copenhagen in December 2009, approved and proposed for implementation a policy statement adopted in support of limiting global warming to no more than 2°C compared to pre-industrial level, in the context of equity and sustainable development. This statement, known as the Copenhagen Accord, reaffirms development issues in the context of climate change, including through the implementation of Low Emission Development Strategies.

The 16th Conference of the Parties to the UNFCCC, held in Cancun in December 2010, adopted the Cancun Agreements, which encourages developing countries to prepare Low Emission Development Strategies for sustainable development and to undertake National Appropriate Mitigation Actions.

The Cancun Agreements highlights the fact that "*stopping climate change requires a paradigm shift towards building a low-carbon emissions society that offers substantial opportunities and ensures continued economic growth and sustainable development*."

In January 2010, the Republic of Moldova associated itself with the Copenhagen Accord and submitted an emissions reduction target that is specified in Annex II of this Agreement "National Appropriate Mitigation Actions in Developing Countries." The target of mitigation actions for Republic of Moldova under this Agreement is "*to reduce, to not less than 25% compared to the base year (1990), the total national level of greenhouse gas emissions by 2020, by implementing economic mechanisms focused on global climate change mitigation, in accordance with the principles and provisions of the Convention*".

This target is presented without indicating specific national appropriate mitigation actions, identified and quantified, and without further clarification of the necessary support to achieve it. Simultaneously, it is recognized that achieving this target will require significant financial, technological and capacity-building support, which can be provided through the UNFCCC mechanisms.

During 2010-2013, it was drawn the *Low Emission Development Strategy of the Republic of Moldova until 2020*, a strategic document that will allow the country to adjust its development path towards a low carbon economy and to achieve a green sustainable development, based on the socio-economic and development priorities of the country. Also, LEDS supports overall objectives, providing strategic national context for mitigation efforts, for which countries receive international support.

LEDS was developed in accordance with the Republic of Moldova's Governmental Programme "European Integration: Freedom, Democracy, Welfare" (2011-2014), Chapter "Environmental Protection" and the provisions of chapter "Climate Change" of the Association Agreement with European Union. The Strategy contains a set of mitigation measures that contribute to the decrease of GHG emissions; they also help to quantify the corresponding reduction of emissions for each mitigation measure, and the financial requirements for their implementation.

The Action Plan annexed to the Strategy includes a list of prioritized national appropriate mitigation actions as provided for non-Annex I Parties to the United Nations Framework Convention on Climate Change. The strategy envisages the implementation procedures, timeframes and provisions on monitoring, reporting and verification. It is anticipated that LEDS will be approved by the Government in the first quarter of 2014 year.

2.1.2. Greenhouse Gases

The most important greenhouse gas in atmosphere is water vapours (H_2O), responsible for approximately 2/3 of the total greenhouse effect. The content of water in atmosphere is not directly influenced by anthropogenic activities, but rather is determined by the cycle of water in nature, expressed in a simpler way, as the difference between evaporation and precipitations.

Carbon dioxide (CO_2) has a 30 per cent share in the greenhouse effect, while methane (CH_4), nitrous oxide (N_2O) and ozone (O_3) taken together account for 3 per cent. The group of artificial substances (man-made): chlorofluorocarbons (CFC) and their substitute, hydrofluorocarbons (HCFC, HFC) and other substances, as well as perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) are also attributed to direct GHG.

There are other photochemically active gases, such as carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC) (include substances such as: propane, butane and ethane), which are not attributed to direct GHG, but have an indirect contribution to greenhouse effect. Such gases influence the formation and destruction of ozone in the atmosphere in the presence of solar rays (ultraviolet radiation) and are considered to be ozone precursors in the troposphere.

Though GHG are considered to be natural components of the air, their presence in atmosphere is strongly affected by anthropogenic activities. Increased concentrations of GHG in atmosphere (caused by emissions of anthropogenic origin) contribute to strengthening of greenhouse effect thus leading to additional warming of the atmosphere.

Table 2-1: Tropospheric Concentration (in the Northern Hemisphere), Concentration Change Rate and Direct GHG Lifetime in Atmosphere

Greenhouse Gases	Preindustrial (1750) tropospheric concentration	Recent (2012) tropospheric concentration	GWP (100-yr time horizon) (IPCC, 2007)	Tropospheric lifetime (years)	Increased radiative forcing* (W/m²)
Concentration in parts per million (ppm)					
Carbon dioxide (CO_2)	280	392.6	1	~ 100	1.85
Concentration in parts per billion (ppb)					
Methane (CH_4)	700	1874	25	12	0.51
Nitrous oxide (N_2O)	270	324	298	114	0.18
Tropospheric ozone (O_3)	25	34	n.a.	hours-days	0.35
Concentration in parts per trillion (ppt)					
CFC-11 (CCl_3F)	zero	238	4750	45	0.06
CFC-12 (CCl_2F_2)	zero	531	10900	100	0.17
CF-113 (CCl_2CClF_2)	zero	75	6130	85	0.024
HCFC-22 ($CHClF_2$)	zero	226	1810	12	0.041
HCFC-141b (CH_3CCl_2F)	zero	23	725	9.3	0.0025
HCFC-142b (CH_3CClF_2)	zero	23	2310	17.9	0.0031
Halon 1211 ($CBrClF_2$)	zero	4.2	1890	16	0.001
Halon 1301 ($CBrClF_3$)	zero	3.3	7140	65	0.001
HFC-134a (CH_2FCF_3)	zero	68	1430	14	0.0055
Carbon tetrachloride (CCl_4)	zero	86	1400	26	0.012
Sulphur hexafluoride (SF_6)	zero	7.5	22800	3200	0.0029

* The „radiative forcing" term refers to the amount of any given GHG heat-trapping potential and it is measured in power units (watt) per surface units (m^2)

The GHG concentration in atmosphere is determined by the difference between GHG emissions and removals. It has been stated with certainty that GHG concentration in atmosphere have increased significantly in comparison with pre-industrial level[15]. Thus, from 1750 to 2012, the concentration of CO_2 increased by 40 per cent, concentration of CH_4 - by 168 per cent, and concentration of N_2O - by 20 per cent (Table 2-1). To a great extent these trends can be attributed to human activities — in particular, to fossil fuels combustion and continuous deforestation of forest lands.

Globally, the amount of annual emissions of carbon dioxide is circa 31.6 Gigatonnes (Gt)[16], which in the past 45 years has increased more than significantly (by 4.9 times). The most important sources of carbon dioxide emissions are fossil fuel combustion, deforestation and industrial processes (for example, cement production). The carbon dioxide lifetime in atmosphere vary between 50 and 200 years. It can be removed from atmosphere through a complex set of natural sinks mechanisms. Also, it is considered that circa 40 per cent of the emitted carbon dioxide can be absorbed by oceans. Photosynthesis, in particular in sea vegetation and plankton is an important, though transitory, mechanism of CO_2 emissions removal, because after the perishing of plants, carbon dioxide is again emitted into the atmosphere.

Concentration of methane in atmosphere is affected by anthropogenic activities such as rice cultivation, animal breeding (enteric fermentation and manure management), coal, oil and natural gas extraction, transportation and distribution of natural gases, solid waste disposal on lands, biomass combustion, etc. The breakdown of methane in the atmosphere takes place through chemical reactions (by means of OH radicals). The lifetime of CH_4 in atmosphere is circa 12 years. The annual accumulation rate of CH_4 in atmosphere is about 40 and 60 Mt, from which approximately 11.5 per cent are generated from anthropogenic activities (in 2010, the global methane emissions represented circa 7 Mt[17]).

It has been stated that circa 1/3 of the atmospheric N_2O is of anthropogenic origin[18], coming from use of synthetic nitrogen fertilizer, soil cultivation, animal breeding (manure management), wastewater handling, adipic acid and nitric acid production, fossil fuels combustion, waste incineration and biomass burning. The other 2/3 of the atmospheric N_2O comes from the soil and denitrification of water in anaerobic conditions. N_2O breaks down photochemically in atmosphere. Global annual N_2O emissions from anthropogenic activities are estimated at circa 9 Mt[19].

PFCs (perfluorocarbones), HFCs (hydrofluorocarbones) and SF_6 (sulphur hexafluoride) are GHG of anthropogenic origin. HFCs are preponderantly used to replace ozone depleting chemical substances, but it is also emitted in the process of HCFC-22 production. PFCs and SF_6 are emitted in various industrial processes, including aluminium and magnesia production, production of semiconductors, in transmission and distribution of electric power, etc. All these gases have a long lifetime in atmosphere and are characterized by a considerable infrared radiation absorption capacity, so that in the future it might have a considerable impact on the global warming.

2.1.3. Global Warming Potential

The radiative forcing effect of a gas in the atmosphere is the reflection of its ability to cause atmospheric warming. Direct effects occur when the gas itself is a GHG, while indirect radiative forcing occurs when chemical transformation of the original gas produces a gas or gases that are GHGs or when a gas influences the atmospheric lifetimes of other gases.

The concept of "Global Warming Potential" (GWP) has been developed to allow scientists and policy-makers to compare the ability of each GHG to trap heat in the atmosphere. By definition, a GWP is the time-integrated change in radiative forcing due to the instantaneous release of 1 kg of gas expressed relative to the radiative forcing from the release of 1 kg of CO_2. In other words, GWP is a relative measure of a warming effect that the emission of a radiative gas (i.e., GHG) might have on the surface of troposphere. The GWP of a GHG takes into account both the instantaneous radiative forcing due to an incremental concentration increase in the atmosphere and the lifetime of these gases in the atmosphere.

This report relate to the GWP for a period of 100 years recommended by the IPCC (IPCC Second Assessment Report, 1996) for use in GHG emissions inventory under UNFCCC and adopted at the COP 3 (Table 2-2).

2.1.4. Republic of Moldova's Contribution to Global Warming

In 1990, Republic of Moldova contributes only about 0.3 per cent of total global GHG emissions. Within the 1990-2010, the total national GHG emissions (without LULUCF) decreased by 69.3 per cent (Table 2-3), which is much more than in some industrialized countries and economies in transition included in Annex I to Convention (Figure 2-1).

[15] <http://cdiac.ornl.gov/pns/current_ghg.html>.
[16] <http://cleantechnica.com/2012/05/25/global-co2-emissions-reach-recordhigh-driven-fossil-fuel-use-rapidly-industrializing-nations/>.
[17] <http://www.globalmethane.org/documents/analysis_fs_en.pdf>.
[18] <http://globalchange.mit.edu/files/document/MITJPSPGC_Rpt206.pdf>.
[19] <http://edgar.jrc.ec.europa.eu/part_N2O.php#1overview>.

Table 2-2: GWP for a Period of 100 Years and Direct GHG Atmospheric Lifetimes

GHG	Chemical formula	Lifetime	SAR	TAR	AR4
Carbon dioxide	CO_2	50-200	1	1	1
Methane	CH_4	12	21	23	25
Nitrous oxide	N_2O	120	310	296	298
Sulphur hexafluoride	SF_6	3200	23900	22200	22800
Hydrofluorocarbons (HFC)					
HFC-23	CHF_3	264	11700	12000	14800
HFC-32	CH_2F_3	5.6	650	550	675
HFC-43-10mee	$C_5H_2F_{10}$	17.1	1300	1500	1640
HFC-125	C_2HF_5	32.6	2800	3400	3500
HFC-134a	$C_2H_2F_2$ (CH_2FCF_3)	14.6	1300	1300	1430
HFC-143a	$C_2H_3F_3$ (CF_3CH_3)	48.3	3800	4300	4470
HFC-152a	C_2H4F_2 (CH_3CHF_2)	1.5	140	120	124
HFC-227ea	C_3HF_7	36.5	2900	3500	3220
HFC-236fa	$C_3H_2F_6$	209	6300	9400	9810
Perfluorocarbones (PFC)					
Perfluoromethane	CF_4	50000	6500	5700	7390
Perfluoroethane	C_2F_6	10000	9200	11900	12200
Perfluoropropane	C_3F_8	2600	7000	8600	8860
Perfluorohexane	C_6F_{14}	3200	7400	9000	9300

Source: SAR – Second Assessment Report (IPCC, 1996), TAR – Third Assessment Report (IPCC, 2001) and AR4 – Fourth Assessment Report (IPCC, 2007).

Table 2-3: Republic of Moldova's Direct GHG Emissions, 1990-2010, Mt CO_2 equivalent

Categories of emissions and stocks	1990	1995	2000	2005	2006	2007	2008	2009	2010
Total	**43.2598**	**17.3809**	**10.9108**	**12.9399**	**12.1180**	**11.3894**	**13.1216**	**13.1243**	**13.2761**
Total net emission	36.0828	16.2228	10.1287	12.8357	11.7152	8.7796	13.2525	12.2528	13.3025
1. Energy	**34.5204**	**11.7107**	**6.6623**	**8.5189**	**7.7036**	**7.4085**	**8.4274**	**9.0660**	**8.9465**
A. Fuel Combustion Activities	33.8375	11.1547	6.1589	7.8586	7.1283	6.7968	7.8186	8.5617	8.4575
1. Energy Industries	19.3933	6.9318	3.1524	3.2361	2.4941	2.4761	3.2951	4.4605	4.1946
2. Manufacturing Industries and Construction	2.1959	0.4530	0.5318	0.5919	0.6517	0.8179	0.9131	0.5086	0.5407
3. Transport	4.0556	1.3382	0.8634	1.6563	1.5817	1.6509	1.7417	1.6583	1.9047
4. Other Sectors	8.0378	2.2585	1.5503	2.2558	2.2507	1.6982	1.7062	1.8534	1.6925
5. Other Works and Needs in Energy Sector	0.1549	0.1733	0.0610	0.1185	0.1501	0.1537	0.1625	0.0809	0.1251
B. Fugitive Emissions from Oil and Natural Gas	0.6829	0.5560	0.5034	0.6603	0.5752	0.6117	0.6088	0.5043	0.4890
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	0.6829	0.5560	0.5034	0.6603	0.5752	0.6117	0.6088	0.5043	0.4890
2. Industrial Processes	**1.9010**	**0.4915**	**0.2812**	**0.5684**	**0.6638**	**0.9458**	**1.0222**	**0.5201**	**0.5650**
A. Mineral Products	1.8881	0.4775	0.2512	0.5097	0.6041	0.8674	0.9292	0.4247	0.4576
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	0.0130	0.0120	0.0166	0.0192	0.0124	0.0177	0.0162	0.0078	0.0044
D. Other Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
E. Production of Halocarbons and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6	NO, NE	0.0019	0.0134	0.0395	0.0474	0.0607	0.0768	0.0876	0.1030
3. Solvents and Other Products Use	**0.0908**	**0.0382**	**0.0316**	**0.0682**	**0.0482**	**0.0522**	**0.0536**	**0.0485**	**0.0539**
4. Agriculture	**5.1202**	**3.3591**	**2.2770**	**2.3734**	**2.2682**	**1.5151**	**2.1177**	**1.9249**	**2.1324**
A. Enteric Fermentation	1.8344	1.3608	0.9112	0.7784	0.7530	0.6088	0.5797	0.6027	0.5984
B. Manure Management	1.6368	0.9764	0.5705	0.5957	0.6179	0.4659	0.4653	0.5306	0.5564
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	1.6490	1.0219	0.7954	0.9993	0.8973	0.4404	1.0726	0.7916	0.9777
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	IE	IE	IE	IE	IE	IE	IE	IE	IE
5. LULUCF	**-7.1770**	**-1.1581**	**-0.7821**	**-0.1042**	**-0.4028**	**-2.6098**	**0.1309**	**-0.8715**	**0.0264**
A. Forest Land	-2.1972	-1.6208	-2.1403	-2.2462	-2.0876	-2.1895	-2.2228	-2.2513	-2.1931
B. Cropland	-4.1933	1.0822	2.1838	2.9614	2.4915	0.3786	3.1430	2.1616	2.9771
C. Grassland	-0.7865	-0.6195	-0.8255	-0.8195	-0.8067	-0.7988	-0.7893	-0.7818	-0.7576
D. Wetlands	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Settlements	IE, NE	IE, NE	IE, NE	IE, NE	IE, NE	IE, NE	IE, NE	IE, NE	IE, NE
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**1.6274**	**1.7815**	**1.6586**	**1.4111**	**1.4343**	**1.4678**	**1.5007**	**1.5649**	**1.5783**
A. Solid Waste Disposal on Land	1.3201	1.5763	1.5091	1.2129	1.2399	1.2833	1.3087	1.3816	1.3881
B. Wastewater Handling	0.3073	0.2052	0.1495	0.1982	0.1943	0.1845	0.1921	0.1832	0.1902
C. Waste Incineration	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items	**0.4282**	**0.6875**	**0.4341**	**0.3627**	**0.3997**	**0.3731**	**0.4260**	**0.4039**	**0.3718**
International Bunkers	0.2174	0.0419	0.0662	0.0677	0.0760	0.0799	0.0893	0.0826	0.0827
CO_2 Emissions from Biomass	0.2108	0.6456	0.3679	0.2950	0.3237	0.2932	0.3367	0.3212	0.2891

Abbreviations: IE – Included Elsewhere; NE – Not Estimates; NO – Not Occurring

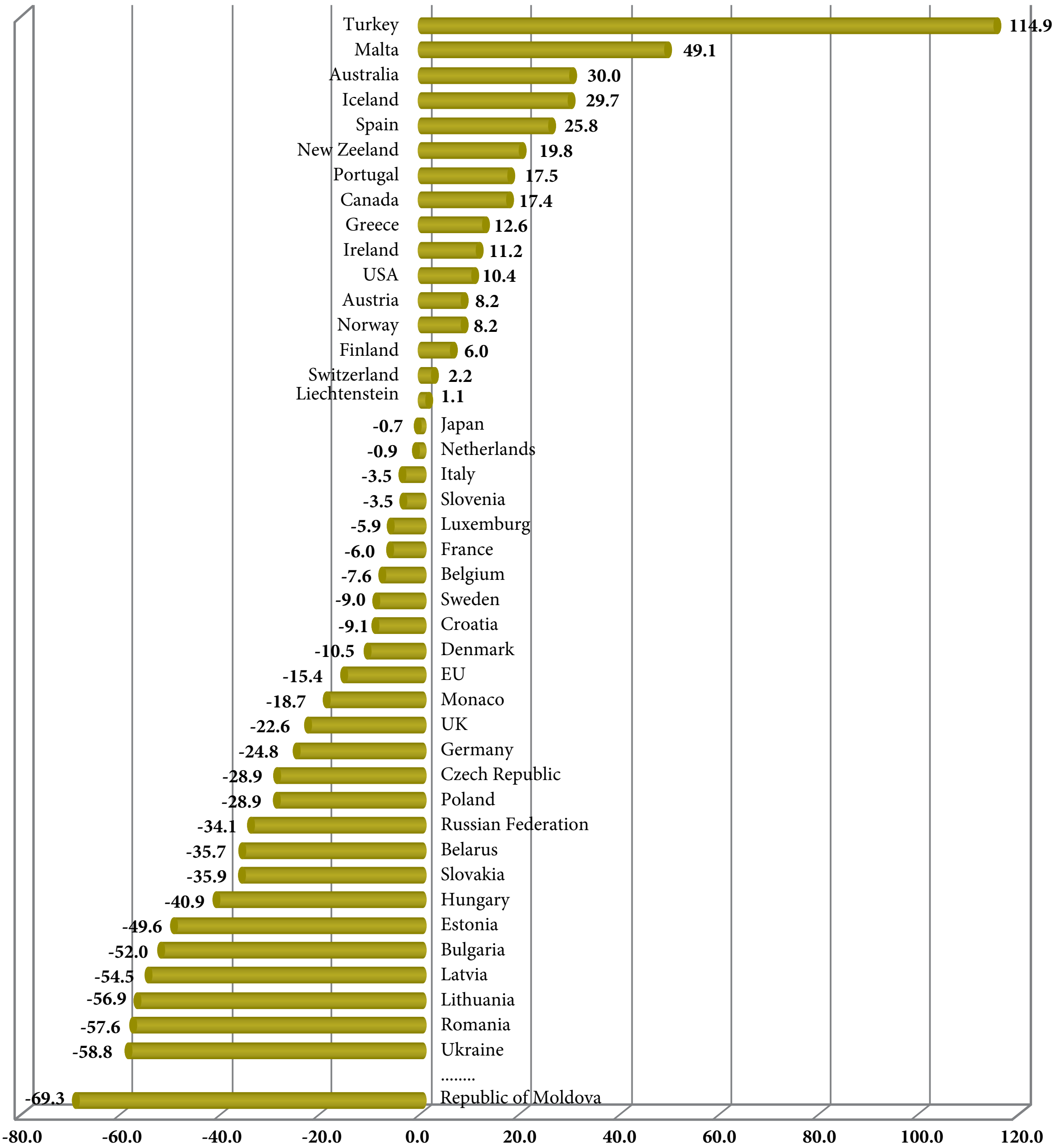


Figure 2-1: Change in Aggregate GHG Emissions for Annex I Parties and the Republic of Moldova, 1990-2010 (change relative to 1990, %)

2.2. Institutional Arrangements, Process for Inventory Preparation

2.2.1. Institutional Arrangements for Inventory Preparation

The Ministry of Environment (MoEN) of the Republic of Moldova is the state authority responsible for development and promotion of policies and strategies addressing environment protection, rational use of natural resources and biodiversity conservation. On behalf of the Government of RM, MoEN is in charge for implementation of international environment treaties to which RM is a Part (including UNFCCC). Representatives of MoEN also act as GEF and UNFCCC Focal Points.

In view of implementing and accomplishing the UNFCCC provisions, as well as mechanisms and provisions of Kyoto Protocol based on Order No. 21 as of February 11, 2004, the Climate Change Office (CCO) was established under the Ministry of Ecology, Constructions and Territory Development of the Republic of Moldova (*reorganized into Ministry of Environment and Natural Resources based on the Government Decision Nr. 357, as of April 23, 2005, respectively into the Ministry of Environment based on Law Nr. 21-XVIII as of September 18, 2009*).

The main tasks of the CCO are:

- providing logistical support to the Government, central and local public administration authorities, non-government and academic organizations, in activities implemented and promoted by the RM under the UNFCCC and Kyoto Protocol; and
- implementing climate change related projects and programs providing for such activities as:
  - GHG emissions evaluations and National Inventory Reports (NIRs) preparation;
  - development and implementation of GHG emissions mitigation projects;
  - development and implementation of projects aimed to adapt to climate change;
  - assessment of the climate change impact on environment and socio-economic components;
  - cooperation, promotion and implementation of activities and projects under the Clean Development Mechanism (CDM) of the Kyoto Protocol;
  - implementation and facilitation of activities aimed at building awareness and information among civil society, relevant experts and decision makers in climate change related issues, etc.

The National Inventory System (NIS) includes all institutional and legal arrangements associated with the national greenhouse gas inventory preparation process, as well as reporting this information on the national and international level. This process implies preliminary planning and preparation activities such as for example, defining specific responsibilities within the inventory preparation process. Such responsibilities are described in section 2.2.2 'Institutional and Legal Arrangements', while Section 2.3 'Process for Inventory Preparation' provides more details about the inventory preparation process.

2.2.2. Institutional and Legal Arrangements

As explained below in Figures 2-2 and 2-3, within the MoEN, the Climate Change Office (CCO) is totally responsible for the activities related to preparation of National Communications (NCs) and National Inventory Reports (NIRs). Further there are outlined the responsibilities and arrangements for the National Inventory System (NIS) of the Republic of Moldova.

Within the CCO the National Inventory Team (NIT) is responsible for estimating emissions by categories of sources and removals by categories of sinks, Key Sources Analysis (KSA), Quality Assurance (QA) and Quality Control (QC) procedures, uncertainties assessment, documentation, reporting and archiving of data related to GHG inventory preparation process.

Below is a brief description of functional responsibilities of the participants in the process:

- The National Inventory Team Leader (NITL), a full time employee in the CCO, is responsible for the inventory preparation process coordination, including supervision of estimating emissions by individual categories of sources and removals by individual categories of sinks, KSA, uncertainty analysis interpretation, QA&QC activities coordination, documentation and archiving the data used in the inventory preparation process, synthesis of sectoral reports - serving as basis for the NIR compilation.
- The task group leaders and national experts (hired on a contract basis) are responsible for estimating emissions by individual categories of sources and removals by individual categories of sinks at sectoral level (Energy, Industrial Processes, Solvents and Other Products Use, Agriculture, LULUCF and Waste). National experts are responsible for the AD collection, application of decision trees in terms of selecting suitable assessment methods and EFs, estimating emission uncertainties by individual categories of sources, as well as for taking correction measures as a response to QA&QC activities. The task group leaders are responsible for development the NIR's sectoral chapters.

The activity data (AD) needed for developing the national GHG inventories are available in the Statistical Yearbooks (SY), Energy Balances (EBs) and other sectoral statistic publications of the National Bureau of Statistics (NBS) of the Republic of Moldova.

It is worth mentioned that the activity data provided by the NBS of the RM in the Statistical Yearbooks, Energy Balances[20], sectoral statistical publications and on its website, as part of the statistical database (see on <http://statbank.statistica.md/pxweb/Database/EN/databasetree.asp>) are available for the period until 1992 for the whole territory of the Republic of the Moldova, while since 1993 only for the right bank of Dniester (without Transnitria, further referred as Administrative Territorial Units on the Left Bank of Dniester) .

The statistical data for the left bank of Dniester are collected by the State Statistical Service beside the Ministry of Economy of the ATULBD[21], being published in the Statistical Yearbooks[22], and other periodic statistical publications available on the website of the Ministry of Economy of the ATULBD (see on <http://www.mepmr.org/gosudarstvennaya-statistika/informacziya>).

[20] Energy Balances of the Republic of Moldova have been not developed only for two years, 1991 and 1992, respectively. CCO of the MoEN has copies of Energy Balances for 1990 and 1993-2011 years.
[21] State Statistical Service, Ministry of Economy of the ATULBD.
[22] CCO of the MoEN has copies of the Statistical Yearbooks of ATULBD for the years of 2000 and 2006-2012, covering the statistical data for the 1990 year and 1995-2011 periods.

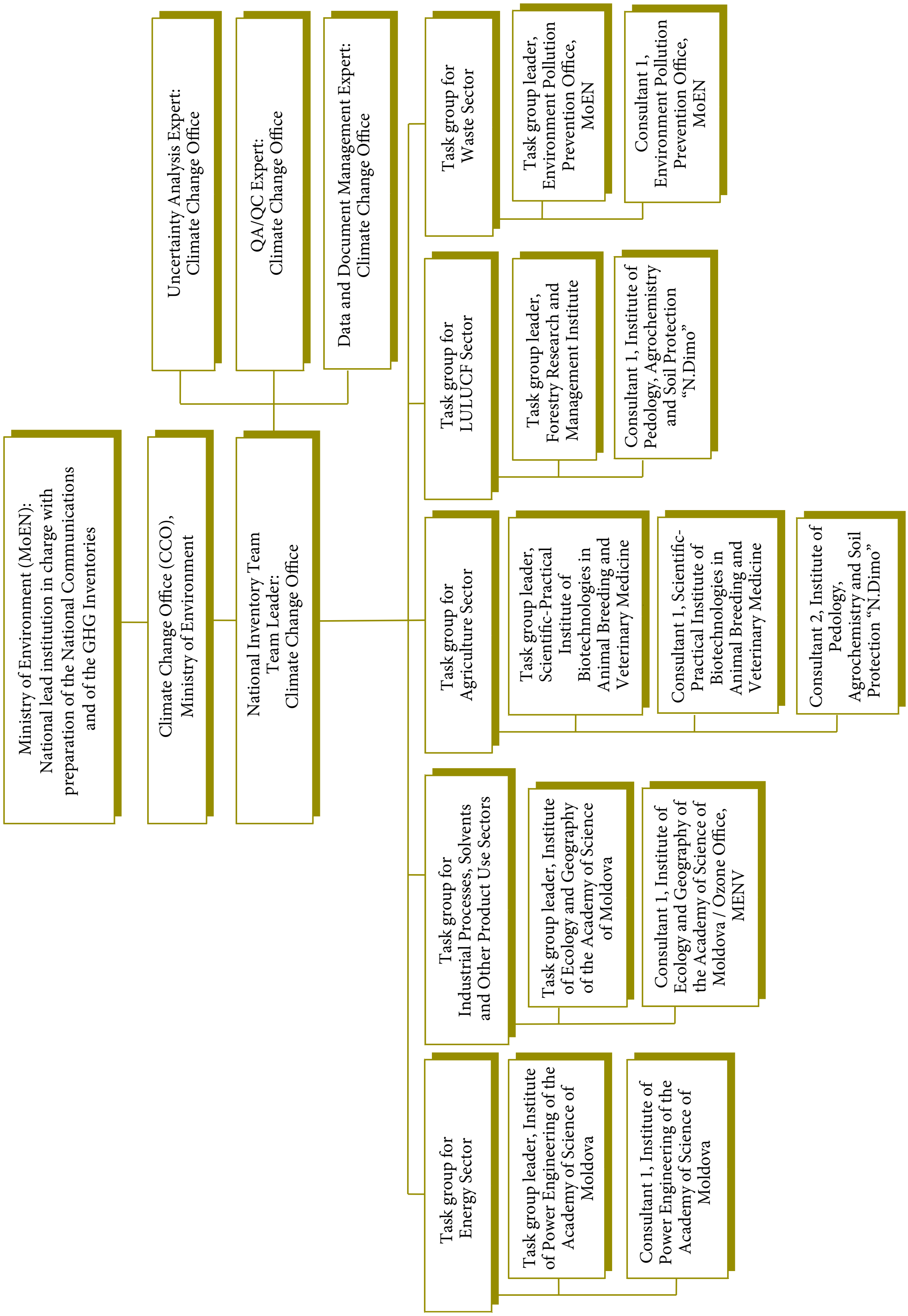


Figure 2-2: Institutional structure for developing the National GHG Inventories

Additional statistical data (unpublished) may be provided at request, in conformity with provisions of the Law nr. 412 as of 09.12.2004 on 'Official Statistics', Article 9 (2), item a) and b), according to which "*the official statistics authorities must disseminate statistical data to users in the amount, manner and terms specified in the statistical works programme*", as well as to "*to ensure access of all users to non-confidential statistic on equal conditions in terms of amount and terms of dissemination*".

Based on the provisions of the Law on Access to Information, adopted by the Decision of the Parliament No. 982-XIV as of 11.05.2000, other relevant activity data are collected by CCO of the MoEN (through surveys and questionnaires), from various state institutions and enterprises.

The main data providers (see also Figure 2-3) are mentioned below:

- from Ministry of Transports and Roads Infrastructure is collected information on the amount of fuel used to ensure operation of road, railway, navigation, air transport and asphalt production;
- from Civil Aeronautical Authority – information on the number of flights by type of aircrafts and amount of fuels used in air transportation;
- from State Enterprise 'Moldavian Railways" – information of fuel used for rail transport;
- from Ministry of Economy – data on fuel consumption and energy production at power plants;
- from Ministry of Information Technology and Communications – information on transport units registered, ages of fleet and/or production year and other relevant characteristics;
- from the Ministry of Agriculture and Food Processing Industry – data on livestock and poultry, as well as on fuel consumption and energy production at sugar plants;
- from the Ministry of Defence – information on fuel used by the National Army;
- from the Ministry of Health – information on use of medicines which contains aerosols (specifically on HFCs), as well as on use of N_2O for anaesthesia purposes;
- from Agency "Moldsilva" – information on forestry related statistics;
- from Agency for Geology and Mineral Resources – information on extraction of mineral resources, inclusive of limestone and dolomite use for cement production, glass production, iron and steel production, etc.;
- from State Ecological Inspectorate – information on illegal felling and stubble fields burning;
- from Ozone Office – information on import-export of freons in bulk and type of freons used in the imported refrigeration and air-conditioning equipment;
- from Land Relations and Cadastre Agency – information on available land by use;
- from Customs Service – statistics on import-export operations in the Republic of Moldova;
- from IPROCOM State Projections Institute – information on existing types of landfills currently operated in the Republic of Moldova, as well as their technical characteristics;
- from Municipal Enterprise "Regia Autosalubritate" in Chisinau – information on the amount of Municipal Solid Waste disposed on the Tintareni Landfill (MSW generated in the Chisinau municipality);
- from "Moldova-Gaz" J.S.C. – information on the amount of natural gas transited through the territory of the Republic of Moldova, as well as on the consumption of natural gas in the natural economy (the whole amount of natural gas used in the Republic of Moldova is imported by Moldova-Gas J.S.C. from Russian Federation),
- from Power Plants (Moldavian Thermal Power Plant, CHP-1 and CHP-2 in Chisinau and CHP-North in Balti) and Municipal Enterprise "TERMOCOM" S.A. – information on the amount of fuel used and energy production;
- from enterprises specialized in transportation and distribution of electricity (Î.S. „Moldelectrica", Î.C.S. „Red Union Fenosa", S.A. „Red-North", S.A. „Red North-West") – information on the amount of PFCs and SF_6 used in electrical equipment;
- from a range of industrial enterprises representing mainly the manufacture of non-metallic mineral products ("Lafarge-Ciment" J.S.C., "Macon" S.A., Glass Factory No. 1 in Chisinau, "Glass-Container" Company in Chisinau, "Cristal-Flor" Glass Company in Floresti, etc.) - information on industrial output, amount of mineral resources used, amount of fuel used, etc.

In the above mentioned context it is worth mentioned that the Article 1 of the Law on Access to Information regulates the relationships between information providers and individual / legal entity in the process of ensuring and implementing the constitutional right of access to information; principles, conditions, ways and manner of accomplishing access to official data owned by information providers; aspects of access to and protection of personal information within the scope of access to such data; rights of data solicitants, including petitioners of personal data; obligations of information providers in the process of ensuring access to official information; ways to protect the right to access to information.

Main data providers:

National Bureau of Statistics of the RM (<http://www.statistica.md/>)
Periodical publications (Statistic Yearbooks, Energy Balances, other sectoral publications), and activity data regarding: fuel consumption; industrial production; solvents use; livestock and poultry; agricultural production; solid waste disposal sites, etc.

Ministry of Economy of the Administrative Territorial Units on the Left Bank of Dniester (<http://www.mepmr.org/gosudarstvennaya-statistika/informacziya>)
Periodical publications (Statistic Yearbooks and other statistical publications) and activity data regarding: industrial production; livestock and poultry; agricultural production; fuel consumption in agriculture sector; electricity production, transport units, etc.

Customs Service (<http://www.customs.gov.md/>)
Provide statistics on import/export operations in the RM

Ministry of Transport and Road Infrastructure (<http://www.mtid.gov.md/>)
Information regarding amount of fuel used to ensure operation of road, railway, navigation, air transport and asphalt production

Civil Aeronautical Authority (<http://www.caa.md/>)
Provide data on the number of flights by types of aircraft and amount of fuels used

State Enterprise 'Moldavian Railways' (<http://www.railway.md/ru/>)
Provide data on fuel consumption in railways sector

Ministry of Agriculture and Food Industry (<http://www.maia.gov.md/>)
Provide data on livestock and poultry, fuel consumption and energy production at sugar plants

Power Plants and Energy Companies (Moldavian Thermal Power Plant, CHP-1, CHP-2, CHP-North, TERMOCOM SA)
Provide data on fuel consumption and energy production at power plants

Moldova-Gaz J.S.C. (<http://www.moldovagaz.md/>)
Provide data on internal consumption of natural and liquefied gases and amount of natural gas transiting the territory of the Republic of Moldova

Industrial Enterprises:
Steel Manufacturing Plants; Cement, Glass and Bricks Manufacturing Plants; Sugar Plants; Wine, Beer and Spirits Manufacturing Plants, etc.

Ozone Office (<http://ozon.md/>)
Provide data regarding consumption of F-gases

Agency "Moldsilva" (<http://www.moldsilva.gov.md/>)
Provide forestry related statistics

State Ecological Inspectorate (<http://inseco.gov.md/>)
Provide data on illegal fellings and stubble fields burning

Agency for Geology and Mineral Resources (<http://www.mediu.gov.md/md/asg/>)
Provide data on limestone and dolomite extracted for being used in the national economy, inclusive for production of cement, glass, iron and steel, etc.

IM Regia Autosalubritate (<http://www.chisinau.md/pageview.php?l=ro&idc=473>)
Provide data on amount of MSW deposited at landfills

Conference of Parties

United Nations Framework Convention on Climate Change

Ministry of Environment

GEF Political and Operational Focal Point, UNFCCC Focal Point

Climate Change Office

Full responsibility for compilation of the National Communications and National Greenhouse Gas Inventories composed of:
- National Inventory Reports;
- IPCC standardized reporting tables

QA & QC activities

Are endured through the support provided by relevant experts representing:
- Institute of Energy of the Academy of Sciences of Moldova – Energy Sector;
- Technical University of Moldova – Industrial Processes, Solvents and Other Product Use Sectors;
- Institute of Pedology, Agrochemistry and Soil Protection „N. Dimo", Agrarian University of Moldova – Agriculture Sector;
- Forest Research and Management Institute – LULUCF Sector;
- State Ecological Inspectorate – Waste Sector.

Figure 2-3: Institutional arrangements under the National Inventory System of the Republic Moldova

Article 4 (1) stipulates that "anyone, under this law's conditions, has the right to look for, receive and make public official information". According to Article 6 (1), "official information are deemed to be all information owned and available to information providers, developed, selected, processed, consolidated and /or adopted by authorities or official persons or made available to them by other legal entities". This Article is a review of information bearing documents as stipulated by the provisions of this law. Article 7 refers to cases of limited access to official information. Rights of data solicitants are reflected in Article 10, while Article 11 refers to the obligations of information provider.

According to Article 13 (1), ways of access to information are the following: hearing of information which can be provided verbally; document review on the premises of the institution; issuing a copy of the requested document or information; issuing a copy of the document, information translated into a different language than the language of the original, for an additional charge; sending by mail (including e-mail) of a copy of the document, information, a copy of the translated document, information into a different language, at the solicitant's request, for a payment. Article 13(2) stipulate that extracts from registers, documents, information, as per solicitant's request, can be made available to the solicitant in a reasonable and acceptable to the solicitant form.

Article 16 of the Law refers to the requirements that have to be met to ensure access to information: the requested information or documents shall be made available to the solicitant from the moment it becomes available for issuing, but not later than 15 working days from the date the application for access to information is registered; the leadership of the public institution may extend the term of providing the information, or document by 5 working days if: (1) the request refers to a very big volume of information requiring their selection; (2) additional consultations are needed to satisfy the request. The solicitant will be informed about any extension of the information delivery term and about the reasons for such extension 5 days prior to the expiry of the initial term. The Law also refers to cases when access to information is denied, to payments for official information provision, to modalities of protecting the right for access to information and prosecution in court of information providers' actions.

Also, a series of laws contain provisions pertaining to wide public to environment protection related information. So, Article 29 (3) of the Law on Natural Resources, adopted by the Parliament Decision No. 1102-XIII as of 06.02.1997, stipulates that „*Government, local public administration authorities, state bodies assigned with natural resources management and environment protection, as well as businesses, shall make public valid and accessible information regarding natural resources use and environment protection activities*".

Article 23 of the Forestry Code, adopted by the Parliament Decree No. 887 as of 21.06.1996, stipulates that "*citizens and NGO-s are entitled to receive information from the state forestry authorities and environment protection bodies about forestry and hunting resources, planned and accomplished conservation measures and use of such resources*".

The Regulation regarding trading and regulated use of halogenated hydrocarbons that deplete the ozone layer, approved by the Law of the Republic of Moldova No. 852-XV as of 14.02.2002, stipulates the procedure of presenting by the MENR of information regarding production, import, export, trading and use (recycled and reclaimed quantities of controlled substances) of halogenated hydrocarbons that deplete the ozone layer, regulated by Montreal Protocol.

2.3. Process for Inventory Preparation

The Climate Change Office adopted a centralized approach to the process of preparing the national inventory comprising the NIR and standard estimation and reporting tables. The National Inventory preparation process is outlined in Figure 2-4.

The National Inventory Team Leader (NITL) is responsible for compiling the estimations and ensuring consistency and quality of the inventory by producing the National Inventory Report (NIR). Estimation of emissions by individual source categories and removals by individual sink categories is the responsibility of national experts who are more competent about individual features of source/sink categories. The national experts, under direct coordination of the task group leaders and national inventory team leader, decide, by applying decision trees, on employing the best estimation methodology, collect AD needed for estimation.

For most source categories methodologies used in the previous inventory cycle are applied. Under such circumstances it was needed to collect new AD for a more recent period under review or for the entire period under review if historical AD were amended or recalculated. If a new source/sink category was to be assessed, or a higher Tier methodology had to be used, then the NITL, task group leaders and national experts would decide on which assessment methodology to use, collect most reasonable AD and EFs, calculate GHG emissions, assess uncertainties, ensured implementation of verification, QA/QC procedures acting on behalf of educational, academic institutions, ministries and subordinated institutions, central administrative authorities and/or private sector. National experts produce explanatory texts for the research on estimation of emissions by individual source categories and removals by individual sink categories, as well as provide the bibliography used.

NITL and task group leaders are responsible for collecting and reviewing these materials, used in drafting the NIR sec-

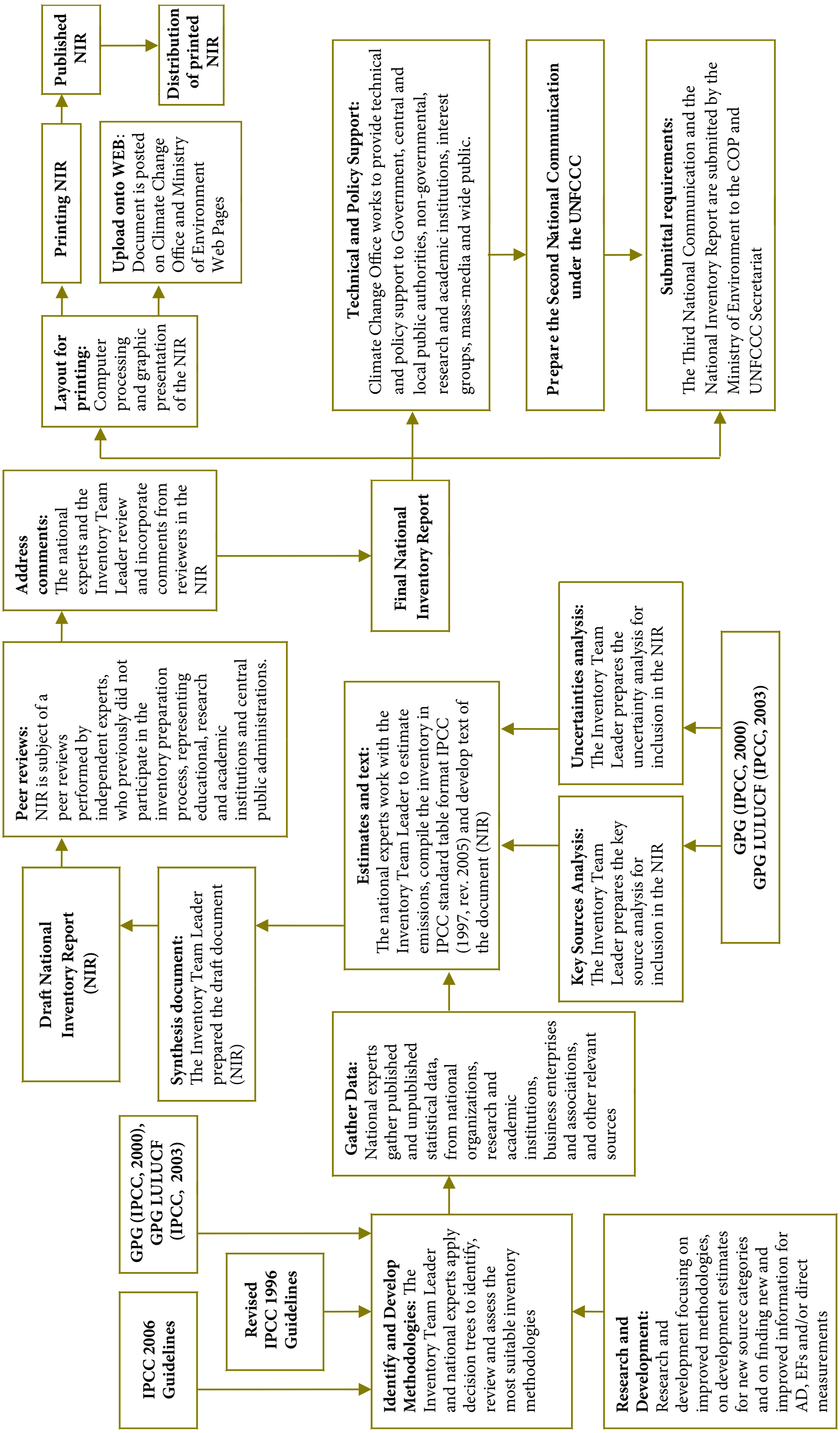


Figure 2-4: Inventory Process in the Republic of Moldova

toral chapters (Chapter 3 'Energy', Chapter 4 'Industrial Processes', Chapter 5 'Solvents and Other Products Use', Chapter 6 'Agriculture', Chapter 7 'LULUCF' and Chapter 8 'Waste').

The NITL is also responsible for drafting other chapters (Executive Summary, Chapter 1 'Introduction', Chapter 2 'Trends in National GHG Emissions', Chapter 9 'Recalculations', 'Bibliography' and 'Annexes'), as well as for checking the correctness of the key sources analysis, compatible with Good Practice Guidance - GPG (IPCC, 2000) and GPG for Land Use, Change in Land Use and Forestry Sector (IPCC, 2003) requirements.

The NIR was produced in compliance with UNFCCC reporting guidelines on annual inventories. In addition to NIR, IPCC standard common reporting format tables were filled-in. NITL and task group leaders have the task to monitor the process of development of standard common reporting format tables (see in **Annex 1**), to ensure the consistency of results.

The national experts accomplished the uncertainties analysis, as well as verification and QA/QC activities, in close cooperation with the task group leaders and NITL. The QA/QC Plan produced in 2005 within the UNDP-GEF Regional Project "Capacity Building for Improving the Quality of the National GHG Inventories (Central Europe and CIS region)" complies with the GPG (IPCC, 2000) requirements.

During the peer reviews, the draft version of the NIR was sent to a group of independent experts (who did not previously participate in the national inventory preparation). The purpose of the inventory peer reviews was to receive from relevant experts in the areas of major interest comments on quality of the work done, in particular on relevance of methodological approaches, EFs and AD used. The received comments were reviewed and estimations and explanatory notes to them were corrected.

Following the final review, after the incorporation of comments received in the process of peer reviews, the Climate Change Office prepared the final version of the National Inventory Report, which was then electronically processed, printed and published.

Once published, the National Inventory Report and the Third National Communication are submitted by the MoEN to the COP, in conformity with international commitments of the Republic of Moldova under the UNFCCC.

2.4. Methodological Issues

2.4.1. Methodologies, Emissions Factors and Data Sources

The national inventory is structured to match the reporting requirement of the UNFCCC and is divided into six main sectors: (1) Energy, (2) Industrial Processes, (3) Solvents and Other Products Use, (4) Agriculture, (5) Land Use, Land-Use Change and Forestry and (6) Waste. Each of these sectors is further subdivided, within the inventory, by source categories (Table 2-4).

Emissions of direct (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) and indirect (NO_x, CO, NMVOC and SO_2) greenhouse gases were estimated based on methodologies contained in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997).

Further, the National Inventory Team used methodologies available in Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000), GPG for Land Use, Land-Use Change and Forestry (IPCC, 2003), Atmospheric Emissions Inventory Guidebook (CORINAIR, 2009) and 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006).

Generally, a GHG inventory can be defined as *a "comprehensive account of anthropogenic sources of emissions and removals by sinks and associated data from source categories within the inventory area over a specified time frame"*. It can be prepared "top-down", "bottom-up", or using a combination approach. The Republic of Moldova's national inventory is prepared using a "top-down" approach, providing estimates at a sectoral level of segregation without attribution to individual emitters. Ideally, a GHG inventory should be developed by using direct measurements of emissions and removals from individual categories of sources or sinks in the country, considering the methodological approach "bottom-up".

The National Inventory Team is continuously working to improve accuracy, completeness and transparency of its inventory. Comprehensive bottom-up inventory is neither practicable nor possible at the present time, although for some sectors, estimates are derived from detailed source specific data.

To the extent possible, AD used in this report are based on officially published data: national (Statistical Yearbooks (SY) of the RM, respectively of the Administrative-Territorial Units from the Left Bank of Dniester river (ATULBD), Energy Balances (EBs), etc.) and international statistical publications (International Statistic Yearbook of Iron and Steel, UN FAO database), publications of academic, research and development institutions (Institute of Pedology, Agrochemistry and Soil Protection "N. Dimo", Institute of Ecology and Geography, Institute of Power Engineering, Forest Research and Management Institute, etc.), AD provided by ministries and subordinated institutions (MITC, MAFI, MD, MH, MTRI, CAA, MEC, SEI, SHS, Ozone Office) and central administrative authorities (National Bureau of Statistics, Forestry Agency "Moldsilva", Agency for Land Relations and Cadastre, Customs Service), data obtained from enterprises and businesses associations (State Enterprise "Moldavian Railways",

Table 2-4: Summary of Methods and Emission Factors Used for Inventory Preparation Process in the Republic of Moldova

Categories by sources and sinks	CO_2		CH_4		N_2O		HFC		PFC		SF_6	
	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF	Method	EF
1. Energy	**T1**	**D, CS**	**T1**	**D**	**T1**	**D**						
A. Fuel Combustion Activities	T1	D, CS	T1	D	T1	D						
1. Energy Industries	T1	D, CS	T1	D	T1	D						
2. Manufacturing Industries and Construction	T1	D, CS	T1	D	T1	D						
3. Transport	T1	D, CS	T1	D	T1	D						
4. Other Sectors	T1	D, CS	T1	D	T1	D						
5. Other (other works and needs in energy sector)	T1	D, CS	T1	D	T1	D						
B. Fugitive Emissions from Oil and Natural Gas	T1	D, CS	T1	D	T1	D						
1. Solid Fuels	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE						
2. Oil and Natural Gas	T1	D, CS	T1	D	T1	D						
2. Industrial Processes	**T2, T1**	**D, CS**	**T1**	**D**	**T1**	**D**	**T2, T1**	**D**	**NO, NE**	**NO, NE**	**T2, T1**	**D**
A. Mineral Products	T2, T1	D, CS	NA	NA	NA	NA						
B. Chemical Industries	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE						
C. Metal Production	T1	D	T1	D	T1	D						
D. Other Production	T1	D, CS	NA	NA	NA	NA						
E. Production of halocorbons and SF_6							NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
F. Consumption of halocorbons and SF_6							T2, T1	D	NO, NE	NO, NE	T2, T1	D
3. Solvents and Other Products Use	**C**	**D**	**NA**	**NA**	**C**	**D**						
A. Paint application	C	D	NA	NA	NA	NA						
B. Degreasing and dry cleaning	C	D	NA	NA	NA	NA						
C. Chemical Products, Manufacture and Processing	C	D	NA	NA	NA	NA						
D. Other	C	D	NA	NA	C	D						
4. Agriculture			**T2, T1**	**D, CS**	**T2, T1**	**D, CS**						
A. Enteric fermentation			T2, T1	D, CS	NA	NA						
B. Manure management			T2, T1	D, CS	T2, T1	D, CS						
C. Rice cultivation			NO	NO	NA	NA						
D. Agricultural soils			NA	NA	T1	D, CS						
E. Prescribed burning of savannas			NO	NO	NA	NA						
F. Field burning of agricultural residues			IE	IE	IE	IE						
5. LULUCF	**T2, T1**	**D, CS**	**T1**	**D**	**T1**	**D**						
A. Forest lands	T2, T1	D, CS	T1	D	T1	D						
B. Croplands	T2, T1	D, CS	T1	D	T1	D						
C. Grasslands	T2, T1	D, CS	NE	NE	NE	NE						
D. Wetlands	NE	NE	NE	NE	NE	NE						
E. Settlements	IE	IE	NE	NE	NE	NE						
6. Waste			**T2, T1**	**D, CS**	**T1**	**D**						
A. Solid Waste Disposal on Land			T2, T1	D, CS	NA	NA						
B. Wastewater Handling			T1	D, CS	T1	D						
C. Waste Incineration			NO, NE	NO, NE	NO, NE	NO, NE						
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**						
International bunkers	T2, T1	D, CS	T1	D	T1	D						
CO_2 emissions from biomass	T1	D, CS										

Abbreviations: T1 – Tier 1 Method; T2 – Tier 2 Method; C – CORINAIR; CS – Country Specific; D – Default; IE – Included Elsewhere; NA – Not Applicable; NE – Not Estimates; NO – Not Occurring.

"Moldova-Gas" J.S.C., "Lafarge-Ciment" J.S.C., "Macon" J.S.C., "Glass Company Plant in Chisinau", "Glass Container Company" J.S.C., M.E. "Cristal-Flor" J.S.C., etc.), legislation acts (*National Complex Program of Enhancing Soil Fertility in 2001-2020*, approved by the Government Decree No. 591 as of 20.06.2000; C*omplex Program for Reclamation of Degraded Lands and Enhancing Soils Fertility. Part I Reclamation of degraded lands*, approved by the Government Decree No. 636 as of 26.05.2003 and C*omplex Program for Reclamation of Degraded Lands and Enhancing Soils Fertility, Part II Enhancing Soils Fertility*, approved by the Government Decree No. 841 as of 26.07.2004, etc.).

2.4.2. Key Categories

According to GPG (IPCC, 2000, 2003), it is *good practice* to identify *key categories*, as it helps prioritize efforts and improve the overall quality of the national inventory.

A "key category" is defined as a "source or sink category, that is prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions, the trend in emissions, or both."

Table 2-5 presents the key categories for the Republic of Moldova inventory based on the Tier 1 methodological approach [with LULUCF: 18 key categories by level (L) and 17 key categories by trend (T); without LULUCF: 17 key categories by level (L) and 15 key categories by trend (T)] using emissions data for the 1990-2010 period.

Following the recommendations set in the GPG (IPCC, 2000, 2003), the inventory was first disaggregated by source and sink categories which further were used to identify key categories. Source categories were defined in conformity with the following guidelines:

- IPCC categories should be used with emissions specified in CO_2 equivalent units according to standard GWP;
- a category should be identified for each gas emitted by the sources, since the methods, emission factors, and related uncertainties differ for each gas;
- source categories that use the same emission factors based on common assumptions should be aggregated before analysis.

Key categories were identified from two perspectives:

- the first analysis the emission contribution that each category makes to the national total (with and without LULUCF); and
- the second perspective analysis the trend of emission contributions from each category to identify where the greatest absolute changes (either increases or reductions) have taken place over a given time (with and without LULUCF categories).

The per cent contributions to both levels and trends in emissions are calculated and sorted from greatest to least.

Table 2-5: Summary Overview of the Republic of Moldova's Key Sources Categories for 1990-2010, Based on Tier 1 Approach

IPCC classification	Key Categories by Sources/Sinks	Gas	Tier 1 Approach				2010 GHG Emissions (Gg CO_2 eq.)
			With LULUCF		Without LULUCF		
			L	T	L	T	
1A1	Energy Industries - Gas	CO_2	X	X	X	X	3564.3081
5B	Cropland	CO_2	X	X			2977.0255
5A	Forest lands	CO_2	X	X			-2193.2612
1A3b	Road Transportation	CO_2	X		X	X	1792.4501
6A	Solid Waste Disposal on Land	CH_4	X	X	X	X	1388.0583
1A4b	Other: Residential	CO_2	X	X	X	X	1017.2414
4D	Direct Emissions from Agricultural Soils	N_2O	X	X	X	X	788.0248
5C	Grasslands	CO_2	X	X			-779.4600
4A	Enteric Fermentation	CH_4	X	X	X		598.3605
1A2	Manufacturing Industries and Construction	CO_2	X	X	X	X	539.2384
1A1	Energy Industries - Coal	CO_2	X	X	X	X	491.5622
1B2	Fugitive Emissions from Oil and Natural Gas	CH_4	X		X	X	487.1800
1A4a	Other: Commercial/Institutional	CO_2	X	X	X		480.8328
4B	Direct Emissions from Manure Management	N_2O	X	X	X	X	412.2018
2A1	Cement Production	CO_2	X	X	X		349.8365
4D	Indirect Emissions from Agricultural Soils	N_2O	X	X	X	X	189.6854
1A4c	Other: Agriculture/Forestry/Fishing	CO_2	X	X	X	X	155.8803
1A1	Energy Industries – Residual Fuel Oil	CO_2	X	X	X	X	132.4424
1A5	Other (Energy)	CO_2			X	X	124.4914
6B	Wastewater Handling	CH_4			X		107.8000
2A3	Limestone and Dolomite Use	CO_2				X	74.4613
1A3c	Railways	CO_2		X		X	67.1844
Sub-total without LULUCF							**12761.2401**
Total National Emissions without LULUCF							13275.9981
Per cent of Total without LULUCF							96.12%
Sub-total with LULUCF							**12765.5445**
Total National Emissions with LULUCF							13302.3867
Per cent of Total with LULUCF							95.96%

Abbreviations: L – Level Assessment; T – Trend Assessment

The 95 per cent cumulative contribution threshold has been used in this analysis to define an upper boundary for the key category identification.

The Key Sources Analysis (KSA) was carried out using the Key Source Calculation Tool developed by the United States Environment Protection Agency (US EPA).

2.4.3. Quality Assurance and Quality Control

Fallowing the GPG recommendations (IPCC, 2000), national inventories have to be transparent, well documented, consistent, complete, comparable, assessed for uncertainties, subject to verification and QA/QC.

Good Practice Guidance (IPCC, 2000) defines the QA/QC terms as follows:

- *Quality Control* (QC) is a system of routine technical activities to measure and control the quality of the inventory as it is being developed. A basic QC system should provide routine and consistent checks to ensure data integrity, correctness, and completeness; identify and address errors and omissions; and document and archive inventory material and record all QC activities;
- *Quality Assurance* (QA) comprises a planned system of review procedures conducted by personnel not directly involved in the inventory compilation and development process.

As a part of continuous efforts to develop a transparent and reliable inventory, during 2005, under the UNDP-GEF Regional Project "Capacity Building for Improving the Quality of Greenhouse Gases National Inventories (Central Europe and CIS region)", the Republic of Moldova developed a "*Quality Assurance and Quality Control Plan*" and the "*Procedures Manual for Quality Assurance and Quality Control Plan*".

The key attributes of the "*Quality Assurance and Quality Control Plan*" include Tier 1 (general procedures) and Tier 2 (source-specific procedures) detailed specific procedures (Figure 2-5) and standard verification and quality control forms and checklists, that serve to standardize the process of implementing quality assurance and quality control activities meant to ensure the quality of the national inventory; peer review carried out by experts not directly involved in the national inventory development process; data quality check including by comparing the sets of data obtained from different sources; inventory planning and coordination at an inter-institutional level; as well as the continuous documentation and archiving of all materials used in inventory preparation process.

It is well known that inventory development implies huge amounts of information that has to be gathered, handled and stored. The process sustainability is ensured through a good management and archiving of materials used along the inventory process.

In the Republic of Moldova, the National Inventory Team has a sufficiently transparent documentation allowing to fully reproducing the GHG emissions estimates. A standard system for documenting and archiving numeric and qualitative information, in compliance with the Revised 1996 IPCC Guidelines (IPCC, 1997) and GPG (IPCC, 2000) recommendations was used.

The activity data sources were documented by inserting references to these into the inventory document text. Estimation methods & emission factors sources and their selection justification are documented in the corresponding chapters of the NIR. Recalculations made are documented and argued both in sectoral Chapters (3-8), as well as in the Chapter 9 'Recalculations and Improvements' of the NIR.

Individual source categories related documentation include: (1) list of personnel responsible for estimates and individual responsibilities as per Terms of Reference; (2) reference sources for the activity data used; (3); justification of emission factors estimation methods selection; (4) samples of GHG emissions estimation process (in Excel format); (5) uncertainties analysis results by individual source categories; (6) annexes; (7) references.

Materials used in the inventory development process were archived both electronically and on hard copies. As the entity responsible for the national inventory development, the CCO holds all documentation used for its compilation.

Summing up, one can assert that transparency and credibility of a national inventory are ensured through: the ability to demonstrate, through appropriate documentation, transparency of inventory development process; further improvements of the inventory process and its basic products; and ensuring that the inventory process employed consistent approaches allowing to obtain comparable results for all source categories.

It is obvious that in comparison with the previous inventory cycles, by continuous integration of QA/QC activities, the Republic of Moldova ensured a better quality inventory.

2.4.4. Recalculations

The NITL revised and recalculated GHG emissions and removals for each calendar year covered by the GHG Inventory for the period from 1990 through 2005, a component part of the SNC of the RM under the UNFCCC. These activities were carried out during the on-going process of improving the quality of the National GHG Inventory (inclusive, by taking into account the updated activity data, new methodological approaches and emission factors used, and identified errors correcting actions).

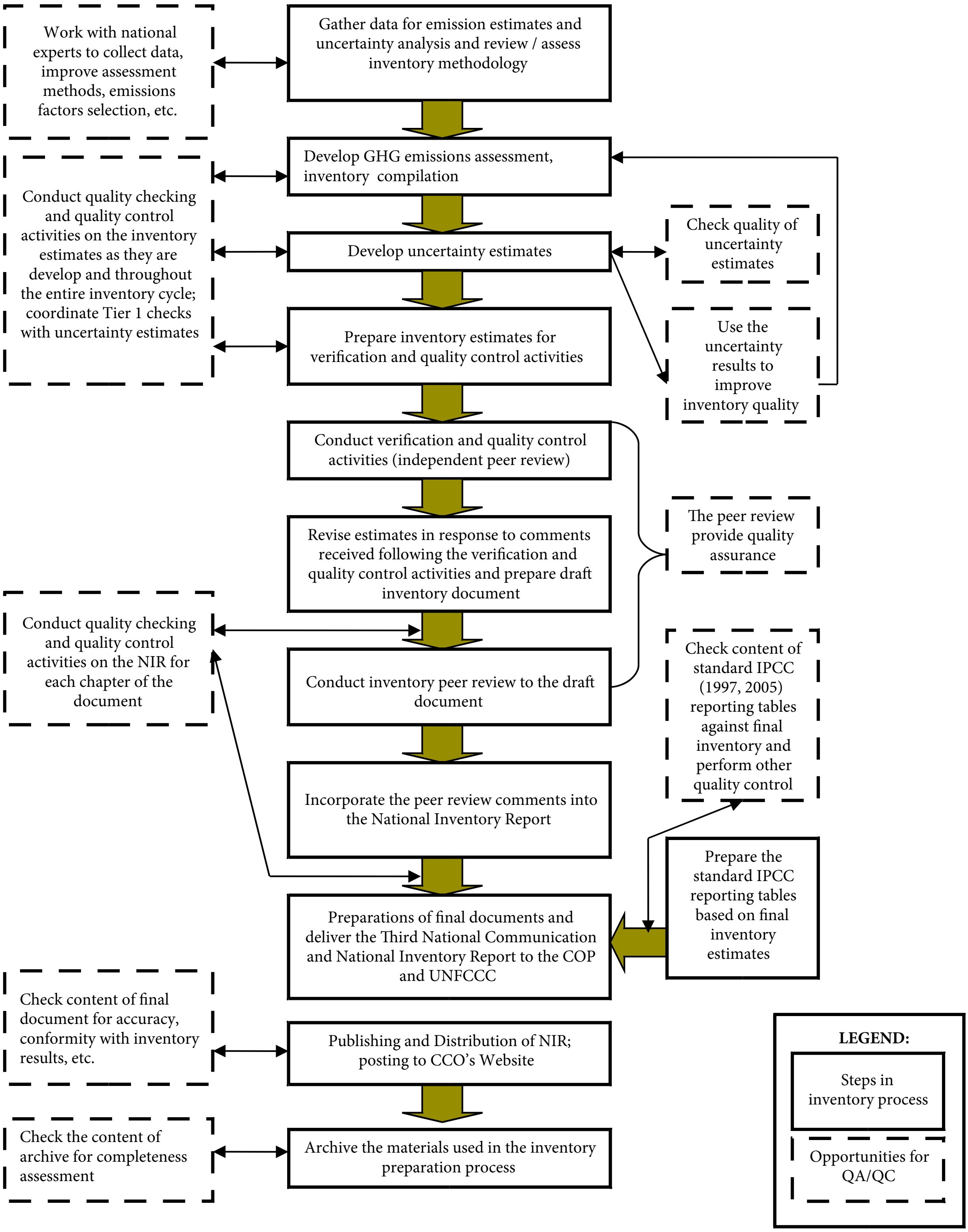


Figure 2-5: The Role of QA/QC Activities in the Inventory Preparing Process

Under the current inventory cycle, improvements were made in all sectors (move to higher tier methodologies, revision of previously used methodological approaches and emission factors, activity data, inclusion new emission sources, etc.), entailing the need to make recalculations of national GHG emissions for the time period from 1990 through 2005, reflected in the Chapter 2 'National GHG Inventory' of the SNC of the RM to the UNFCCC.

In comparison with the results reported under the SNC of the RM under the UNFCCC, the changes made during the development of the current inventory, resulted in increased values of total direct GHG emissions in the time period from 1990 through 2005, with a variation from a minimum of 0.5 per cent in 1992, to a maximum of 11.4 per cent in 1998 (Table 2-6).

With reference to the net direct GHG emissions included into the SNC of the RM under the UNFCCC, changes made in the development of the current inventory, resulted in a decreasing trend in GHG emissions during the 1990-1994 time periods, varying from a minimum of 2.4 per cent in 1994, up to 14.7 per cent in 1992 and in an increasing trend in GHG emissions during the 1995-2005 time periods, varying from a minimum of 1.4 per cent in 1995 to 24.1 per cent in 2004 (Table 2-7).

2.4.5. Uncertainty Assessment

Uncertainty estimates are an essential element of a complete and transparent emissions inventory. Uncertainty information is not intended to challenge the validity of inventory estimates, but to help prioritize efforts to improve the accuracy of future inventories and guide future decisions on methodological choice. While the RM's National Inventory Team calculates the emission estimates with the highest possible accuracy, uncertainties are associated to a varying degree with the development of emission estimates for any inventory.

Some of current estimates, such as those for CO_2 emissions from energy-related activities and cement processing, are considered to have minimal uncertainty associated with them. For some other categories of emissions, however, a lack of data, the use of emission factors used by default or an incomplete understanding of how emissions are generated increases the uncertainty surrounding the estimates presented.

Additional research in the following areas could help reduce uncertainty in the Republic of Moldova's Inventory:

- *Incorporating excluded emission sources.* Quantitative estimates for some of the sources and sinks of GHG emissions are not available at this time. In particular, emissions from a number of categories in Industrial Processes and Land Use, Land-Use Changes and Forestry sectors are not included in the inventory because data are incomplete.
- *Improving the accuracy of emission factors.* Further research is needed in some cases to improve the accuracy of emission factors used to calculate emissions from a variety of sources. For example, the accuracy of current emission factors applied to CH_4 fugitive emissions from oil and natural gas, emissions of CO_2 from solvents and other products use, indirect N_2O emissions from waste management and indirect N_2O emissions from agricultural soils etc., is highly uncertain.
- *Collecting more detailed activity data.* Although methodologies for estimating emissions for some sources exist, problems arise in obtaining activity data at a level of detail in which aggregate emission factor can be applied (for example, the ability to estimate emissions of F-gases (HFCs, PFCs and SF_6) from Industrial Processes sector is limited).

Table 2-6: Recalculations of Total Direct GHG Emissions included into the SNC of the RM under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
SNC	42.8860	38.1755	28.4969	22.7609	19.8476	16.7582	16.7713	14.6508
TNC	43.2598	38.8643	28.6479	23.1660	20.9036	17.3809	17.2985	16.0263
Difference, %	0.9	1.8	0.5	1.8	5.3	3.7	3.1	9.4
	1998	1999	2000	2001	2002	2003	2004	2005
SNC	12.6051	10.8223	9.8400	10.8259	10.9663	11.5323	11.6809	11.8835
TNC	14.0435	11.9511	10.9108	11.5891	11.3244	11.8425	12.5511	12.9399
Difference, %	11.4	10.4	10.9	7.0	3.3	2.7	7.5	8.9

Abbreviations: SNC – Second National Communication, TNC – Third National Communication.

Table 2-7: Results of the Total Net Direct GHG Emissions Recalculations included into the SNC of the RM under the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997
SNC	41.2128	37.0195	27.5809	22.2194	18.9747	16.0022	16.0317	13.3259
TNC	36.0795	33.7842	23.5364	20.7493	18.5244	16.2201	16.2899	16.1992
Difference, %	-12.5	-8.7	-14.7	-6.6	-2.4	1.4	1.6	21.6
	1998	1999	2000	2001	2002	2003	2004	2005
SNC	11.4486	9.5114	8.4868	9.4376	9.7344	10.2184	10.3618	10.5024
TNC	13.8533	11.3904	10.1276	11.3083	11.2526	10.7959	12.8607	12.8354
Difference, %	21.0	19.8	19.3	19.8	15.6	5.7	24.1	22.2

Abbreviations: SNC – Second National Communication, TNC – Third National Communication.

The overall inventory uncertainty was estimated using a Tier 1 methodological approach (IPCC, 2000). An estimate of the overall quantitative uncertainty, ±7.76 per cent level uncertainty and ±3.55 per cent trend uncertainty, are shown in Table 2-8.

Table 2-8: Estimated Overall National Inventory Quantitative Uncertainty, %

Indicator	CO_2	CH_4	N_2O	Total
Level Uncertainty	±9.70	±14.16	±28.83	±7.76
Trend Uncertainty	±4.08	±9.91	±8.36	±3.55

Emissions evaluated under the RM's GHG Inventory reflect current best estimates; in some cases, however, estimates are based on approximate methodologies, assumptions, and incomplete data. As new information become available in the future, the RM's National Inventory Team will continue to improve, revise and recalculate its GHG emission estimates.

2.4.5. Completeness Assessment

RM's National GHG Inventory is, mostly, a complete inventory of the following direct GHG – CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, using also the indirect GHGs such as CO, NO_x, NMVOC and SO_2.

Despite the effort to cover all existent sources and sinks, the inventory still has some gaps, most being determined by lack of activity data needed to estimate certain emissions and removals, such as: emissions of F-gases (HFCs, PFCs and SF_6) from 2F3 'Fire Extinguishers', 2F5 'Solvents' and 2F6 'Other Applications with ODS'; CO_2 emissions and removals from 5D 'Wetlands'; and GHG emissions from 6C 'Waste Incineration' (in particular, from medical waste).

As part of the improvement plan, during the future inventory activities, the National Inventory Team will continue the efforts to identify new and relevant data for the GHG emissions/removals assessment.

2.5. Reporting Greenhouse Gas Emissions

2.5.1. Summary of Direct GHG Emission Trends

Between 1990 and 2010, the total direct greenhouse gas emissions dynamic expressed in CO_2 equivalent, revealed a decreasing trend in the Republic of Moldova, reducing by circa 69.3 per cent: from 43.2598 Mt CO_2 equivalent in 1990 to 13.2761 Mt CO_2 equivalent in 2010 (Figure 2-6).

The most significant emissions reductions have been registered under the following source categories: 1A4 'Other Sectors' (-78.9 per cent), 1A1 'Energy Industries' (-78.4 per cent), 2A 'Mineral Products' (-75.6 per cent), 1A2 'Manufacturing Industries and Constructions' (-75.4 per cent), 4A 'Enteric Fermentation' (-67.4 per cent), 4B 'Manure Management' (-66.0 per cent), 2C 'Metal Production' (-65.9 per cent), 1A3 'Transport' (-53.0 per cent), 4D 'Agricultural Soils' (-40.7 per cent), 6B 'Wastewater Handling' (-38.1 per cent), etc.

Between 2009 and 2010, total direct GHG emissions increased in the Republic of Moldova by circa 1.2 per cent, in particular due to increased emissions from the source categories 1A5 'Other' (+54.6 per cent), 4D 'Agricultural Soil' (+23.5 per cent), 2F 'Consumption of HFCs and SF_6' (+17.6 per cent),

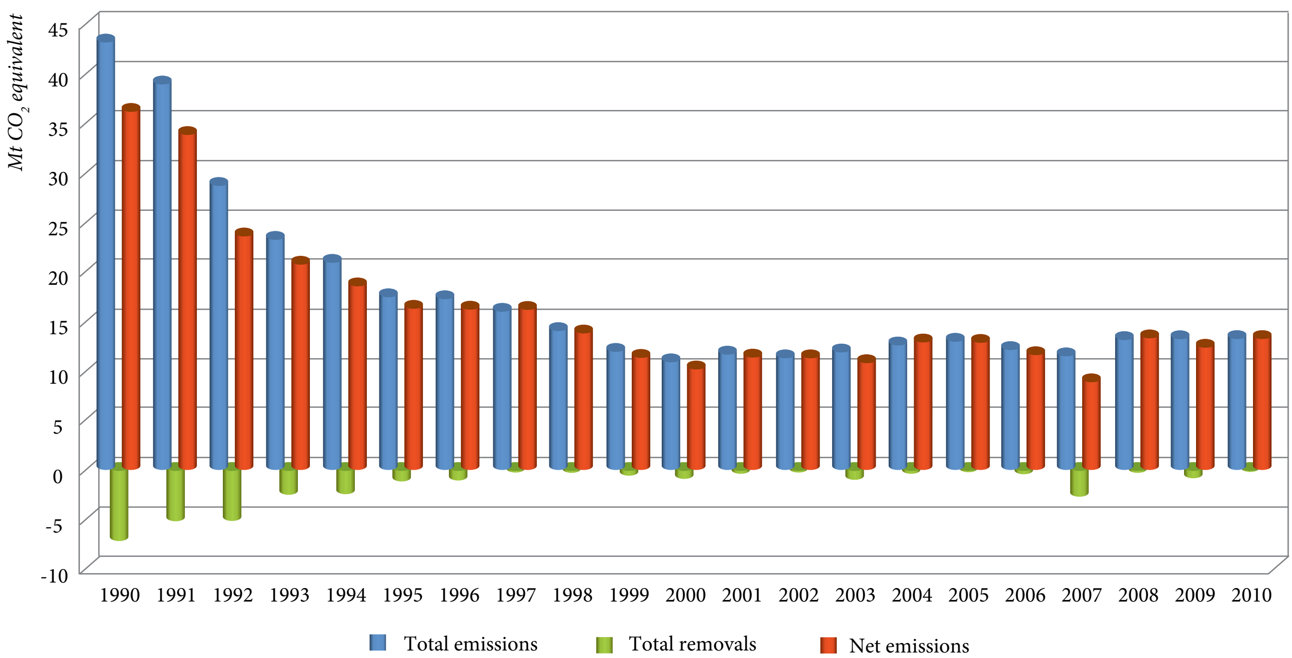


Figure 2-6: Greenhouse Gas Emission and Sink Trends in the Republic of Moldova, 1990-2010

1A3 'Transport' (+14.9 per cent), 3A-D 'Solvents and Other Products Use' (+11.0 per cent), 2A 'Mineral Products' (+7.7 per cent), 1A2 'Manufacturing Industries and Constructions' (+6.3 per cent), 4B 'Manure Management' (+4.9 per cent), 6B 'Wastewater Handling' (+3.8 per cent), etc.

2.5.2. Direct GHG Emission Trends by Gas

In the time series from 1990 through 2010, the total CO_2 emissions (without CO_2 removals in LULUCF sector) decreased by circa 74.9 per cent (from 35.3561 Mt in 1990, to 8.8852 Mt in 2010).

Emissions of CH_4 have decreased by circa 41.6 per cent (from 4.5884 Mt CO_2 eq. in 1990, to 2.6808 Mt CO_2 eq. in 2010, while emissions of N_2O decreased by circa 51.5 per cent (from 3.3153 Mt CO_2 eq. in 1990, to 1.6071 Mt CO_2 eq. in 2010) (Table 2-9).

Halocarbons emissions (HFCs, PFCs) and sulphur hexafluoride (SF_6) emissions have been registered so far in the Republic of Moldova commenced in 1995, considered as a reference year for F-gases (HFCs, PFCs and SF_6) in the Republic of Moldova. Evolution of these emissions denotes a steady trend towards increase in the last years, though their share in the total national emissions structure is insignificant for now.

CO_2 continue to contribute most to the total national direct greenhouse gas emissions in the Republic of Moldova. Figure 2-7 shows the variation of the share of direct GHG emissions by gas in the structure of total national emissions in 1990 and 2010.

In 2010, source categories of CO_2 having the biggest share in the total dioxide of carbon emissions in the Republic of Moldova were: 1A1 'Energy Industries' (4.1883 Mt or 47.0

Table 2-9: GHG Emissions in the Republic of Moldova within 1990-2010, Mt CO_2 eq.

	1990	1991	1992	1993	1994	1995	1996
CO_2 (without LULUCF)	35.3561	31.0769	21.8231	16.5959	14.9995	11.5570	11.6641
CO_2 (with LULUCF)	28.1758	25.9968	16.7116	14.1791	12.6202	10.3962	10.6555
CH_4 (without LULUCF)	4.5884	4.4620	4.3616	4.1363	4.0357	3.8149	3.7936
CH_4 (with LULUCF)	4.5907	4.4640	4.3635	4.1388	4.0371	3.8169	3.7950
N_2O (without LULUCF)	3.3153	3.3255	2.4631	2.4338	1.8684	2.0071	1.8367
N_2O (with LULUCF)	3.3163	3.3263	2.4639	2.4348	1.8690	2.0079	1.8373
HFCs	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	0.0019	0.0041
PFCs	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
SF_6	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
Total (without LULUCF)	43.2598	38.8643	28.6479	23.1660	20.9036	17.3809	17.2985
Total (with LULUCF)	36.0828	33.7870	23.5389	20.7527	18.5263	16.2228	16.2919
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
CO_2 (without LULUCF)	10.6911	9.0655	7.1684	6.3903	7.0002	6.6770	7.4889
CO_2 (with LULUCF)	10.8640	8.8753	6.6077	5.6070	6.7194	6.6052	6.4424
CH_4 (without LULUCF)	3.3948	3.2648	3.2389	3.1089	3.0090	3.0052	2.9385
CH_4 (with LULUCF)	3.3973	3.2671	3.2411	3.1097	3.0102	3.0055	2.9386
N_2O (without LULUCF)	1.9338	1.7038	1.5323	1.3983	1.5634	1.6227	1.3892
N_2O (with LULUCF)	1.9348	1.7047	1.5332	1.3986	1.5639	1.6228	1.3892
HFCs	0.0066	0.0095	0.0115	0.0134	0.0165	0.0195	0.0259
PFCs	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
SF_6	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	0.0000
Total (without LULUCF)	16.0263	14.0435	11.9511	10.9108	11.5891	11.3244	11.8425
Total (with LULUCF)	16.2026	13.8565	11.3935	10.1287	11.3099	11.2530	10.7960
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
CO_2 (without LULUCF)	7.9717	8.3678	7.6996	7.6515	8.7307	8.9607	8.8852
CO_2 (with LULUCF)	8.2813	8.2632	7.2964	5.0388	8.8607	8.0887	8.9113
CH_4 (without LULUCF)	2.8866	2.8704	2.7878	2.6925	2.6923	2.6825	2.6808
CH_4 (with LULUCF)	2.8868	2.8706	2.7881	2.6942	2.6929	2.6828	2.6810
N_2O (without LULUCF)	1.6608	1.6622	1.5833	0.9846	1.6218	1.3935	1.6071
N_2O (with LULUCF)	1.6609	1.6623	1.5835	0.9859	1.6222	1.3937	1.6072
HFCs	0.0320	0.0394	0.0471	0.0604	0.0763	0.0871	0.1024
PFCs	NE, NO	NE, NO	0.0000	0.0000	0.0000	0.0000	0.0000
SF_6	0.0000	0.0000	0.0003	0.0004	0.0004	0.0005	0.0006
Total (without LULUCF)	12.5511	12.9399	12.1180	11.3894	13.1216	13.1243	13.2761
Total (with LULUCF)	12.8611	12.8357	11.7152	8.7796	13.2525	12.2528	13.3025

Abbreviations: NE – Not Estimated; NO – Not Occurring.

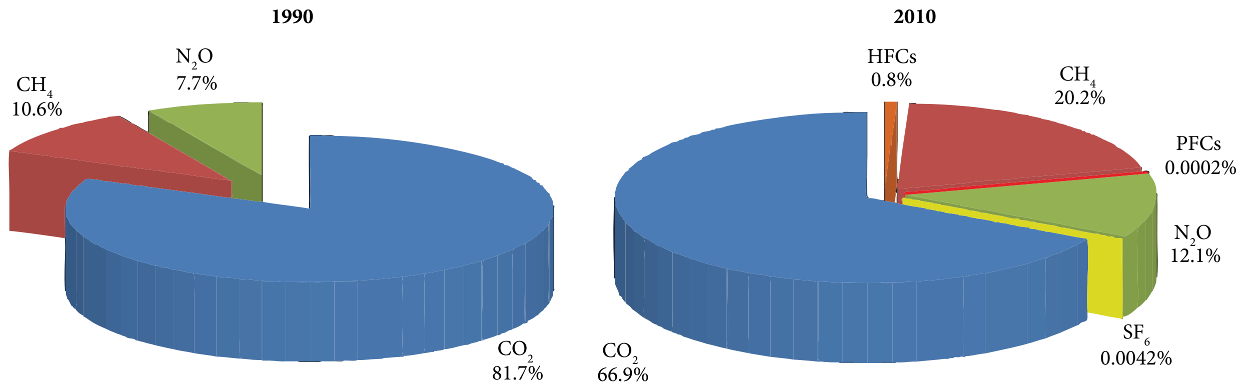


Figure 2-7: Breakdown of GHGs in the structure of total GHG emissions in the RM, 1990-2010

per cent of the total), 1A3b 'Road Transport' (1.8619 Mt or 20.9 per cent of the total), 1A4 'Other Sectors' (1.6540 Mt or 18.6 per cent of the total), 1A2 'Manufacturing Industries and Constructions' (0.5392 Mt or 6.1 per cent of the total), 2A 'Mineral Production' (0.4576 Mt or 5.1 per cent of the total) and 1A5 'Other' (0.1245 Mt or 1.4 per cent of the total) (Figure 2-8).

In 2010, the source categories of CH_4 having the biggest share in the total methane emissions in the Republic of Moldova were: 6A 'Solid Waste Disposal on Land' (1.3881 Mt CO_2 eq. or 51.8 per cent of the total), 4A 'Enteric Fermentation' (0.5984 Mt CO_2 eq. or 22.3 per cent of the total), 1B2 'Fugitive Emissions From Oil and Natural Gas' (0.4872 Mt CO_2 eq. or 18.2 per cent of the total), 6B 'Wastewater Handling' (0.1078 Mt CO_2 eq. or 4.0 per cent of the total), 4B 'Manure Management' (0.0574 Mt CO_2 eq. or 2.1 per cent of the total) and 1A4 'Other sectors' (0.0325 Mt CO_2 eq. or 1.2 per cent of the total) (Figure 2-9).

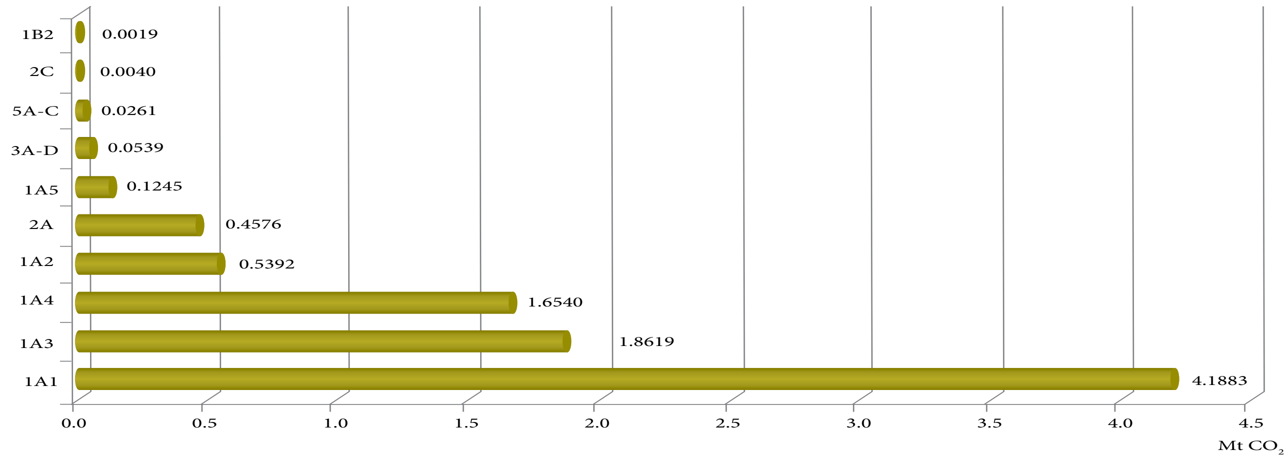


Figure 2-8: Source Categories of CO_2 in the Republic of Moldova, 2010

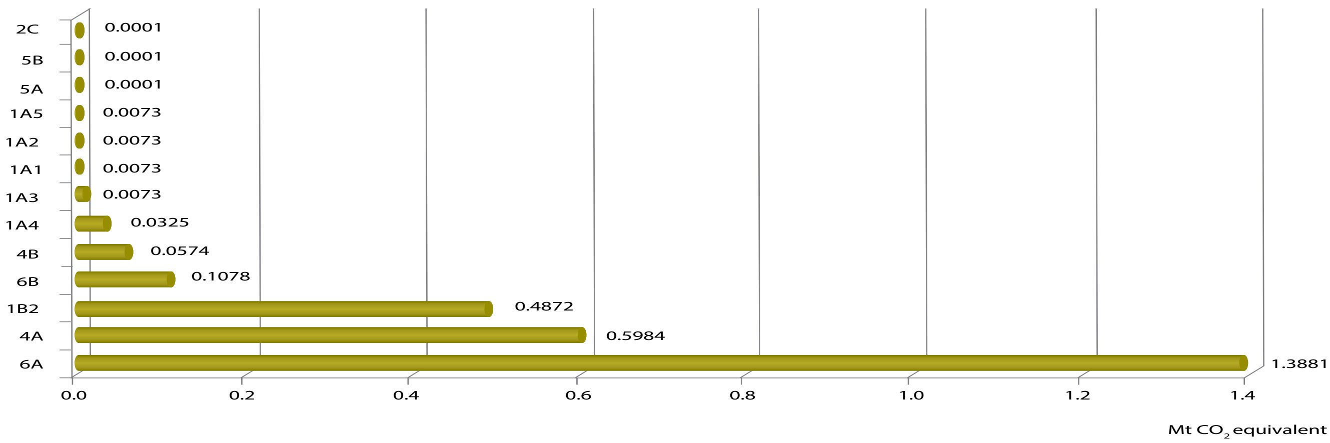


Figure 2-9: Source Categories of CH_4 in the Republic of Moldova, 2010

In 2010, the source categories of N_2O having the largest share in the total nitrous oxide emissions in the Republic of Moldova were: 4D 'Agricultural Soils' (0.9777 Mt CO_2 eq. or 60.8 per cent of the total), 4B 'Manure Management' (0.4989 Mt CO_2 eq. or 31.0 per cent of the total), 6B 'Wastewater Handling' (0.8245 Mt CO_2 eq. or 5.1 per cent of the total) and 1A3 'Transport' (0.3550 Mt CO_2 eq. or 2.2 per cent of the total) (Figure 2-10).

2.5.3. GHG Emission Trends by Sources

According to the UNFCCC Reporting Guidelines (IPCC, 1997), emissions estimates are grouped into six large categories: Energy Sector, Industrial Processes Sector, Solvents and Other Products Use Sector, Agriculture Sector, Land Use, Land-Use Change and Forestry Sector and Waste Sector. Interpretation of GHG emissions inventory results under Land Use, Land-Use Change and Forestry Sector is somewhat different from other sectors: positive figures indicate that this sector is a net source of emissions, while negative figures state that the sector is a net source of CO_2 removals.

In the time series 1990 through 2010, total GHG emissions in the Republic of Moldova tended to decrease, so emissions under Energy Sector decreased by circa 74.1 per cent, Industrial Processes Sector – by circa 70.3 per cent, Solvents and Other Products Use Sector – by circa 40.7 per cent, Agriculture Sector – by 58.4 per cent, Land Use, Land-Use Change and Forestry Sector – by 100.4 per cent, Waste Sector – by 3.0 per cent (Table 2-10).

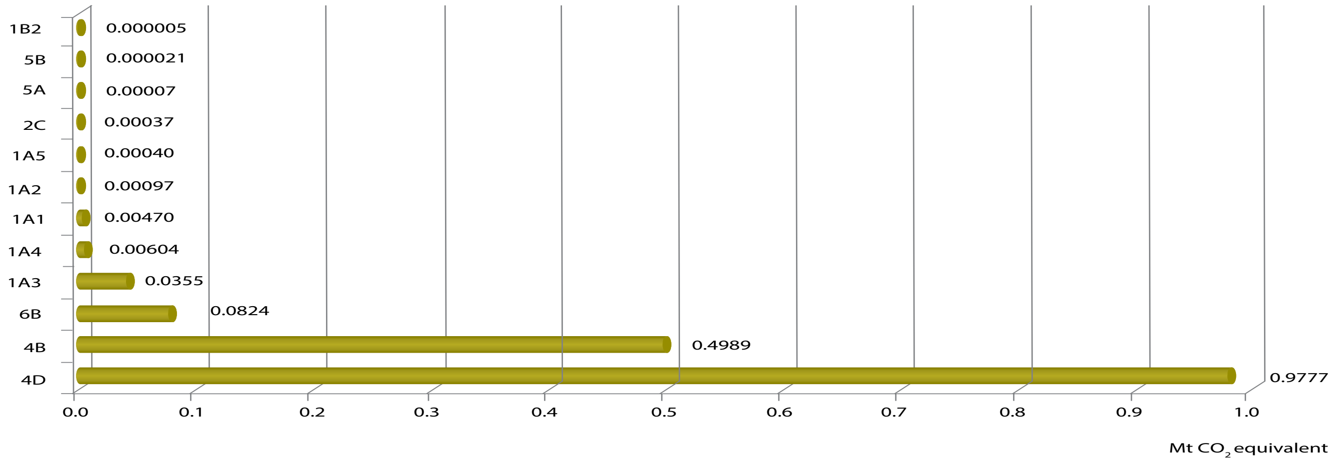


Figure 2-10: Source Categories of N_2O in the Republic of Moldova, 2010

Table 2-10: GHG Emissions in the Republic of Moldova by Sector within 1990-2010, Mt CO_2 eq.

	1990	1991	1992	1993	1994	1995	1996
1. Energy	34.5204	30.2204	21.3842	16.4752	15.0077	11.7107	11.9417
2. Industrial Process	1.9010	1.8067	1.1743	0.7701	0.6230	0.4915	0.4368
3. Solvents	0.0908	0.0782	0.0625	0.0508	0.0417	0.0382	0.0339
4. Agriculture	5.1202	5.0028	4.1542	4.0033	3.4099	3.3591	3.0718
5. LULUCF	-7.1770	-5.0773	-5.1089	-2.4133	-2.3773	-1.1581	-1.0066
6. Waste	1.6274	1.7563	1.8727	1.8665	1.8213	1.7815	1.8143
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
1. Energy	10.7761	9.2605	7.3728	6.6623	7.2653	6.9497	7.7622
2. Industrial Process	0.4898	0.3433	0.3086	0.2812	0.2727	0.3304	0.3828
3. Solvents	0.0299	0.0238	0.0309	0.0316	0.0453	0.0385	0.0357
4. Agriculture	2.9873	2.7318	2.4885	2.2770	2.4541	2.5246	2.1969
5. LULUCF	0.1763	-0.1870	-0.5577	-0.7821	-0.2791	-0.0714	-1.0465
6. Waste	1.7432	1.6841	1.7503	1.6586	1.5517	1.4812	1.4650
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
1. Energy	8.2344	8.5189	7.7036	7.4085	8.4274	9.0660	8.9465
2. Industrial Process	0.4288	0.5684	0.6638	0.9458	1.0222	0.5201	0.5650
3. Solvents	0.0438	0.0682	0.0482	0.0522	0.0536	0.0485	0.0539
4. Agriculture	2.4012	2.3734	2.2682	1.5151	2.1177	1.9249	2.1324
5. LULUCF	0.3099	-0.1042	-0.4028	-2.6098	0.1309	-0.8715	0.0264
6. Waste	1.4430	1.4111	1.4343	1.4678	1.5007	1.5649	1.5783

Energy Sector is the most important source of total national direct GHG emissions, its share varying from 79.8 per cent to 67.3 per cent over the time series from 1990 through 2010. Other relevant sources are represented by Agriculture Sector, Waste Sector, and Industrial Processes Sector (Figure 2-11).

Energy Sector

Energy-related activities are by far the largest source of GHG emissions in the Republic of Moldova. The Energy Sector includes emissions of all GHGs from fuel combustion for the primary purpose of delivering energy. Emissions in this sector are classified as either fuel combustion (94.5 per cent of total emissions per sector in 2010) or fugitive releases defined as intentional or unintentional releases of GHGs from the production, processing, transmission, storage, and delivery of fossil oil and natural gas (5.5 per cent of total emissions per sector in 2010) (Figure 2-12, Table 2-11).

Overall, these emissions accounted, in 2010, for 67.3 per cent of total Republic of Moldova's direct GHG emissions. Between 1990 and 2010, total GHG emissions from Energy Sector decreased by circa 74.1 per cent: from 34.5204 Mt CO_2 eq. in 1990 to 8.9465 Mt CO_2 eq. in 2010.

The 1A1 'Energy Industries' contribute more than any other category to the Republic of Moldova's emissions, accounting for circa 46.9 per cent of the total per sector in 2010 (56.2 per cent in 1990). Other relevant categories are represented by 1A3 'Transport', accounting for circa 21.3 per cent of the total (11.7 per cent in 1990) and 1A4 'Other Sectors', accounting for 18.9 per cent of the total per sector (23.3 per cent in 1990) (Figure 2-13).

Industrial Processes Sector

The Industrial Processes Sector represents an important GHG emission source in the Republic of Moldova that includes emissions generated by non-energy industrial activities. In 2010, this sector accounted for 4.2 per cent of the total national GHG emissions (4.4 per cent in 1990). During 1990-2010 time periods, total sectoral GHG emissions decreased by circa 70.3 per cent: from 1.9010 Mt CO_2 eq. in 1990, to 0.5650 Mt CO_2 eq. in 2010 (Table 2-12, Figure 2-14).

Between 2008-2009 respective emissions decreased by 49.1 per cent as a consequence of the global economic crises that significantly affected the industrial sector in RM. However, between 2009 and 2010, the total national GHG emissions

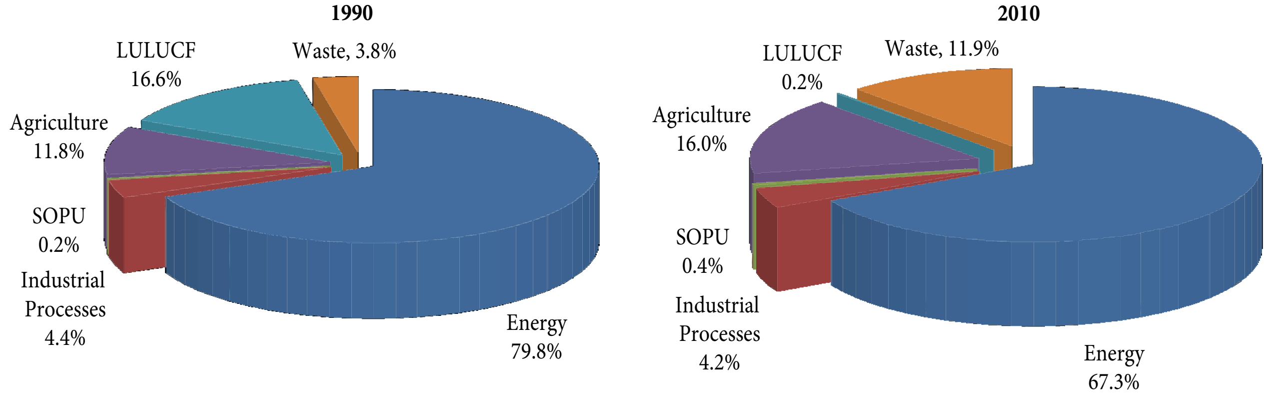


Figure 2-11: Sectoral Breakdown of the Total GHG Emissions in 1990 and 2010

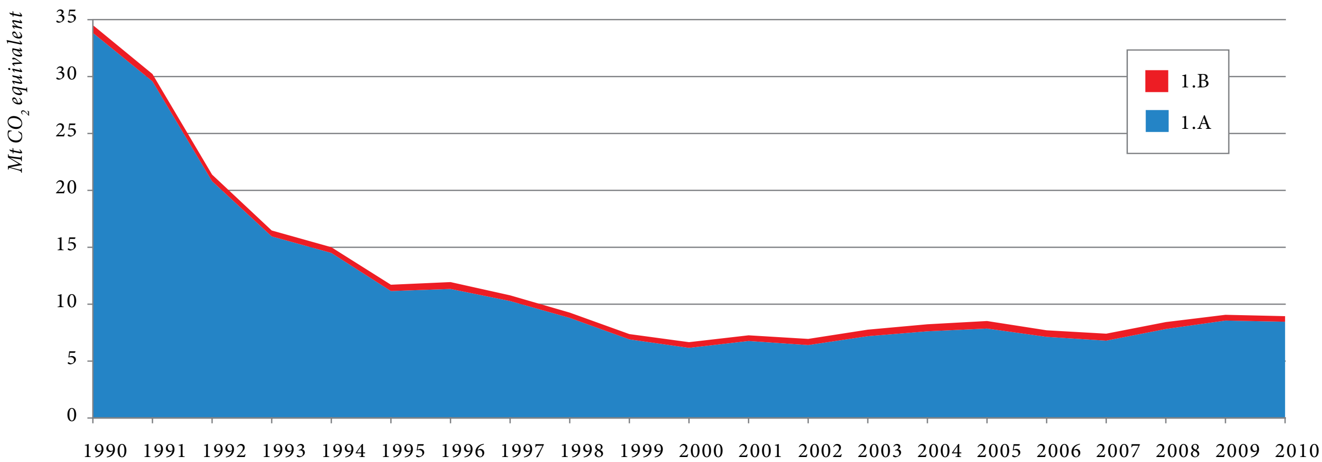
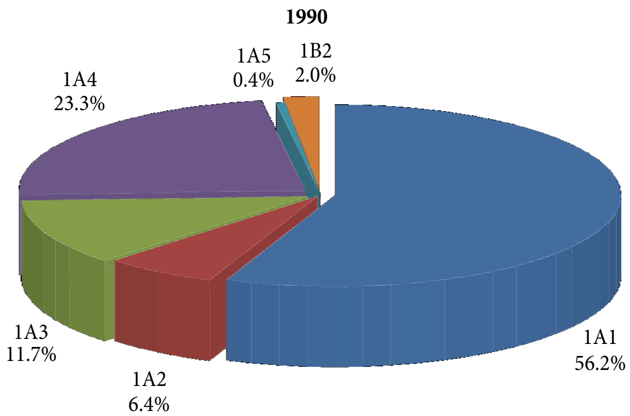


Figure 2-12: GHG Emissions from Energy Sector in the Republic of Moldova, 1990 – 2010

Table 2-11: GHG Emissions from Energy Sector, 1990–2010, Mt CO_2 equivalent

Source Categories	1990	1995	2000	2005	2006	2007	2008	2009	2010
1. Energy	**34.5204**	**11.7107**	**6.6623**	**8.5189**	**7.7036**	**7.4085**	**8.4274**	**9.0660**	**8.9465**
A. Fuel Combustion	33.8375	11.1547	6.1589	7.8586	7.1283	6.7968	7.8186	8.5617	8.4575
A.1. Energy Industries	19.3933	6.9318	3.1524	3.2361	2.4941	2.4761	3.2951	4.4605	4.1946
A.2. Manufacturing industries and constructions	2.1959	0.4530	0.5318	0.5919	0.6517	0.8179	0.9131	0.5086	0.5407
A.3. Transport	4.0556	1.3382	0.8634	1.6565	1.5816	1.6509	1.7417	1.6583	1.9047
A.3a. Civil Aviation	NO, NE	NO, NE	NO, NE	0.0002	0.0001	0.0002	0.0002	0.0001	0.0001
A.3b. Road Transport	3.4383	1.0927	0.7398	1.4908	1.4090	1.5069	1.6085	1.5725	1.8271
A.3c. Railways	0.5070	0.1617	0.0931	0.1290	0.1665	0.1398	0.1289	0.0759	0.0753
A.3d. Navigation	0.0191	0.0002	0.0001	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
A.3e. Pipeline Transport	0.0912	0.0836	0.0304	0.0361	0.0057	0.0038	0.0038	0.0095	0.0019
A.4. Other sectors	8.0378	2.2585	1.5503	2.2558	2.2507	1.6982	1.7062	1.8534	1.6925
A.4a. Institutional/Commercial	1.4241	0.3950	0.2300	0.7109	0.6529	0.3663	0.3717	0.4716	0.4847
A.4b. Residential	4.6573	1.1322	1.0811	1.3614	1.4195	1.1798	1.1851	1.2428	1.0509
A.4c. Agriculture/Forestry/Fishing	1.9564	0.7313	0.2393	0.1834	0.1783	0.1521	0.1494	0.1390	0.1569
A.5. Other works and needs in energy	0.1549	0.1733	0.0610	0.1185	0.1501	0.1537	0.1625	0.0809	0.1251
B. Fugitive Emissions	0.6829	0.5560	0.5034	0.6603	0.5752	0.6117	0.6088	0.5043	0.4890
B.1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
B.2. Oil and Natural Gas	0.6829	0.5560	0.5034	0.6603	0.5752	0.6117	0.6088	0.5043	0.4890

Abbreviations: NE – Not Estimates; NO – Not Occurring



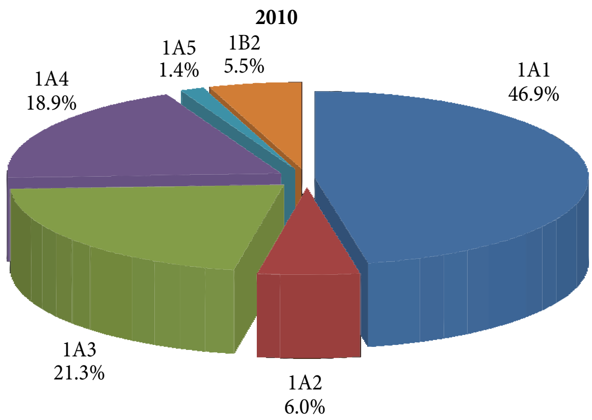


Figure 2-13: Energy Sector Greenhouse Gas Sources in the Republic of Moldova in 1990 and 2010

Table 2-12: GHG Emissions from Industrial Processes within 1990-2010, Mt CO_2 eq.

Source Categories	1990	1995	2000	2005	2006	2007	2008	2009	2010
2. Industrial Processes	**1.9010**	**0.4915**	**0.2812**	**0.5684**	**0.6638**	**0.9458**	**1.0222**	**0.5201**	**0.5650**
A. Mineral Products	1.8881	0.4775	0.2512	0.5097	0.6041	0.8674	0.9292	0.4247	0.4576
A1. Cement Production	0.9717	0.2485	0.1728	0.3651	0.4571	0.7027	0.7899	0.3406	0.3498
A2. Lime Production	0.1487	0.0282	0.0110	0.0066	0.0074	0.0110	0.0104	0.0033	0.0023
A3. Limestone and Dolomite Use	0.6195	0.1625	0.0322	0.0988	0.1010	0.1189	0.0942	0.0514	0.0745
A4. Soda Ash Use	0.0330	0.0146	0.0140	0.0182	0.0161	0.0142	0.0140	0.0101	0.0120
A7. Other Mineral Products	0.1153	0.0237	0.0213	0.0211	0.0225	0.0207	0.0207	0.0194	0.0189
B. Chemical Industry	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
C. Metal Production	0.0130	0.0120	0.0166	0.0192	0.0124	0.0177	0.0162	0.0078	0.0044
C1. Iron and Steel Production	0.0130	0.0120	0.0166	0.0192	0.0124	0.0177	0.0162	0.0078	0.0044
D. Other	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
E. Production of Halocarbons and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of Halocarbons and SF_6	NO, NE	0.0019	0.0134	0.0395	0.0474	0.0607	0.0768	0.0876	0.1030
F1. Refrigeration and Air Conditioning Equipment	NO, NE	0.0002	0.0081	0.0235	0.0270	0.0351	0.0462	0.0537	0.0654
F2. Foam Blowing	NO, NE	0.0017	0.0053	0.0159	0.0201	0.0252	0.0301	0.0334	0.0370
F4. Aerosols	NO, NE	NO, NE	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F8. Electrical Equipment	NO, NE	NO, NE	NO, NE	0.0000	0.0003	0.0004	0.0005	0.0005	0.0007

Abbreviations: NE – Not Estimates; NO – Not Occurring

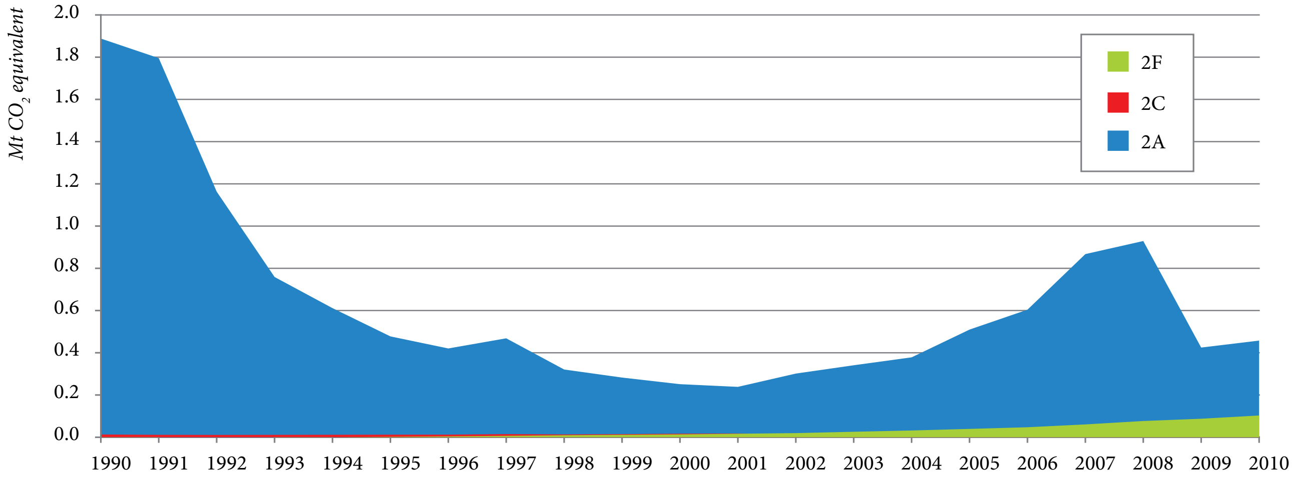


Figure 2-14: GHG Emissions from Industrial Processes within 1990–2010

increased by 8.6 per cent, in particular as a result of cement production growth, widespread use of limestone and dolomite, of soda ash (Na_2CO_3), as well as due to the increased use of halocarbons and SF_6.

The most important source of emission in this sector is represented by 2A1 „Cement Production", with a share of circa 61.9 per cent of the total sectoral emissions in 2010 (51.1 per cent in 1990) (Figure 2-15).

Other relevant sources in 2010 were represented by categories 2A3 'Limestone and Dolomite Use' accounting for 13.2 per cent from the total (32.6 per cent in 1990), 2F1 'Refrigeration and Air Conditioning Equipment' – circa 11.6 per cent from the total, 2F2 'Foam Blowing' – 6.5 per cent of the total, 2A7 'Other Mineral Products' (Mineral Wool Production, Brick Production, Expanded Clay Production) accounting 3.3 per cent from the total (6.1 per cent in 1990) and 2A4 'Soda Ash Use' accounting 2.1 per cent from the total (1.7 per cent in 1990).

Solvents and Other Products Use Sector

In the Republic of Moldova the Solvents and Other Products Use Sector is a modest source and includes emissions of non-methane volatile organic compounds (NMVOC), also considered as a CO_2 emissions source - as the majority of solvents are obtained from fossil fuels, as well as N_2O emissions from use of N_2O for anaesthesia. In 2010, the respective sector accounted for as little as circa 0.4 per cent of the total national GHG emissions (0.2 per cent in 1990).

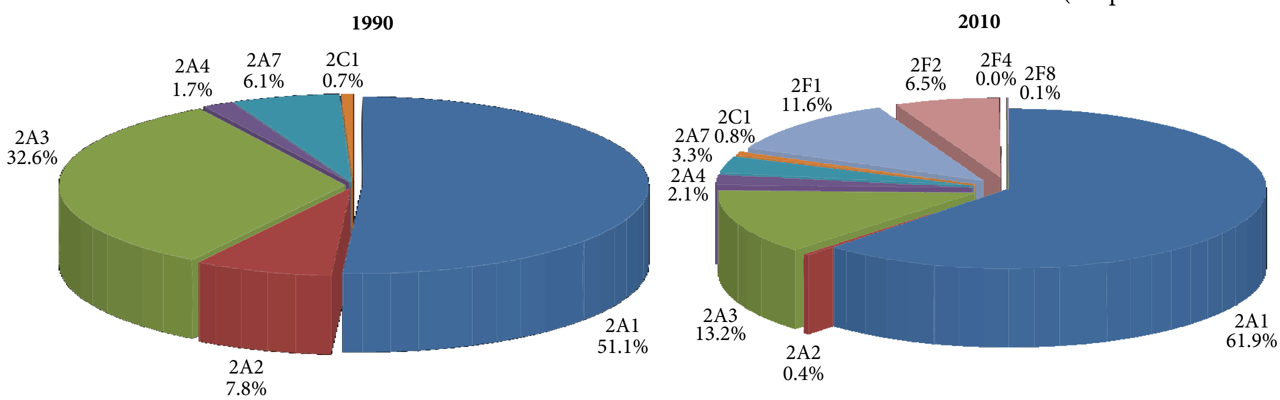


Figure 2-15: Breakdown of Industrial Processes' GHG Emissions by Category in 1990 and 2010

Table 2-13: GHG Emissions from Solvents and Other Products Use within 1990–2010, Mt CO_2 eq.

Source Categories	1990	1995	2000	2005	2006	2007	2008	2009	2010
3. Solvents and Other Products Use	**0.0908**	**0.0382**	**0.0316**	**0.0682**	**0.0482**	**0.0522**	**0.0536**	**0.0485**	**0.0539**
A. Paint Application	0.0319	0.0036	0.0060	0.0308	0.0180	0.0219	0.0206	0.0192	0.0207
B. Degreasing and Dry Cleaning	0.0332	0.0197	0.0107	0.0173	0.0089	0.0094	0.0112	0.0085	0.0124
C. Chemical Products, Manufacture and Processing	0.0056	0.0007	0.0007	0.0019	0.0023	0.0030	0.0041	0.0036	0.0030
D. Other	0.0201	0.0142	0.0142	0.0181	0.0190	0.0179	0.0176	0.0172	0.0177
D1. Printing	0.0007	0.0001	0.0001	0.0004	0.0003	0.0003	0.0004	0.0003	0.0004
D2. Domestic Solvents Use	0.0130	0.0130	0.0128	0.0124	0.0124	0.0123	0.0123	0.0122	0.0122
D3. Other Products Use	0.0063	0.0010	0.0013	0.0054	0.0064	0.0053	0.0049	0.0046	0.0051

Abbreviations: NE – Not Estimates; NO – Not Occurring

Between 1990 and 2010, the total GHG emissions covered by this sector decreased by 40.7 per cent: from 0.0908 Mt CO_2 eq. in 1990, to 0.0539 Mt CO_2 eq. in 2010 (Table 2-13). However, between 2009 and 2010, respective emissions increased in the RM by circa 11.0 per cent, in particular as a result of increased use of household products.

Within the Solvents and Other Products Use Sector, in 2010, the largest source of emissions was represented by 3A 'Paint Application' accounting for circa 38.5 per cent of the total sectoral emissions (35.1 per cent in 1990). Other relevant source categories are represented by 3D 'Other' accounting for 32.9 per cent of the total (22.2 per cent in 1990), 3B 'Degreasing and Dry Cleaning' – 23.0 per cent of the total sectoral emissions (36.6 per cent in 1990) and 3C 'Chemical Products, Manufacture and Processing' – 5.6 per cent of the total sectoral emissions (6.2 per cent in 1990) (Figure 2-16).

Agriculture Sector

The Agriculture Sector represents an important source of GHG emissions in the Republic of Moldova: CH_4 emissions, in particular from 4A 'Enteric Fermentation', 4B 'Manure Management'; N_2O emissions from 4B 'Manure Management' and 4D 'Agricultural Soils'. In the Republic of Moldova there are no registered emissions from 4C 'Rice Cultivation' and 4E 'Prescribed Burning of Savannas', as for the emissions from 4F Field Burning of Agricultural Residues, these are monitored in the LULUCF Sector, under the category 5B 'Cropland'.

In 2010, Agriculture Sector accounted for circa 16.0 per cent of the total national GHG emissions (11.8 per cent in 1990). Between 1990 and 2010 total GHG emissions originated from this sector decreased by circa 58.4 per cent: from 5.1202 Mt CO_2 eq. in 1990, to 2.1324 Mt CO_2 eq. in 2010 (Table 2-14, Figure 2-17), in particular, due to a sharp drop

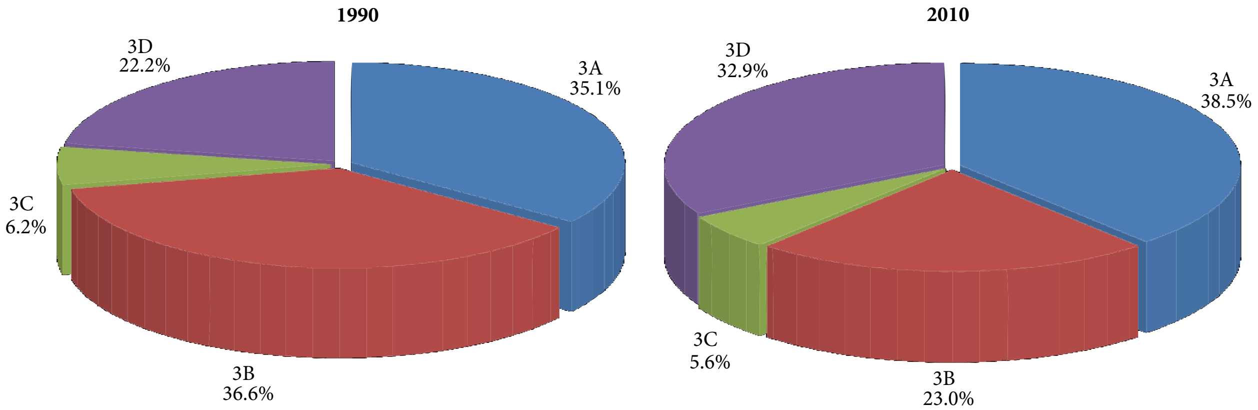


Figure 2-16: Breakdown of Solvents and Other Products Use GHG Emissions by Category in the Republic of Moldova in 1990 and 2010

Table 2-14: GHG Emissions from Agriculture Sector within 1990–2010, Mt CO_2 eq.

Source Categories	1990	1995	2000	2005	2006	2007	2008	2009	2010
4. Agriculture	**5.1202**	**3.3591**	**2.2770**	**2.3734**	**2.2682**	**1.5151**	**2.1177**	**1.9249**	**2.1324**
A. Enteric Fermentation	1.8344	1.3608	0.9112	0.7784	0.7530	0.6088	0.5797	0.6027	0.5984
B. Manure Management	1.6368	0.9764	0.5705	0.5957	0.6179	0.4659	0.4653	0.5306	0.5564
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	1.6490	1.0219	0.7954	0.9993	0.8973	0.4404	1.0726	0.7916	0.9777
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	IE	IE	IE	IE	IE	IE	IE	IE	IE

Abbreviations: IE – Included Elsewhere; NE – Not Estimates; NO – Not Occurring

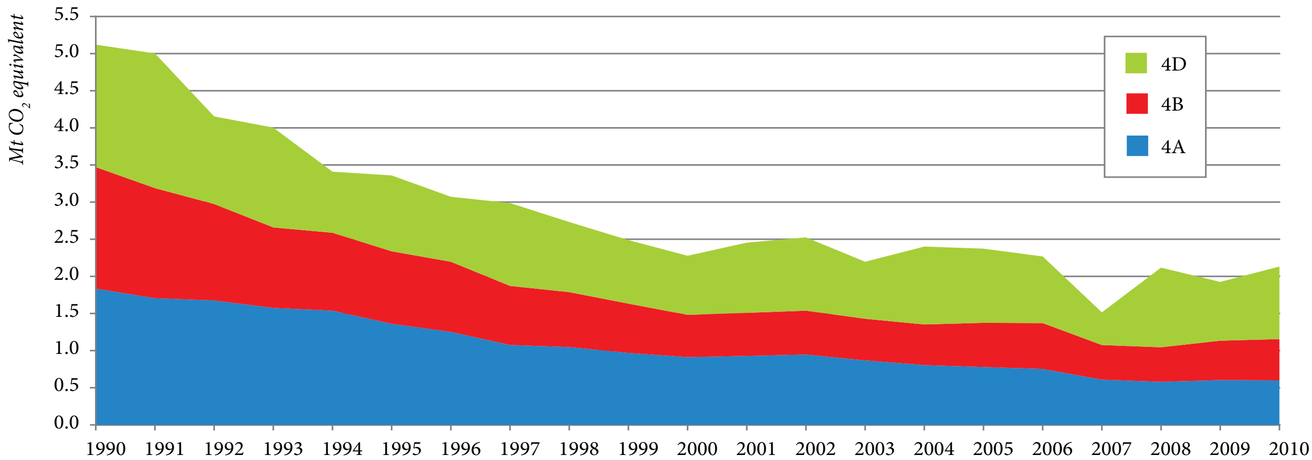


Figure 2-17: GHG Emissions from Agriculture Sector in the RM within 1990–2010

in such indicators as: domestic livestock and poultry population, amounts of synthetic nitrogen and organic fertilizers applied to soils, amounts of agricultural crop residues returned to soils, carbon losses from mineral soils and changes of tillage practices.

Between 2009 and 2010, direct greenhouse gas emissions originated from Agriculture Sector increased by circa 10.8 per cent, in particular as a result of increase of N_2O emissions from 4D 'Agricultural Soils' and 4B 'Manure Management'. In 2010, the largest source of emission was 4D 'Agricultural Soils', accounting for 45.8 per cent of the total sectoral emissions (35.8 per cent in 1990). Other relevant sources are represented by 4A 'Enteric Fermentation', accounting for 28.1 per cent of the total (35.8 per cent in 1990) and 4B 'Manure Management', accounting for circa 26.1 per cent of the total sectoral emissions (32.0 per cent in 1990) (Figure 2-18)

Land Use, Land-Use Change and Forestry Sector

Generally, during 1990-2010, the LULUCF Sector represented a source of net carbon removals (the only exceptions were 1997, 2004, 2008 and 2010 years, when sector represented a source of net emissions). Between 1990 and 2010, net CO_2 emissions/removals dynamic registered a clear decreasing trend, reducing by 100.4 per cent, from -7.1770 Mt in 1990 to +0.0264 Mt in 2010 (Table 2-15, Figure 2-19).

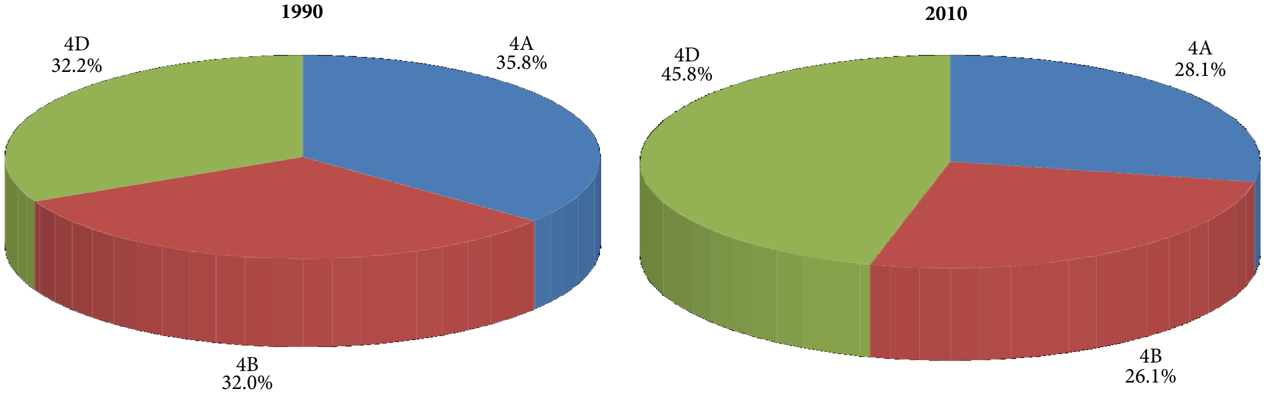


Figure 2-18: Breakdown of Agriculture GHG Emissions by Category in the RM in 1990 and 2010

Table 2-15: Emissions and Removals in LULUCF Sector within 1990-2010, Mt CO_2 eq.

Source Categories	1990	1995	2000	2005	2006	2007	2008	2009	2010
5. LULUCF	**-7.1770**	**-1.1581**	**-0.7821**	**-0.1042**	**-0.4028**	**-2.6098**	**0.1309**	**-0.8715**	**0.0264**
A. Forest Land	-2.1972	-1.6208	-2.1403	-2.2462	-2.0876	-2.1895	-2.2228	-2.2513	-2.1931
B. Cropland	-4.1933	1.0822	2.1838	2.9614	2.4915	0.3786	3.1430	2.1616	2.9771
C. Grassland	-0.7865	-0.6195	-0.8255	-0.8195	-0.8067	-0.7988	-0.7893	-0.7818	-0.7576
D. Wetlands	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Settlements	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE
F. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE

Abbreviations: IE – Included Elsewhere; NE – Not Estimates; NO – Not Occurring.

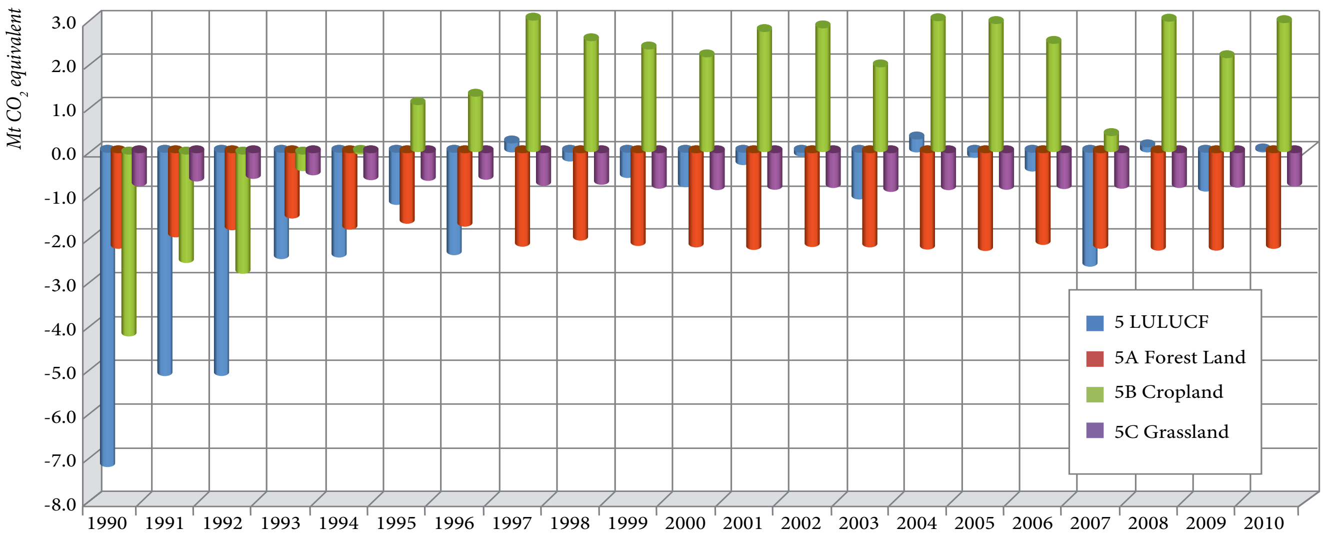


Figure 2-19: Emissions/Removals in LULUCF Sector by Source and Sink Categories within 1990-2010, Mt CO_2 eq.

Between 2009 and 2010, CO_2 net removals decreased by circa 103.0 per cent in the LULUCF Sector. This situation can be explained, in particular, due to changes in the use and management of agricultural soils (5B 'Cropland'), that contributed to the substantial decrease of organic carbon from the agricultural soils, changing the humus balance from a positive one like in 1990-1992, to a relatively neutral balance, specific to 1993-1994, respectively to a profoundly negative balance, like in 1995-2010 time periods. This process was also influenced by some changes in the maintenance and use of forests (5A 'Forest Land'), authorized increased amounts of harvested wood, substantial increase of illegal fellings, increased conversion of forest lands into croplands, etc.

In 1990, the largest source of carbon removals under LULUCF Sector was 5B 'Cropland' (lands covered with wood vegetation – multiannual plantations as well as the agricultural soils) accounting for 58.4 per cent of the sectoral totals, followed by 5A 'Forest Land' (forests, protective forests, etc.) accounting for 30.6 per cent, respectively by 5C 'Grassland', accounting for 11.0 per cent (Figure 2-20).

Starting with 1993, the 5B 'Cropland' category became a source of CO_2 emissions, as a result of profoundly negative balance from agricultural soils, as well as due to reduction of multiannual plantation areas.

As was mentioned above, emissions from 5B 'Cropland' in 1997, 2004, 2008 and 2010 took precedence over net carbon removals registered in other categories, and this despite the fact that the contribution of land areas occupied by forest ecosystems (5A 'Forest Land') in the process of carbon removals is still growing, especially due to the expansion of areas covered with forest vegetation. Subsequently, growth could be extended at the expense of increasing productivity of existing forests by applying broader reconstruction of damaged trees and with low productivity.

In the RM the emissions/removals from 5D 'Wetlands' and 5F 'Other land' were not estimated, while the emissions/removals from 5E 'Settlements' were partly taken into account in 5B 'Cropland' category, especially CO_2 removals from land covered with wood vegetation, including terrestrial and underground biomass of orchards, vineyards, and trees in individual gardens.

Waste Sector

Waste Sector is an important source of GHG emissions: CH_4 emissions from 'Solid Waste Disposal on Land' (Category 6A) and 'Wastewater Handling' (Category 6B), as well as N_2O emissions from 'Human Sewage' (Category 6B). Currently, in RM there are no registered emissions within 6C 'Waste Incineration' category.

In 2010, Waste Sector accounted for circa 11.9 per cent of the total national direct GHG emissions (3.8 per cent in 1990). In the time series from 1990 through 2010, total GHG emissions from this sector decreased by circa 3.0 per cent: from 1.6274 Mt CO_2 eq. in 1990, to 1.5783 Mt CO_2 eq. in 2010 (Table 2-16). At the same time, between 2009 and 2010, GHG emissions from Waste Sector increased by 0.9 per cent.

Reduction of total GHG emissions from the Waste Sector within 1990-2005 is explained by the economic decline that occurred in the Republic of Moldova during the period under review, by a significant drop in the wellbeing of population, and respectively, capacity to generate solid and other

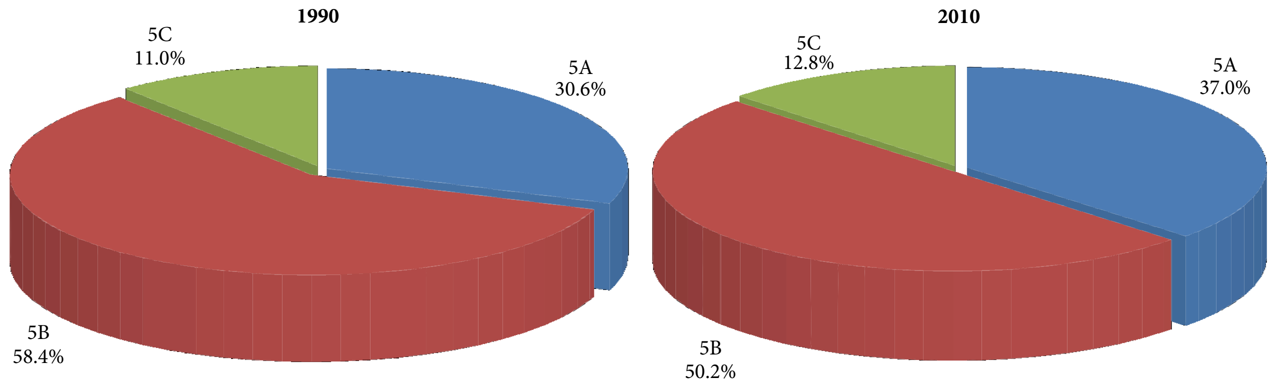


Figure 2-20: Breakdown of GHG Emissions and Removals by source and sink categories in LULUCF Sector, in 1990 and 2010

Table 2-16: GHG Emissions from Waste Sector within 1990–2010, Mt CO_2 eq.

Source Categories	1990	1995	2000	2005	2006	2007	2008	2009	2010
6. Waste	**1.6274**	**1.7815**	**1.6586**	**1.4111**	**1.4343**	**1.4678**	**1.5007**	**1.5649**	**1.5783**
A. Solid Waste Disposal on Land	1.3201	1.5763	1.5091	1.2129	1.2399	1.2833	1.3087	1.3816	1.3881
B. Wastewater Handling	0.3073	0.2052	0.1495	0.1982	0.1943	0.1845	0.1921	0.1832	0.1902
C. Waste Incineration	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE

Abbreviations: NE – Not Estimates; NO – Not Occurring

types of wastes. At the same time, starting with 2006, there has been a clear growing trend of direct GHG emissions from the 'Waste Sector' (Figure 2-21).

In 2010 the largest source of GHG emissions within the Waste Sector was Category 6A 'Solid Waste Disposal on Land', accounting for circa 87.9 per cent of the total sectoral emissions (81.1 per cent in 1990) (Figure 2-22).

2.5.4. Emission Trends for Ozone and Aerosol Precursors

Though not considered greenhouse gases, photochemically active gases like carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC), have an indirect global warming effect. These gases are considered as ozone precursors influencing the formation and destruction of tropospheric and stratospheric ozone. In particular, they are emitted from transportation, fossil fuel combustion, consumption of solvents and other household products, etc. The national GHG inventory of the Republic of Moldova includes emissions of the following ozone and aerosol precursors: NOx, CO, NMVOC and SO_2.

In 1990-2010, nitrogen oxides emissions decreased by 73.0 per cent: from 137.2194 kt in 1990 to 37.0635 kt in 2010, carbon monoxide emissions decreased by 73.9 per cent: from 428.0672 kt in 1990 to 111.9294 kt in 2010, non-methane volatile organic compounds emissions decreased by 81.4 per cent: from 512.2303 kt in 1990 to 95.2324 kt in 2010, while sulphur dioxide emissions decreased by 93.6 per cent: from 294.9063 kt in 1990 to 18.7756 kt in 2010 (Table 2-17).

In 2010, the source categories of NO_x having the biggest share in the total nitrogen oxides emissions in the Republic of Moldova were: 1A3 'Transport' (18.7731 kt or 50.7 per cent of the total), 1A1 'Energy Industries' (11.4309 kt or 30.8 per cent of the total), 1A4 'Other Sectors' (4.2172 kt or 11.4 per cent of the total), 1A2 'Manufacturing Industries and Constructions' (1.5105 kt or 4.1 per cent of the total) and 2A 'Mineral Products' (0.7316 kt or 4.1 per cent of the total) (Figure 2-23).

In 2010, the source categories of CO having the biggest share in the total carbon monoxide emissions in the Republic of Moldova were: 1A3 'Transport' (85.1121 kt or 76.0 per cent of the total), 1A4 'Other Sectors' (22.1317 kt or 19.8 per cent of the total), 2C 'Metal Production' (12.4158 kt or 2.2 per cent of the total) and 1A1 'Energy Industries' (1.4003 kt or 1.3 per cent of the total) (Figure 2-24).

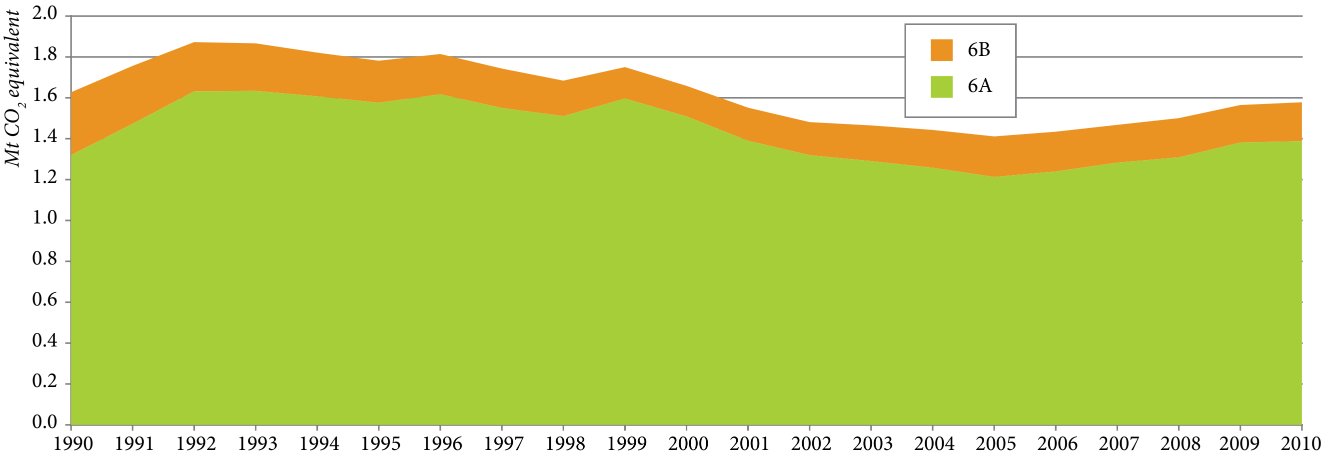


Figure 2-21: Total Waste Sector GHG Emissions Trends in the RM within 1990–2010

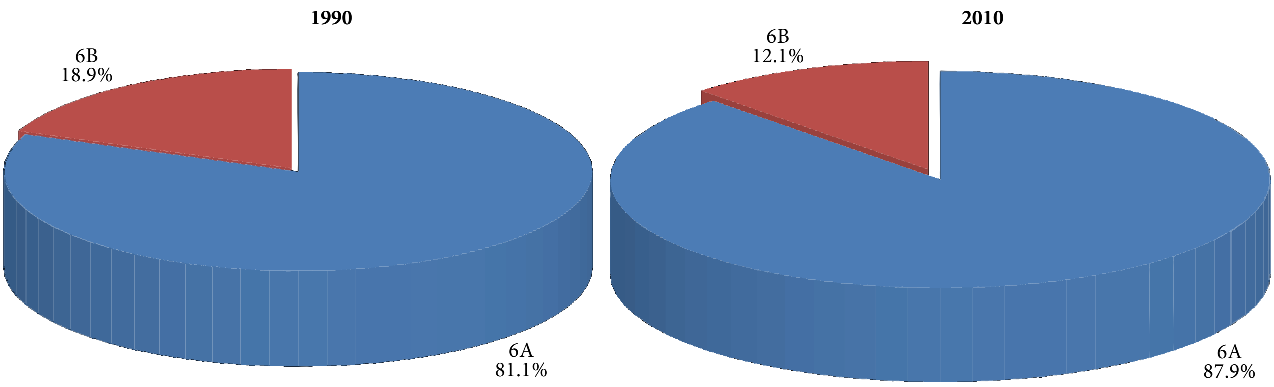


Figure 2-22: Breakdown of Waste GHG Emissions by Category in the Republic of Moldova in 1990 and 2010

Table 2-17: Ozone and Aerosol Precursors Emission Trends in the RM in 1990-2010, kt

	1990	1991	1992	1993	1994	1995	1996
NO_x	137.2194	118.9043	79.9920	63.1479	56.7902	47.8938	45.1745
CO	428.0672	376.9457	195.6386	160.3229	146.6000	145.3208	142.8140
NMVOC	512.2303	424.0149	334.4593	266.7580	175.1392	162.6902	148.9657
SO_2	294.9063	256.1539	170.1669	146.0971	102.6067	61.0006	58.9692
	1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
NO_x	41.9948	35.2592	25.8379	24.5483	26.7705	27.4538	30.8025
CO	138.7959	122.6704	86.9378	84.2057	87.3850	99.7837	118.1225
NMVOC	75.1749	62.6311	39.5516	37.4619	45.6717	45.6605	48.3082
SO_2	33.9676	26.9756	14.0259	9.9288	9.4514	10.5082	13.0501
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
NO_x	32.3275	49.3686	31.0410	31.4840	34.8908	34.9055	37.0635
CO	121.9150	124.7128	116.0094	118.1991	120.5858	114.0031	111.9294
NMVOC	56.2400	67.3736	65.8121	129.9583	87.1732	60.5991	95.2324
SO_2	11.2448	11.8426	12.3622	10.7123	14.8404	18.2960	18.7756

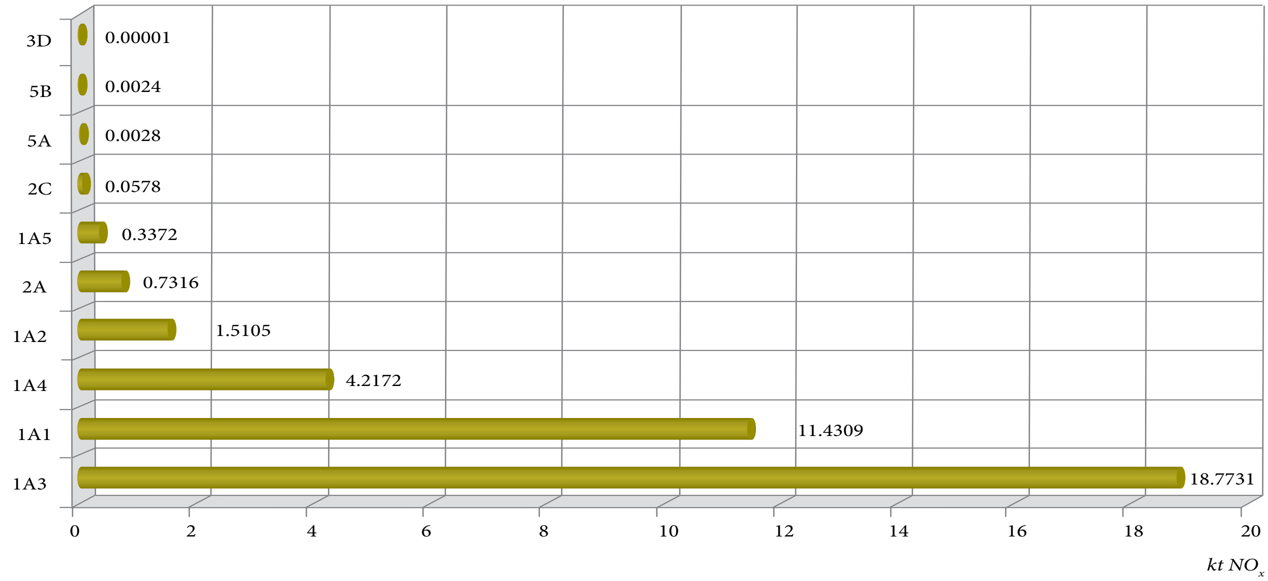


Figure 2-23: 2010 Source Categories of NO_x in the Republic of Moldova

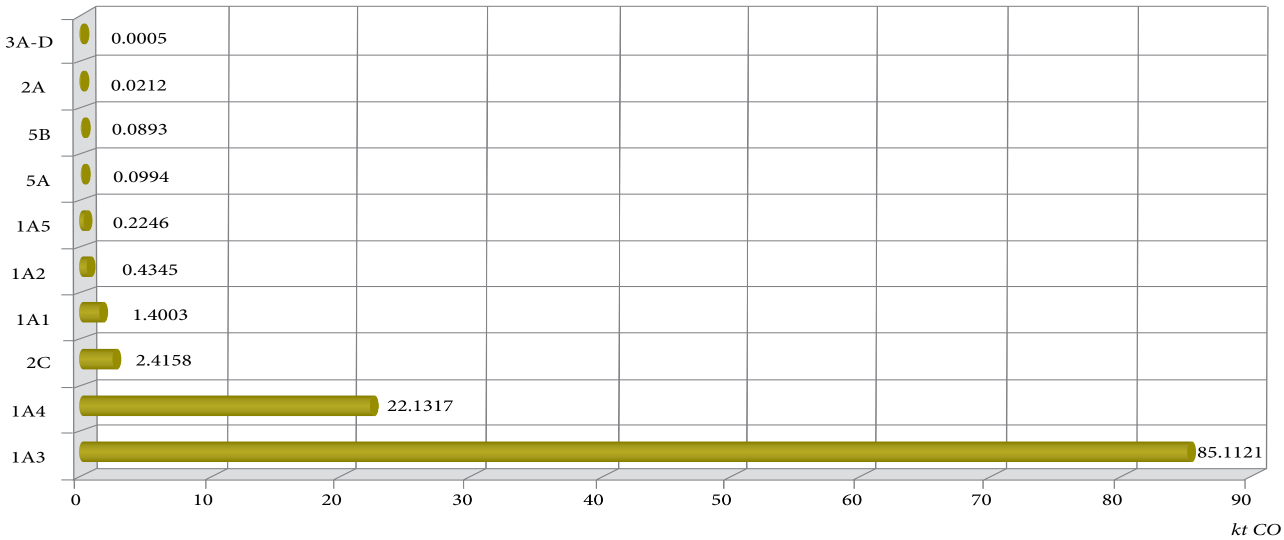


Figure 2-24: 2010 Source Categories of CO in the Republic of Moldova

In 2010, the source categories of NMVOC having the biggest share in the total non-methane volatile organic compounds emissions in the Republic of Moldova were: 2A 'Mineral Products' (53.3495 kt or 56.0 per cent of the total), 3A-D 'Solvents and Other Products Use' (18.8146 kt or 19.8 per cent of the total), 1A3 'Transport' (16.1605 kt or 17.0 per cent of the total), 2D 'Other Production' (foods and beverages) (2.8602 kt or 3.0 per cent of the total), 1A4 'Other Sectors' (2.6764 kt or 2.8 per cent of the total), 1B2 'Fugitive Emissions From Oil and Natural Gas' (0.8833 kt or 0.9 per cent of the total) (Figure 2-25).

In 2010, the source categories of SO_2 having the biggest share in the total sulphur dioxide emissions in the Republic of Moldova were: 1A1 'Energy Industries' (8.3173 kt or 44.3 per cent of the total), 1A4 'Other Sectors' (5.0450 kt or 26.9 per cent of the total), 1A3 'Transport' (2.8017 kt or 14.9 per cent of the total), 1A5 'Other' (Other Needs and Works in Energy Sector) (1.4976 kt or 8.0 per cent of the total), 1A2 'Manufacturing Industries and Constructions' (0.5832 kt or 3,1 per cent of the total) and 2A 'Mineral Products' (0.4887 kt or 2.6 per cent of the total) (Figure 2-26).

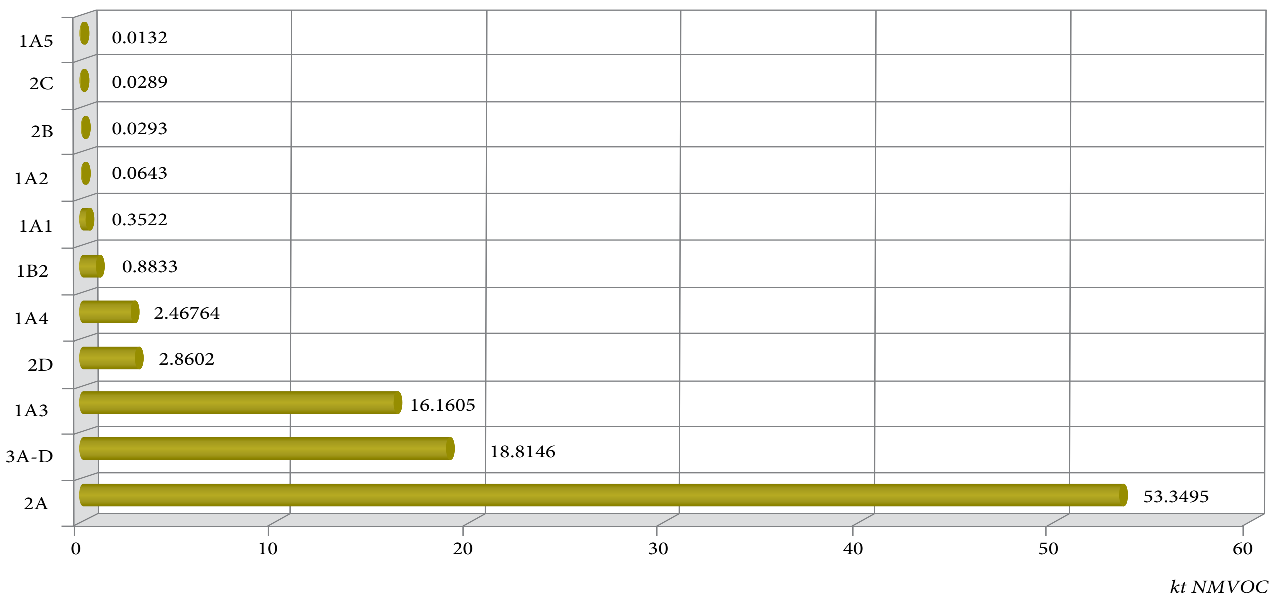


Figure 2-25: 2010 Source Categories of NMVOC in the Republic of Moldova

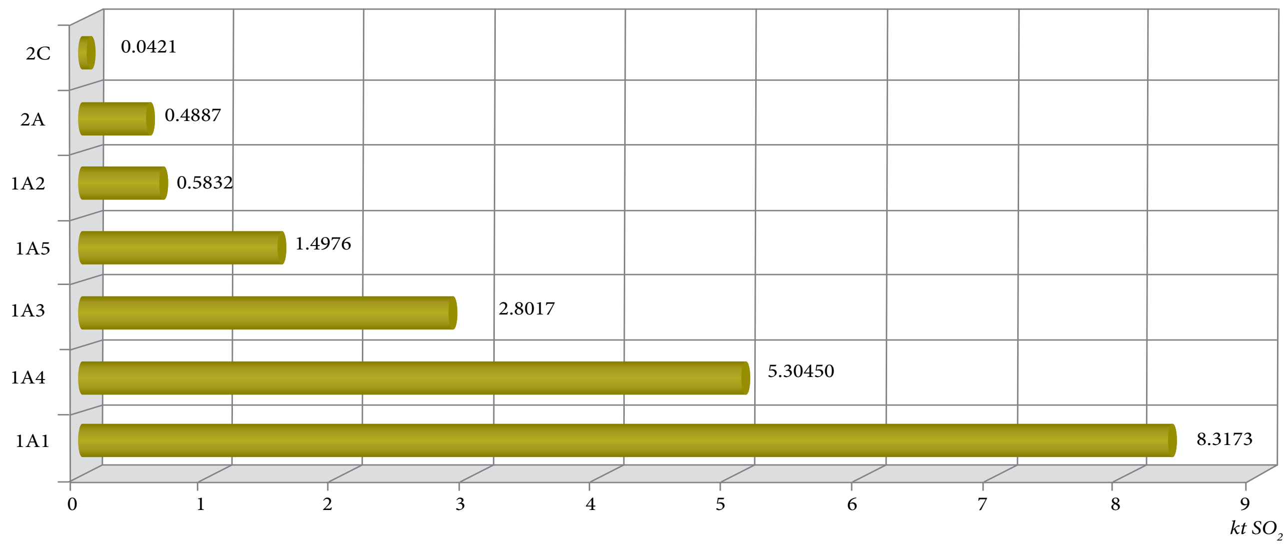
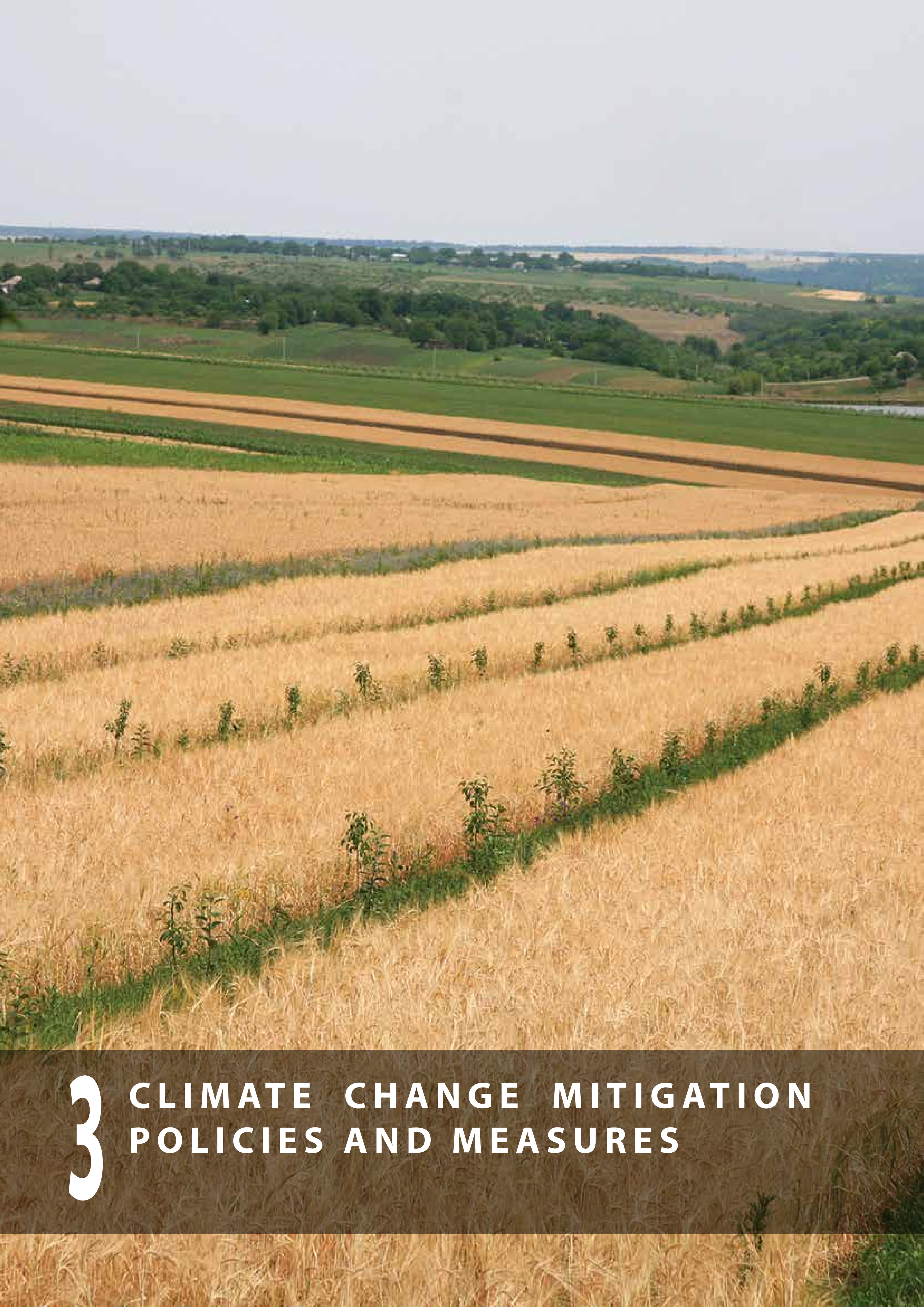


Figure 2-26: 2010 Source Categories of SO_2 Total Emissions in the Republic of Moldova



3 CLIMATE CHANGE MITIGATION POLICIES AND MEASURES

CHAPTER 3. CLIMATE CHANGE MITIGATION POLICIES AND MEASURES

3.1. Introduction

Among the countries of the world, the Republic of Moldova is distinguished by lower per capita CO_2 emissions. In 2010, the latter constituted 1.3 tons of CO_2/capita[23], reducing by approximately seven times versus 1990, when this indicator recorded 9.06 tons of CO_2/capita. For the sake of comparison, in 2009 Romania recorded 3.7 tons/capita, Russian Federation - 11.1 tons/capita, Latvia - 3.0 tons; Lithuania - 3.8 tons; USA - 17.3 tons and the UK - 7.7 tons of CO_2/capita[24]. Behind such a low level of CO_2 emissions in the Republic of Moldova is basically the economic regress occurring during the last 20 years since the Declaration of Independence (27 August 1991). With a GDP of US$ 1,967.2 (in 2011) per capita, the Republic of Moldova continues distinguishing itself as one of the poorest country in Europe. The subsequent economic growth of the country is expected to be difficult to achieve without increasing the greenhouse gas emissions. At the same time, it is important that in the process of economic growth to insure the implementation of the most advanced policies and technologies leading to creation of as lowest as possible emissions. Over the past five years, the Government has managed to observe this principle, approving and applying a whole set of normative acts oriented towards insuring energy efficiency, use of renewable energy sources, soil conservation, sustainable waste management, etc.

Republic of Moldova has developed and plans to approve in the first quarter of 2014 year the *Low Emission Development Strategy of the Republic of Moldova until 2020,* which comes to provide a whole vision on changing the economic development paradigm of the RM in the medium term towards green economic development, based on a study of constraints to economic development with reduced carbon emissions. In this context, the strategy will consolidate and guide the sector development approach outlining the medium term country objectives and a strategic view on climate changes[25]. The approach established in the LEDS is to amplify the financial coverage by promoting adequate greenhouse gas emissions mitigation policies in the national economy sectors, without compromising the economic growth.

The **overall objective** of the Strategy is:

„Reducing by 2020, the total national greenhouse gas emissions by at least 20% compared to the business-as-usual scenario, to support the global effort in maintaining the global average temperature increase trend in the next 100 years within the limit of up to 2°C".

[23] <www.ecosystemmarketplace.com/>

[24] <http://data.worldbank.org/indicator/EN.ATM.CO2E.PC>

[25] <http://www.clima.md/doc.php?l=ro&idc=236&id=3101>

The overall objective is supported by specific objectives, which include reducing by 2020 the greenhouse gas emissions originating from the following sectors:

- Energy (stationary combustion of fossil fuels, as well as from operations with oil and natural gas) – by 20% compared to BAU scenario;
- Transports (mobile combustion of fuels) – by 15% compared to BAU scenario;
- Buildings – by 20% compared to BAU scenario;
- Industry – by 15% compared to BAU scenario;
- Agriculture – by 15% compared to BAU scenario;
- Forestry – by 25% compared to BAU scenario;
- Waste – by 10% compared to BAU scenario.

To accomplish the overall and specific objectives of the LEDS, national appropriate mitigation actions (NAMAs) have been identified for each sector under consideration (energy, transports, buildings, industry, agriculture, forestry and waste), and prioritized by applying a multi-criteria analysis method.

NAMAs are divided into three categories:

1. *Unilateral*: mitigation actions taken by the country on its own;
2. *Supported*: mitigation actions supported through funding, technological transfer and capacity strengthening on behalf of developed countries included in Annex I to the UNFCCC; and
3. *Crediting*: mitigation actions with credit generation possibilities on carbon market.

The mitigation potential of the NAMAs to be implemented within 2014-2020, presented in accordance with the objectives of reducing GHG emissions from the Low-Emission Development Strategy of the RM until 2020[26] is presented in **Annex 2**, and the *Action Plan for the implementation of priority nationally appropriate mitigation actions* to achieve the overall objective of *Low Emissions Development Strategy of the RM until 2020*, respectively in **Annex 3**.

LEDS is the main document among other policy, legislative and normative acts of the country which specified expressly the state policy in combating greenhouse gas emissions. In addition to this crucial document, a number of other acts have been approved in relation to overcoming climate change challenges, their key priority being anyway focused on poverty reduction, economic growth, energy and food security, etc.; environmental aspects however being reflected with no specific accents.

[26] <http://www.clima.md/doc.php?l=ro&idc=236&id=3101>

Among these, it is worth mentioning the National Development Strategy “Moldova 2020”[27], Energy Strategy for the period until 2030[28], the Law on Energy Efficiency[29], Law on Renewable Energy[30], National Strategy for Sustainable Development of Agro-Industrial Complex of the Republic of Moldova (2008-2015)[31], National Waste Management Strategy for 2013-2027[32], and others.

Even if the given documents are not expressly dedicated to overcoming climate change challenges, the accomplishment of objectives set in these documents will imminently lead to a significant reduction of specific greenhouse gas emissions.

The policies stated in the mentioned documents are to be implemented through respective programs and plans. In this context, there have already been approved the National Program for Energy Efficiency 2011-2020[33], the Methodology for Determining, Approving, and Applying Tariffs for Electric Power Produced from Renewable Energy Sources and Biofuels[34], the Soil Fertility Conservation and Enhancement Program for 2011-2020[35], the State Program for Forestry Fund Land Regeneration and Afforestation for 2003-2020[36], and others.

3.2. Climate Change Mitigation Policy Development Process

The MoEN, through its Policy Analysis, Monitoring, and Evaluation Unit, is the official coordinator of climate change related policies in the Republic of Moldova.

Part of the policies with impact on climate change is under the responsibility of other ministries: the Ministry of Economy (General Department for Energy Efficiency and Security), Ministry of Transports and Road Infrastructure (Road Transport Department), and the Ministry of Agriculture and Food Industry (General Sector Development Policy Department).

The policies and programs specific to each of the mentioned ministries are examined in this chapter.

[27] National Development Strategy “Moldova 2020”, Law No. 166 of 11.07.2012, Official Gazette No. 245-247/791 of 30.11.2012.

[28] Energy Strategy of the Republic of Moldova for the period until 2030, Government Resolution No. 102 of 05.02.2013, Official Gazette No. 27-30/146 of 08.02.2013.

[29] Law on Energy Efficiency No. 142 of 02.07.2010, Official Gazette No. 155-158/545 of 03.09.2010.

[30] Law on Renewable Energy No. 160-XVI of 12.07.2007, Official Gazette No. 127-130/550 of 17.08.2007.

[31] Government Resolution No. 282 of 11.03.2008.

[32] Government Resolution No. 248 of 10.04.2013 on Approving the Strategy for Waste Management in the Republic of Moldova for 2013-2027, Official Gazette No. 82 of 12.04.2013.

[33] National Energy Efficiency Program for 2011-2020, No. 833 of 10.11.2011, Official Gazette No. 197-202/914 of 18.11.2011.

[34] Methodology for Determining, Approving, and Applying Tariffs for Electric Power Produced from Renewable Energy Sources and Biofuels, No. 321 of 22.01.2009, Official Gazette No. 45-46/172 of 27.02.2009.

[35] Government Resolution No. 626 of 20.08.2011.

[36] Government Resolution No. 737 of 17.06.2003.

3.3. Clean Development Mechanism of Kyoto Protocol

The Business-As-Usual (BAU) Scenario, provided in the Chapter 4 of the TNC reveals that RM is on track in respecting its commitments made through associating itself with the Copenhagen Accord. RM acknowledges that the Clean Development Mechanism (CDM) of the Kyoto Protocol contributes and could play a significant role further on towards accomplishing the assumed commitments.

To rationally use the potential of reducing GHG emissions through the CDM of the Kyoto Protocol, the necessary institutions and regulatory framework have been created in the country. Thus a Designated National Authority (DNA)[37] under the CDM of the Kyoto Protocol has been instituted within the MoEN, the task of which is to implement and fulfil the provisions of the UNFCCC and the mechanisms and provisions of the Kyoto Protocol.

Two institutions are effectively involved in promoting projects within the CDM of the Kyoto Protocol:

- The Climate Change Office operating under the MoEN and representing a knowledge centre for national policy analysis and evaluation of greenhouse gas emissions (GHG)[38];
- Carbon Finance Office operating under the MoEN, currently supervising the implementation of some CDM projects in the Republic of Moldova.

By the end of 2013, there have been recorded 11 requests for launching CDM projects, eight of which have been approved.

There is no carbon market in the RM, and no special budget has been established for carbon reduction.

3.4. Economic Instruments

Taxes and other economic instruments can play a leading role towards achieving the objectives of combating climate change. They can provide incentives for a behaviour that protects or enhances the environment and also discouraging the actions leading to negative impact on it. An economic instrument such as the „tax” contributes to reach the environmental objectives with low cost and in an efficient manner. Once the taxes are reflected in the prices for products and services, the latter would send adequate signals of structural changes in the economy, making it more sustainable. They can encourage innovations and development of new technologies. The revenues obtained as a result of applying environment taxes can be subsequently used to reduce other taxes, contributing thus to reduction of distortions in the economy.

[37] Government Resolution No. 1574 of 26.12.2003 on Instituting the National Commission for the Implementation and Fulfillment of the United Nations Framework Convention on Climate Change, as well as of the Kyoto Protocol mechanisms and provisions, Official Gazette No. 6-12 of 01.01.2004.

[38] <www.clima.md>.

From the experience of other countries, a tax applied should undergo the success test before getting a green light in the long run. In other words, it should be well conceived, without accumulating negative impacts in the future, and if such negative impacts emerge, these should be minimal. The implications for international competitiveness should be certainly taken into account. The Government should put the environmental taxes into application wherever these pass such tests.

Until now, a few levers of this kind have been used in the RM, namely to reduce CO_2 emissions. Thus, the Law on Environment Pollution Fee[39], amended lately in 2008, sets the pollution payments in a way they do not cause an obvious interest to reduce GHG emissions. Pursuant to the Law, the fee for pollutant emissions in the air of mobile sources using gasoline (ethylated, non-ethylated) as fuel, petrol for airplane engines (aviation gasoline, kerosene), and diesel oil shall be established for legal and physical persons importing such fuel. The fee for pollutant emissions of mobile sources shall be calculated in proportion of 1% of the customs cost of ethylated gasoline, petrol for airplane engines, and diesel oil, while the fee for non-ethylated gasoline – in proportion of 0.5%. For emissions from stationary combustion of fuels, the fee is fixed per each tone, with its increasing for exceeding the norm, without specifying if it is established for direct GHG emissions too.

The environment pollution tax established for cars[40] aimed to reduce the carbon monoxide (CO) emissions, not also the carbon dioxide (CO_2) emissions. The tax was applied episodically; however, it is worth mentioning that over the past period the Government has been applying increasing incentives to promote energy efficiency and renewable energy sources. For instance, for 2012, the Government allocated 25 million lei to the Energy Efficiency Fund from the State Budget, along with the donor support, this amount increasing up to 80 million lei for 2013[41]. At the same time, to marginalize the import of second hand vehicles which are considered as high emissions sources, the Parliament of RM introduced an age limit for their import into the country[42].

The existing environment pollution fees set in the Law on Environment Pollution Fees contributed to accumulate in 2009 US$ 15.6 million in the National Environmental Fund (NEF) and US$ 0.685 million in the Local Environmental Funds (LEFs). However, these are still very limited resources compared to real needs.

To improve the given situation and respond to the national and global environmental priorities, in 2011, the Global Environmental Fund (GEF) launched a project for the Republic of Moldova on strengthening the capacity for promoting fiscal reforms in environmental area. The GEF support value constitutes US$ 475 thousand, with a co-funding of US$ 610 thousand.

The project objective is to set a sound basis for the institutionalization of a fiscal reform in environmental area at national level, with the support from respective Government institutions, including of the Ministry of Environment, Ministry of Finance and other ministries, by creating a National Commission for Environmental Fiscal Reform (EFR), which at the first stage will be considered as a Project Board of Directors, then evolving into a fiscal commission for environment[43].

3.5. Climate Change Mitigation Policies and Measures by Sector

3.5.1. Energy Sector

The key document outlining the policies in energy sector is the Energy Strategy of the Republic of Moldova until 2030, which develops the sector policies and objectives set out in the National Development Strategy "Moldova 2020"[44].

The energy security of the country is at an unsatisfactory level, the dependence on imported energy exceeding 95%. In addition, energy efficiency is very low, the energy intensity exceeding the West-European one by approximately three times, the country being evaluated as the poorest in Europe.

In such circumstances, the accumulated problems can be overcome only through massive investments in the sector, transfer of technologies, and state of art knowledge. The most plausible way in this sense is considered the promotion of Western European ideals, with the subsequent accession to the EU, which is an essential condition for opening economic growth opportunities, along with energy security opportunities. This fundamental concept is developed in the Energy Strategy of the Republic of Moldova until 2030.

The Strategy pursues the following three main objectives for the period until 2030:

1). Insuring *energy supply security*;
2). Creating *competitive markets* and insuring their regional and European integration;

[39] Law on Environment Pollution Fee No. 1540-XIII of 25.02.1998, Official Gazette No. 54-55/378 of 18.06.1998.

[40] Instruction on calculating the environment pollution fee upon carrying out instrumental environment inspection of auto transport means of 25.11.98, Official Gazette Nol. 109-110/211 of 10.12.1998

[41] <http://www.interlic.md/2012-12-24/the Energy Efficiency Fund allocated 80 million lei for funding eligible projects -27858.html>.

[42] Law on Amendments and Additions to Some Legislative Acts No. 154 of 21.07.2005, Official Gazette of the Republic of Moldova No. 126-128/611 of 23.09.2005 (age limit on the import of auto vehicles has been increased from 7 to 10 years through Law on Amendments and Additions to Some Legislative Acts No. 178 of 11.07.2012, Official Gazette No. 190-192/644 of 14.09.2012; however, higher fees are charged for the import of vehicles older than 7 years).

[43] <http://www.thegef.org/gef/whatisgef>.

[44] National Development Strategy "Moldova 2020", Law No. 166 of 11.07.2012, Official Gazette No. 245-247/791 of 30.11.2012.

3). Insuring *environment sustainability* and *combating climate changes*.

The specific objectives for the period 2013-2020 are as follows:

- Insuring the natural gas supply security by diversifying routes and sources of supply, types of carrier (conventional gas, non-conventional gas, LNG), and storages, while enhancing the role of RM as natural gas transit corridor;
- Strengthening the role of RM as electric power transit corridor through the construction of new interconnection lines, connection to the ENTSO-E system and strengthening the internal electric power transmission network;
- Creating a strong platform for generating electricity and heat through refurbishment, efficient central heating and high performance marketing;
- Improving the energy efficiency and increasing the share of renewable energy sources used;
- Insuring the legislative, institutional, and operational framework for real competition, effective market opening, setting the price for energy in a transparent and fair manner, integration of RM's energy market in the EU internal market;
- Insuring a modern and competitive institutional framework for the energy industry development.

To achieve these objectives, the Strategy sets out concrete measures and timeframes for their realization. These include:

- *Diversification of natural gas routes and sources* – construction the Ungheni (Moldova) – Iaşi (Romania) gas pipeline until 2014 (with a capacity of 1.6 billion m^3/year, the RM currently consumes circa 3 billion m^3 per year, together with the left bank of river Dniester); participation in the construction of East-West natural gas transmission lines; the RM has underground gas storage reserves, but in economic terms, this issue is not yet sufficiently studied;
- *Strengthening the electric power transit role* – construction of HVL 400 kV: Suceava (Romania) – Balti (Moldova) and HVL Străşeni (Moldova) - Iaşi (Romania), or alternatives; construction of a new 330kV interconnection line Bălţi (Moldova) - CHE Novodnestrovsk (Ukraine); joining to ENTSO-E by 2019-2020, most probably through a „back-to-back" station, the cost of which amounts to 210 million Euro;
- *Production of electricity and heat* –by 2020 to build 1,050 MW new capacities, of which combined cycle – 650 MW on natural gas in Chisinau; renewable capacity – 400 MW; rehabilitation of existing capacities; with regard to heating power: corporate restructuring of Termocom JSC, while resolving the problem of debts for the natural gas consumed by transferring to the natural gas supplier the natural gas networks built from public funds;
- *Improving energy efficiency and increasing the use of renewable energy sources* – by creating a modern regulatory framework; the objectives set out for the period until 2020 are as follows:
  - reducing energy intensity by 10% until 2020;
  - reducing losses in the transmission and distribution lines by up to 11% in 2020 (up to 13% in 2015) for electric power, by 39% in 2020 (by 20% in 2015) for natural gas, and by 5% in 2020 (by 2% in 2015) for heating;
  - reducing greenhouse gas emissions (compared to 1990) by at least 25% until 2020;
  - reducing the energy consumption in buildings by 20% until 2020;
  - insuring a 10% share of renovated public buildings by 2020.
  - in line with EU targets to improve energy efficiency, the National Energy Efficiency Program for 2011-2020[45] sets long term energy savings up to 20% by 2020, which constitutes 14,167.9 TJ, and will contribute to reducing greenhouse gas emissions by 761,498.7 tons of CO_2 equivalent; the interim target for energy savings to be achieved by 2016 is 9%, which equals 6,021.4 TJ and will contribute to the reduction of greenhouse gas emissions by 323,637.5 tons of CO_2 equivalent;
  - insuring a 10% share of annual electric power production from renewable energy sources by 2020;
  - stimulating the use of energy produced from renewable energy sources compared to the gross domestic consumption: 20% by 2020, with an interim target of 10% in 2015;
  - insuring a 10% share of biofuels in total fuels by 2020, with an interim target of 4% in 2015;
- *Insuring real competition, effective opening of electricity and natural gas market* – by creating proper regulations and increasing the number of power sources. The available interconnection capacity with the neighbouring countries should be allocated regularly. Within 2013-2015 ANRE will gradually open the market by eliminating the regulated tariffs. As regards the natural gas market, it was de jure liberalized in 1998, but the final consumers have no possibility to choose the natural gas supplier due to the lack of alternative natural gas suppliers.
- *Insuring a modern institutional framework* – by transposing and implementing the EC Energy Package III[46]: market liberalization, auctions for energy and using interconnection capacities, etc.

[45] National Energy Efficiency Program for 2011-2020, No. 833 of 10.11.2011, Official Gazette No. 197-202/914 of 18.11.2011.

[46] <http://www.energy-community.org/portal/page/portal/ENC_HOME/AREAS_OF_WORK/Implementation/III_Package>.

The specific objectives for the period 2020-2030 are the following:

- *Enhancing the use of renewable energy sources. Insuring the availability of long term carbon capture and storage (CCS) technology.* In conditions when the carbon capture and storage technology at coal operating plants is not performing well, the renewable sources will have to register a more accelerated development;
- *Improving energy efficiency.* The increase in CO_2 prices on the market will accelerate the implementation of energy efficiency actions;
- *Introducing intelligent electricity grids.* A specific regulatory framework will have to be developed and funds attracted for carrying out such idea.

Electricity from Renewable Sources

The policy framework regulating the promotion of electric power production from renewable sources is set out in the Law on Renewable Energy[47]. If the objective of involving renewable sources in satisfying the demand for electric power is achieved by 2020 we expect a diminishing of greenhouse gas emissions by circa 240 Gg CO_2, as a result of putting into operation approximately 400 MW power generation capacity, mainly coming from wind and photovoltaic sources.

Although the Law on Renewable Energy was approved in 2007, little progress has been achieved until to date in implementing effectively such sources, the main reason being the uncertainty created to investors to recover the investment in such kind of power plants.

According to respective Tariff Methodology[48], the regulatory body has the right to adjust the tariff calculated according to the Methodology to the energy price level, associated with the best European and worldwide practices. By April 2013, only about 120 kW photovoltaic plants and 83 kW biogas plants had been put into operation, the electricity being sold at the tariffs approved by ANRE.

Currently, several biogas power plants are in process of construction, with a total capacity of circa 2 MW, and several small capacity photovoltaic sources are also being constructed with the financial support including up to 20% in grants from the EBRD through MoSEFF credit line[49]. Private initiatives of installing photovoltaic installations are also recorded in the private house sector[50], but these are promoted with evident caution.

The flaws of the legal framework regulating electricity production from RES were acknowledged, and a new draft Law on Renewable Energy was developed, which envisages to transpose into the national legislation Directive 2009/28/CE of the European Parliament and Council of 23 April 2009 on Promotion and Use of Renewable Energy Sources and Abrogation of Directive 2001/77/CE and Directive 2003/30/CE. The new law to be approved in 2013 establishes the procedure for setting the so-called „Feed-in" tariffs, as well as the capacity of renewable sources accepted for construction every year.

To successfully fulfil the commitments made for the implementation of RES and energy efficiency actions, the Government has created a Fund for Energy Efficiency (FEE)[51]; a good part of the Fund are planned as non-reimbursable financial support to investors in RES. As mentioned above, in 2012, the Government, having donors' support, allocated 25 million MDL for this Fund; the budget allocations in 2013 being increased to 80 million MDL.[52]

It should be mentioned that for RM's conditions, which is highly dependent on the import of electricity and striving to cover electricity demand on the territory of right bank of river Dniester from own sources, RES should be promoted very cautiously. Due to the lack of important biomass reserves, the highest development of RES is expected to take place on account of wind and photovoltaic sources. However, the latter cannot be considered as sources that can meet the pre-set energy demand, for which reason the presence of traditional power capacity is required in order to take over the wind (WF) or photovoltaic power, when the wind or solar radiation is missing or the latter do not correspond to the forecasted ones. The most reasonable sources out of the traditional ones for taking over such power are gas turbine units or combined cycle power plant (CCPP). However, the operation of CCPP in tandem with WF leads to a significant diminishing of the investment effort for the construction of mentioned sources, as well as to CCPP efficiency decreasing from 52%, taken into calculation, to 43%. In such circumstances, for RM case, there is a more beneficial solution than the implementation of wind sources. This corresponds to the construction of a coal power plant, which insures:

- a price for electricity lower by 24% than tandem CCPP+PP one; even if the cost of reducing the greenhouse gas emissions were taken into consideration up to the level of CCPP+PP tandem, the price at the coal power plant would be lower, as long as the price of CO_2 does not exceed 57 US$/ton CO_2; for comparison, it should be mentioned that currently, the CO_2 price on the carbon market does not exceed 9-10 US$/ton CO_2;
- the coal power plant allows the displacement of approximately 331 million m^3 of natural gas from energy

[47] Law on Renewable Energy No. 160-XVI of 12.07.2007, Official Gazette No. 127-130/550 of 17.08.2007.

[48] Methodology for determining, approving, and applying tariffs for electric power produced from renewable energy sources and biofuel No. 321 of 22.01.2009, Official Gazette No. 45-46/172 of 27.02.2009.

[49] <http://www.ebrd.com/pages/project/psd/2012/43067.shtml>.

[50] Private house in Criuleni, total capacity of photovoltaic installations being 3 kW.

[51] Regulation on Organization and Functioning of the Fund for Energy Efficiency, Government Resolution No. 401 of 12.06.12, Official Gazette No. 126-129 of 22.06.2012.

[52] <http://www.interlic.md/2012-12-24/The Fund for Energy Efficiency has allocated 80 million lei for financing eligible projects-27858.html>.

balance, not 64 million m^3 as it occurs in the CCPP+PP case, thus diversifying the types of fuel used, as the coal can be purchased on the world market, its reserves being substantially larger than those of natural gas; such a solution significantly increases the energy security of the country, being incomparable with the case of promoting the wind sources of the same capacity[53].

Biomass for Heating

The biomass use for heating contributes to increasing the energy security, as well as to reducing the GHG emissions. A barrier to spreading the given sources is attributed to the presence of higher infrastructure costs, compared to the ones encountered with traditional sources. Therefore, the financial support for promoting such type of projects should be established adequately. The relevant policies in this regard are set in the Law on Energy Efficiency[54], being formulated more pragmatically in the National Energy Efficiency Program[55]. The implementation of the given policies is conceived through the Fund on Energy Efficiency, mentioned above. At the same time, the most important support in promoting biomass based heating projects recorded until to date comes from foreign assistance, basically from EBRD, through MoSEFF Project (1.15 million Euro already allocated to biomass based boiler houses, which insure GHG emissions reduction by circa 2.3 Gg CO_2[56]), mentioned above, as well as through the Energy and Biomass Project in Moldova funded by the European Union (14.56 million Euro) and UNDP Moldova (0.56 million Euro), totalling 14.56 million Euro for the implementation period 2011-2014[57], the community contribution being at least 15% of the project investment value. By the end of 2012, 121 public institutions out of those 130 totally planned were equipped with biomass based heating systems with a total capacity of 35 MW, which insure a reduction by circa 30 Gg CO_2/yr.

The potential of using biomass at national level constitutes 21,042 TJ[58] annually, which represents 22% of the total energy resources needs in the country.

Co-generation Power Plants

The key document that establishes the policies for using cogeneration power plants is the Law on Energy Efficiency[59], which provides for promoting energy efficiency and supporting programs for the implementation of advance energy production technologies, such as cogeneration.

This policy is more pragmatically developed in the National Energy Efficiency Program for 2011-2020. According to the latter, the global efficiency of new combined cycle heat and power plants should be not lower than 80%, while the efficiency of electricity production should be between 45-50%, these sources being given priority over the electricity imported or produced at condensing power plants.

It should be mentioned that, in addition to a high efficiency in place, CHP should have a load factor of at least 51% (4,500 hours/year)[60] in order to become economically viable.

Cogeneration is to be promoted through the following key actions:

- analysis of the national potential for applying high efficiency cogeneration, including high efficiency micro-cogeneration;
- creation of a legal framework required for CHP promotion, including the introduction of „Feed-in" tariffs for the new CHPs.

Currently, CHP-1, CHP-2 and CHP-North, depreciated long ago, account for the majority heating centrally produced on the right bank of Dniester River. Due to poor quality of heat services provided by these sources the consumers prefer to switch to autonomous boiler, leading to a continuous decreasing of CHP thermal load with negative impact on their global efficiency. Thus, according to data provided by ANRE[61], over the past five years, the efficiency of CHP-1 has varied between 64.7-82.6%, of CHP-2 - between 70.5-72.1%, and of CHP-North - between 79.5-83.2%. An efficiency of 80% is established for CHP of "Titotex" S.E., built in 2010, and located on the left bank of Dniester River. As to small capacity CHPs, only two of these are operating in the RM (at State University of Moldova and at Yeast Factory, both located in municipality of Chisinau).

Due to the low performance of centralized heating system in Chisinau, mainly because of the quality of services provided which leave much to be desired, as well as due to the significant debts accumulated, the Government decided to restructure the latter by approving Government Resolution No. 83 of 22.12.2011[62], the goal of which is to create a feasible, competitive, and transparent heating complex, to provide the consumers with quality heating at affordable tariffs, to strengthen the energy security of the country and increase energy efficiency.

The main objective of the reform is to improve the long term heat and power supply feasibility and financial affordability.

[53] Ion Comendant (2012). The impact of promoting wind sources on the national energy system development. International Conference "Moldova's Energy – 2012. Regional development aspects", 4-6 October, 2012, Chisinau, Moldova, 8 pages.

[54] Law on Energy Efficiency No. 142 of 02.07.2010, Official Gazette No. 155-158/545 of 03.09.2010.

[55] National Energy Efficiency Program for 2011-2020 No. 833 of 10.11.2011, Official Gazette No. 197-202/914 of 18.11.2011.

[56] <http://www.moseff.org/index.php?id=101#c1249>.

[57] <http://www.biomasa.aee.md/project-background-ro/>.

[58] <http://www.biomasa.aee.md/img/docs/biomass-heating-systems-ro.pdf>.

[59] Law on Energy Efficiency No. 142 of 02.07.2010, Official Gazette No. 155-158/545 of 03.09.2010.

[60] <http://www.carbontrust.com/media/19529/ctv044_introducing_combined_heat_and_power.pdf>.

[61] <www.anre.md>.

[62] Government Resolution No. 983 of 22.12.2011 on Corporate, Institutional, and Financial Restructuring of the Centralized Heating System in Chisinau Municipality, Official Gazette No. 233-236 of 27.12.2011.

This objective is in line with the provisions of the Energy Strategy of the Republic of Moldova until 2020, approved through Government Resolution No. 958 of 21 August 2007, being aimed at increasing energy efficiency and receptiveness to consumer needs. The implementation of actions for rehabilitation and modernization of heating networks involves reducing the heat losses from 22.1% in 2010 to 16.7% by 2020, close to performance value. Such improvements will reduce the tariffs of „Termocom" JSC by approximately 4.0%.

Carbon Emissions Mitigation Technologies

The carbon emissions mitigation technologies cover a whole series of generic options for reducing the GHG upon fossil fuel combustion, starting with those associated with high efficiency conversion processes, and finishing with carbon capture and storage. The Republic of Moldova has no capacity to develop its own technologies in this regard, for which reason the country plans to transfer such technologies from other countries. The successful resolution at international level of the problem of carbon capture and storage at coal power plants depends on the structure of power plants the country will choose in its development after 2020. As specified in the Energy Strategy until 2030, if the given technologies (CCS) do not register progress, the country will continue focusing on the development of renewable energy sources.

Buildings Sector

The policies on energy consumption in buildings are outlined in the National Energy Efficiency Program for 2011-2020, Energy Strategy of the Republic of Moldova until 2030, as well as in the draft Law on Energy Performance of Buildings[63]. The latter will transpose Directive 2010/31 of 19 May 2010 of the European Parliament and European Council on Energy Performance of Buildings.

The buildings sector can contribute to energy savings by 10-20% of the national target of 20% savings by 2020.

The draft Law establishes minimum energy performance requirements for buildings, use of energy from renewable sources in buildings, energy inspections of buildings and heating systems to be carried out, financial incentives for promoting energy performance improvement of buildings, etc. The document also identifies buildings, the energy consumption of which is to be almost equal to zero, thus:

- after 30 June 2019, the new public buildings shall be buildings with almost zero energy consumption;
- by 30 June 2021, all new buildings shall be buildings with almost zero energy consumption;
- The Government shall develop and approve a National Plan for Increasing the Number of Buildings with Almost Zero Energy Consumption.

[63] <http://mdrc.gov.md/libview.php?l=ro&idc=143&id=2318&t=/Decision making transparency/Announcements-public consultation/MRDC-announces-the initiation of public consultation on draft Law on Energy Performance of Buildings, and draft Law on Amendments and Additions to Some Legislative Acts>.

The Law introduces the Building Performance Certificate, as well as the procedure for issuing such certificate. The sale or renting of buildings will not be possible without energy performance certificates.

Starting with January 2012, the Government provides energy performance certificates for buildings with a total area of 500 m^2 that are constructed, sold or rented. By July 2015, this threshold will be reduced from 500 m^2 to 250 m^2.

Competent public authorities will develop an additional program for rehabilitation of old buildings for the period 2013-2020, which will be aimed at improving the energy performance of old buildings and reducing the heating costs.

Competent public authorities will examine the possibility to introduce starting with January 2013 sanctions for non-observance of the above mentioned provisions. Sanctions will be effective, proportionate, and discouraging.

According to the Energy Strategy until 2030, by 2020, the energy consumption in buildings will be reduced by 10%.

Over the last 10 years, the house owners have made efforts to diminish the energy intensity in the buildings sector: for approximately 10% of the total 30.1 million m^2 of urban buildings and 1-2% of the total 48.8 million m^2 of buildings in rural area walls insulation works have already been carried out, as well as doors and windows replaced with more efficient ones[64].

3.5.2. Transport Sector

As a rule, the reduction of GHG emissions in transport sector is viewed through:

- Reducing carbon content in the fuel used by road vehicles;
- Increasing the road fuels combustion efficiency;
- Encouraging the use of "green" transport means and promoting public transport, as well as zero emissions transport means (cycling, walking);
- Promoting global emissions trading schemes;
- Improving the infrastructure and charging fees for its use;
- Insuring modal shift and improving commodity transport.

It is assumed to accomplish these objectives on the territory of RM through policies formulated in several normative acts of the country.

Reducing Carbon Content in Fuels used by Road Vehicles

It is assumed to reduce carbon content in fuels used by road vehicles in two ways: (a) by substituting the traditional fuels (gasoline and diesel oil) with compressed natural gas and liquefied oil; (b) by diluting the traditional fuels with biofuels.

[64] Greenhouse Gas Reduction Strategies in the Transport Sector: Preliminary Report, OECD/ITF, 2008.

The first way has no political support properly formulated in the normative acts of the country. The price of liquefied gas is much lower than the price of gasoline and diesel oil, and forces the car owners to follow it. For instance, in April 2013, the difference of respective prices was more than two-fold. When the distance covered is long, such a discrepancy leads to a shorter payback period of investments made in vehicle re-equipment with a liquefied gas system, which fact encourages the application of this way of improving the auto transport efficiency. As a result, in 2011, liquefied gas accounted for 4.2% of the total fuel used in the road transport, gasoline accounted for 21%, and diesel oil – for 75%[65].

The second way is promoted through the National Development Strategy "Moldova 2020", Law on Renewable Energy, National Energy Efficiency Program for 2011-2020, etc.

According to the National Development Strategy "Moldova 2020, by 2020 the share of biofuels in total fuel used in the country should reach 10%, while by 2015 - 4% of the total. It can be found in the same document that the volume of ethanol and gasoline mixture in the volume of sold gasoline will constitute 6% by 2015 and 10% by 2020, while the volume of biodiesel oil in the volume of sold diesel oil will constitute 5% by 2015.

The Law on Renewable Energy (2007) establishes that by 2010 the volume of bioethanol mixture in gasoline should constitute 6% of the volume of sold gasoline, while the volume of biodiesel mixture in diesel oil, respectively 5% of the sold diesel oil. For 2020, these objectives were set at 20%, for both bioethanol, and biodiesel oil.

Biofuels have not been used in the RM until currently. However, biofuels are produced for export. For instance, according to the Annual Report of State Ecological Inspectorate[66], in 2009, Moldova produced and exported 260 tons of biodiesel oil. It should be noted, that the first bioethanol production plant was put into operation in the Republic of Moldova in 2013[67].

Increasing the Road Fuels Combustion Efficiency

The Republic of Moldova has no car manufacturing industry. All car types required are imported. To insure a high efficiency of the latter, the Government approved several resolutions limiting the age of imported vehicles. Thus, the Parliament approved amendments to the Customs Code through Law No. 154 of 21.07.2005[68], which provide for prohibiting the import of cars and micro-busses aged over seven years, and of trucks and busses aged over 10 years. The actions taken lead to completing the car fleet with new vehicles and withdrawing the old ones that do not meet the requirements of national standards. Over the last years, the car fleet in the country is being completed with new transport units which are less pollutant.

Through the amendments introduced to Law No. 178 of 11.07.2012, starting with 2013 the vehicles of operation age between 7 and 10 are allowed to be imported. At the same time, pursuant to Budget Law for 2013, higher excises shall be applied upon import of cars older than 7 years, and the excise will increase by 5% for each year of operation. Thus, upon import of eight years old cars, the excise rate will grow by 5%, for 9 year old vehicles – by 10%, while for 10 year old ones – by 15%. The import of cars over 10 operating years old into the Republic of Moldova shall be prohibited.

The results recorded in the first months of 2013 have demonstrated that the introduction of excises does not contribute to blocking the import of old cars. Of those 4330 cars registered for the first time in Moldova over 80% are cars over 5 years old. Half of these are between 8-10 years old[69].

If follow statistic data for 2012, we can notice obvious changes in the sales rate. Cars aged between 8-10 years represented only 2% of the total 25 thousand vehicles registered. At the same time, the share of cars up to two years of age represented circa 19%.

Encouraging the Use of Green Transport Means

Green transport includes cars with electric engines and hybrid ones. The latter combine an internal combustion engine with the technologies used in fully electrical vehicles. To date, such vehicles are not spread in the RM. The List of prioritized NAMAs, which is an Annex to the Low Emission Development Strategy of the Republic of Moldova until 2020, includes as an effective mitigation measure the promotion of such kind of cars, with the hope to get adequate external financial support for their effective promotion. The latest Technological Needs Assessment (TNA) Report[70] has demonstrated that the rational use of the hybrid electric vehicles potential can insure an annual reduction of CO_2 by circa 25 Gg, while that of the electric vehicles – an annual reduction of CO_2 by circa 97 Gg until 2020.

Promoting the Emission Trading Schemes

The Air Transport Development Strategy until 2012[71] stipulates that the planned renewal of the airplane stock im-

[65] Energy Balance of the Republic of Moldova for 2011. <http://www.statistica.md/pageview.php?l=ro&idc=263&id=2197>.

[66] <http://mediu.gov.md/images/documente/starea_mediului/rapoarte/nationale/p7_Anuarul_IES_2009.pdf>.

[67] <http://unimedia.info/stiri/prima-si-unica-fabrica-de-bioetanol-si-biogaz-din-rm-a-fost-data-in-exploatare-59689.html>, <http://zorgbiogas.ru/about/news/15778?lang=ru>.

[68] Law on Amendments and Additions to Some Legislative Acts No. 154 of 21.07.2005, Official Gazette of the Republic of Moldova No. 126-128/611 of 23.09.2005 (age limit upon import of vehicles has been increased from 7 to 10 years through the Law on Amendments and Additions to Some Legislative Acts No. 178 of 11.07.2012, Official Gazette of the Republic of Moldova No. 190-192/644 of 14.09.2012, but higher fees are charged upon import of vehicles older than 7 years.)

[69] <http://www.eco.md/index.php?option=com_content&view=article&id=8390:importul-mainilor-vechi-a-redus-piaa-primar-auto-cu-27&catid=104:auto&Itemid=475>.

[70] <http://www.tech-action.org/Moldova.asp>.

[71] Civil Aviation Development Strategy for 2007-2012, GR No. 987 of 30.08.2007, Official Gazette No. 146-148 of 14.09.2007.

proves the fuel consumption efficiency and reduces the CO_2 emissions. Starting 2023 year, the aviation sector, which accounts for 2% of global greenhouse gas emissions, will be mandatorily included in the EU Emission Trading Scheme (EU ETS). This means that all air companies flying from and to the EU shall compensate the emissions during the flight by purchasing European Union Allowances (EUA) and/or Certified Emission Reductions (CER).

The emission ceiling for 2012 was 3%, while for 2013-2020 it will be 5%, respectively, compared to the emissions in the base year within the period 2004-2006 (EU Directive 2008/101/CE). Therefore, the EU regulations for flight to and from the EU are valid for the RM as well, the aviation sector being thus the first sector of the RM which is to be mandatorily included in the EU ETS, with an officially set emission ceiling.

Road Infrastructure Improvement

The bad condition of roads has a negative impact on the environment. Fuel consumption on bad roads increases by up to 20%, generating addition emissions of harmful substances in the atmosphere. Besides this, bad roads are and additional source of noise and vibration[72].

RM is affected by an intensive process of road degradation. In 1992, circa two thirds of the length of national roads were in good condition, in 1998 – less than half of them, while in 2006 – only around 7% of these roads were in good condition. Although the evolution of local roads condition was analyzed to a smaller extent, the survey of 1,500 km (out of 6,000 km) of local roads, carried out in 2006 stated a bad and a very bad condition of approximately 96% of their length.

The intensive degradation of public roads in the RM happened due to insufficient financing of maintenance and repair works. During the period 1998–2006, road financing was below 10% of the needs. The allocated funds would only allow carrying out routine maintenance works (maintenance in winter time, filling holes, profiling, etc.). Due to non-execution of current and capital repairs required, over 80% of the roads length have exceeded the set operation term.

A relative improvement in the roads condition was achieved in 2010–2011, due to increased collections in the Road Fund (from 241 million MDL in 2009 to 788 million MDL in 2011). But these collections are insufficient to bring the entire road network to an adequate condition.

The effects conditioned by insufficient financing of road maintenance and repair works were amplified by systemic problems. The technical standards and norm used in road sector are obsolete and do not correspond to current requirements, while the institutional structure of the road maintenance system is inefficient.

[72] National Development Strategy "Moldova 2020", Law No. 166 of 11.07.2012, Official Gazette No. 245-247/791 of 30.11.2012.

To overcome the issue of bad roads, the leadership of the country qualified the roads in the National Development Strategy "Moldova 2020" as one of the four critical barriers (education, roads, access to financing, and business environment), without the elimination of which it is impossible to insure a harmonious and sustainable development of the country. Thus, according to "Moldova 2020" Strategy, by 2020 about 1,900 km of national public roads are to be rehabilitated and 4,900 km of local roads – to be repaired, while by 2014 - 900 and 700 km, respectively. As a result, by 2020 RM will have 38% of very good roads, and 42% of good roads, with corresponding impacts on GHG emissions.

In addition to "Moldova 2020" Strategy there is a number of other documents in the transport sector that basically express the desire to resolve the issue of roads. Among these are: Strategy for Road Transport Infrastructure for 2008-2017[73], Law on Roads (1995), Law on Road Fund (1996), etc.

3.5.3. Buildings Sector

A number of distinctive approaches are required to apply to increase energy efficiency in the buildings sector. These include consumer consultation, financial incentives, standards for buildings, and voluntary agreements. The country leadership acknowledges that without changing the consumer attitude and behaviour towards energy efficiency it is impossible to stop the growing trend of energy consumption in this sector.

Such awareness takes place in conditions when, according to a study carried out by IMAS-INC in 2012[74], the perception of information about global warming or its consequences is very low, 5-6% of respondents considering they are very well informed; with regard to climate system or actions that can be undertaken to diminish the global warming effects only 3% of respondents state that they are very satisfied with the level of information they have. The majority of the population does not know the reasons of global warming. Out of a list of 12 possible reasons, each was mentioned in proportion of 5-8% as being responsible to a great extent, or in proportion of 10-20% as being responsible to a certain extent for global warming. Practically no distinction was made between the correct and incorrect answers. More than half of respondents (54%) consider it incorrect that the climate on Earth has changed naturally; while people are not those who caused the current global warming. Even a bigger number of respondents (69%) miss link the causality between the Sun and global warming, while approximately one

[73] Government Resolution No. 85 of 01.02.2008.

[74] National Sociological Study: Republic of Moldova - what the population knows about climate change. Beneficiary: Office for Climate Change, Ministry of Environment of the Republic of Moldova. Developed within the UNEP-GEF Project "Support to the Republic of Moldova in the Preparation of the Third National Communication in compliance with the obligations under the United Nations Framework Convention on Climate Change", Chişinău 2012. <http://clima.md/public/files/Constientzare/Raport_IMAS_RO.pdf>.

third of respondents expect more benefits than damages if the global warming will happen.

It is envisaged to insure adequate information of the household consumers on energy efficiency and its impact on climate change by applying the policies reflected in the Communication Strategy on Energy Efficiency, which is a component part of the National Energy Efficiency Program for 2011-2020. Concurrently, according to the Program, the approaches for increasing energy efficiency in the household sector will be used; the key responsibility in this regard will belong to the Agency for Energy Efficiency of the Republic of Moldova.

3.5.4. Industrial Sector

A number of policies related to reduction of GHG emissions in industrial sector have been approved or are in process over the last period. The most relevant ones are as follows:

- Law on Adherence of the Republic of Moldova to the Montreal Protocol Amendment on Substances Destroying the Ozone Layer (2006)[75] and Law on Approving the Regulation on Trading Regime and Use of Halogenated Hydrocarbons Destroying the Ozone Layer (2007)[76], through which the substances destroying the ozone layer are prohibited or subject to a strict recording regime and management in the Republic of Moldova;
- Energy Strategy of the Republic of Moldova until 2020[77], abrogated in 2012 with the publication of the new Energy Strategy of the Republic of Moldova until 2030. According to the Energy Strategy of the Republic of Moldova until 2020, a National Energy Conservation Program (NECP) was to be implemented within 2003-2010, being updated every two years, taking into consideration the EU Commission Green Paper of 22 June 2005 "Energy Efficiency or Making More with Less" and the Green Paper of 8 March 2006 "European Strategy for Sustainable, Competitive, and Secure Energy"; standards aimed at increasing the efficiency of energy consuming equipment were also to be developed, approved and applied in compliance with the EU standards on energy efficiency; and activities specific to each industrial branch were to be implemented.
- The NECP established as a mandatory task carrying out energy audits every 3 years for industrial sector, starting with energy intensive enterprises, and energy expertise of technologies and equipment, developing current and future actions for energy saving and increasing energy efficiency, staff training and development in compliance with normative acts, mandatory energy expertise of modernization and refurbishment projects, development by enterprises of regulations to stimulate savings of energy and energy resources and apply sanctions for irrational consumption of the latter, modernization and automation of the recording system and regulation of energy flows, etc.

Unfortunately, the intentions mentioned above were not fully implemented, while energy efficiency in this sector made its way in this period having as an impetus the high prices for energy resources, access to advanced technologies, financial availability of enterprises, as well as the capacity of their managers to rationally use the energy efficiency reserves available.

In this context, remarkable results have been achieved through technical assistance provided by foreign donors. It should be mentioned the clean production and energy efficiency projects in approximately 15 enterprises, launched within 2000-2005 by the Centre for Clean Production and Energy Efficiency in cooperation with partners from Norway, the Norwegian Energy Efficiency Group (NEEG), and Norwegian Society of Charted Engineers (NSCE). Following the implementation of the above mentioned projects, the CO_2 emissions were reduced by 348 tons/year.

The capacities of the Centre for Clean Production and Energy Efficiency of the Republic of Moldova were strengthened within the TACIS Project „Cleaner production in three countries – Moldova, Georgia, and Kazakhstan", implemented in 2003-2006.

In September 2009, the European Bank for Reconstruction and Development (EBRD) launched a Credit Line for Energy Efficiency in Moldova („MoSEFF" Project), with an effective impact on reduction of GHG emissions by circa 24,178 tons annually.

The UNIDO-GEF Project GF/MOL/10/001 „Reducing Greenhouse Gas Emissions through Increasing Energy Efficiency in the Industrial Sector of the Republic of Moldova", launched in 2010 for a 3-year implementation period (12/05/2010-31/12/2013), is aimed at reducing GHG emissions in the industrial sector of RM through new policies and standards. It is planned to create the necessary prerequisites for a group of experts well equipped and trained in energy management system implementation (EnMS) to assist enterprises in developing and implementing energy efficiency enhancement projects, as well as in implementing the international standard ISO 50001, already approved at national level in 2012 (MS ISO 50001: 2012).

- In addition to the overall objectives set for the country, the National Energy Efficiency Program for 2011-

[75] Law on Moldova's Adherence to Montreal Protocol Amendment on Substances Destroying the Ozone Layer, No. 119-XVI of 18.05.2006. Official Gazette No. 87-90/391 of 09.06.2006.

[76] Law on Approving the Regulation on Trading Regime and Use of Halogenated Hydrocarbon Destroying the Ozone Layer, No. 852-XV of 14.02.2002. Official Gazette of the Republic of Moldova No. 54-55/383 of 18.04.2002 (amended in 2007).

[77] Energy Strategy of the Republic of Moldova until 2020. GR No. 958 of 21.08.2007. Official Gazette No. 141-145/1012 of 07.09.2007.

2020[78] formulates objectives for industrial sector. Thus, the following actions will be taken to reduce energy demand and use the energy saving potential by applying advanced machines and equipment:

- developing and proposing voluntary agreements for energy savings in industry; according to estimations, long term agreements allow saving between 10 and 20% of energy; voluntary agreements will be transparent and will contain, as the need may be, quantified monitoring and reporting objectives;
- developing an energy efficiency program for industrial sector;
- considering the possibility to include white certificate schemes;
- monitoring the energy consumption in the sector by developing energy efficiency questionnaires (by the Agency for Energy Efficiency) and distributing these to intensive energy enterprises to fill in at the end of each year;
- insuring the information and training of the industrial sector in energy management and training energy managers, if needed;
- avoiding the use of fluorinated gas, if it is possible and cost-efficient to do so; even if policies will be applied in the future to gradually eliminate the use of fluorinated gas with a high global warming potential (GWP), avoiding leakages and correspondingly recovering the high GWP fluorinated gas are still of vital importance; for the key applications, Regulation CE 842/2006, which is necessary to transpose in Moldovan legislation as soon as possible, already contains comprehensive provisions on related to insulation and recovery, capable to reduce the fluorinated gas leakages significantly.

It should be noted that the environment related issues in the industrial sector are reflected episodically, and usually very generally in a number of legislative acts, such as: the Law on Entrepreneurship and Enterprises (1992), Law on Standardization (1995), Law on Certification (1999), Law on Licensing of Some Types of Activity (2001), Law on Industrial Security of Hazardous Industrial Objects (2000), Law on Technical Regulation Activity (2006), etc.

3.5.5. Agriculture Sector

In agriculture sector, GHG emissions basically originate from three main sources: enteric fermentation, manure management and agriculture soils. In 2010, agriculture sector represented the major source of CH_4 and N_2O emissions, with a share of circa 24.5% and 91.9%, respectively, of total national emissions. The CH_4 emissions come from enteric fermentation and manure management, while N_2O emissions – from agricultural soils, and to a smaller extent, from manure management.

The source of CH_4 emissions from 4A „Enteric Fermentation" category is the stomach of ruminants, in which the methane is created, and then emitted into the atmosphere. Both methane emissions and nitrous oxide come from 4B „Manure Management" category. As a rule, the poorly aerated animal manure management systems generates large quantities of CH_4, and smaller quantities of N_2O; while well aerated systems generate less CH_4 emissions and more N_2O emissions.

Direct N_2O emissions from agricultural soils are those resulting from nitrogen incorporated in the soil with mineral and organic fertilizers, from the incorporation in the soil of nitrogen contained in animal excreta during grazing by domestic animals, from the incorporation in the soil of agricultural residues and nitrogen mineralization in connection with the carbon losses from the soil as a result of changing the use of agricultural land and soil management practices.

Enteric Fermentation

RM has no policies oriented expressly towards diminishing the impact of enteric fermentation on environment. The main goal of activities in animal breeding sector has been providing the population with animal food products to a full extent. To accomplish this objective, programs and strategies are implemented, which improve the genetic fund of animals and poultry, and contribute to increasing the animal productivity, and reducing specific costs for fodder per product unit. Along with these positive effects registered in animal productivity specific emissions (per product unit) of greenhouse gas are diminishing too, although the global volume of emissions will inevitably grow with the revitalization of animal breeding sector, and increase of the stock of domestic animals and poultry.

The main policies in animal breeding sector with indirect impact on the RM's targets to UNFCCC implementation process in the RM are reflected in several laws and strategies, including: Law on Veterinary Activity (1993), Law on Selection and Reproduction in Animal Breeding (1995), Law on Animal Breeding (1999), Law on Foodstuffs (2004), National Strategy for Sustainable Development of Agro-Industrial Complex of the Republic of Moldova for 2008-2015 (2008)[79].

Based on these, the following specific actions were taken to carry out respective policies, including:

- Issuance of the Orders of the Ministry of Agriculture and Food Industry on Actions for Improving the Genetic Fund of Cattle Through Artificial Insemination No. 101 of 21.05.2008, No. 46 of 24.02.2009, No. 58 of 02.04.2010, and No. 98 of 26.05.2011[80];

[78] National Energy Efficiency Program for 2011-2020, No. 833 of 10.11.2011. Official Gazette No. 197-202/914 of 18.11.2011.

[79] Government Resolution No. 282 of 11.03.2008.

[80] <http://lex.justice.md/?search=true>.

- Creation of the State Enterprise for Researches in Selection and Hybridization of Pigs "Moldsuinhibrid"[81];
- Approval of the Program for Recovery and Improvement of Poultry Branch for 2002-2010[82].

The implementation of these programs contribute positively to revitalization of animal breeding sector, increasing productivity and animal stock, and, as a final result, to increasing global production of animal products. Along with these positive trends, the volume of GHG emissions will grow as well, but specific emissions (per product unit) will reduce.

Manure Management

Specific policies dedicated to manure management are not reflected in the normative acts of the RM. Along with this, the country's policies oriented towards stimulating the use of renewable energy resources, as well as soil conservation technologies, contribute to increasing the value of animal manure, being either used for biogas production as fuel for electric power generation or as a fertilizer on agricultural fields, obtained including through:

- Depositing the manure on specially arranged and correspondingly equipped platforms;
- Applying the method of manure processing by composting;
- Processing the manure to obtain biogas.

Thus, in 2006, a power plant of circa 83 kW was put into operation in Coloniţa village. The plant operates on animal manure collected from the neighbouring localities that are close to the plant. Starting with 2011 year, the produced energy is delivered to the electricity network at a tariff approved by ANRE.

Agriculture Soils

RM has especially valuable soils, which sometimes are used improperly. The soil can resist crop productivity higher than the one obtained to date. The economic crisis, and the implementation of reforms in agriculture, along with the increasing number of small landowners lacking corresponding equipment and special knowledge contributes, as a consequence, to intensification of soil degradation. The main reasons for soil degradation are: (1) improper use of tillage technologies; (2) allocation of land plots without taking into account the soil conservation needs; (3) insufficient crop rotation; (4) lack of funding resources at national, local and individual landowner levels; (5) limited access to information on how to use efficiently the soil; (6) unauthorized deforestation on agricultural land; (7) lack of adequate forestry buffer zones. Soil degradation is estimated at 3.1 billion MDL in annual losses, including losses through soil erosion, land sliding and formation of ravines, and losses of agricultural products.

The main desertification agents in the RM are: (1) misbalance between natural and anthropic ecosystems determined by the high share of arable land; (2) soil erosion, including deflation; (3) dehumification and chemical degradation; (4) active land sliding; (5) soil salinization and desalinization, (6) physical degradation; (7) wetland degradation/destruction; (8) excessive grazing, etc.[83]

The long-term preservation of soil quality status by increasing the organic matter content in soil in form of humus is the only way for reducing GHG emissions from agriculture soils.

The objectives for accomplishing this goal are stipulated in the National Strategy for Sustainable Development of Agro-Industrial Complex of the Republic of Moldova (2008-2015)[84]; the Strategy for Agricultural and Food Sector Development for 2006-2015[85]; the Program for Rational Use of New Land Lots and Increasing Soil Fertility for 2003-2010 (Part I[86] and Part II[87]).

Unfortunately, the given strategies and programs, as well as the previously approved ones were not realized properly. As a result, over the last 20 years, RM agriculture has been based mainly on exploitation of natural soil fertility (the existing humus content in the soil). As a consequence, every increase in the crop yield caused by climate factors being not followed by measures to compensate for the loss of organic matter used for forming the crop has led to increasing the GHG emissions. Thus, the intensification of dehumification processes as a result of subsistence agriculture has led to reducing the carbon reserves seized in the soil, increasing the CO_2 emissions and diminishing the quality and fertility of agricultural soils.

To overcome the created situation, in 2011, the Ministry of Agriculture and Food Industry developed, and the Government approved the Program for Soil Fertility Conservation and Enhancement for 2011-2020[88]. In particular the Pro-

[81] Government Resolution No. 1095 of 08.09.2003 on Some Actions for Regenerating the Genetic Resources of Pigs. Official Gazette No. 200-203/1149 of 19.09.03.

[82] Government Resolution No. 1247 of 24.09.2002 „On Some Actions for Revitalization of Poultry Complex, Official Gazette No. 135-136 of 03.10.2002 (amended in 2009 and abrogated in 2012).

[83] <http://www.undp.md/media/tender_supportdoc/2013/645/Strategia%20Nationala%20a%20Programului%20de%20Granturi%20 Mici.pdf>.

[84] Government Resolution No. 282 of 11.03.2008 on Approval of the National Strategy for Sustainable Development of Agro-Industrial Complex of the Republic of Moldova (2008-2015). Official Gazette No. 57-60 of 21.03.2008.

[85] Government Resolution No. 1199 of 17.10.2006 On Approval of the Strategy for Agricultural and Food Sector Development for 2006-2015. Official Gazette No. 170-173 of 03.11.2006.

[86] Government Resolution No. 636 of 26.05.2003 on Approval of the Program for Rational Use of New Land Lots and Soil Fertility Enhancement (Part I). Official Gazette No. 99-103 of 06.06.2003.

[87] Government Resolution No. 841 of 26.07.2004 on Approval of the Program for Rational Use of New Land Lots and Soil Fertility Enhancement (Part II). Official Gazette No. 138-146 of 13.08.2004.

[88] Government Resolution No. 626 of 20.08.2011 on Approval of the Program for Soil Fertility Conservation and Enhancement for 2011-2020. Official Gazette No. 139-145 of 26.08.2011.

gram envisages to stop the active forms of degradation in the upper soil layer on an area of circa 877 thousand hectares of arable land (circa 50% of the total area of arable land), and take soil conservation and fertility enhancement on an area of 1.7 million hectares until 2020.

Unfortunately, the financial coverage of this Program is insufficient for the time being (circa 18 million MDL annually) and cannot insure radical changes in the existing situation. Some positive change in the situation can be expected from the actions taken by economic entities involved in agriculture through massive implementation of environmentally friendly and low cost agricultural practices, such as crop rotation, applying green fertilizers, use of conservative tillage systems, etc. To date, non-conventional plowing is being applied on approximately 70% of the arable land area in the RM, while the new technologies, like „no-till" and „mini-till" are used only on approximately 2.4% of the arable area of the country. Vegetable agricultural residues are applied only on approximately 30% of the arable area. Crop rotation is not applied regularly. With regard to fertilizers used, it should be noted that the used quantity is insufficient, constituting on average circa 20 kg of active substance per hectare; organic fertilizers are practically not applied, the latter not exceeding circa 10 kg/ha on average (being mainly used in greenhouses or upon creating orchards).

To improve the situation with regard to soil conservation, the following urgent actions are needed:

- Insuring a correct anti-erosion and hydrological organization of agricultural land by taking into consideration the suitability of land areas for different use;
- Implementing conservative tillage systems;
- Creating a mandatory organic soil fertilizing system by using green fertilizers and organizing the process of manure collection from individual farms (households) for subsequent composting and application of the latter at commune level;
- Use in larger extent the crop rotation, and reducing the share of row crops;
- Insuring harmless chemical fertilization (minimum required) of agricultural crops, etc.

3.5.6. Forestry Sector

It is good to know that forests represent a key element in maintaining the ecosystem balance, protecting land and aquatic resources, improving the national landscape, as well as the shape and microclimate of localities. The forests have always played this role, and whenever the human activity contributed to climate change, the importance of forests has always increased even more, the latter becoming a crucial element for seizing carbon and regulating the thermal and hydrological regime of landscapes.

According to historical data, only two centuries ago, the territory where our country is situated used to be covered with forests in proportion of over 30%. To date, the share of forests is much smaller, the latter occupying circa 12% of the country's territory. This is in conditions, when the forests in Europe cover approximately 45% of the continent's area[89].

To change the created situation, the Government outlined as an objective to increase the forest area up to 15%[90] by 2020, improving the condition of existing forests as well. In this sense, several specific policies have been approved over the last decade to accomplish this objective, which equals to planting circa 130 thousand hectares of forestry vegetation by 2020.

In addition to increasing the forests area, RM's forests require multiple actions to be taken to improve their quality. Thus, according to results presented in different reports/specialized studies, the main dis-functionalities characterizing the current status of RM's forests include the following:

- worsening of forest vitality and health;
- spreading of adventive and invasive species;
- vegetative origin from second to forth (2-4) generation sprouts of circa 60% of forests (in case of oak species, this percentage is circa 90%), having a much lower resistance to the action of hazardous biotic and abiotic factors;
- noncompliance of circa 40% of the arboretum to stationary conditions.

Such situation influences the productivity of cvercinea species, 43% of which have a superior productivity, and 57% - an inferior productivity.

To improve the situation created in the forestry sector, the following actions are required:

- carrying out a complex study of the current status of forests and projecting its evolution in the future, including the assumption of climate changes;
- developing and implementing a national program for improving the condition of degraded forests and forestry biodiversity conservation;
- defining the seed base creation process;
- insuring gradual reconstruction/substitution of arboretums non-complying with stationary conditions;
- insuring gradual conversion of cvercinea arboretum from grove regime to forest regime.

The regeneration of existing forests and extension of areas covered with forestry vegetation are provided for in several normative acts of the country, updated repeatedly

[89] <http://www.ecomagazin.ro/republica-moldova-codasa-la-capitolul-paduri-vezi-care-este-cea-mai-impadurita-tara-din-europa/>.

[90] National Strategy and Action Plan on Biological Diversity Conservation, Law No. 112-XV of 27.04.2001. Official Gazette No. 90-91/700 of 02.08.2001.

throughout the process, including in Law No. 1515-XII of 16.06.1993 on Environment Protection (1993), Forestry Code (Parliament Resolution No. 887-XII of 26.06.1996), Law on Improvement through Afforestation of Degraded Land (Parliament Resolution No. 1041-XIV of 15.06.2000), Strategy for Sustainable Development of Forestry Sector (Parliament Resolution No. 350-XV of 12.07.2001), National Strategy and Action Plan on Biological Diversity Conservation (Parliament Resolution No. 112-XV of 27.04.2001), Government Resolution No. 636 of 26.05.2003 on Approval of the Program for Rational Use of Land and Soil Fertility Enhancement (2003), Government Resolution No. 737 of 17.06.2003 on Approval of the State Program for Regeneration and Afforestation of Forestry Fund Land for 2003-2020, Government Resolution No. 739 of 17.06.2003 on the Implementation of the Strategy for Sustainable Development of National Forestry Sector; multiple international agreements that the RM is a party to (UNFCCC, UNCBD, UNCCD, etc.), other laws and resolutions of the Government referring directly or indirectly to the forestry sector.

Regeneration and Afforestation of the Forestry Fund Lands

The State Program for Regeneration and Afforestation of Forestry Fund Land is planned for the period 2003-2020, covering respective policies which are underway. The Program provides for regeneration and afforestation of land plots from the Forestry Fund on an area of 95.1 thousand hectares, while the execution of the volume of works indicated requires 588.1 million MDL in total or 32.2 million MDL annually. Within 2002-2010 time periods, there were planned forest regeneration works on a total area of 47.5 thousand hectares, including: plantation of forestry crops – 12.3 thousand hectare, supporting natural regeneration – 19.5 thousand ha and natural regeneration – 15.7 thousand hectares.

However, the planned works were not fully carried out within the respective period due to limited financial resources available. Thus, forest regeneration works were effectively carried out on 30.2 thousand ha (63.6%), including plantation of forestry crops – on 8.5 thousand ha (69.1%), supporting natural regeneration – on 17.2 thousand ha (88.2%), and natural regeneration – on 4.5 thousand ha (28.7%).

Out of the total area covered by forest regeneration works of 30.2 thousand ha, 8,535 ha (28%) were planted with forestry crops, while 21,669 ha (72%) were subject to regeneration works and natural regeneration supporting works. The objectives were not accomplished also because of the failure to use the possibility to carry out the cutting of key products, including those affected by natural hazards. Thus, the State Program for Regeneration and Afforestation of the Forestry Fund Land for 2003-2020 has been implemented in proportion of only 32%. If maintain the same pace of works, the entire Program accomplishment is unlikely be finalized. As stated above, the main reason of such status of things is the lack of adequate financial coverage.

Rational Use of Land and Soil Fertility Enhancement

The Program for Rational Use of Land and Soil Fertility Enhancement91 was envisaged for the period 2002-2010.

The forestry improvement works planed in this document included:

- creation of new forestry protection belts and reconstructing the existing ones;
- afforestation of degraded land on an area of 133.1 thousand hectares, including:
  - forestry protection belts – 12.14 thousand hectares;
  - anti-erosion forestry belts – 28.33 thousand hectares;
  - water forestry protection belts – 14.94 thousand hectares;
  - forestry plantations on degraded land areas – 72.65 thousand hectares;
  - reconstruction of forestry protection belts – 5.02 thousand hectares.

The analysis of accomplishments under this Program stated that the objectives set were not effectively achieved, the main reason being the lack of adequate financing for the planned actions.

Out of the total area of 133.1 thousand hectares planned for afforestation, 58.3 thousand hectares (43%) were planed under new forest, field protection belts were created on an area of 75 ha (0.6%), water protection belts were created on 168 ha (0.1%), 57.9 thousand ha (80%) of degraded land were afforested, no anti-erosion belts were created.

CDM Projects

Two projects have been proposed and are currently underway within the CDM of the Kyoto Protocol, dedicated to forest regeneration, afforestation, and soil conservation:

- „Soil Conservation in Moldova" Project was effectively launched with the World Bank support in 2002. The Project envisages actions for soil rehabilitation and conservation through afforestation of 20.3 thousand of degraded land, with the main goal to contribute to the implementation of UNFCCC provisions, as well as of the Kyoto Protocol mechanisms. The land plots to be subject to afforestation are owned by 383 local authorities, and 23 forestry enterprises from within the territorial-administrative structures of the country, except for ATULBN. The main project activity, i.e. plantation of forestry crops, is practically finalized. In addition to the planted forestry crops, the net reduction of CO_2 in the first 20-year period will constitute 3.6 million tons, of which 1.9 million tons are already contracted for the period 2004-2017 from the World Bank Funds. Approximately one million tons of CO_2 emissions were reported for the period 2004-2010.

[91] Government Resolution No. 636 of 26.05.2003. Rational Use of Land and Soil Fertility Enhancement Program

- „Community Forestry Sector Development in Moldova" Project was effectively launched in 2006, with the World Bank support, with the goal to create new community forests on an area of 8.5 thousand hectares through afforestation of eroded and non-productive land, carbon sequestration, regional and local forestry resources improvement, additional supply with timber, and sustainable local/regional development. The planned crediting period is 30 years (2006-2035). The expected total sequestration of CO_2 emissions throughout the entire crediting period is 1.3 million tons, of which 600 thousand tons of CO_2 have already been contracted by the World Bank Funds.

Foreign Assistance

RM is the recipient of the Japanese Grant under the Policy for Human Resource Development for the „Community Program for Supporting Sustainable and Integrated Management of Forests and Carbon Sequestration through Afforestation". The Grant amount constitutes 975,900 US dollars. The Grant is carried out by „Moldsilva" Agency and Forestry Management and Research Institute.

The Program was joined by 19 beneficiaries during 2010-2011. The total budget of those 19 projects designated is circa 4 million MDL, of which local contribution constitutes 15%. The works scheduled under those 19 sub-projects will have a positive impact on forests and meadows of respective communes, substantially contributing to their improvement, increasing the level of their administration, and achieving environmental and economic benefits appreciable for the population from the applicant localities. Thus, works are scheduled in forests and other forestry vegetation on an area of 1,453 hectares, including forest development works on 1,162 hectares, and reconstruction / support works on 291 hectares to regenerate the arboretums destroyed mainly through illicit cuttings. It is also planned to improve circa 609 hectares of community meadows under these projects. The total volume of net sequestrations of CO_2 emissions within the Grant until 2020 is estimated at circa 100 thousand tons.

Timber Use

In addition to carbon sequestration in the process of photosynthesis, forests constitute an additional source of GHG emission reduction, as a result of using the timber collected in the process of forest care for energy purposes, substituting in this way the consumption of fossil fuels. To improve the efficiency in this process, the Government approved Resolution No. 1337 of 16 December 2005[92]. The Resolution was issued in compliance with the provisions of Forestry Code[93] for the purpose of insuring the rational, expedient, and efficient use of harvested timber, improvement of the condition and eco-protective functions of forests. This Resolution provided the possibility to harvest the timber while cutting the main products in the period 2006-2010 within the Forestry Fund managed by "Moldsilva" Agency, which totals 1,359.3 thousand m^3.

3.5.7. Waste Sector

Usually, the reduction of GHG emissions in the waste sector is anticipated in three ways: by diminishing the methane emissions at the municipal solid waste disposal sites (landfills) and wastewater treatment plants; by re-using and recycling the municipal waste; and by recovering the energy stored in municipal waste and wastewater, which substitutes the energy obtained by burning fossil fuels.

To illustrate the importance of waste with regard to their impact on environment, it should be mentioned that these contribute to creation of 55.8% of total methane, and 5.5% of the nitrous oxide emissions generated at the national level, respectively, the contribution of this sector constituting circa 11.9% of the total national GHG emissions in 2010.

It is possible to diminish respective emissions by redirecting bigger quantities of biodegradable waste outside the landfills. This can be achieved by encouraging waste recycling and increasing the energy recovery from these.

There are opportunities to reduce GHG emissions in the wastewater handling sector as well. Thus, wastewater accounts for circa 11% of the total GHG emissions in the Waste Sector. The solution for reducing GHG emissions is considered to be excluding the anaerobic treatment upon operating wastewater treatment systems or recovering the methane emissions generated in this process. To date, the legal framework sets some requirements for reducing the GHG emissions during wastewater handling, treatment, and discharge, but does not provide for the use of silt fields from the wastewater treatment plants to reduce respective emissions.

Policy and Legislative-Normative Framework

Those circa 35 legislative acts and over 50 Government Resolutions approved in the field of environment protection until currently were not expressly focused on the above mentioned objectives, respective normative acts having only a partial impact.

Among these, it is worth paying attention to the policies oriented towards discouraging waste storage in respective landfills and encouraging their recycling, providing sewerage services to urban areas and to social objects in rural areas. This remedy for reducing emissions proved to be the most efficient in countries of best practices in waste management[94]. In this sense, it should be mentioned several most relevant national normative acts:

[92] Government Resolution No. 1337 of 16 December 2005 on Providing the Possibility to Harvest Timber while Cutting the Main Products for the period 2006-2010

[93] Law No. 887-XIII of 21 June 1996

[94] The UK's Fifth National Communication under the United Nations Framework Convention on Climate Change. 2009.

- Law on Environment Pollution Fee[95], approved in 1998, and amended afterwards, including lately in 2008:
  - Sets a fee for waste storage, but the payment standard applied only to wastes causing N_2O, CO_2 and CH_4 emissions included in List No. 2 „Aggressiveness ratios for some pollutants eliminated in the air", Annex 2 of this document;
  - The fee standard for waste stocks at pig complexes and farms vary between circa 3 US$/m^3 (with protection screen) to circa 6 US$/m^3 (without protection screen). Respectively, for cattle complexes and farms, this standard constitutes 0.7-0.14 US$/m^3, while for poultry farms - 0.37-0.74 US$/m^3. The analysis of these values reveals that the fees have been determined by taking into consideration the impact of mentioned wastes on the soil, ground water, and other environment aspects, but not on climate change, given that the emissions from such biomass record higher values when placed in storages with protection screen. However, less money is paid for such storage, thus encouraging, rather than discouraging CH_4 emissions into the atmosphere;
  - The fee standards for discharging pollutants with wastewater are set in fixed amount, without specifying the impact of each pollutant on climate changes. For instance, in Chisinau municipality, the fee for one conventional ton of discharges constitutes 234 MDL (approximately 19 US$).
- As a response to policies expressed in the Law on Industrial and Household Wastes[96], a National Program for Rational Use of Industrial and Household Waste[97] was approved. The guiding principle applied upon drafting the program was the formula "the pollutant pays". The Program was also based on such principles, as minimization of wastes, maximum inclusion of wastes in the economic circuit (processing, use), and their safe location in the environment, stipulating the implementation deadlines. The audit carried out in 2010[98] revealed that these were not fully accomplished for the following objective and subjective reasons: lack of implementation procedures and methods; lack of financial coverage, institutional changes in government structures; redistribution of competences, etc. Although the legislation provides for waste storage against payment, such fees are not established. Some of the existing fees are paid for environment pollution, but can be obtained only through court. Such fees are paid on basis of calculations made by environmental inspectors, to the National Environment Fund. The order of payment for waste storage in municipal solid waste disposal sites is unclear, and the source of waste disposal sites land rehabilitation is undetermined. Non-differentiated fee payment does not encourage the companies to reduce the quantity of waste produced and discharged for storage.
- Law on Air Protection[99] sets fees for exceeding the maximum admissible concentration of pollutants in the atmosphere. However, the GHGs are not included in the monitoring categories, proceeding from the Instruction on assessing the damage caused to ambient air by pollution from stationary sources[100]. At the same time, another instruction approved in 2004, namely Instruction on assessing the damage caused to ambient air by production and household waste management[101], expressly sets such fee, which is calculated in the amount of 18 MDL per ton of CO_2. In practice, however, this fee encounters difficulties in application, given the need for laboratory samples while technical capacities for making proper tests are missing. In other words, the mentioned fee has not been applied yet.
- Strategy for Water Supply and Sanitation in the Localities of the Republic of Moldova[102] provides for equipping the wastewater treatment plants with silt treatment technologies, while there no requirements for applying actions to insure the effective use of methane.

It should be noted that even in the absence of palpable legal incentives for rational use of biodegradable wastes, over the past seven years, the economic entities were more interested to apply the policy of reusing respective wastes due to a significant increase in prices of energy resources which are imported.

Thus, the price of natural gas within 2005-2012 increased by 5.25 times, in 2013 reaching 410 US$/thousand m^3 at border crossing, versus the average price of circa 76.1 US$/thousand m^3 recorded in 2005. As a consequence, many enterprises started using the biomass wastes from their basic activity to obtain energy carriers in the technological process. Among these there should be mentioned such enterprises, as: Avantaj-AV, Orhei-Vit JSC, Floarea Soarelui JSC, IM Transoilrefinary LLC, Grincart Construct LLC and others.

[95] Law on Environment Pollution Fee No. 1540-XIII of 25.02.98, Official Gazette of the RoM No.54-55/378 of 18.06.1998.

[96] Law No. 1347-XIII of 09.10.1997 "on Production and Household Wastes".

[97] Government Resolution No. 606 of 28.06.2000 (abrogated in 2012).

[98] Resolution of the Court of Accounts on the Audit Report on environment related performance –solid household waste management, No. 35 of 01.06.2010, Official Gazette No. 141-144/25 of 10.08.2010.

[99] Law on Protection of Ambient Air, No. 1422 of 17.12.1997, Official Gazette No. 44-46 of 21.05.1998.

[100] Instruction on assessing the damage caused to ambient air by pollution from stationary sources No. 381 of 16.08.04. Ministry of Environment, Official Gazette No. 186 of 15.10.2004.

[101] Instruction on assessing the damage caused to ambient air by production and household waste management 08.06.2004, Ministry of Environment, Official Gazette No. 189-192/384 of 22.10.2004.

[102] Government Resolution No. 662 of 13.06.2007 on Approving the Strategy for Water Supply and Sanitation in Localities of the Republic of Moldova, Official Gazette No. 86-89/696 of 22.06.2007.

To overcome the problems accumulated in the waste sector, in 2013 the Government approved Strategy for Waste Management in the Republic of Moldova for 2013-2027[103].

The Strategy is aimed at promoting a new collection procedure for household wastes, production waste, recovery of re-usable materials, environment protection, and implementation of a unitary street cleaning program which would contribute to reducing the quantity of wastes stored in respective zones by setting an adequate treatment system for each type of waste, with the aim to protect the environment.

The specific objectives for wastes that are responsible for GHG emissions, i.e. vegetable wastes, animal manure, waste from timber processing, and others, include the following: (a) encouraging the rational use of aerobic and anaerobic methods and construction of waste composting and fermentation capacities, at least one in each district; (b) supporting the energy recovery where the material recovery is not feasible from the technical and economic points of view, in safety conditions for the health of the population and environment.

To accomplish these objectives, it is envisaged to: (1) create separate collection networks for vegetable waste, animal manure, wastes from wood processing; (2) promote projects for energy recovery from vegetable wastes where the material recovery is not feasible; (3) create packaging waste collection capacities.

[103] Government Resolution No. 248 of 10.04.2013 on Approving the Strategy for Waste Management in the Republic of Moldova for 2013-2027. Official Gazette No. 82 of 12.04.2013.

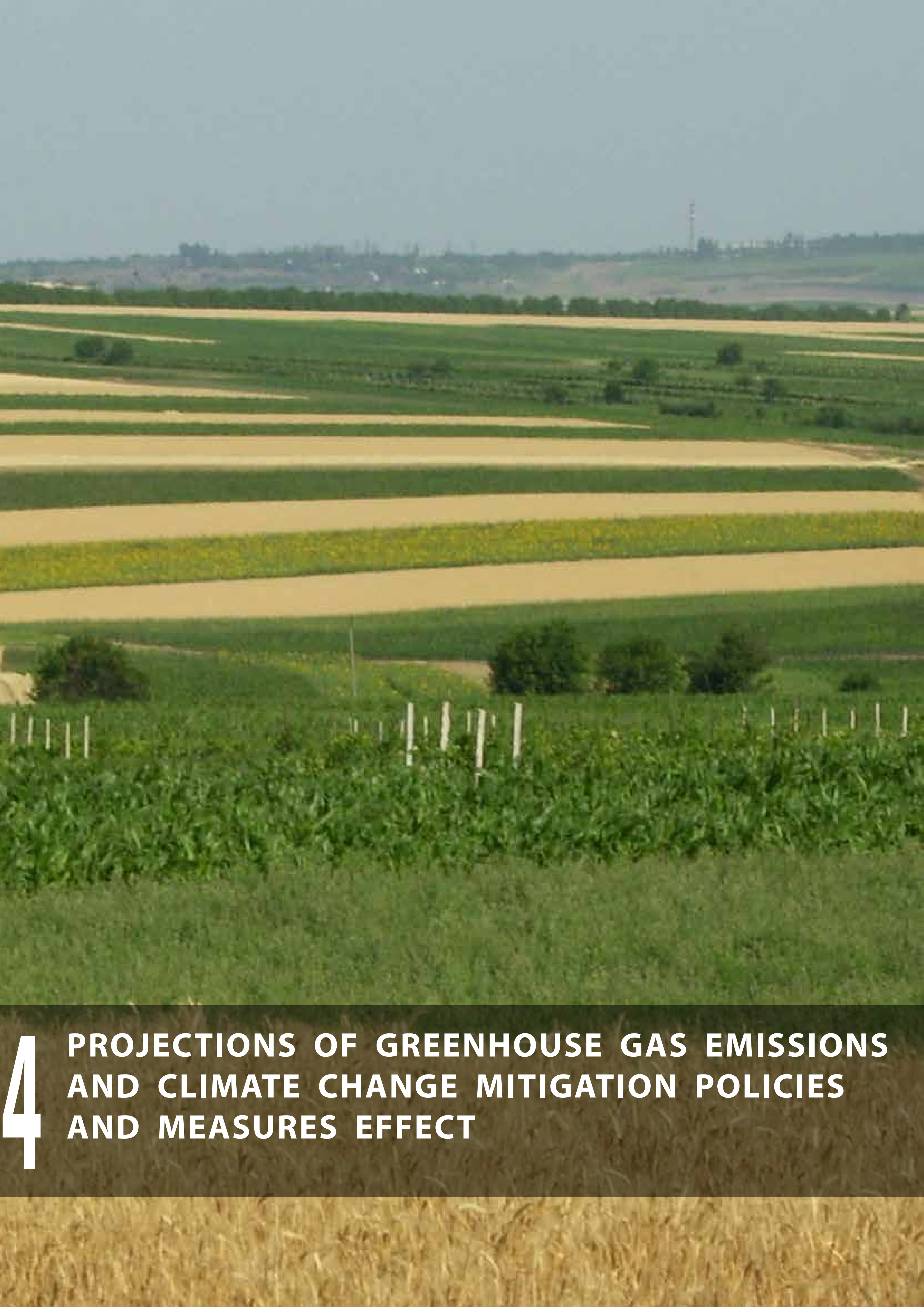
At the same time, the Strategy promotes an information, awareness, and motivation system for all the parties, including for enterprises involved in waste management, on the impact of wastes, implicitly of hazardous waste on the health of the population and of environment.

CDM Projects

Two national projects were proposed under the CDM of the Kyoto Protocol for reducing the waste related GHG emissions, the first one through fermentation of biodegradable waste from a sugar refinery and production of biogas for electric power generation, while the second is designed to burning the methane recovered at Tintareni landfill, with subsequent biogas use for electric power generation.

According to the first project „Biogas production from sugar beet pulp pressed at Südzucker Moldova sugar refinery" (Drochia) it is planned to reduce the GHG emissions produced in the process of sugar residues decay by 8 thousand tons of CO_2 equivalent in the first year of project implementation, and by 32 thousand tons of CO_2 equivalent in ten years.

The second project is designed for „Biogas recovery and electric power generation at Tintareni landfill" (Chisinau), being launched by „TEVAS GRUP" LLC. During the first crediting year it is planned to reduce the GHG emissions by approximately 53 thousand tons of CO_2 equivalent and by 47 thousand tons of CO_2 equivalent in ten years.



4 PROJECTIONS OF GREENHOUSE GAS EMISSIONS AND CLIMATE CHANGE MITIGATION POLICIES AND MEASURES EFFECT

CHAPTER 4. PROJECTIONS OF GREENHOUSE GAS EMISSIONS AND CLIMATE CHANGE MITIGATION POLICIES AND MEASURES EFFECT

4.1. Medium-Term Projections of Greenhouse Gas Emissions

While developing the GHG emissions projections, it has been taken into account the impact of mitigation policies and actions mentioned in Chapter 3, inclusive the Low Emission Development Strategy of the Republic of Moldova until 2020, which incorporates mitigation targets by sector.

Table 4-1 provides historic data on total GHG emissions (1990-2010), as well as GHG emission projections for *With Measures Scenario*, for the period until 2020, in compliance with the policies mentioned in Chapter 3. Historic emissions correspond to those included in the *National Inventory Report, 1990-2010. Sources of emissions and sequestration of greenhouse gas in the Republic of Moldova* (2013). Both, historic data and projected GHG emissions cover the whole territory of the RM, including ATULBD.

The RM's progress in achieving the mitigation pledges is evaluated against the base year (1990), with a recorded GHG emissions volume equal to 43259.8 Gg CO_2 equivalent (without LULUCF). As can be noted from Table 4-1, the level of GHG emissions compared to 1990 year, in 2010 was just 30.7 per cent. If the mitigation policies mentioned in Chapter 3 are fully implemented, respective reduction would be more significant by 2020; reaching a level of circa 27.6% of the emissions recorded in 1990. Thus, the RM's commitment under the Copenhagen Accord (2010), to reduce GHG emissions by at least 25% until 2020, compared to reference year (1990), will be much over fulfilled.

Throughout the years, the structure of GHG emissions would change essentially as well, the share of carbon dioxide having a diminishing trend, while the share of other greenhouse gas (CH_4, N_2O, HFC, PFC and SF_6), will record a growing trend (Figure 4-1).

Table 4-1: Greenhouse Gas Emissions in the RM within 1990-2020, Gg CO_2 equivalent

Greenhouse gas	BY	1990	1995	2000	2005	2010	2015	2020
	Historic data						Projections	
CO_2 (with LULUCF)		28175.8	10396.2	5607.0	8263.6	8911.3	6994.2	7102.5
CH_4 (with LULUCF)		4590.7	3816.9	3109.7	2870.6	2681.0	3022.9	2790.2
N_2O (with LULUCF)		3316.3	2007.9	1398.6	1662.3	1607.2	1669.4	1803.0
F-gas (HFC, PFC and SF_6)		0.0	1.9	13.4	39.5	103.0	151.8	226.3
Total net emissions (with LULUCF)		36082.8	16222.8	10128.7	12836.0	13302.5	11838.2	11921.9
Total emissions (without LULUCF)	43259.8							
Compared to base year (without LULUCF), %			-62.5	-76.6	-70.3	-69.3	-72.6	-72.4
Level of emissions compared to base year, %			37.5	23.4	29.7	30.7	27.4	27.6

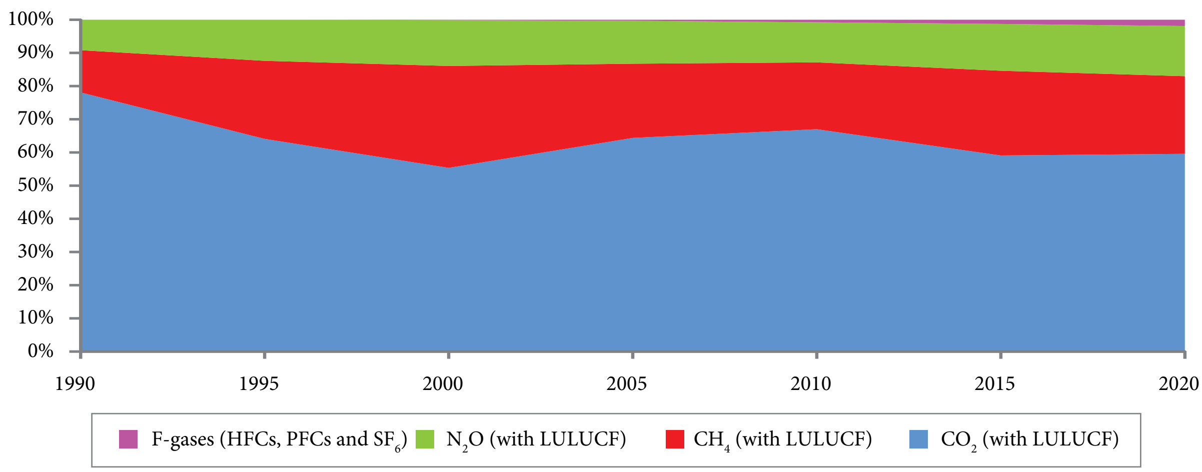


Figure 4-1: Structure of total GHG emissions in the RM within 1990-2020, %

In 1990 the share of CO_2 emissions (with LULUCF) represented circa 78.1% of total GHG emissions in the RM, while in 2010, its share constituted just 67.0% of the total national emissions: by 2020, the share of CO_2 emissions would reduce to 59.6% of the total. The respective changes are partly due to the growing contribution of LULUCF sector in carbon sequestration, as well as due to increased emissions trend of other GHGs, mainly of CH_4 and N_2O, as a consequence of agriculture sector development, basically of animal breeding sector (emissions from the enteric fermentation and manure management), also due to the increasing living standard of the population, with direct impact on the level of household wastes generation.

4.2. Methods and Tools Used to Assess the Mitigation Potential

The GHG emission projections were undertaken for three scenarios: (1) business-as-usual (BAU); (2) with measures (WM); and (3) with additional measures (WAM), taking into account the fact that the reflection of mitigation potential through comparison methods can mobilize more adequately the decision makers to achieve the established objectives.

The mitigation scenarios developing process, particularly in case of BAU and WAM, was affected somehow by the uncertain evolution of some social-economic factors, with major impact on long term GHG emissions, as well as on the capacity to identify adequate long term mitigation opportunities.

To assess the mitigation potential, the national experts applied available software and tools, using the top-down and bottom-up methodological approaches.

Mitigation scenarios were developed for each individual sector (energy, transport, industrial processes, agriculture, LULUCF and waste); the GHG emissions being estimated separately for each GHG (CO_2, CH_4, N_2O, HFC, PFC and SF_6).

The list of considered tools, as well as the ones selected for use, accompanied by a brief justification for their selection is provided in Table 4-2.

4.3. Medium-Term Projections of Greenhouse Gas Emissions by Sector

4.3.1. Energy Sector

In energy sector, GHG emissions projections and mitigation actions have been identified separately for stationary combustion (power and heat generation) and mobile combustion (transport sector). Fugitive emissions from operations with oil and natural gas, including extraction, processing, and distribution of oil and natural gas were set at the level of 2010.

I. Stationary Combustion

I.A. Electrical Power Sector

Mitigation potential in the electrical power sector was determined based on the analysis of three alternative scenarios (BAU, WM and WAM) of electric power sources development for satisfying the same demand of power throughout the years until 2030.

Table 4-2: Tools used to assess the mitigation potential in the Republic of Moldova

Sector	Recommended tools	Used tools	Notes
Energy	MESSAGE, MARKAL, ENPEP-BALANCE, LEAP, RETScren	ENPEP, jointly with sub-programs: WASP, IMPACT LEAP Standard calculation tool (IPCC, 1997)	1) Within the electricity sub-sector (for electric power generation sources located on the right bank of the Dniester River), the GHG emissions mitigation potential was assessed by means of ENPEP software package; 2) Within the heat and energy, and transport sub-sectors, the GHG emissions mitigation potential was assessed by means of LEAP software; 3) In case of Moldovan Thermal Power Plant in Dnestrovsc, located on the left bank of the Dniester River, the mitigation potential was assessed by using the standard calculation tool (IPCC, 1997), which is a component part of the Revised 1996 IPCC Guidelines (IPCC, 1997).
Industry	LEAP	Standard calculation tool (IPCC, 1997)	In case of industrial, agricultural, and land use, changes in land use and forestry management sectors, the GHG emissions mitigation potential was assessed by using the standard calculation tool (IPCC, 1997), which is a component part of the Revised 1996 IPCC Guideline (IPCC, 1997), by taking into consideration the GPG (IPCC, 2000, 2003) recommendations.
Agriculture	STAIR		
LULUCF	COPATH		
Waste	LEAP	Calculation tool created by Swiss Company INFRAS for First Order Decay Method Standard calculation tool (IPCC, 1997)	To assess the mitigation potential of methane emissions from solid household waste storages, the experts used a calculation tool created by the Swiss Company INFRAS for First Order Decay Method. To assess the mitigation potential of methane and nitrous oxide emissions originating from wastewater treatment, the experts used the standard calculation tool (IPCC, 1997), which is a component part of the Revised 1996 IPCC Guideline (IPCC, 1997), by taking into consideration also the GBP (IPCC, 2000) recommendations.

Respective scenarios have been evaluated and improved by applying ENPEP software developed by the International Agency for Atomic Energy. This tool allows carrying out the entire range of analyses required for determining the GHG emissions mitigation effect in the complexity of implementing refurbishments and building new plants in the energy system. By applying the WASP model which is an integral part of ENPEP software, the energy sources that need to be constructed or refurbished within the analysed period are selected in optimization way. The results achieved in this study are automatically transferred to IMPACT model (another component part of ENPEP software), designed for determining emissions of the plants selected by WASP study.

The WM scenario is in line with the official policies on electrical power sector development.[104, 105] The main priority of this economical branch is to reach a high energy security by 2020 through construction of combined cycle power plants (650 MW), extending interconnections with neighbouring countries and joining to ENTSO-E, rehabilitating the existing CHPs, improving energy efficiency and build high capacity renewable energy sources, up to 400 MW (in WM scenario, the capacity of renewable sources was set at the level of 250 MW) by 2020 year, continuing to refurbish the MTPP in Dnestrovsk. The balancing power required in relation to putting the renewable sources into operation is insured by gas turbines, constructed for this purpose. The electricity import reaches zero values by the end of 2020 year.

Unfortunately, the WM scenario has no in depth studies behind, which would demonstrate that this scenario is well justified and takes the national circumstances into consideration to a full extent, including the consumers payment capacity for electricity produced by the new sources. Starting with this and guiding by the objective of reaching an acceptable energy security level, with lower costs, the WAM scenario was further developed and assessed.

The WAM has been developed by applying the WASP tool which selects the type of power units from a preliminarily established list, the power and year of putting the source into operation, by using the dynamic programing method. The preliminarily established list of power units includes:

- Combined cycle plants of various power and technical and economic characteristics;
- Efficient coal power plants;
- Construction of new electric and heat power grids, designed as energy sources;
- Existing cogeneration power plants subject to refurbishment, as a result of which the operation life of the latter increases, as well as the electricity production efficiency;
- MTPP groups with subsequent refurbishments.

The electricity import constitutes 25% of the total electricity consumption. Nuclear power plants have been excluded from the list of candidates for the reasons stated in a study carried out by a group of authors in 2007[106]. Neither the renewable energy sources participate in covering the load.

BAU scenario serves as a comparison base for identifying the advantages under WM and WAM scenarios, including from the point of view of GHG emissions reduction potential, and covers the following considerations:

- The current electricity import from Ukraine is increasing approximately as much as the increase in total electricity consumption in the future;
- The construction of new interconnection lines with electricity systems of neighbouring countries is being considered;
- The refurbishments at the existing CHPs have an impact of increasing their operating life and insignificant increase of electricity production efficiency;
- The process of MTPP refurbishment continues at the level reached over the last five years.

As a basis for calculating all scenarios, the projection of electricity demand was used, developed starting from the following considerations: economic growth rate (GDP); electricity consumption trend over the last years; reduction of power losses in the transmission and distribution networks, including the diminishing of non-recorded power consumption; the system load factor increasing trend as a result of improving the power consumption efficiency and increasing the power demand in summer time as a consequence of increased air conditioners use; application in the nearest future of zonal and binomial tariffs, all directed towards smoothing the curb of consumption load.

The load curve projection was developed by analysing the load curves of the electricity system of RM over the last years and other parameters which allow increasing the load factor. The following has been taken into consideration: technical and economic characteristics of the current energy system; a power reserve within the limit of 10-40%; a 10% annual discount rate; study period: 2005-2033; the projections of fuel price evolution, particularly for natural gas according to the principles set forth in the Contract for Natural Gas Supply from the Russian Federation to the RM.

[104] Energy Strategy of the Republic of Moldova until 2030. Government Resolution No. 102 of 05.02.2013. Official Gazette No.27-30/146 of 08.02.2013.

[105] National Development Strategy "Moldova 2020". Law No. 166 of 11.07.2012. Official Gazette No. 245-247/791 of 30.11.2012.

[106] Ion Comendant, Andrei Sula, Sergiu Robu, Iulia Dupleva. Development of electric power sources in the RM, including with the eventual participation of nuclear power plants. Issues of Regional Energy No. 2, 2007, IE AMS, page 1-20. <http://ieaMS.webart.md/contents_ro/?volume_id=13>.

I.A.1. Technical and Economic Calculations

Table 4-3 provides the results of energy source selection, their capacity, as well as their operation starting year.

Table 4-3: Year of putting the new sources into operation and their power, MW

Year	2014	2015	2016	2017	2018	2019	2020	2024
	BAU							
Refurbishment of CHPs		60			70	70	70	
Import					100	100		
	WM							
Combined cycle					100	175	375	
Wind sources	2.5	15	25	32.5	40	55	75	
Photovoltaic sources		1.5			1.5		1.5	
Gas turbines	2.5	16.5	25	32.5	41.5	55	76.5	
Refurbishment of CHPs		60			70	70	70	
Import	50	-150		-50	-50			
	WAM							
Refurbishment of CHPs		60			70	70	70	
Coal based power plants								180
Import					100	100		-250

The WM scenario involves the construction of 650 MW combined cycle power plants, the first group of 100 MW being put into operation in 2018, the second group of 175 MW – in 2019, and the remaining 375 MW – in 2020. Renewable sources are put into operation gradually, the wind ones starting with 2.5 MW in 2014, and finishing with 75 MW in 2020, accumulating 245 MW in total for this period; and the photovoltaic ones starting with 1.5 MW in 2015, totalling 4.5 MW of constructed sources within the period under consideration. To insure the balancing power for these sources, approximately 250 MW gas turbines will be put into operation.

Regardless of the possibility to select the generation units from a large list of such, in the WMS scenario, the WASP found inappropriate to involve these in covering the growing energy demand in the course of years, except for the construction of a group on coal to be put into operation in 2024. Up to this moment, the WMS repeats the BAU. The only difference is the load level of local power plants, and the energy import level throughout the years.

This fact is noted in Figures 4-2, 4-3 and 4-4. WM scenario is distinguished by a higher energy security - import practically equal to zero by 2020. However, even in the WM scenario, the right bank of Dniester River will consume the electricity produced by the MTPP. At the same time, the capacity of newly constructed plants on the right bank of Dniester River will be able to meet the power demand, if needed. Such a higher energy security is costly. According to Figure 4-5 which reveals the electricity price evolution for the considered scenarios, the price of power produced un-

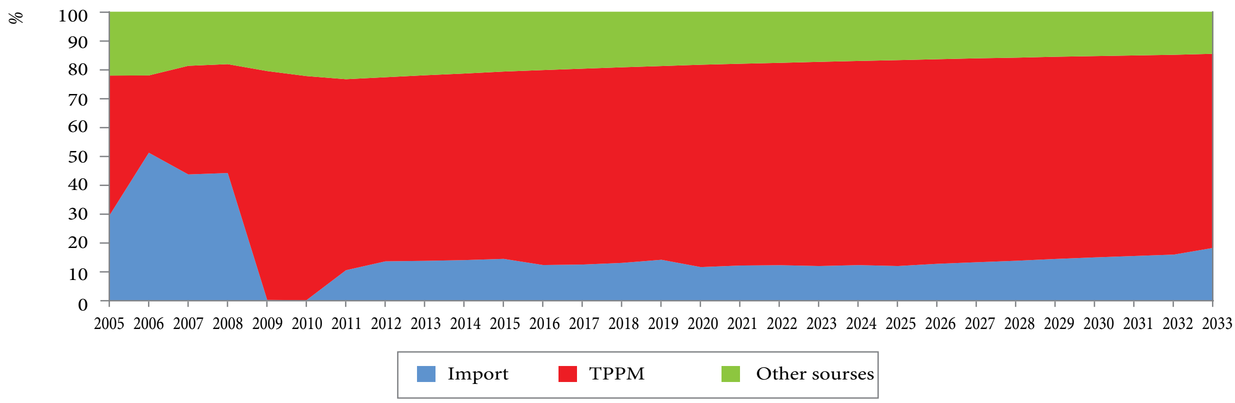


Figure 4-2: Evolution of electricity production structure for the BAU

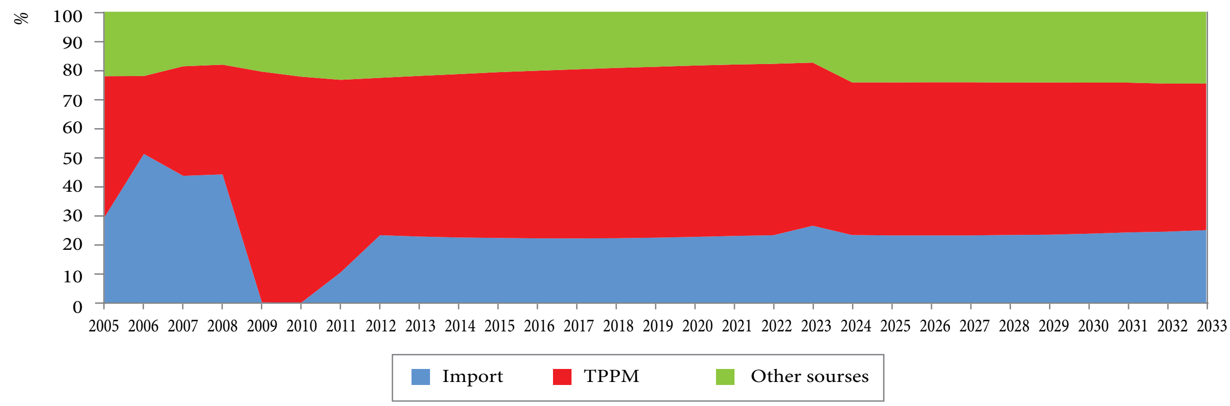


Figure 4-3: Evolution of the electricity production structure for the WAM

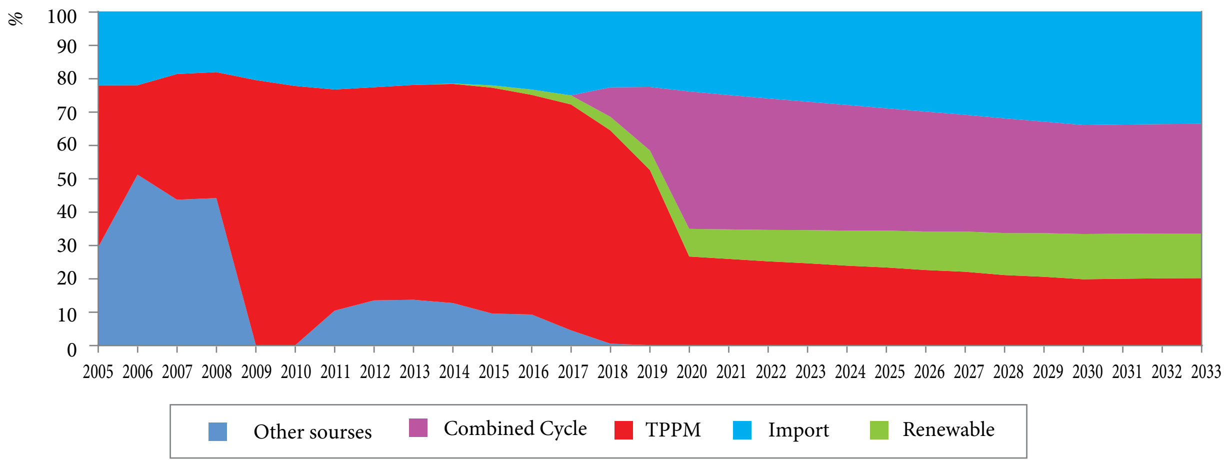


Figure 4-4: Evolution of electricity production structure for the WM

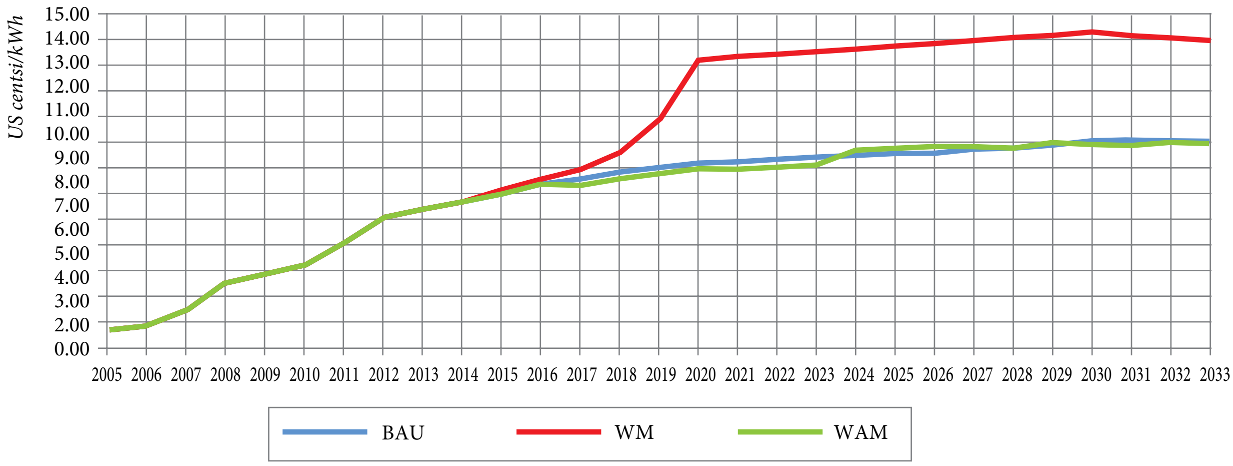


Figure 4-5: Evolution of the average price of electricity produced

der the WM scenario increases significantly starting from the year of putting into operation the new electric power plants, by 2020 exceeding the price of the BAU scenario by 44%, and that of the WAM scenario by 48%.

Such a significant discrepancy in the price for electricity is due to big investments that are to be made in the scenarios under consideration. Their evolution is provided in Figures 4-6, 4-7 and 4-8.

While the amount of investments required to be used within the 2014-2020 periods under BAU is US$ 101.6 million, the one under WAM is US$ 152.3 million, under WM it amounts at US$ 2,019.4 million, i.e. almost by 20 times

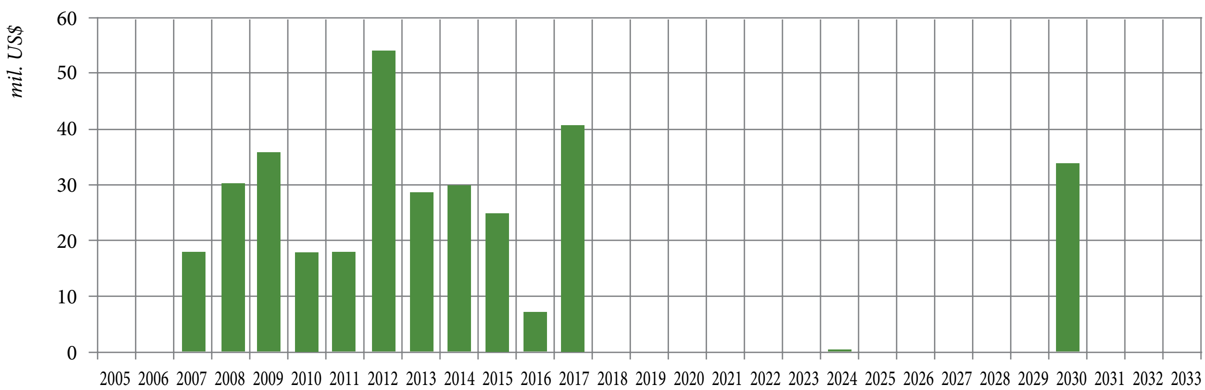


Figure 4-6: Evolution of investments in the electrical power sector under BAU scenario

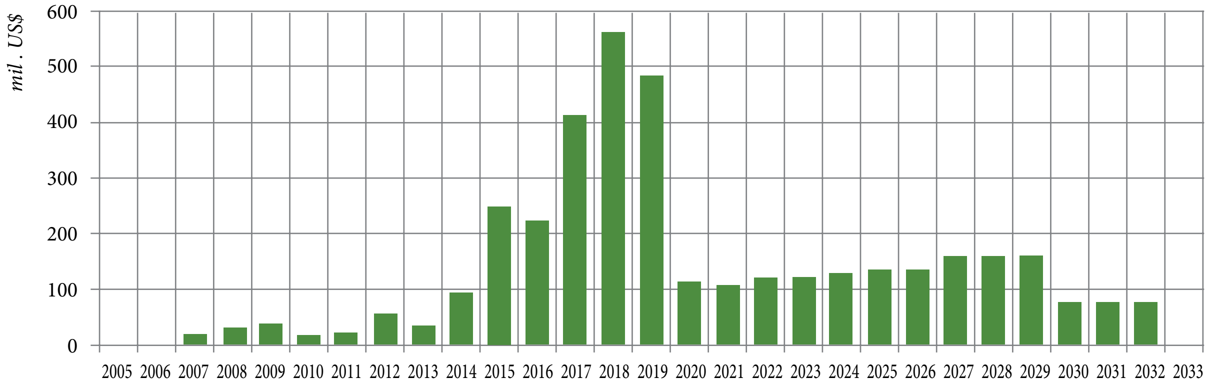


Figure 4-7: Evolution of investments in the electrical power sector under WM scenario

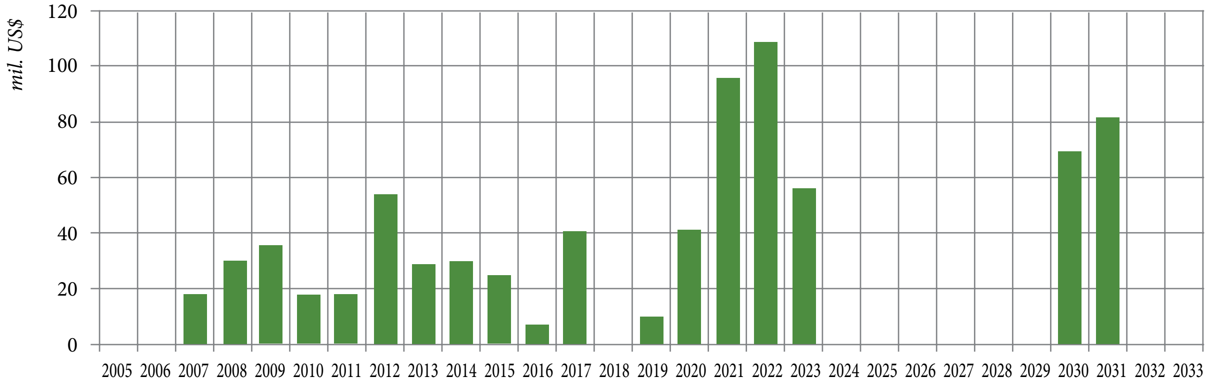


Figure 4-8: Evolution of investments in the electrical power sector under WAM scenario

more than under the BAU scenario. Such a significant increase of the electricity price could be unaffordable for the consumers, and this fact should be considered in more details to avoid such perspectives.

I.A.2. Assessing the Mitigation Potential

After examining three power sources development scenarios from the economic and energy security points of view, the scenarios were assessed also from the point of view of GHG emissions by applying IMPACT model. The GHG emissions were calculated using the methodological approaches and emission factors available in the IPCC Guidelines (1997, 2000).

Conventional fuels used in the production of electricity included: natural gas and insignificant quantities of residual fuel oil (maximum 0.02% of the total) – under BAU and WM; natural gas, insignificant quantities of residual fuel oil (maximum 0.02% of the total) and coal, starting with 2024 – under the WAM. The evolution of natural gas consumption is revealed in Figure 4-9, while the total conventional fuel consumption in Figure 4-10.

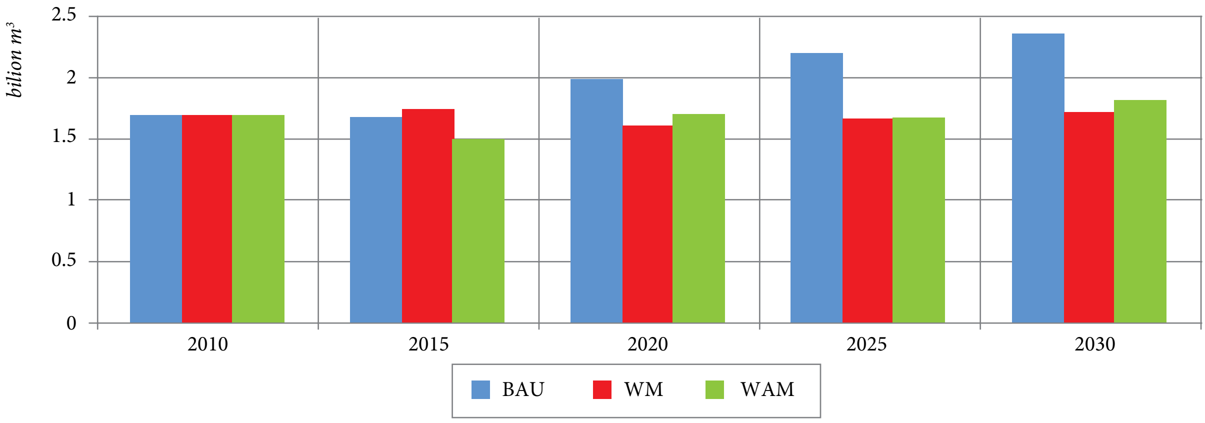


Figure 4-9: Evolution of natural gas consumption in the electrical power sector

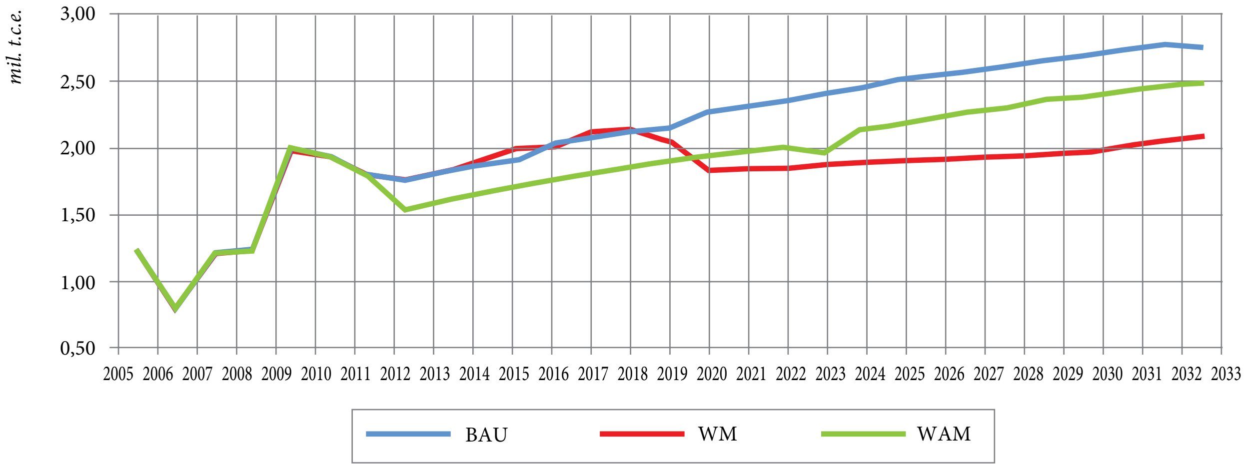


Figure 4-10: Total conventional fuel consumption in the electrical power sector

According to Figure 4-10, within the period until 2018-2019, the BAU and WM are distinguished by practically the same consumption of conventional fuel, while later on under the WM scenario the fuel consumption is much lower than in the WAM scenario. This is explained by the fact that once the combined cycle groups and renewable energy sources are put into operation, the electricity production efficiency increases significantly, by diminishing insignificantly the conventional fuel used. The above mentioned conventional fuel leads to generation of larger quantities of direct greenhouse gas emissions (Figure 4-11).

As can be noted, with small exceptions, the BAU creates the highest quantity of GHG emissions throughout the entire study period, while the smallest quantity of emissions corresponds to the WAM scenario, this distinction being preserved until 2030, after which the WM becomes the scenario with the lowest emissions. The WAM is characterized through such volume of emissions due to the fact that it is achieved by maintaining the energy import volume at the level of approximately 25%, which fact diminishes the quantity of power produced by local plants (see in Figures 4-2 and 4-3).

I.A.3. Constraints to Mitigation Scenarios Implementation

As mentioned in Chapter 3, the already approved policies in electrical power sector (taken into calculation upon developing the WM scenario) ensure a high energy security of the country, but will inevitably increase the price of electricity, by 44% compared to the BAU.

Such an evolution of the energy price in the next six years is not in line with the consumers' payment capacity. The situation could be overcome only if the planned investments for the WM scenario implementation are financed with international support, particularly from EU, to which the RM is striving to join. The lack of such support will require revising the energy source development scenarios for the country, so that the energy price corresponds to the consumer affordable consumption basket.

The wish to involve renewable energy sources for covering approximately 10% of the demand for 2020 under the WM

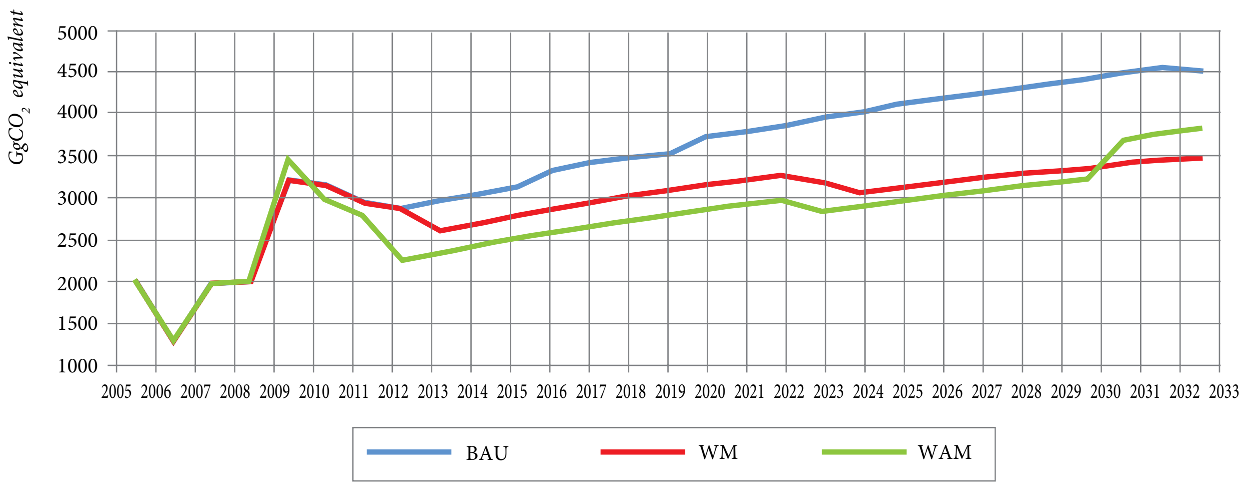


Figure 4-11: Dynamic of GHG emissions in the electrical power sector of the RM

scenario cannot be examined without presence of traditional energy sources in order to take over the power of the Wind Farms (WF) and photovoltaic source, when the wind and solar radiation is missing. The most reasonable traditional sources in this sense are gas turbine and combined cycle power plants (CCPP). The examination of CCPP together with the WF demonstrated that for a 200 MW of WF[107]:

- the price of electricity increases from 12.2 US¢/kWh, associated with the CCPP without WF presence in the system, to 14.75 US¢/kWh, due to the diminishing of CCPP efficiency as a result of displacement of produced power by the WF and reduction of its efficiency from 52% to 43%;
- the investment effort increases from US$ 130 million, in case of separate operation of the CCPP, to US$ 430 million, in case of CCPP+WF, equal to the construction of an efficient coal power plant of the same 200 MW capacity, the specific investment for which would be 2,150 US$/kW;
- the natural gas consumption is reduced only by 64 million m^3/year, not by 110 million m^3/year, as expected, if the wind source would be able to operate without CCPP;
- the wind sources practically do not lead to increasing the energy security, with the only exception that it diminishes the gas consumption at CCPP by approximately 19%;
- CCPP efficiency reduction leads to a smaller share of emission reductions, constituting 60% compared to the case, in which the WF would not require operating together with the CCPP.

There is a better solution for the RM than implementing WF sources. This corresponds to construction of a coal power plant that insures:

- A better price for electricity, much smaller than the tandem CCPP+WF, and equal to 11.9 US ¢/kWh, which is lower by 24% than in the case of CCPP+WF tandem (14.75 US¢/kWh). Even if taking into consideration the cost of GHG emissions reduction up to the level of the tandem CCPP+WF, the price at the coal power plant will be lower as long as the CO_2 price does not exceed 57 US$/t$CO_2$. For comparison, it should be mention that in September 2012, the CO_2 price on the carbon market was around 8.6 US$/t$CO_2$.
- Coal power plant allows displacing from the energy balance circa 331 million m^3 of natural gas, more than in the case of CCPP+WF tandem (64 million m^3), thus diversifying the types of fuel used, with the possibility to purchase the coal on the global market, as its reserves are substantially bigger than those of natural gas. Such a solution significantly increases the energy security of the country, incomparable with the case of promoting wind sources of the same capacity.

Following the reasons mentioned above, the WM scenario requires additional analyses of the opportunities for its promotion. All considered scenarios involve the operation of MTPP at a much lower price of natural gas than the price applied on the right bank of the Dniester River. Before 2012, the electricity production at this plant was based on natural gas at a price that didn't exceed 150 US$/thousand m^3, versus circa 400 US$/thousand m^3 established for the gas supplied to the right bank of the Dniester River in 2012-2013 periods. In 2012, the Transnistrian regional authorities increased the price for natural gas up to circa 257 US$/thousand m^3[108]. As a result, in order to maintain the price for electricity produced at the level of 2012, the MTPP decided to substitute natural gas with coal imported from Ukraine, the price of which is much lower for 1kal. This decision obviously will lead to a significant increase of GHG emissions in the electrical power sector of the RM. Under these circumstances, the evolution of GHG emissions under three considered scenarios could suffer corresponding changes.

WM, and to a certain extent WAM scenario, are not supported by studies that would demonstrate more thoroughly their economic, technical, and social viability, this fact causes reserves versus their implementation within the restrained time frames set in the Energy Strategy of the Republic of Moldova until 2030. Regardless the support from the European Union, a member of which the RM is striving to become in perspective, after 2020, a 6-7 year time frame for absorbing over two billion US dollars for the construction of renewable sources (250 MW), refurbishment of existing heat and power plants (300 MW), construction of new combined cycle power plants with total capacity of 650 MW, as well as of high-voltage lines, including connection lines with neighbouring countries, is by far a very optimistic scenario. In these circumstances, a delay in accomplishing the objectives of reducing the GHG emissions assumed under the WM scenario is not excluded.

I.B. Thermal Power Sector

Within the energy sector, the thermal power sector is responsible for circa 13% of total GHG emissions at national level. The main consumer of heat power is the residential sector (for heating, household hot water, and cooking), in less extent industry and agriculture sectors. The primary energy sources used for obtaining heat power include natural gas, oil products (residual fuel oil, oven fuel oil), coal, electricity, firewood and agricultural residues, solar energy and other renewable energy sources. To identify mitigation

[107] I. Comendant. The impact of wind sources promotion on the national energy system development. International Conference "Moldova Energy – 2012. Regional development aspects". 4-6 October 2012, Chisinau, Republic of Moldova, 8 pages.

[108] <http://www.publika.md/locuitorii-din-apropierea-centralei-electrice-de-la-cuciurgan--ingrijorati--furnizorul-a-revenit-la-folosirea-carbunelui_1299121.html?signed_request=>

potential in this sector, there were examined three scenarios: BAU, WM and WAM.

BAU was developed based on energy resources consumption, which in turn, was determined based on the projected evolution of the population number (for both right and left bank of Dniester River), as well as based on GDP rate growth, which will increase by 8.2% annually on average within 2011-2015 period and by 6.3% within 2016-2020 period. The energy consumptions are determined based on the projections of the Ministry of Economy, extrapolation of statistical data for 2000-2010 and by considering the trends for this period. The energy intensity in the considered period will reduce from 1.23 kg c.e./$ US in the base year 2005 to 0.60 kg c.e./$ US in 2030[109]. The recently enforced legislative and normative acts, as well as the development trends of techniques and technologies in the given area have been taken into consideration as well.

WM scenario was developed based on National Development Strategy "Moldova 2020", which provides for reducing the specific energy consumption by 20% until 2020. The energy consumption will be reduced through: thermal rehabilitation of buildings constructed before 1990; demolishing part of buildings and substituting them with new buildings of increased energy efficiency; improving in-house heating systems (metering by apartments, programmed regulation of temperature in each separate room, etc.); improving the heating power transmission and distribution systems (rationalizing the systems, reducing losses and transportation costs, etc.); improving the efficiency of heat sources (condensing boilers, co-generation installations, heat pumps). The emissions will be also reduced through increasing the volume of used biomass and solar energy.

WAM scenario envisages the implementation of measures included in the WM, but in more significant extent, counting on increased support from foreign donors in improving energy efficiency, involving solar energy and biomass in generation of heat.

I.B.1. Technical and Economic Calculations

The dynamic of total energy consumption in thermal power sector is provided in Figure 4-12, while the evolution of the structure of energy types used is provided in Figure 4-13.

It can be noted from Figure 4-13, that compared with the 2010 year level, by 2020 it is envisaged to reduce under BAU scenario the share of used natural gas by 2%, firewood – by 1%, and increase the share of electricity by 3%. Under the WM and WAM, the structure of energy types used suffers significant transformations, the share of natural gas is diminishing by 6-9%, and that of coal – by 1-2%. At the same time, the use of renewable sources is increasing, under the WM: firewood – by 12%, solar energy – by 1%; under the WAM the solar energy reaching 7%.

It was noted an increase in the electricity share, but it does not mean that the given increase takes place in absolute value as well. According to the information provided in Table 4-4 bellow, it diminishes by 30% and 35% under the WM and WAM, respectively.

Table 4-4: Evolution of the energy resources consumption in 2020, by types of energy, compared to effective values in 2010

Type of energy	Effective, 2010	2020			2020		
		BAU	WM	WAM	BAU	WM	WAM
	PJ				Compared to effective values in 2010, %		
Natural gas	47.8	50.5	34.3	26.7	-5	28	44
Liquefied gas	1.8	1.9	2.3	2.0	-8	-30	-12
Electricity	6.6	9.9	8.7	9.0	-50	-30	-35
Oil products	0.8	0.8	0.3	0.3	-1	59	63
Coal	5.0	5.0	3.6	3.3	0	28	35
Wood	22.6	24.5	28.4	15.3	-8	-26	32
Solar	0.1	0.3	0.4	4.6	-195	-300	-4099
TOTAL	84.8	93.0	78.0	61.2			

[109] SNC of the RM to UNFCCC (2009).

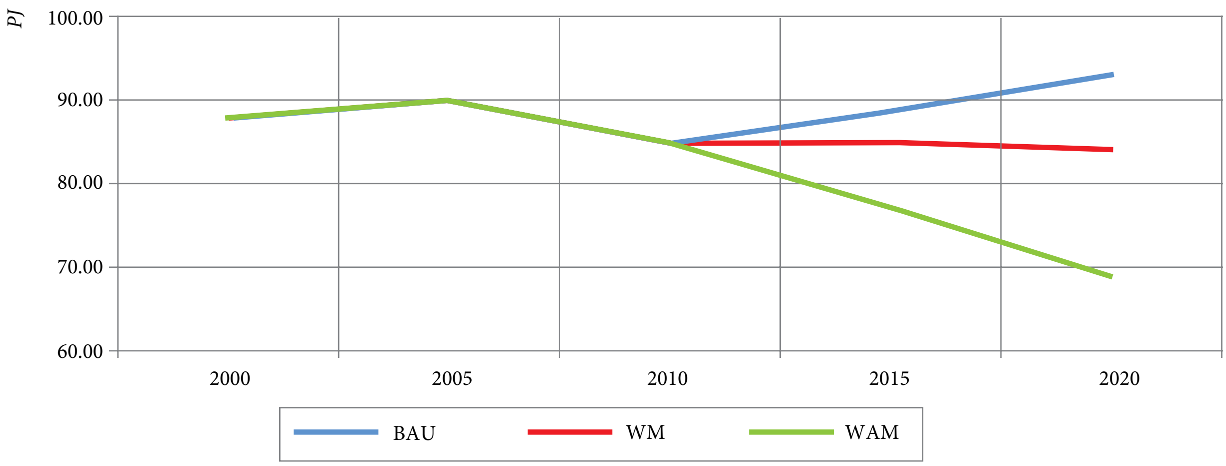


Figure 4-12: Dynamic of total energy consumption in the thermal power sector

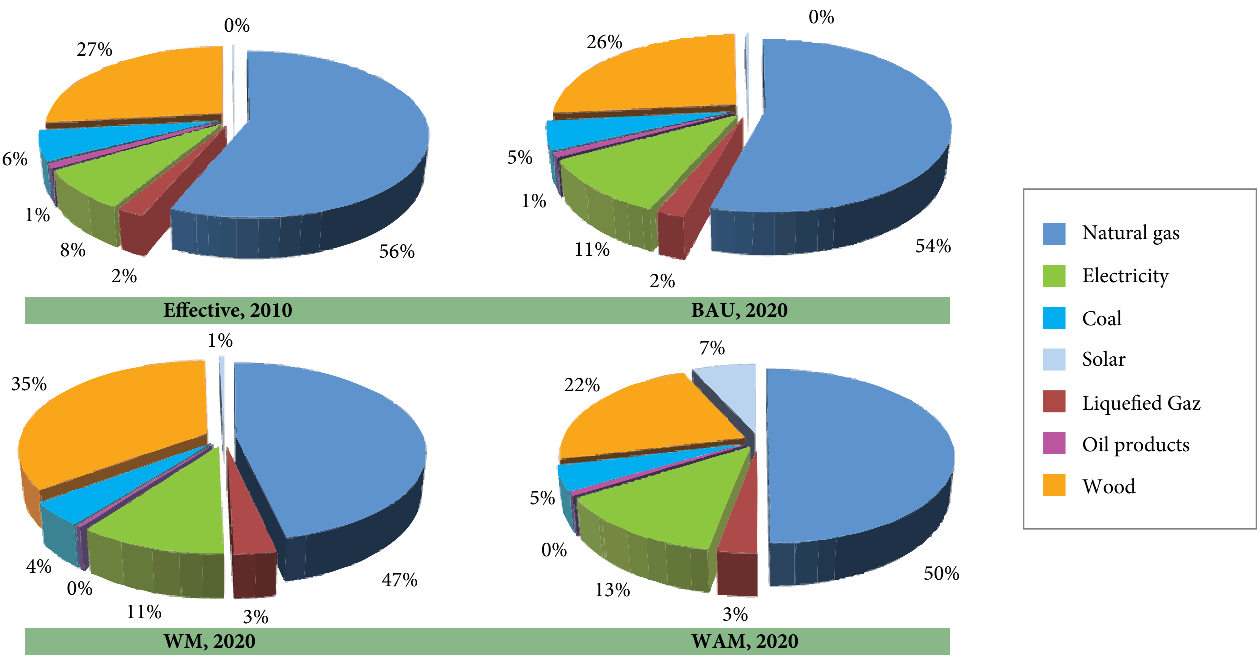


Figure 4-13: Evolution of the structure of energy resources used in thermal power sector

Figure 4-14 reflects the calculation results of fuel/energy consumption by sectors, from which can be noted that residential sector currently accounts for circa 85% of the total heating consumption (industrial sector accounting for circa 15.0%, and agriculture - 0.3%).

In future, a diminishing trend in heat consumption will persist in all assessed scenarios for residential sector, as a result of increased consumption in industry, also as result of promoting energy efficiency measures in residential sector, (Table 4-5).

Compared to the level effectively recorded in 2010, by 2030 the consumption of heat in industry will grow by circa 49% under the WM, by 38% under the WAM, while in the residential sector, the heat consumption will diminish by 6% in case of the WM and by 27% in case of the WAM, respectively.

Table 4-5: Structure of heat consumption by sectors, PJ

Sectors	2000	2005	2010	2015	2020	2025	2030
	Historical data			BAU			
Residential sector	67.66	70.14	72.13	72.45	73.22	73.60	73.97
Industry	19.40	19.55	12.49	15.94	19.39	20.22	21.18
Agriculture	0.70	0.25	0.22	0.27	0.29	0.33	0.36
Total	87.76	89.95	84.83	88.66	92.91	94.15	95.51
	Historical data			WM			
Residential sector	67.66	70.14	72.13	70.66	68.25	67.23	67.53
Industry	19.40	19.55	12.49	14.00	15.52	16.84	18.62
Agriculture	0.70	0.25	0.22	0.26	0.26	0.35	0.47
Total	87.76	89.94	84.83	84.92	84.03	84.42	86.62
	Historical data			WAM			
Residential sector	67.66	70.14	72.13	63.53	54.00	53.11	52.41
Industry	19.40	19.55	12.49	13.45	14.72	15.83	17.23
Agriculture	0.70	0.25	0.22	0.25	0.24	0.27	0.30
Total	87.76	89.95	84.83	77.23	68.96	69.20	69.93

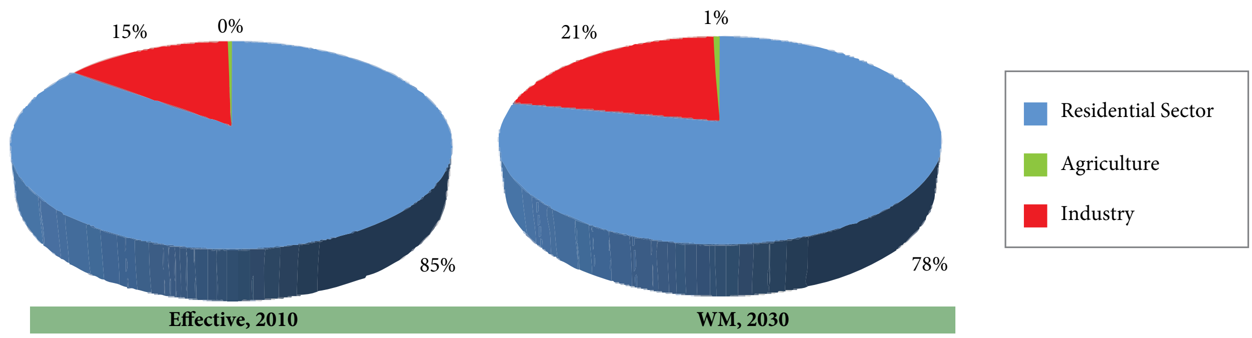


Figure 4-14: Breakdown of sectors in the total heat consumption structure, % of the total

I.B.2. Assessment of Mitigation Potential

The GHG emissions were calculated by means of LEAP software, using the calculation results for heating power consumption, by types of primary sources. Emission factors were taken from IPCC Guidelines (1997, 2000). The results of calculations are provided in Figure 4-15 and Table 4-6.

It should be noted that net emissions do not include GHG emissions originating from electricity production (these being taken into calculation under the electrical power sector), as well as emissions from combusting of firewood and agricultural residues (according to recommendations provided in the IPCC Guidelines (1997, 2000), these emissions are not included in the national totals, being reported for information purposes under the „Memo Items").

Compared to 2005 year, by 2020 the total net emissions will diminish by 1.3% in case of the BAU, by 23.2% in case of the WM, and by 32.6% in case of the WAM. Such reductions in emissions will be recorded if the energy consumption will increase by 3.3% in the BAU, while in the WM scenario the energy consumption will diminish by 6.6% and in the WAM it will diminish by 23.0% (Table 4-6). In other words, the GHG emissions reduction will be more pronounced than the reduction of energy consumption, inclusive as result of implemented energy efficiency measures and renewable energy sources.

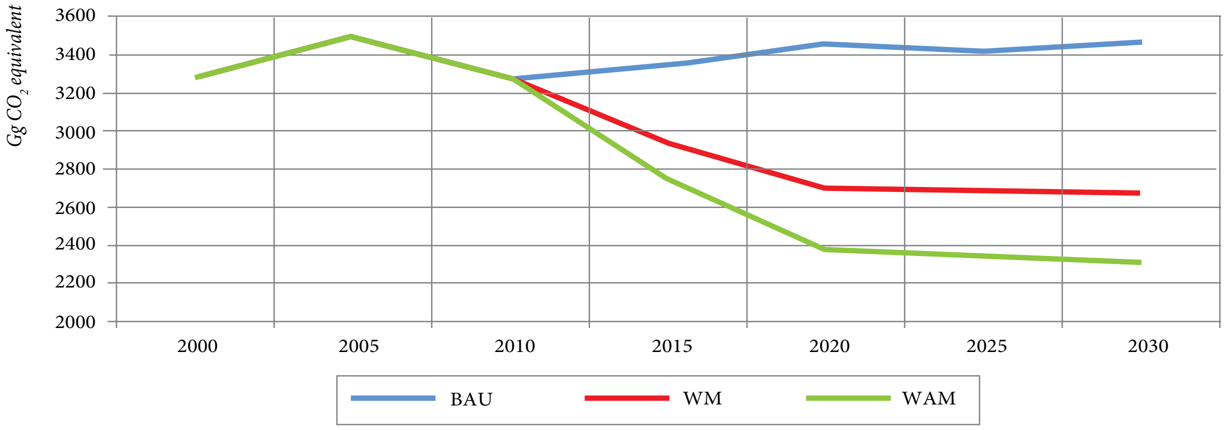


Figure 4-15: Dynamics of net GHG emissions originating from thermal power sector

Table 4-6: GHG emissions generated under the thermal power sector of the Republic of Moldova, Gg CO_2 equivalent

Years	2000	2005	2010	2015	2020	2025	2030
	Historical data			BAU			
Natural gas	2714.9	3026.7	2701.3	2756.4	2849.2	2888.6	2928.2
Petroleum gas	56.6	99.9	117.2	122.8	126.0	127.0	130.2
Oil products	250.8	68.9	59.9	58.9	60.7	61.1	59.0
Coal	265.3	305.9	412.8	414.3	420.8	341.8	349.7
Wood and agricultural residues	934.6	956.6	990.8	1040.3	1072.7	1093.9	1103.5
Electric power	2284.0	1752.1	1422.2	1766.6	2126.8	825.9	842.7
Total emissions	6506.3	6210.0	5704.3	6159.4	6656.2	5338.3	5413.3
Net emissions	3287.6	3501.3	3291.2	3352.4	3456.7	3418.5	3467.1
	Historical data			WM			
Natural gas	2714.9	3026.7	2701.3	2439.6	2208.1	2182.7	2157.3
Petroleum gas	55.7	98.3	115.2	129.9	165.8	162.9	170.7
Oil products	253.8	67.6	59.0	31.4	26.0	26.4	27.2
Coal	298.9	329.1	424.3	336.1	304.4	312.8	321.3
Wood and agricultural residues	936.2	959.9	992.8	1184.7	1277.7	1276.6	1321.3
Electric power	2240.0	1729.2	1421.6	1708.4	1889.7	2021.6	2267.6
Total emissions	6499.4	6210.7	5714.3	5830.1	5871.7	5983.0	6265.3
Net emissions	3323.2	3521.6	3299.9	2937.0	2704.3	2684.9	2676.5
	Historical data			WAM			
Natural gas	2714.9	3026.7	2701.3	2317.2	1946.4	1896.4	1834.3
Petroleum gas	55.7	98.3	115.2	152.6	131.0	127.7	121.2
Oil products	253.8	67.6	59.0	27.2	22.0	22.0	22.0
Coal	298.8	329.0	424.3	249.6	274.9	296.0	329.8
Wood and agricultural residues	936.2	959.9	992.8	928.1	671.4	647.3	616.6
Electric power	2240.0	1729.2	1421.6	1606.6	1925.3	2057.9	2271.9
Total emissions	6499.4	6210.8	5714.3	5281.3	4971.0	5047.4	5195.9
Net emissions	3323.2	3521.6	3299.9	2746.6	2374.3	2342.2	2307.4

I.B.3. Constraints to Mitigation Scenarios Implementation

The heat supply issues are among the most complicated in the Republic of Moldova. Urban localities were equipped with central heating systems, the majority of which have irrational design with regard to both heating sources, and network configuration. Cogeneration sources exist only in Chisinau and Balti municipalities, with rather obsolete equipment; in addition, these do not fully cover the localities from the territorial point of view. Thermal Power Plants and Thermal Plants were designed on expensive imported fuels, the local fuels being fully ignored. In most of the cases, the plants were located far from the consumer load centre, which fact contributed to big losses of heat and excessive energy consumption upon transmission. Added to these is the bad execution of construction works, irresponsible operation and poor management of respective enterprises. Under the current conditions, these bottlenecks are overlapping the unavailability of payment of a considerable part of consumers, politicization of the issue in relation to its social aspect, economic interests of autonomous systems installation firms, incompetence of decision makers, unfavourable investment climate, etc. Such complex circumstances make the heat supply sector unattractive for investors - all privatization attempts failed. Financial shortages do not allow for reconstruction and rationalization of the heat supply system by the state. The price of imported energy and the price at the MTPP, which is much lower than the price associated with a newly built cogeneration power plant, represent another constraint in the development of thermal power sector of the RM.

II. Mobile Combustion

II.A. Transport Sector

In 2010, the share of transport sector in total GHG emissions constituted 14.3%. In 2011, the transport sector consumed in total circa 369 thousand tons of motor fuels, of which: 71% diesel oil, 22.2% gasoline, 3.5% fuel for reactive engines, 2.7% liquefied petroleum gas and 0.6% compressed natural gas.

Road transport uses predominantly diesel oil and gasoline and, to a smaller extent – compressed natural gas and liquefied petroleum gas; rail and naval transport uses mainly diesel oil, while the air transport – fuels for reactive engines (GHG emissions originating from combustion of kerosene within the international air transport are not included in the national totals, being reported only for information purposes under the „Memo items").

In 2010, the structure of total energy consumption within the transport sector included: 95.7% was used for road transport; 2.2% - for rail transport; 2.0% - for air transport; and circa 0.1% – for naval transport.

II.A.1 Mitigation Scenarios

The mitigation potential in the transport sector was determined by assessing three fuel consumption scenarios until 2030 (BAU, WM and WAM). The considered scenarios have been assessed by applying LEAP software and Excel models developed by the national team of experts using the regression analysis, including several influencing factors. To confirm the existence of a strong influence of each considered factor, the experts followed only those factors, for which the *p-value* ≤ 0.05. The regression analysis was based on statistic data related to the 2000-2010 periods. The emission factors were taken from the IPCC Guidelines (IPCC, 1997, 2000).

BAU scenario is based on continuing the current growth rate of the number of transport units, increasing the passenger transport activity, depending on the evolution of the population in the RM, increasing the commodity transport activity depending on the GDP evolution, as well as necessary actions for maintaining the road and naval transport.

WM scenario takes into account the following:

1) More moderate growth of the number of private cars than in BAU scenario, by 15 thousand units per year;
2) Rehabilitation of road transport infrastructure, the effect of which leads to a reduction of specific fuel consumption by 6% until 2020;
3) Substitution of diesel oil with biodiesel in proportion of 5% by 2020;
4) Substitution of gasoline with bioethanol in proportion of 5% by 2020;
5) Increasing the use of LPG and CNG fuels by 5% until 2020;
6) Increasing the use of urban electric transport by 5% until 2020.

WAM scenario takes into account the following:

1) More moderate growth of the number of private cars than in BAU scenario, by 10 thousand units per year;
2) Rehabilitation of the road transport infrastructure, the effect of which will lead to a reduction of specific fuel consumption by 12% until 2020;
3) Substitution of diesel oil with biodiesel in proportion of 10% by 2020;
4) Substitution of gasoline with bioethanol in proportion of 10% by 2020;
5) Increasing the use of LPG and CNG fuels by 10% until 2020;
6) Increasing the use of urban electric transport by 10% until 2020.

II.A.2. Projections of Fuels Consumption

The fuels consumption for the analysed period was determined by extrapolating statistic data for the 2000-2010 periods. Also, it was taken into account projections of the growth rate of national GDP, number of the population in the country, as well as of the commodity and passenger traffic. Table 4-7 provides the extrapolation results of the number of private transport units considered in the analysed scenarios for the 2010-2030 periods in the transport sector of the RM.

Table 4-7: Dynamic of the number of private transport units in the Republic of Moldova within the 2010-2030 periods, in thousand units

Scenario	2010	2015	2020	2025	2030
BAU	507	607	707	807	907
WM	507	582	657	732	807
WAM	507	557	607	657	707

Compared to BAU, WM and WAM scenarios consider a reduction of the number of private transport units by withdrawing from use the old cars with high fuel consumption. For 2010-2030 periods, the projected increase on the number of private transport units in the BAU is 79%, in the WM – 59%, and in the WAM – 39%, respectively. In the future, the passenger traffic is expected to intensify by 53%, while the commodity traffic – by 137%. Table 4-8 provides information on the evolution of total fuel consumption in the transport sector. In 2010-2030 periods, fuel consumption is expected to grow by 97% in the BAU scenario, by 77% in the WM, and by 58% - in the WAM scenario, respectively.

Table 4-8: Dynamics of fuel consumption in the transports sector of the Republic of Moldova within the period 2010-2030, PJ

Scenario	2010	2015	2020	2025	2030
BAU	28.3	33.9	40.4	47.6	55.6
WM	28.3	32.3	36.9	42.9	50.0
WAM	28.3	30.8	33.7	38.5	44.6

Figure 4-16 and Table 4-9 provide information on fuels structure in considered scenarios. Thus, compared to 2010, by 2030 the BAU scenario revealed an increase in the shares of diesel oil by 4.4% and natural gas by 0.7%, while the shares of gasoline is expected to reduce by 4.8% and that of liquefied petroleum gas – by 0.3%.

Table 4-9: Dynamics and structure of fuel consumption in the transports sector within the 2010-2030 periods, PJ

Scenario	Type of fuel	2010	2015	2020	2025	2030
BAU	Diesel oil	17.3	20.2	24.9	30.3	36.5
	Gasoline	10.1	12.5	14.0	15.6	17.2
	Liquefied petroleum gas (LPG)	0.8	0.9	1.0	1.2	1.5
	Natural gas	0.1	0.3	0.4	0.5	0.5
	Biofuels	0.0	0.0	0.0	0.0	0.0
	TOTAL	**28.3**	**33.9**	**40.4**	**47.6**	**55.6**
WM	Diesel oil	17.3	19.0	22.0	26.3	31.6
	Gasoline	10.1	11.2	11.3	12.1	13.2
	Liquefied petroleum gas (LPG)	0.8	1.1	1.5	1.8	2.1
	Natural gas	0.1	0.4	0.5	0.6	0.7
	Biofuels	0.0	0.7	1.6	2.1	2.4
	TOTAL	**28.3**	**32.3**	**36.9**	**42.9**	**50.0**
WAM	Diesel oil	17.3	17.7	19.3	22.8	27.3
	Gasoline	10.1	10.0	9.0	9.3	9.9
	Liquefied petroleum gas (LPG)	0.8	1.3	1.8	2.1	2.4
	Natural gas	0.1	0.5	0.6	0.7	0.8
	Biofuels	0.0	1.3	2.9	3.7	4.2
	TOTAL	**28.3**	**30.8**	**33.7**	**38.5**	**44.6**

In case of WAM scenario, by 2030 the share of all fuels is expected to increase compared to 2010, diesel oil – by 0.1%, liquefied petroleum gas – by 2.3%, natural gas - by 1.5%, biofuels – by 9.5%, except for gasoline, the share of which will reduce by 13.2%. The trends characteristic to the WAM scenario are also characteristic to the WM scenario, but are manifested to a smaller extent.

II.A.3. Assessment of Mitigation Potential

Tables 4-10 and 4-11, and Figure 4-17 reveal the dynamic of net GHG emissions originating from the transport sector of the RM within the scenarios analysed for the period until 2030.

According to BAU scenario, the level of emissions recorded in the base year will be achieved only by 2030 (Table 4-10).

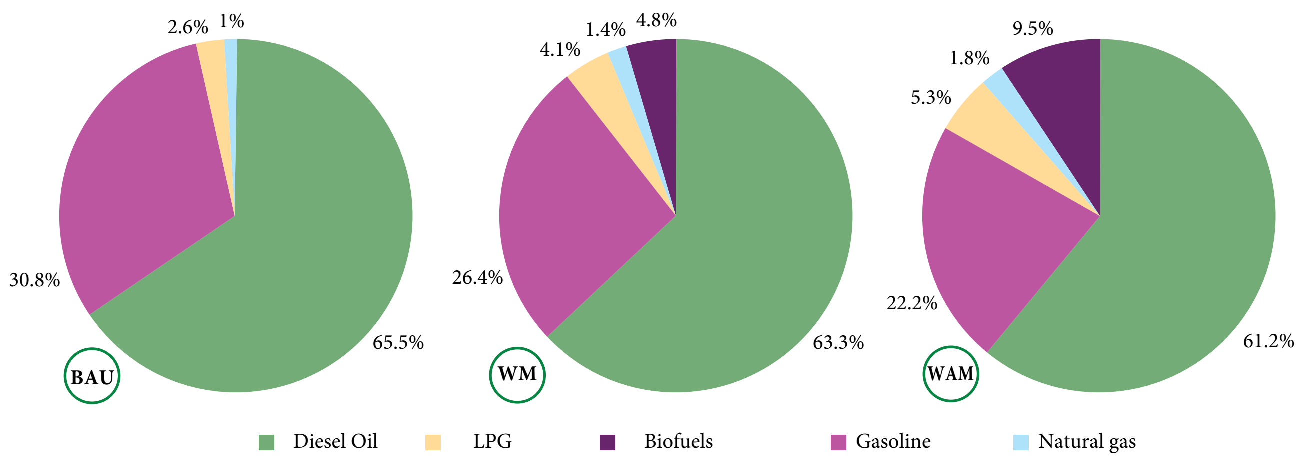


Figure 4-16: Structure of fuel consumption in the transports sector by 2030, % of the total

Table 4-10: GHG emissions from fuel combustion in the transports sector of the RM within the scenarios analysed for the period until 2030, Mt CO_2 equivalent

Scenario	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					Projections			
BAU	4.056	1.329	0.848	1.655	1.905	2.494	2.976	3.511	4.112
WM	4.056	1.329	0.848	1.655	1.905	2.325	2.600	3.012	3.510
WAM	4.056	1.329	0.848	1.655	1.905	2.164	2.259	2.566	2.975

Compared to BAU scenario, the WM scenario forecasts a reduction of GHG emissions in the transports sector by circa 13% until 2020, while the WAM scenario – by circa 24% (Table 4-11).

Table 4-11: The degree of reduction of the total GHG emissions in the transports sector compared to BAU, %

Scenario	2015	2020	2025	2030
WM	-7	-13	-14	-15
WAM	-13	-24	-27	-28

II.A.4. Constraints to Mitigation Scenarios Implementation

There are several constraints to mitigation scenarios implementation in the transports sector, among which are:

- The poor capacity of Moldovan economy to rehabilitate the road network which is rather deteriorated;
- Existence of a fleet of vehicles that are not adjusted to the European quality and safety standards;
- Delayed implementation of priority infrastructure projects;
- Geopolitical division of the country, which impedes the long-term network development, particularly for transit activities;
- Investment plans in the urban transport infrastructure focus their efforts on resources rather than on the need for creating a stable sector framework.

4.3.2. Industrial Processes Sector

The industrial processes sector includes GHG emissions generated from non-energy industrial activities. GHG emissions from fossil fuel combustion in industrial sector are assessed within the energy sector. According to the 4th IPCC Assessment Report (IPCC, 2007), emissions generated from non-energy industrial activities vary between circa 20% and 50% of total sector emissions, the rest being taken into consideration within the energy sector.

The most relevant GHG (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) emission sources within the industrial processes sector are: clinker and lime production, use of limestone and dolomite, use of soda ash, bricks and glass production, iron and steel production, use of refrigeration and air conditioning equipment, extinguishers, aerosols, foam, electric equipment, etc.

The projections of GHG emissions were carried out based on methodological approaches provided in the Revised 1996 IPCC Guideline (IPCC, 1997), GPG (IPCC, 2000) and 2006 IPCC Guidelines (IPCC, 2006).

A. Mitigation Scenarios

Based on macroeconomic indicators of the RM, there were prepared three industrial processes sector development scenarios for medium and long-term, until 2030.

BAU scenario represents an option in which it is assumed to reach a growth rate of industrial sector compared to 2010 year, by 139% until 2015, by 183% until 2020, by 232% until 2025 and by 282% until 2030. The evolution of macroeconomic indicators was determined based on projections made by the Ministry of Economy of the Republic of Moldova (updated in November 2012), statistic data extrapolation, by considering the sector evolution trends recorded within the 1990-2012 period. The development trends of techniques and technologies in the industrial sector have also been taken into consideration.

WM scenario represents an option involving a growth rate of the industrial sector, compared to the 2010 year, by 139.5% until 2015, by 186% until 2020, by 238% until 2025, and by 293% until 2030, respectively. This WM scenario involves

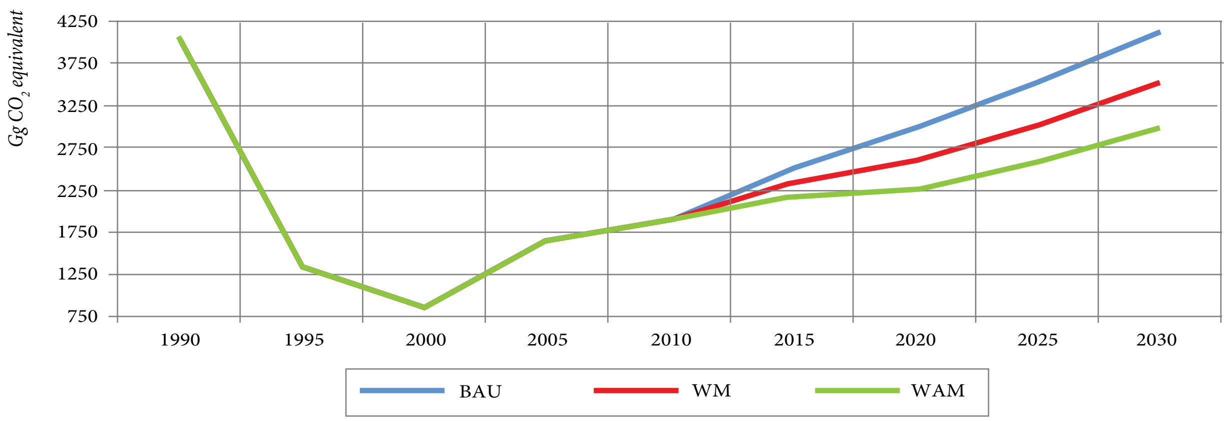


Figure 4-17: Evolution of GHG Emissions in the Transports Sector for the period until 2030

applying some mitigation measures, including: using efficient production technologies, keeping records and efficient management of raw material consumption, applying efficient management systems and reducing production losses, and using recycled raw material. It is also assumed to restrict the use and marketing of certain applications of fluorinated gas, installing leakage detection systems in the key applications, respectively reducing fluorinated gas leakages in respective equipment, as well as recovering the gas before final elimination of equipment at the end of its life shelf, and recycling and/or destroying such gas; substituting fluorinated gas with alternative and less hazardous chemical substances, including from among the new generation of fluorinated gas substituents.

WAM scenario represents an option involving a growth rate of industrial sector, compared to 2010 year, by 140% until 2015, by 189% until 2020, by 244% until 2025, and by 304% until 2030, respectively. This scenario involves a broader application of mitigation measures specific to WM scenario, as well as the implementation of some additional measures, including those specific to the process (*i.e., in case of cement production, substitution of a part of clinker with alternative cement materials, such as granulated blast furnace slag, fly ash and natural pozzolan; in case of steal production – using electric arc furnace of more efficient design, higher capacity, with raw material preheating, foamy slagging, fuel and oxygen injection, etc.*). WAM scenario also provides for a stricter use and marketing of certain fluorinated gas applications, installation to a larger extent of leakage detection systems in the key applications, and reducing fluorinated gas leakages from respective equipment, and recovering such gas before its final elimination at the end of life shelf, and recycling and/or destroying it; the scenario also provides for substitution to a larger extent of fluorinated gas with alternative chemical substances from among new generation substituents. In addition to these, the scenario provides for moving faster to cutting edge technologies with a lower global heating potential, as well as implementing more broadly the provisions on equipment insulation and recovery of fluorinated gas.

B. Projections on Industrial Production

The projections on industrial production with highest impact on GHG emissions originating from industrial processes sector, considered under three alternative scenarios (BAU, WM and WAM), are provided in Table 4-12.

Data on industrial production activity was generated according to the macroeconomic indicators determined on the basis of projections carried out by the Ministry of Economy; statistic data extrapolation for 1990-2012 time periods, by considering the trends of these years; as well as on the basis

Table 4-12: GHG emissions from industrial processes sector under the considered scenarios in the Republic of Moldova within the 1990-2030 periods

	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
Clinker, kt	1801.34	459.74	320.28	678.66	655.55	911.22	1199.66	1520.89	1848.66
Lime, kt	204.30	38.80	15.10	9.10	3.18	10.01	13.01	17.02	20.66
Limestone, kt	1454.14	374.52	50.00	235.83	177.70	247.00	325.19	412.26	501.11
Dolomite, kt	22.14	11.86	23.58	0.07	0.10	0.15	0.19	0.24	0.29
Soda ash, kt	79.41	35.23	33.75	43.76	29.03	40.35	53.12	67.34	81.86
Brick, million pieces	235.50	59.20	52.90	73.70	49.70	69.10	90.90	115.30	140.10
Keramzite, thous. m^3	443.15	59.46	48.72	63.40	61.42	85.37	112.40	142.49	173.20
Steel, kt	708.77	656.80	908.20	1048.44	241.56	1100.86	1127.07	1179.50	1231.92
	Historical data					WM			
Clinker, kt	1801.34	459.74	320.28	678.66	655.55	914.50	1219.33	1560.22	1920.77
Lime, kt	204.30	38.80	15.10	9.10	3.18	10.10	13.42	17.47	21.48
Limestone, kt	1454.14	374.52	50.00	235.83	177.70	247.89	330.52	422.93	520.66
Dolomite, kt	22.14	11.86	23.58	0.07	0.10	0.15	0.19	0.25	0.31
Soda ash, kt	79.41	35.23	33.75	43.76	29.03	40.49	53.99	69.09	85.05
Bricks, million pieces	235.50	59.20	52.90	73.70	49.70	69.31	92.42	118.26	145.58
Keramzite, thous. m^3	443.15	59.46	48.72	63.40	61.42	85.68	114.24	154.78	179.96
Steel, kt	708.77	656.80	908.20	1048.44	241.56	1127.07	1179.50	1231.92	1284.34
	Historical data					WAM			
Clinker, kt	1801.34	459.74	320.28	678.66	655.55	917.78	1239.00	1599.55	1992.88
Lime, kt	204.30	38.80	15.10	9.10	3.18	10.19	13.83	17.93	22.30
Limestone, kt	1454.14	374.52	50.00	235.83	177.70	248.78	335.85	433.59	540.21
Dolomite, kt	22.14	11.86	23.58	0.07	0.10	0.15	0.20	0.25	0.32
Soda ash, kt	79.41	35.23	33.75	43.76	29.03	40.64	54.86	70.83	88.25
Bricks, mill. pieces	235.50	59.20	52.90	73.70	49.70	10.19	13.83	17.93	22.30
Keramzite, thous. m^3	443.15	59.46	48.72	63.40	61.42	85.99	116.08	149.86	186.72
Steel, kt	708.77	656.80	908.20	1048.44	241.56	1231.92	1284.34	1336.76	1415.39

of industrial sector sustainable development policies stipulated in the NDS "Moldova 2020", NDS for 2008-2011, Industrial Sector Development Strategy for the period until 2015, as well as based on the development plans of the industrial sector at branch and enterprise level, particularly in the case of enterprises from non-metallic products manufacturing branch, as well as from the metallurgical industry.

The projections of the import of fluorinated gas in stock and incorporated in products into the Republic of Moldova are provided in Table 4-13. Activity related data was generated on the basis of macroeconomic indicators determined on the basis of projections carried out by the Ministry of Economy; statistic data extrapolation on the import of fluorinated gas into the Republic of Moldova, both in stock or in preloaded air conditioning systems for premises and vehicles; in refrigerators, freezers, refrigerated display cases, and chillers; in component foam products; in aerosols for medical purposes; as well as in high voltage electric switching devices, within the period 1995-2010, by considering the trends of these years; also based on refrigeration sector sustainable development policies proceeding from the perspective of subsequent transposition in the Moldovan legislation of CE Regulation 842/2006 of 17.05.2006 on Certain Fluorinated Gas Types.

C. Assessment of Mitigation Potential

The GHG emissions were calculated using a standard calculation tool, which is a component part of the Revised 1996 IPCC Guidelines (IPCC, 1997), using the results of economic calculations regarding the industrial production evolution during 2015-2030 for the considered scenarios.

The applied methodologies and emission factors were taken from the Revised 1996 IPCC Guidelines (IPCC, 1997), GPG (IPCC, 2000) and 2006 IPCC Guidelines (IPCC, 2006) (country specific emission factors were also used). The methodologies applied upon calculating the GHG emissions within the mitigation scenarios are reflected in more details in the „*National Inventory Report for 1990-2010, Greenhouse Gas Emission Sources and Sinks in the RM*" (2013).

Below are provided the calculation results for GHG emissions originating from the industrial processes sector, both by gas (Table 4-14), and by source categories (Table 4-15).

Compared to 1990 year, by 2030 it will be recorded a level of GHG emissions: by 9.5% lower under the BAU scenario, by 19.4% lower under the WM and by 24.8% lower under the WAM. Compared to BAU, the implementation of assumed mitigation measures will allow reducing by 2030 the GHG emissions originating from industrial processes sector by 11.0% in case of WM and by 16.9% in case of WAM scenarios (Figure 4-18).

The evolution of industrial production, the consumption of halocarbons and SF_6, and the application of mitigation measures will influence the breakdown of different gases and source categories, in the structure of total sector GHG emissions (Tables 4-16 and 4-17).

Compared to BAU, the mitigation (WM and WAM) scenarios envisage a reduction of the share of source category 2F

Table 4-13: Import of fluorinated gas (in stock and incorporated in equipment and products) into the Republic of Moldova within the period 1995-2030

	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data				BAU			
HFC-32, t	0.0849	0.4848	6.8224	35.1357	42.3226	51.4288	62.5251	74.9304
HFC-125, t	0.1805	0.9367	9.4343	50.2100	61.9011	76.5943	94.4766	114.7506
HFC-134a, t	31.0491	61.4569	197.7094	319.9240	409.2403	507.4678	614.2596	721.6843
HFC-143a, t	0.0996	0.4219	2.4704	18.1594	24.6709	32.0767	40.2830	49.7802
CF_4, t	NO	NO	NO	0.2100	0.2934	0.4032	0.5424	0.7116
SF_6, t	NO	NO	0.0960	1.1600	1.4422	1.8137	2.2846	2.8571
	Historical data				WM			
HFC-32, t	0.0849	0.4848	6.8224	35.1357	41.2202	49.0169	58.5896	69.3901
HFC-125, t	0.1805	0.9367	9.4343	50.2100	60.4348	73.4842	89.4528	107.7664
HFC-134a, t	31.0491	61.4569	197.7094	319.9240	377.5767	415.2376	348.2888	268.8127
HFC-143a, t	0.0996	0.4219	2.4704	18.1594	24.1651	31.0564	38.6389	47.3191
CF_4, t	NO	NO	NO	0.2100	0.2937	0.4053	0.5481	0.7239
SF_6, t	NO	NO	0.0960	1.1600	1.4432	1.8208	2.3039	2.8987
	Historical data				WAM			
HFC-32, t	0.0849	0.4848	6.8224	35.1357	40.1763	46.7063	54.7800	63.9631
HFC-125, t	0.1805	0.9367	9.4343	50.2100	59.1517	70.7291	84.9565	101.4648
HFC-134a, t	31.0491	61.4569	197.7094	319.9240	330.6720	335.0177	253.5855	239.0457
HFC-143a, t	0.0996	0.4219	2.4704	18.1594	23.6176	29.9154	37.1059	45.2035
CF_4, t	NO	NO	NO	0.2100	0.2940	0.4074	0.5538	0.7362
SF_6, t	NO	NO	0.0960	1.1600	1.4442	1.8279	2.3232	2.9403

Table 4-14: GHG emissions from industrial processes sector by gas, within 1990-2030 periods, Gg CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
CO_2	1899.8	488.4	266.2	527.1	461.6	657.9	860.1	1085.8	1315.1
CH_4	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.2	0.3
N_2O	1.1	1.0	1.4	1.6	0.4	1.7	1.7	1.8	1.9
HFC	NO, NE	1.9	13.4	39.4	102.4	156.7	240.6	323.8	402.3
PFC	NO, NE	NO, NE	NO, NE	NO, NE	0.1	0.1	0.2	0.3	0.3
SF_6	NO, NE	NO, NE	NO, NE	0.0	0.6	0.7	0.9	1.1	1.4
Total	1901.0	491.5	281.2	568.4	565.1	817.3	1103.7	1413.0	1721.2
	Historical data					WM			
CO_2	1899.8	488.4	266.2	527.1	461.6	638.2	830.7	1042.6	1248.5
CH_4	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.3	0.3
N_2O	1.1	1.0	1.4	1.6	0.4	1.7	1.8	1.9	2.0
HFC	NO, NE	1.9	13.4	39.4	102.4	151.0	225.2	259.8	279.1
PFC	NO, NE	NO, NE	NO, NE	NO, NE	0.1	0.1	0.2	0.3	0.3
SF_6	NO, NE	NO, NE	NO, NE	0.0	0.6	0.7	0.9	1.1	1.3
Total	1901.0	491.5	281.2	568.4	565.1	791.9	1059.0	1305.8	1531.5
	Historical data					WAM			
CO_2	1899.8	488.4	266.2	527.1	461.6	627.9	805.3	999.2	1193.5
CH_4	0.1	0.1	0.2	0.2	0.1	0.3	0.3	0.3	0.3
N_2O	1.1	1.0	1.4	1.6	0.4	1.9	2.0	2.1	2.2
HFC	NO, NE	1.9	13.4	39.4	102.4	140.2	207.8	216.7	232.0
PFC	NO, NE	NO, NE	NO, NE	NO, NE	0.1	0.1	0.2	0.2	0.3
SF_6	NO, NE	NO, NE	NO, NE	0.0	0.6	0.7	0.8	1.1	1.3
Total	1901.0	491.5	281.2	568.4	565.1	771.1	1016.3	1219.5	1429.6

Table 4-15: GHG emissions from industrial processes sector, by sources categories, within the 1990-2030 periods, Gg CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
2A Mineral products	1888.1	477.5	251.2	509.7	457.6	639.8	841.7	1066.7	1295.3
2C Metal production	13.0	12.0	16.6	19.2	4.4	20.0	20.4	21.1	21.9
2F Consumption of halocarbons and SF_6	NO, NE	1.9	13.4	39.5	103.1	157.5	241.6	325.1	404.0
2 Industrial processes	1901.0	491.5	281.2	568.4	565.1	817.3	1103.7	1413.0	1721.2
	Historical data					WM			
2A Mineral products	1888.1	477.5	251.2	509.7	457.6	620.3	812.6	1024.1	1229.8
2C Metal production	13.0	12.0	16.6	19.2	4.4	19.9	20.2	20.6	20.9
2F Consumption of halocarbons and SF_6	NO, NE	1.9	13.4	39.5	103.1	151.8	226.2	261.1	280.8
2 Industrial processes	1901.0	491.5	281.2	568.4	565.1	791.9	1059.0	1305.8	1531.5
	Historical data					WAM			
2A Mineral products	1888.1	477.5	251.2	509.7	457.6	610.2	787.6	981.4	1175.7
2C Metal production	13.0	12.0	16.6	19.2	4.4	19.9	20.0	20.1	20.2
2F Consumption of halocarbons and SF_6	NO, NE	1.9	13.4	39.5	103.1	141.0	208.8	218.0	233.6
2 Industrial processes	1901.0	491.5	281.2	568.4	565.1	771.1	1016.3	1219.5	1429.6

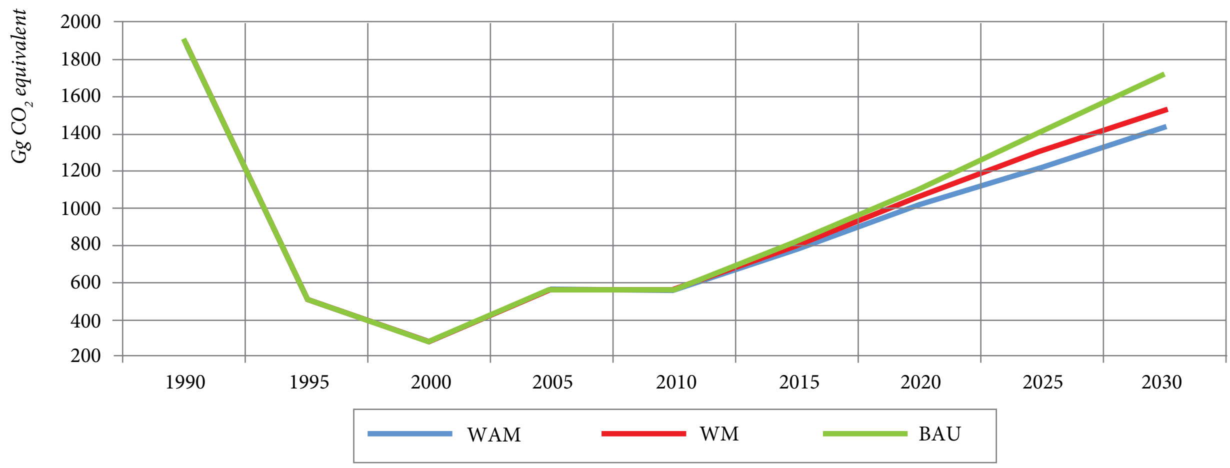


Figure 4-18: GHG emissions from industrial processes sector within the 1990-2030 periods, Gg CO_2 equivalent

„Consumption of halocarbons and SF_6" in the structure of total GHG emissions at sector level; concurrently, the share of source categories 2A „Mineral products" and 2C „Metal production" will have a growth trend.

D. Constraints to Mitigation Scenarios Implementation

The main constraints to the efficient implementation of mitigation scenarios in the industrial processes sector are:

- high degree of moral and physical depreciation of equipment in the industrial enterprises of the country and limited possibilities of the state to financially support the industrial enterprises restructuring process;
- lack of real progress in attracting direct foreign investment in the industrial sector, insufficient resources for carrying out an aggressive policy for technological transfer and innovations;

Table 4-16: Breakdown of different gases in the structure of total GHG emissions originated from industrial processes sector within the 1990-2030 periods, %

	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
CO_2	99.9	99.4	94.7	92.7	81.7	80.5	77.9	76.8	76.4
CH_4	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
N_2O	0.1	0.2	0.5	0.3	0.1	0.2	0.2	0.1	0.1
HFC	NA	0.4	4.8	6.9	18.1	19.2	21.8	22.9	23.4
PFC	NA	NA	NA	NA	0.0	0.0	0.0	0.0	0.0
SF_6	NA	NA	NA	0.0	0.1	0.1	0.1	0.1	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Historical data					WM			
CO_2	99.9	99.4	94.7	92.7	81.7	80.6	78.4	79.8	81.5
CH_4	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
N_2O	0.1	0.2	0.5	0.3	0.1	0.2	0.2	0.1	0.1
HFC	NA	0.4	4.8	6.9	18.1	19.1	21.3	19.9	18.2
PFC	NA	NA	NA	NA	0.0	0.0	0.0	0.0	0.0
SF_6	NA	NA	NA	0.0	0.1	0.1	0.1	0.1	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Historical data					WAM			
CO_2	99.9	99.4	94.7	92.7	81.7	81.4	79.2	81.9	83.5
CH_4	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
N_2O	0.1	0.2	0.5	0.3	0.1	0.2	0.2	0.2	0.2
HFC	NA	0.4	4.8	6.9	18.1	18.2	20.4	17.8	16.2
PFC	NA	NA	NA	NA	0.0	0.0	0.0	0.0	0.0
SF_6	NA	NA	NA	0.0	0.1	0.1	0.1	0.1	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4-17: Breakdown of different source categories in the structure of total GHG emissions originated from industrial processes sector within the 1990-2030 periods, %

	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
2A Mineral products	99.3	97.2	89.3	89.7	81.0	78.3	76.3	75.5	75.3
2C Metal production	0.7	2.4	5.9	3.4	0.8	2.5	1.8	1.5	1.3
2F Consumption of halocarbons and SF_6	NA	0.4	4.8	6.9	18.2	19.3	21.9	23.0	23.5
2 Industrial processes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Historical data					WM			
2A Mineral products	99.3	97.2	89.3	89.7	81.0	78.3	76.7	78.4	80.3
2C Metal production	0.7	2.4	5.9	3.4	0.8	2.5	1.9	1.6	1.4
2F Consumption of halocarbons and SF_6	NA	0.4	4.8	6.9	18.2	19.2	21.4	20.0	18.3
2 Industrial processes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Historical data					WAM			
2A Mineral products	99.3	97.2	89.3	89.7	81.0	79.1	77.5	80.5	82.2
2C Metal production	0.7	2.4	5.9	3.4	0.8	2.6	2.0	1.6	1.4
2F Consumption of halocarbons and SF_6	NA	0.4	4.8	6.9	18.2	18.3	20.5	17.9	16.3
2 Industrial processes	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

- instability of the legislation, particularly on fiscal and budget policy;
- increasing deficit of technical and engineering staff and skilled workers in industry and intensification of the gap between the education level of vocational-technical specialists and the real needs of the industrial sector;
- lack of a sufficient political will in transposing EC Regulation 842/2006 on fluorinated gas emissions mitigation, etc.

4.3.3. Agriculture Sector

In agriculture sector, the registered emissions include methane emissions generating from the animal breeding sector, particularly from source categories 4A „Enteric fermentation" and 4B „Manure management", as well as nitrous oxide emissions from source categories 4B „Manure management" and 4D „Agricultural soils". According to the GPG for LULUCF (IPCC, 2003), the CO_2 emissions/removals from category 5B „Croplands" have been considered under the LULUCF sector. The GHG emissions projections were developed based on methodological approaches provided in the Revised 1996 IPCC Guideline (IPCC, 1997), GPG (IPCC, 2000) and 2006 IPCC Guideline (IPCC, 2006).

A. Mitigation Scenarios

Based on macroeconomic indicators, the national experts developed and analysed three scenarios (BAU, WM and WAM) of the agriculture sector development for a timeframe until 2030.

BAU scenario represents an option in which the progress of agricultural technologies, quantity of used chemicals and fertilizers, improvement of the agricultural crop structure will be at a level that would lead to some increase of agricultural production, as well as of the amount of agricultural residues returned into the soil. The projected carbon balance under the BAU scenario will be reduced from -0.60 t/ha in 2010 to -0.26 t/ha in 2030. However, compared to 1990, the carbon balance in agricultural soils under this scenario will continue remaining rather negative. In animal breeding sector, the livestock number will grow. For instance, within the 2010-2030 periods, the cattle number will increase by 27.1%, while the sheep number – by 31.1%. The evolution of macroeconomic indicators has been determined based on projections carried out by the Ministry of Economy of the RM (updated as of November 2012). Also, it was taken into consideration a number of strategic documents, such as: Strategy for Agricultural and Food Sector Development for 2006-2015 (approved through Government Resolution No. 1199 of 17.10.2006), National Development Strategy for 2008-2011 (approved through Law No. 295-XVI of 21.12.2007), and National Strategy for Sustainable Development of Agro-Industrial Complex of the Republic of Moldova for 2008-2015 (approved through GR No. 282 of 11.03.2008).

WM scenario implies, according to policies described in Chapter 3, implementing advanced soil tillage and fertilization technologies on agricultural land, and increasing and gradually substituting the currently used species of animals and poultry by species with higher productivity indicators, as well as using sustainable animal manure management systems in animal breeding. For areas used in „No-Till" and "Mini-Till" based agriculture system all the organic residues for key crops will be left as fertilization source on the following areas: in 2015 – on 50 thousand hectares of wheat or barley, and on 50 thousand hectares of corn or sunflower; in 2020 – 100 thousand hectares of wheat or barley, and 100 thousand hectares of corn or sunflower; in 2025 – 150 thousand hectares of wheat or barley, and 150 thousand hectares of corn or sunflower; in 2030 – 200 thousand hectares of wheat or barley, and 200 thousand hectares of corn or sunflower. The area planted annually with intermediary crops will be twice as small as the area on which „No-Till" or „Mini-Till" agriculture system will be implemented. The vetch yield per hectare, to be used as green fertilizer, is planned to reach circa 20 t/ha, equal to 28 t/ha of manure with litter. The projected carbon balance under this scenario will reduce from -0.60 t/ha in 2010 to -0.03 t/ha in 2030. In animal breeding sector, the livestock population will increase; within 2010-2030, the number of cattle will increase by 31.4%, of sheep – by 43.6%, and of swine – by 17.2%.

WAM scenario implies requesting the same set of mitigation measures as in the WM, but to a larger extent. It is assumed to implement „No-Till" or „Mini-Till" agriculture systems on arable land areas as follows: in 2015 – 100 thousand hectares of wheat or barley and 100 thousand hectares of corn or sunflower; in 2020 – 150 thousand hectares of wheat or barley, and 150 thousand hectares of corn or sunflower; in 2025 – 200 thousand hectares of wheat or barley, and 200 thousand hectares of corn or sunflower; in 2030 – 300 thousand hectares of wheat or barley and 300 thousand hectares of corn and sunflower. Concurrently, the areas planed with intermediary crops will be as follows: in 2015 – 100 thousand hectares; in 2020 –150 thousand ha; in 2025 – 200 thousand ha; in 2030 – 300 thousand ha. The vetch yield per hectare, to be used as green fertilizer, is planned to reach circa 20 t/ha, equal to 28 t/ha of manure with litter. The projected carbon balance under this scenario will go down from -0.60 t/ha in 2010 to +0.49 t/ha in 2030, thus becoming positive. In animal breeding sector, during 2010-2020, the livestock population will increase: the number of cattle by 78.0%, the number of sheep – by 50.4%, and the swine number – by 56.3%.

B. Projections of Economic Indicators

The projections of economic indicators in the agriculture sector (animal breeding and plant production) with direct impact on GHG emissions originating from agriculture sector under three assessed scenarios are provided bellow, being developed in compliance with the polices stated in Chapter 3, and reflected in the Strategy for Sustainable Development of Agricultural and Food Sector for 2006-2015, Milk Sector Strategy of the Republic of Moldova until 2027, National Strategy for Sustainable Development of Agro-Industrial Complex of the Republic of Moldova (2008-2015), Soil Conservation and Fertility Enhancement Program for 2011-2020, etc.

Table 4-18 provides information on projections of livestock population until 2030, while Tables 4-19, 4-20, and 4-21 provide information on projected values of factors that lead to an increase in organic matter flow in soil, and long-term preservation of soil fertility, as well as to reduction of GHG emissions.

Table 4-18: Projections of livestock population within the 2005-2030 periods, in thousand heads

Categories of animals and poultry	2005	2010	2015	2020	2025	2030
	Historical data		BAU			
Cattle	340	236	240	260	280	300
Dairy cows	233	166	170	180	190	200
Other cattle	107	70	70	80	90	100
Sheep	833	801	825	900	975	1050
Goats	122	120	110	110	112	114
Horses	72	54	55	55	56	57
Assess and mules	4	3	3	3	3	3
Swine	493	512	425	450	475	500
Rabbits	279	277	280	285	290	295
Poultry	22774	23811	22825	23250	23675	24100
	Historical data		WM			
Cattle	340	236	250	270	290	310
Dairy cows	233	166	175	180	185	190
Other cattle	107	70	75	90	105	120
Sheep	833	801	850	950	1050	1150
Goats	122	120	100	95	95	95
Horses	72	54	55	55	56	57
Assess and mules	4	3	3	3	3	3
Swine	493	512	450	500	550	600
Rabbits	279	277	285	290	295	300
Poultry	22774	23811	23200	23650	23700	23750
	Historical data		WAM			
Cattle	340	236	270	320	370	420
Dairy cows	233	166	185	205	225	245
Other cattle	107	70	85	115	145	175
Sheep	833	801	860	975	1090	1205
Goats	122	120	95	90	90	90
Horses	72	54	55	55	56	57
Assess and mules	4	3	3	3	3	3
Swine	493	512	500	600	700	800
Rabbits	279	277	290	295	300	305
Poultry	22774	23811	23600	23675	23750	23825

Table 4-19: Projections on use of nitrogen fertilizers in the RM within 2005-2030 periods

	2005	2010	2015	2020	2025	2030
	Historical data		BAU			
Chemicals fertilizers, F_{SN}, kt N (a.s.)	16.1	20.6	21.5	22.5	25.0	30.0
Organic fertilizers, F_{ON}, kt N (a.s.)	0.2	0.1	0.1	0.1	0.2	0.3
	Historical data		WM			
Chemicals fertilizers, F_{SN}, kt N (a.s.)	16.1	20.6	25.0	30.0	45.0	60.0
Organic fertilizers, F_{ON}, kt N (a.s.)	0.2	0.1	0.1	0.3	0.6	1.1
	Historical data		WAM			
Chemicals fertilizers, F_{SN}, kt N (a.s.)	16.1	20.6	30.0	45.0	60.0	90.0
Organic fertilizers, F_{ON}, kt N (a.s.)	0.2	0.1	0.3	0.6	1.1	1.7

Table 4-20: Projections of the amount of urine and dung nitrogen deposited by grazing animals and the amount of nitrogen in crop residues returned to soil in the RM within the 2005-2030 periods

	2005	2010	2015	2020	2025	2030
	Historical data		BAU			
Urine and dung, F_{PRP}, kt N (a.s.)	7.5	6.2	7.7	8.0	8.5	8.9
Crop residues, F_{CR}, kt N (a.s.)	28.0	25.0	27.3	33.8	37.9	41.6
	Historical data		WM			
Urine and dung, F_{PRP}, kt N (a.s.)	7.5	6.2	8.4	9.2	10.2	11.1
Crop residues, F_{CR}, kt N (a.s.)	28.0	25.0	30.1	40.6	49.8	60.5
	Historical data		WAM			
Urine and dung, F_{PRP}, kt N (a.s.)	7.5	6.2	9.7	10.0	11.0	12.0
Crop residues, F_{CR}, kt N (a.s.)	28.0	25.0	39.8	50.5	61.3	83.1

Table 4-21: Projections of the amount of nitrogen mineralized due to loss of soil carbon as a result of land/use or soil management practices change in the RM within the 2005-2030 periods

	2005	2010	2015	2020	2025	2030
	Historical data		BAU			
Arable lands, thousand ha	1625.5	1571.2	1630.0	1738.0	1778.0	1800.0
Nitrogen mineralized as a result of loss of soil C, F_{SOM}, kt a.s.	109.2	106.4	84.3	85.1	86.3	79.5
	Historical data		WM			
Arable lands, thousand ha	1625.5	1571.2	1630.0	1738.0	1778.0	1800.0
Nitrogen mineralized as a result of loss of soil C, F_{SOM}, kt a.s.	109.2	106.4	83.8	89.5	89.7	88.1
	Historical data		WAM			
Arable lands, thousand ha	1625.5	1571.2	1630.0	1738.0	1778.0	1800.0
Nitrogen mineralized as a result of loss of soil C, F_{SOM}, kt a.s.	109.2	106.4	92.8	93.1	88.7	37.3

C. Assessment of Mitigation Potential

The applied methodologies and emission factors were taken from the Revised 1996 IPCC Guidelines (IPCC, 1997), GPG (IPCC, 2000) and 2006 IPCC Guidelines (IPCC, 2006) (country specific emission factors were also used), using the results of economic indicators calculations within the 2005-2030 periods under the considered scenarios. Calculation results of GHG emissions, by gases and source categories, are provided in Table 4-22, and breakdown of different source category in total sector related GHG emissions, respectively in Table 4-23.

Table 4-22: GHG emissions originating from agriculture sector under the considered scenarios for the 1990-2030 periods, Gg CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
CH_4 emissions, including:	**2089**	**1492**	**983**	**843**	**656**	**727**	**796**	**848**	**905**
enteric fermentation	1834	1361	911	778	598	648	707	750	800
manure management	255	132	72	65	57	79	89	98	105
N_2O emissions, including:	**3031**	**1867**	**1294**	**1530**	**1477**	**1427**	**1399**	**1423**	**1404**
manure management	1382	845	498	531	499	548	469	439	400
agricultural soils	1649	1022	795	999	978	879	930	984	1004
Total direct GHG emissions, including:	**5120**	**3359**	**2277**	**2373**	**2132**	**2154**	**2196**	**2271**	**2309**
enteric fermentation	1834	1361	911	778	598	648	707	750	800
manure management	1637	976	570	596	556	627	558	537	505
agricultural soils	1649	1022	795	999	978	879	930	984	1004
	Historical data					WM			
CH_4 emissions, including:	**2089**	**1492**	**983**	**843**	**656**	**749**	**819**	**875**	**940**
enteric fermentation	1834	1361	911	778	598	668	729	780	840
manure management	255	132	72	65	57	81	90	95	100
N_2O emissions, including:	**3031**	**1867**	**1294**	**1530**	**1477**	**1534**	**1640**	**1823**	**1990**
manure management	1382	845	498	531	499	564	484	450	400
agricultural soils	1649	1022	795	999	978	970	1156	1373	1590
Total direct GHG emissions, including:	**5120**	**3359**	**2277**	**2373**	**2132**	**2283**	**2459**	**2698**	**2930**
enteric fermentation	1834	1361	911	778	598	668	729	780	840
manure management	1637	976	570	596	556	645	574	545	500
agricultural soils	1649	1022	795	999	978	970	1156	1373	1590
	Historical data					WAM			
CH_4 emissions, including:	**2089**	**1492**	**983**	**843**	**656**	**822**	**938**	**1043**	**1152**
enteric fermentation	1834	1361	911	778	598	738	844	940	1040
manure management	255	132	72	65	57	84	94	103	112
N_2O emissions, including:	**3031**	**1867**	**1294**	**1530**	**1477**	**1745**	**1917**	**2064**	**2149**
manure management	1382	845	498	531	499	573	523	470	420
agricultural soils	1649	1022	795	999	978	1172	1394	1594	1729
Total direct GHG emissions, including:	**5120**	**3359**	**2277**	**2373**	**2132**	**2567**	**2855**	**3107**	**3301**
enteric fermentation	1834	1361	911	778	598	738	844	940	1040
manure management	1637	976	570	596	556	658	617	573	532
agricultural soils	1649	1022	795	999	978	1172	1394	1594	1729

Table 4-23: Breakdown of different source categories in the structure of total GHG emissions from agriculture sector under the considered scenarios, %

	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
Total direct GHG emissions, including:	100	100	100	100	100	100	100	100	100
enteric fermentation	36	41	40	33	28	30	32	33	35
manure management	32	29	25	25	26	29	25	24	22
agricultural soils	32	30	35	42	46	41	42	43	43
	Historical data					WM			
Total direct GHG emissions, including:	100	100	100	100	100	100	100	100	100
enteric fermentation	36	41	40	33	28	29	30	29	29
manure management	32	29	25	25	26	28	23	20	17
agricultural soils	32	30	35	42	46	42	47	51	54
	Historical data					WAM			
Total direct GHG emissions, including:	100	100	100	100	100	100	100	100	100
enteric fermentation	36	41	40	33	28	29	30	30	32
manure management	32	29	25	25	26	26	22	18	16
agricultural soils	32	30	35	42	46	46	49	51	52

As can be noted from Figure 4-19, BAU scenario is distinguished by the lowest GHG within the period until 2030. In 2020, the direct GHG emissions under WM scenario will exceed the level recorded in the BAU scenario by 12%, while those recorded under the WAM scenario by 30%, respectively (Table 4-24). In both cases, under WM and WAM scenarios, the GHG emissions will grow constantly during 2010-2030, the highest level of emissions being recorded under the WAM scenario. This is explained by the need to develop the agriculture sector which has been regressing in the Republic of Moldova, specifically since 1990 to 2000.

The animal breeding sector development will imminently lead to an increase of GHG emissions from enteric fermentation (within the 2010-2020 periods, from 598 to 729 Gg CO_2 equivalent under the WM scenario, and from 598 to 844 Gg CO_2 equivalent under the WAM scenario, respectively), while the growth of crops productivity will contribute to an increase of GHG emissions as result of intensifying the use of agricultural soils (within the 2010-2020 periods, from 978 to 1156 Gg CO_2 equivalent under the WM scenario and from 978 to 1394 Gg CO_2 equivalent under the WAM scenario). At the same time, the implementation of planned manure management practices will contribute to an increase of GHG emissions within the 2010-2020 periods, from 556 to 574 Gg CO_2 equivalents under the WM scenario and from 556 to 617 Gg CO_2 equivalents under the WAM scenario.

The level of direct GHG emissions recorded in the agriculture sector by 2030 will be anyway much lower than the level recorded in the base year (1990), by circa 55% under the BAU, by 43% under the WM, and by 35% under the WAM, respectively.

Table 4-24: Dynamic of GHG Emissions in Agriculture Sector Compared to BAU scenario, %

Scenario	2015	2020	2025	2030
WM	6	12	19	27
WAM	19	30	37	43

D. Constraints to Mitigation Scenarios Implementation

Among the constraints to implementation the mitigation scenarios in agriculture sector (animal breading and plant production) the following should be noted:

- per hectare yield is relatively low compared to other countries in the region, varying strongly from year to year, which prove the lack of mechanisms for mitigating the risks of negative impacts on the sector (inadequate agricultural equipment, insufficient application of fertilizers, lack of irrigation, land fund fragmentation, soil erosion, land sliding, frequent droughts, extreme climate events: heavy rains, hail, frosts, floods, etc.)
  - this situation will persist as long as there is no any strategy on combating and preventing climate risks and reducing their impact;
- the current production structure reflects the subsistence character of agriculture in the RM – the plant production sector is dominated by low-value crops, while the production of high value crops has been reduced, inclusive as result of ageing vineyards and orchards, moral and physical depreciation of irrigation systems, lack of a modern market infrastructure (storage capacities, collection stations, in-the-field cooling equipment, packing houses, etc.), relatively high production cost and chronic shortage of funds;
- current low efficiency of agriculture sector also derives from the poor link with the foreign markets and low competitiveness of domestic agricultural products – the situation will remain unchanged if vertical coordination is not achieved, establishing close relations with the other links of the value chain – retailers, processors, exporters, other intermediaries, concurrently eliminating the existing bottlenecks related to the functioning of markets associated with the agricultural sector; on the other hand, the slow progress of transition from the GOST based standard system to international standard

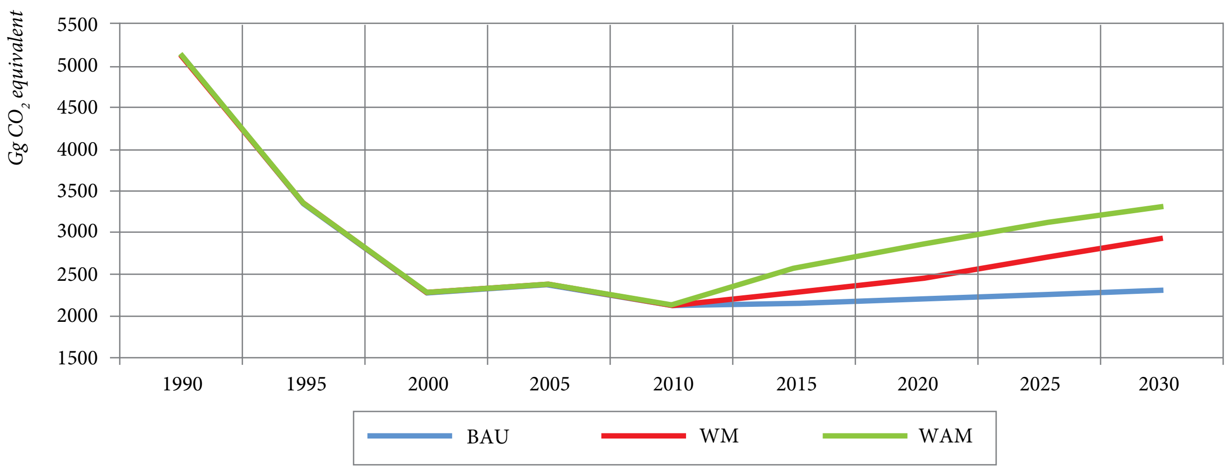


Figure 4-19: Dynamic of GHG Emissions in Agricultural Sector under the Considered Scenarios

also delays the penetration of Moldovan products on the high value markets;

- the share of agriculture in the fixed capital investments is low and continuously decreasing – agriculture will remain further avoided by foreign investors, if the business and investment environment is not improved, including by reviewing the restriction regarding the ownership of agricultural land by companies with foreign capital;
- other impediments to sustainable sector development include high fragmentation of circa 50% of agricultural land in private ownership, which fact has a negative impact on the economic performance of the sector;
- the exodus of the population abroad leads to depopulation of villages, which fact creates problems in ensuring labour force for the sector;
- scientific-research institutions from the sector are insufficiently financed, and their experimental technical and material base is obsolete.

4.3.4. LULUCF Sector

Within the LULUCF sector, the registered CO_2 emissions and removals originate from the following source/sink categories: 5A „Forest lands", 5B „Croplands" and 5C „Grasslands". CO_2 emissions and removals originating from category 5E „Settlements" have been reported in the source/sink category 5B „Croplands".

The projections of CO_2 emissions and removals were carried out based on methodological approaches described in the Revised 1996 IPCC Guidelines (IPCC, 1997), GPG for LULUCF (IPCC, 2003) and 2006 IPCC Guidelines (IPCC, 2006). Concurrently, to calculate the sequestration level by forestry vegetation, the national experts used also the module CO_2 FIX V2.0 developed by the European Forestry Institute for the CASFOR Project.

A. Mitigation Scenarios

Based on mitigation policies stated in Chapter 3, the national experts developed and assessed three scenarios for LULUCF sector for the period until 2030.

BAU scenario reflects the forestry development policies and strategies approved before 2005, given the fact that after 2005 and until 2010, which is a reference year for this study, no relevant strategic documents were approved.

WM scenario has been prepared using as main support:

- Government Resolution No. 593 of 01.08.2011 on *Approval the National Program for Constituting the National Environmental Network*. This program provides for afforestation of river water and water basin protection zones and belts on an area of 30.4 thousand hectares by the end of 2018;
- Government Resolution No. 626 of 20.08.2011 on *Approval the Program for Land Conservation and Soil Fertility Enhancement for 2011-2020*. This program provides for stabilization of 50 ha of landslides through afforestation, as well as creation of 20 ha of protection belts;
- Government Resolution No. 282 of 11.03.2008 on *Approval the National Strategy for Sustainable Development of Agro-Industrial Complex of the Republic of Moldova for 2008-2015*. The Strategy provides for:
  - creating forestry protection belts of agricultural fields on an area of 12.4 thousand hectares;
  - creating anti-erosion forestry belts on 28.34 thousand ha;
  - creating forestry belts of water and water basins on 14.9 thousand ha;
  - creating 75 thousand hectares of vineyard plantations;
  - uprooting 55 thousand hectares of non-profitable vineyard.

WAM scenario implies an increase in the indicators for area extension of other types of vegetation by 20% starting with 2011, increase of forest area extension indicators by 20% starting with 2012. Such increase can be achieved through the following activities:

- speeding the pace of perennial plantations area extension through creation and implementation of adequate financial systems (preferential loans, exemption from taxes and fees, compensations, etc.);
- speeding the pace of forest area extension, including through a broader application of agri-forestry and forestry-pastoral practices (plantation of forestry protection belts/alignments from fruit trees, improvement of meadows by planting groups of arbores, etc.);
- extending the forest areas at the expense of private owners (planting forestry vegetation on private land areas with government funds in form of loans/long term investments, creating a lending system and providing facilities in the given area, etc.).

B. Projections of Economic Indicators

Activity data on the evolution of land areas covered with vegetation (Table 4-25) were generated based policy documents mentioned above, as well as being guided by the overall trends regarding the need to continue improving the quality and quantity indicators of forests and other types of forestry vegetation. The harvest of wood matter in the process of forestry cuttings within 2010-2030 period envisage an increase in the use of current growths by circa 18% (under the BAU scenario), by 80% (under the WM scenario) and 200% (under the WAM scenario) (Table 4-26).

Table 4-25: Evolution of economic indicators in the LULUCF sector within the 2005-2030 periods

Indicators	2005	2010	2015	2020	2025	2030
	Historical data		**BAU**			
Forests, thousand ha	362.7	374.5	384.3	394.1	404	413
Forestry vegetation not part of the forestry fund, thousand ha	49.3	49	52.2	55.4	58.3	61.2
Arable lands, thousand ha	1625.5	1571.2	1630.0	1738.0	1778.0	1800.0
Orchards, thousand ha	142.3	147.4	151.7	155.9	160.2	164.6
Vineyard, thousand ha	155.5	153.6	156.1	158.6	161.1	163.6
Grasslands, thousand ha	373.5	354.3	338.3	322.3	306.3	290.3
Trees in settlement lands, million trees	8.3	8.3	8.3	8.3	8.3	8.3
	Historical data		**WM**			
Forests, thousand ha	362.7	374.5	441.0	507.5	507.5	507.5
Forestry vegetation not part of the forestry fund, thousand ha	49.3	49	102.5	121.5	141.5	161.5
Arable lands, thousand ha	1625.5	1571.2	1630.0	1738.0	1778.0	1800.0
Orchards, thousand ha	142.3	147.4	172.4	197.4	222.4	247.4
Vineyard, thousand ha	155.5	153.6	173.6	176.1	178.6	181.1
Grasslands, thousand ha	373.5	354.3	430.8	507.3	583.8	660.3
Trees in settlement lands, million trees	8.3	8.3	8.3	8.4	8.4	8.4
	Historical data		**WAM**			
Forests, thousand ha	362.7	374.5	474.9	597.9	697.9	777.9
Forestry vegetation not part of the forestry fund, thousand ha	49.3	49	97.5	146	194	242
Arable lands, thousand ha	1625.5	1571.2	1630.0	1738.0	1778.0	1800.0
Orchards, thousand ha	142.3	147.4	181.9	216.4	250.9	285.4
Vineyard, thousand ha	155.5	153.6	173.6	193.6	213.6	233.6
Grasslands, thousand ha	373.5	354.3	454.3	554.3	654.3	754.3
Trees in settlement lands, million trees	8.3	8.3	8.4	8.4	8.4	8.5

Table 4-26: Evolution of current increments of wood mass harvested during authorized cuttings and illicit logging within the 2005-2030 periods

Indicators	2005	2010	2015	2020	2025	2030
	Historical data		**BAU**			
Total volume of current increments, thousand m^3	1285.7	1324.1	1362.2	1400.3	1438.4	1476.5
Total volume of harvested wood mass, thousand m^3	395.8	438.5	480.3	493.6	505.6	517.6
	Historical data		**WM**			
Total volume of current increments, thousand m^3	1285.7	1324.1	1639.8	1893.5	2143.5	2343.5
Total volume of harvested wood mass, thousand m^3	395.8	438.5	577.4	666.2	746.2	796.2
	Historical data		**WAM**			
Total volume of current increments, thousand m^3	1285.7	1324.1	1742.6	2235.8	2635.8	3035.8
Total volume of harvested wood mass, thousand m^3	395.8	438.5	787.7	1009.6	1209.6	1309.6

C. Assessing the Mitigation Potential

CO_2 removals in the LULUCF sector were assessed using the CO_2 FIX V2.0 module developed by the European Forestry Institute for CASFOR Project, as well as the standard calculation tool which is a component part of the Revised 1996 IPCC Guidelines (IPCC, 1997), based on the methodological approaches and emission factors included in the GPG for LULUCF (IPCC, 2003) and 2006 IPCC Guidelines (IPCC, 2006) (country specific emission factors were also used), and results of calculations for the evolution of economic indicators recorded in the respective sector within the 1990-2030 periods for the considered scenarios.

Table 4-27 provides information on the calculation results on GHG emissions/removals by source/sink categories within the LULUCF sector, while Figure 4-19 reveals the dynamic of total emissions/removals in this sector. In all considered scenarios, the most significant removals are achieved in category 5A „Forest lands". Although in base year the category 5B "Croplands" was represented as a category with the highest share of CO_2 sequestration (in 1990: -4193 Gg CO_2), further it became a net source of CO_2 emissions (in 2010: +2977 Gg CO_2). The drastic diminishing of carbon returned into the soil from animal manure led to a positive carbon balance in the soil of +0.56 t/ha in 1990, and to a rather deep negative balance of – 0.60 t/ha in 2010. Within 2000-2010, the carbon balance in agricultural soils became negative, constituting on average -0.50 t/ha. Further on, it is assumed that agricultural soils will gradually become a carbon sequestration source again, but this could happen after 2025 under the WAM scenario. The fundamental measure towards achieving this desideratum resides in applying

Table 4-27: CO_2 emissions/removals from LULUCF sector under the considered scenarios within the 1990-2030 periods, Gg

Indicators	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
5. LULUCF	**-7177**	**-1158**	**-782**	**-104**	**26**	**-560**	**-363**	**-337**	**-629**
5A. Forest lands	-2197	-1621	-2140	-2246	-2193	-3071	-2766	-2600	-2500
5B. Croplands	-4193	1082	2184	2961	2977	2450	2284	2123	1711
5C. Grasslands	-787	-620	-826	-819	-758	61	119	140	160
	Historical data					WM			
5. LULUCF	**-7177**	**-1158**	**-782**	**-104**	**26**	**-1613**	**-2330**	**-2923**	**-3577**
5A. Forest lands	-2197	-1621	-2140	-2246	-2193	-3605	-3837	-4000	-4100
5B. Croplands	-4193	1082	2184	2961	2977	2135	1795	1377	823
5C. Grasslands	-787	-620	-826	-819	-758	-143	-288	-300	-300
	Historical data					WAM			
5. LULUCF	**-7177**	**-1158**	**-782**	**-104**	**26**	**-2183**	**-4133**	**-5315**	**-5528**
5A. Forest lands	-2197	-1621	-2140	-2246	-2193	-3743	-4512	-4600	-4700
5B. Croplands	-4193	1082	2184	2961	2977	1754	771	-315	-378
5C. Grasslands	-787	-620	-826	-819	-758	-194	-392	-400	-450

conservative farming technologies and green fertilization of agricultural soils.

By 2020, the CO_2 emissions will reduce by over six times under the WM scenarios, compared to the BAU scenario, and by over 11 times under the WAM. Regardless the growing trend in CO_2 removals after 2010 in case of WM and WAM scenarios, by 2030 the sequestration level registered in the base year will not be achieved yet (Figure 4-20). In case of BAU, it is expected to achieve by 2030 just 9% of CO_2 removals level of 1990 year; in case of other scenarios, the sequestration levels will be higher, 50% under the WM and 77% under the WAM, respectively.

D. Constraints to Mitigation Scenarios Implementation

The key constraints to mitigation scenarios implementation in LULUCF sector are as follows:

- diminishing of budget allocations for afforestation activities;
- destruction of new plantations through grazing, and other forestry contraventions;
- reorientation of private agricultural land holders towards intensive agriculture;
- worsening of climate conditions;
- failure to implement financial and economic mechanisms for stimulating the extension of different types of forestry vegetation, perennial plantations, etc.;
- increased wood matter crop volume, including through illicit cuttings;
- essential extension of arboretums affected by diseases and forestry pests, with the reduction of annual growths by 10-50%;
- inefficient agriculture subsidization system, focused on short term objectives;
- insufficient funding of measures and actions to combat soil degradation and reduce the volume of GHG emissions;

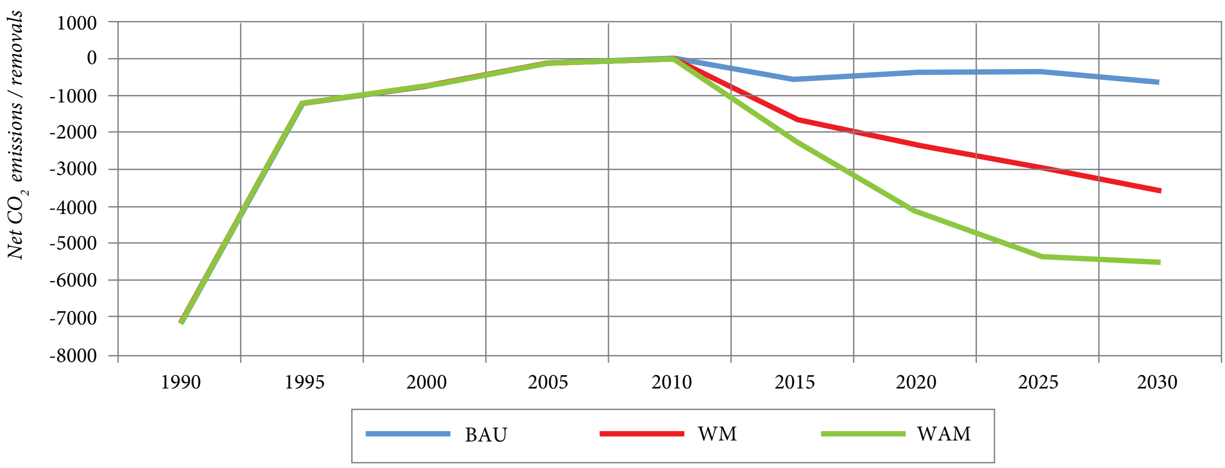


Figure 4-20: CO_2 emissions/removals from LULUCF sector under the considered scenarios within the 1990-2030 periods, Gg

- lacking a complex of economic and fiscal mechanisms for regulating and stimulating actions to combat soil degradation and diminishing CO_2 emissions from croplands;
- excessive fragmentation of the agricultural land fund into over 2 million private land shares, which impede the performance of agricultural soil protection and improvement works, sustainable use of agricultural land, and the GHGs mitigation measures;
- failure to insure perennial grass seeds (sainfoin, alfalfa, ryegrass, etc.) and annual leguminous plants (winter vetch, spring vetch, melilotus, etc.) required in order to reestablish carbon balance in the soil, and reduce CO_2 emissions;
- lacking a state program for economic stimulation of entities involved in agriculture to sow intermediary crops as green fertilizers.

4.3.5. Waste Sector

GHG emissions monitored in waste sector include CH_4 and N_2O emissions from 6A "Solid waste disposal on land" and 6B 'Wastewater handling" source categories. GHG emissions projections were carried out based on methodological approaches available in the Revised 1996 IPCC Guidelines and GPG (IPCC, 2000).

A. Mitigation Scenarios

Based on macroeconomic indicators of the Republic of Moldova, there were developed three scenarios on medium-term and long-term sector development.

BAU scenario represents an option which implies a 5% annual growth rate for solid municipal wastes generation in urban areas within the 2010-2020 periods, and annual 1% growth rate within 2021-2030 periods. In Chisinau Municipality, such rate will be 3% annually within the 2010-2020 periods, and 1% annual growth rate within 2021-2030 periods, respectively. Industrial wastes will respectively grow by 1.9% and 1.5% annually. The share of the population connected to centralized sewerage system will increase slowly: by 2.2% until 2030. The share of the population connected to centralized sewerage system will constitute 61.1% in 2015, 69.9% in 2020, and 80.9% in 2030. The number of the population within this period will decrease, while the protein consumption will constitute 28.105 kg/year in 2010, 28.386 kg/year in 2015; 28.667 kg/year in 2020; and 28.948 kg/year in 2025.

WM scenario assumes that to the rhythm of solid municipal waste generation considered under the BAU scenario are applied specific mitigation measures aimed to: promoting and developing recyclable waste recovery systems (including paper) in urban areas of the Republic of Moldova (in Chisinau municipality this practice is already in process of implementation). In conditions of increasing volume of waste generation, on average by 4% annually (by 3% in urban areas, and by 5% in rural localities), the promotion of separate collection of paper and cardboard in proportion of 10% in urban localities, and 5% in rural areas will allow reducing the total GHG emissions by 4% until 2020; recovering the biogas at Ţanţăreni landfill starting with 2013 year will ensure an annual reduction by circa 53 Gg CO_2 equivalent. With reference to evolution of wastewater volume and rational use of recovered methane emissions, the WM scenario envisages the connection to centralized sewerage system of 65% of the population by 2015, 80% by 2020, and 100% by 2025, while the protein consumption will grow versus the BAU by 2% in 2015, by 3% in 2020, and by 3.5% in 2025.

WAM scenario corresponds to the WM scenario, however by applying at more advanced implementation level the mitigation measures, specified in the Waste Management Strategy for the period until 2027, approved through Government Resolution No. 248 of 10.04.2013, which provides for the construction of: two mechanical-biological Waste Treatment Plants in Chisinau and Balti municipalities, to which there will be added other 5-6 districts located around respective municipalities; as well as seven regional landfills for the remaining districts comprising 3-4 district each. It should be mentioned also that two options were evaluated at the stage of drafting the Waste Management Strategy for the period 2013-2027, inclusive: (i) construction of two mechanical-biological waste treatment plants or (ii) construction of two incinerators in Chisinau and Balti municipalities. Taking into consideration the undertaken studies on solid municipal waste morphological composition in the Republic of Moldova, preference would be given to mechanical-biological treatment technology. The medium-term impact (until 2020) of building two mechanical-biological waste treatment plants and/or two incinerators, will reside in different level of GHG emission reductions within the waste sector, by 20% and by 18%, respectively. By 2015, efficient sewerage systems are expected to be in place in Chișinău and Bălţi municipalities, which will insure zero GHG emissions from wastewater treatment. By 2020, similar systems are assumed to be implemented in 4 towns: Chișinău, Bălţi, Orhei, and Cahul, while by 2025, Ungheni and Soroca will join to this range. The WAM scenario assumes that the protein consumption will increase by 1.5% in 2015, by 2.5% in 2020, and by 2.75% in 2025, compared to the BAU.

B. Projected Sector Specific Indicators

The projections of the evolution of some sector specific indicators, with impact on GHG emissions are presented below for three scenarios (BAU, WM and WAS). Projections on municipal solid waste disposal on managed (i.e., Chisinau municipality) and unmanaged solid waste disposal sites (i.e., urban settlements on the right and left bank of Dniester River), as well as the projections of industrial waste disposal on land used in BAU are provided in Table 4-28.

Table 4-28: Projections of the volume of solid waste disposal on land under BAU in the Republic of Moldova within the 2005-2030 periods, thousand tons

Indicators	2005	2010	2015	2020	2025	2030
	Historical data		Projections			
Managed Waste Disposal on Land	590.00	597.60	692.78	803.12	883.44	971.78
Unmanaged Waste Disposal on Land	410.05	428.20	532.36	663.04	729.34	802.27
Industrial Waste Disposed at Landfills	605.06	616.41	676.94	744.39	804.78	870.49
Total Solid Waste Disposed on Land	1605.11	1642.21	1902.09	2210.55	2417.55	2644.55

Table 4-29: Projections of total organic wastewater in the Republic of Moldova under the considered scenarios for the 2005-2030 periods

Indicators	2005	2010	2015	2020	2025	2030
	Historical data		BAU			
TOW dom+ind, t CBO_5	60457106	51049751	58052800	58421900	68727675	68292700
	Historical data		WM			
TOW dom+ind, t CBO_5	60457106	51049751	61285325	71251650	81896875	81010424
	Historical data		WAM			
TOW dom+ind, t CBO_5	60457106	51049751	47095950	53193275	58589800	57325251

The projections of total amount of organic matter contained in industrial wastewater (TOW_{ind}) and in domestic wastewater (TOW_{dom}), used to estimate methane emissions from wastewater treatment are provided in Table 4-29.

The projections on consumption of proteins per capita, used to estimate N_2O emissions from human sewage are provided in the Table 4-30.

Table 4-30: Projections of the consumption of proteins per capita in the Republic of Moldova under the considered scenarios for the 2005-2030 periods

Indicators	2005	2010	2015	2020	2025	2030
	Historical data		BAU			
Proteins, g/cap/day	71.9	71.0	77.8	78.5	79.3	91.0
Proteins, kg/cap/year	26.2	25.9	28.4	28.7	28.9	33.1
	Historical data		WM			
Proteins, g/cap/day	71.9	71.0	78.3	79.3	79.7	93.6
Proteins, kg/cap/year	26.2	25.9	28.7	28.9	29.1	34.2
	Historical data		WAM			
Proteins, g/cap/day	71.9	71.0	78.2	78.9	81.9	98.2
Proteins, kg/cap/year	26.2	25.9	28.6	28.8	29.9	35.8

C. Assessment of Mitigation Potential

GHG emissions from waste sector were estimated by using the INFRAS Tool for calculating CH_4 emissions from solid waste disposal sites, provided to national experts under the UNDP/GEF RER/01/G31 Regional Project „Capacity building to improving the quality of GHG inventories (Europe/CIS region), as well as the software for the Workbook of the Revised 1996 IPCC Guidelines (IPCC, 1997) and the results of technical-economical evaluations at sectoral level for the period from 2005 to 2030, under the considered scenarios. Applied methodologies and emission factors were used from the Revised 1996 IPCC Guidelines (IPCC, 1997) and GPG (IPCC, 2000). Country specific emission factors were also used. Estimations of direct GHG emissions generated from the source categories covered by the waste sector are provided in the Table 4-31.

Figure 4-21 reveals the evolution of GHG emissions in the waste sector of the Republic of Moldova within the period 2005-2030.

Table 4-31: Direct GHG emissions from waste sector under the analysed scenarios in the Republic of Moldova for the 1990-2030 period

	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
CH_4 from SWDS	1320.1	1576.3	1509.1	1212.9	1388.1	1689.9	1658.4	1618.0	1570.0
CH_4 from wastewater handling	215.6	127.7	76.9	113.3	107.8	115.5	117.8	138.6	160.0
N_2O from human sewage	91.7	77.6	72.6	84.8	82.4	89.9	89.9	86.8	84.0
CO_2 from waste incineration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N_2O from waste incineration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total direct GHG emissions	**1627.4**	**1781.5**	**1658.6**	**1411.1**	**1578.3**	**1895.3**	**1866.1**	**1843.4**	**1814.0**
	Historical data					WM			
CH_4 from SWDS	1320.1	1576.3	1509.1	1212.9	1388.1	1649.8	1325.8	1203.1	1056.4
CH_4 from wastewater handling	215.6	127.7	76.9	113.3	107.8	123.5	143.6	165.3	190.0
N_2O from human sewage	91.7	77.6	72.6	84.8	82.4	89.9	89.9	86.8	90.0
CO_2 from waste incineration	0.0	0.0	0.0	0.0	0.0	0.0	251.3	320.8	409.4
N_2O from waste incineration	0.0	0.0	0.0	0.0	0.0	0.0	21.0	26.1	34.2
Total direct GHG emissions	**1627.4**	**1781.5**	**1658.6**	**1411.1**	**1578.3**	**1863.1**	**1831.6**	**1802.1**	**1780.0**
	Historical data					WAM			
CH_4 from SWDS	1320.1	1576.3	1509.1	1212.9	1388.1	1689.9	998.7	861.1	695.0
CH_4 from wastewater handling	215.6	127.7	76.9	113.3	107.8	102.9	94.9	118.2	130.0
N_2O from human sewage	91.7	77.6	72.6	84.8	82.4	89.9	89.9	86.8	88.0
CO_2 from waste incineration	0.0	0.0	0.0	0.0	0.0	0.0	301.6	385.0	491.3
N_2O from waste incineration	0.0	0.0	0.0	0.0	0.0	0.0	25.2	31.3	41.0
Total direct GHG emissions	**1627.4**	**1781.5**	**1658.6**	**1411.1**	**1578.3**	**1882.7**	**1510.3**	**1482.3**	**1445.3**

By 2015, all considered scenarios registered a growth in GHG emissions, reducing afterwards according to a slower trend under the BAU and WM scenarios. Following the implementation of a set of more effective mitigation measures under the WAM scenarios, the GHG emissions will register a more pronounced reduction, as compared to BAU and WM scenarios. As result, by 2030 the level of GHG emissions, in the case of BAU and WM scenarios will exceed the level of emissions recorded in the base year by 11.5 and by 9.4%, respectively. Only the WAM scenario reveals a reduction of direct GHG emissions by 11.2% compared to 1990 year. At the same time, compared to the level of GHG emissions recorded by the BAU, in 2020 the WM scenario will record a reduction of emissions by 2% and the WAM scenario by 19%, respectively.

D. Constraints to Mitigation Scenarios Implementation

Although environment protection is regulate by approximately 35 legislative acts and over 50 Government Resolutions, waste management is still underdeveloped and requires restructuring both from the point of view of legal and institutional framework, and from the point of view of waste recovery and recycling infrastructure. Waste management was outlined as a priority in the Republic of Moldova during the transition to market economy, and particularly with the appearance of a broad mix of current consumption goods, including the packaging that the latter benefit from. In addition, there are a number of barriers impeding the efficient waste management, namely:

- Lack of legislative, normative, and technical regulations on waste management and wastewater treatment, adequate to the current situation, and in line with the EU directives requirements;
- Lack of an integrated waste management and wastewater treatment system planning, organization, and implementation infrastructure (national and international);
- Lack of clearly defined responsibilities for each stakeholder involved in the sector, including government institutions, non-government organizations, private sector, civil society, etc.;
- Lack of adequate capacities for disposal and partial coverage of waste collection and transportation in urban localities (60-80%), and absence of such services in rural localities (up to 10-20%);
- Lack of wastewater treatment capacities, lack of industrial wastewater pre-treatment capacities, which constitutes a high risk for surface water pollution;
- Lack of hazardous waste treatment capacities, including medical wastes, which poses a high risk for the environment once disposed together with the municipal wastes;
- Lack of an infrastructure for administrating other waste categories, such as construction and demolition waste, animal manure, street garbage, etc.;
- Insufficient financing for waste management and wastewater treatment at state and private level;
- Low implementation of the legislative and regulatory framework in the respective area, application of small penalties, which favour non-observance of the legislation;
- Lack of support from and low participation of the public in the current waste management and wastewater treatment systems;
- Wastewater sector is not considered an important one, water supply remaining the priority sector, which fact makes the sector vulnerable to pollution, as water supply systems are built without treatment stations, etc.

4.4. Medium-Term Projections of Total Greenhouse Gas Emissions

Projections of total GHG emissions, by sector, under the considered scenarios (BAU, WM and WAM) in the Republic of Moldova, for the period until 2030 are revealed in Tables 4-32 and 4-33.

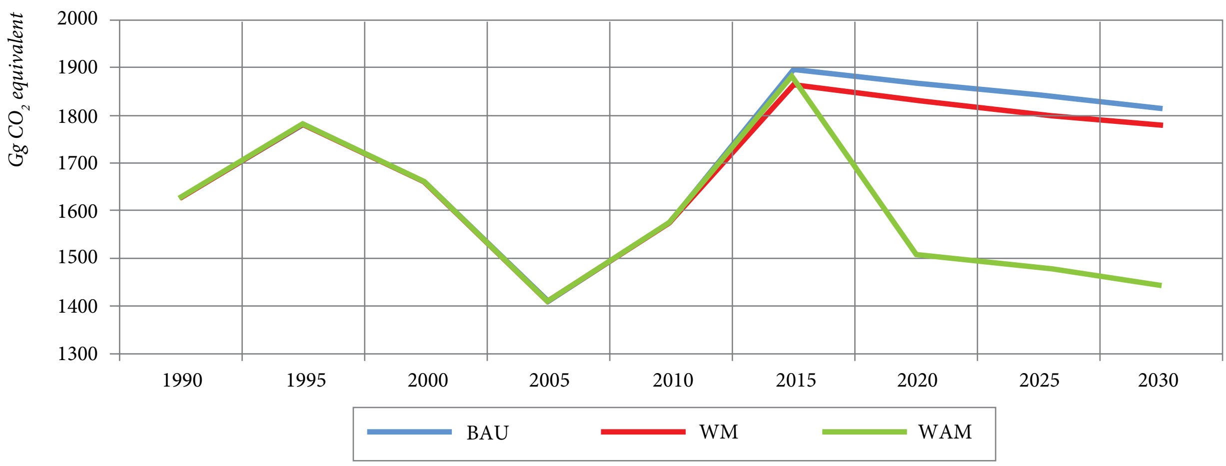


Figure 4-21: Dynamics of GHG emissions generated from waste sector under the considered scenarios for the 2005-2030 periods

Table 4-32: Projections of total GHG emissions and removals, by sector, under the considered scenarios in the Republic of Moldova, for the period until 2030, Gg CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
Energy	34520	11711	6662	8519	8947	9656	10827	12097	13192
Industrial processes	1901	491	281	568	565	817	1104	1413	1721
Solvents and other products used	91	38	32	68	54	53	53	53	53
Agriculture	5120	3359	2277	2373	2132	2154	2196	2271	2309
LULUCF	-7177	-1158	-782	-104	26	-560	-363	-337	-629
Waste	1627	1781	1659	1411	1578	1895	1866	1843	1814
Total (with LULUCF)	36083	16223	10129	12836	13302	14016	15682	17341	18461
Total (without LULUCF)	43260	17381	10911	12940	13276	14576	16045	17678	19089
	Historical data					WM			
Energy	34520	11711	6662	8519	8947	8461	8850	9399	9948
Industrial processes	1901	491	281	568	565	792	1059	1306	1532
Solvents and other products used	91	38	32	68	54	53	53	53	53
Agriculture	5120	3359	2277	2373	2132	2283	2459	2698	2930
LULUCF	-7177	-1158	-782	-104	26	-1613	-2330	-2923	-3577
Waste	1627	1781	1659	1411	1578	1863	1832	1802	1780
Total (with LULUCF)	36083	16223	10129	12836	13302	11838	11922	12334	12666
Total (without LULUCF)	43260	17381	10911	12940	13276	13451	14252	15257	16242
	Historical data					WAM			
Energy	34520	11711	6662	8519	8947	8890	8357	8638	8970
Industrial processes	1901	491	281	568	565	771	1016	1220	1430
Solvents and other products used	91	38	32	68	54	53	53	53	53
Agriculture	5120	3359	2277	2373	2132	2567	2855	3107	3301
LULUCF	-7177	-1158	-782	-104	26	-2183	-4133	-5315	-5528
Waste	1627	1781	1659	1411	1578	1883	1510	1482	1445
Total (with LULUCF)	36083	16223	10129	12836	13302	11982	9658	9185	9671
Total (without LULUCF)	43260	17381	10911	12940	13276	14164	13792	14500	15199

Table 4-33: Breakdown of Greenhouse Gas Emissions, by Sector, under the Considered Scenarios in the Republic of Moldova, %

	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
Energy	79.8	67.4	61.1	65.8	67.4	66.2	67.5	68.4	69.1
Industrial processes	4.4	2.8	2.6	4.4	4.3	5.6	6.9	8.0	9.0
Solvents and other products used	0.2	0.2	0.3	0.5	0.4	0.4	0.3	0.3	0.3
Agriculture	11.8	19.3	20.9	18.3	16.1	14.8	13.7	12.8	12.1
LULUCF	-16.6	-6.7	-7.2	-0.8	0.2	-3.8	-2.3	-1.9	-3.3
Waste	3.8	10.2	15.2	10.9	11.9	13.0	11.6	10.4	9.5
Total (with LULUCF)	83.4	93.3	92.8	99.2	100.2	96.2	97.7	98.1	96.7
Total (without LULUCF)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Historical data					WM			
Energy	79.8	67.4	61.1	65.8	67.4	62.9	62.1	61.6	61.2
Industrial processes	4.4	2.8	2.6	4.4	4.3	5.9	7.4	8.6	9.4
Solvents and other products used	0.2	0.2	0.3	0.5	0.4	0.4	0.4	0.3	0.3
Agriculture	11.8	19.3	20.9	18.3	16.1	17.0	17.3	17.7	18.0
LULUCF	-16.6	-6.7	-7.2	-0.8	0.2	-12.0	-16.4	-19.2	-22.0
Waste	3.8	10.2	15.2	10.9	11.9	13.9	12.9	11.8	11.0
Total (with LULUCF)	83.4	93.3	92.8	99.2	100.2	88.0	83.6	80.8	78.0
Total (without LULUCF)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Historical data					WAM			
Energy	79.8	67.4	61.1	65.8	67.4	62.8	60.6	59.6	59.0
Industrial processes	4.4	2.8	2.6	4.4	4.3	5.4	7.4	8.4	9.4
Solvents and other products used	0.2	0.2	0.3	0.5	0.4	0.4	0.4	0.4	0.3
Agriculture	11.8	19.3	20.9	18.3	16.1	18.1	20.7	21.4	21.7
LULUCF	-16.6	-6.7	-7.2	-0.8	0.2	-15.4	-30.0	-36.7	-36.4
Waste	3.8	10.2	15.2	10.9	11.9	13.3	11.0	10.2	9.5
Total (with LULUCF)	83.4	93.3	92.8	99.2	100	84.6	70.0	63.3	63.6
Total (without LULUCF)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Compared to the total GHG emissions (without LULUCF) recorded in 2010, by 2030 the total national GHG emissions are expected to increase by circa 44% under the BAU, by 22% under the WM and by 14% under the WAM scenarios.

Compared to 2010 year, when circa 67.4% of the total GHG emissions originated from the energy sector, 16.1% – from agriculture sector, 11.9% – from waste sector, while the rest 4.7% – from industrial sector, by 2030 the share of these sectors in the structure of total GHG emissions will change essentially, particularly under WM and WAM scenarios, which will be characterized by a diminishing share of energy and waste sector; and increasing share of the industrial processes and agriculture sectors; under WM scenario, the share of sectors in the structure of total GHG emissions will be as follows: energy sector – 61.2%, industrial processes sector – 9.4%, agricultural sector – 18.0%, and waste sector – 11.0%; while under the WAM scenario, respectively: energy sector – 59.0%, industrial processes sector – 9.4%, agriculture sector – 21.7%, and waste sector – 9.5% (Table 4-33).

In relation to BAU, the implementation of planned mitigation measures will allow reducing by 2030 the total GHG emissions (without LULUCF) by circa 15% under the WM scenario and by 20% under the WMS scenario; the net GHG emissions (with LULUCF) are expected to reduce by 31% under the WM scenario and by 48% under the WAM scenario (Figure 4-22). As can be noted from Figure 4-23, the LULUCF sector significantly influences GHG emission abatement potential in the Republic of Moldova.

The implementation of planned mitigation measures will influence also the breakdown of different greenhouse gases in the structure of total GHG emissions (Table 4-34). Within the period 2010-2030, the total CO_2 emissions (without LULUCF) will increase by 57.3% under BAU, by 24.8% under the WM and by 14.2% under the WAM scenarios; CH_4 emissions will increase by 17.2% under the BAU, by 0.4% under the WM and will reduce by 7.5% under the WAM scenarios; N_2O emissions will increase by 2.3% under BAU, by 36% under the WM and by 45.6% under the WAM scenarios; F-gas emissions will increase by 292.2% under the BAU, by 172.5% under the WM and by 126.8% under WAM scenarios (Table 4-35).

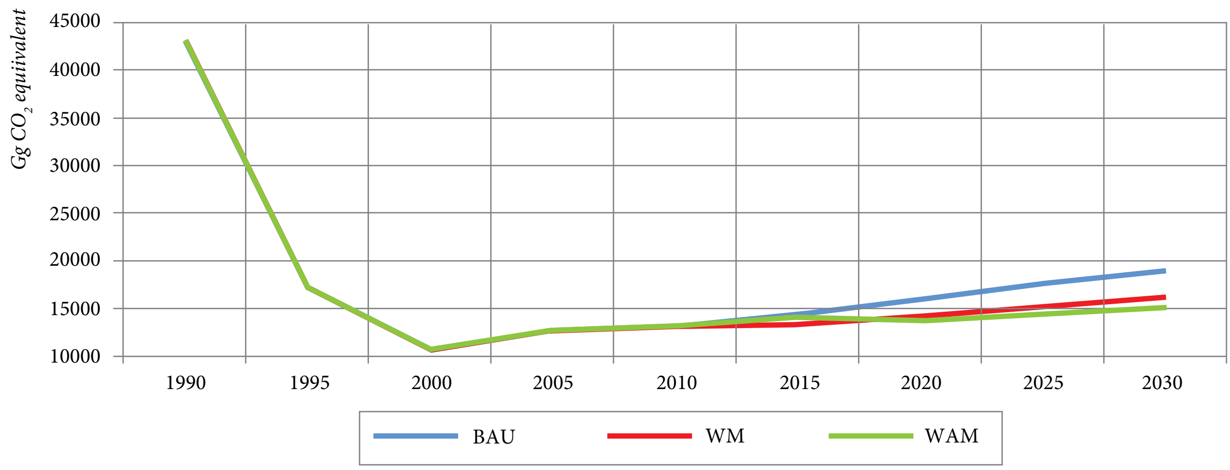


Figure 4-22: Projections of total GHG emissions (without LULUCF) under the considered scenarios in the Republic of Moldova for the period until 2030

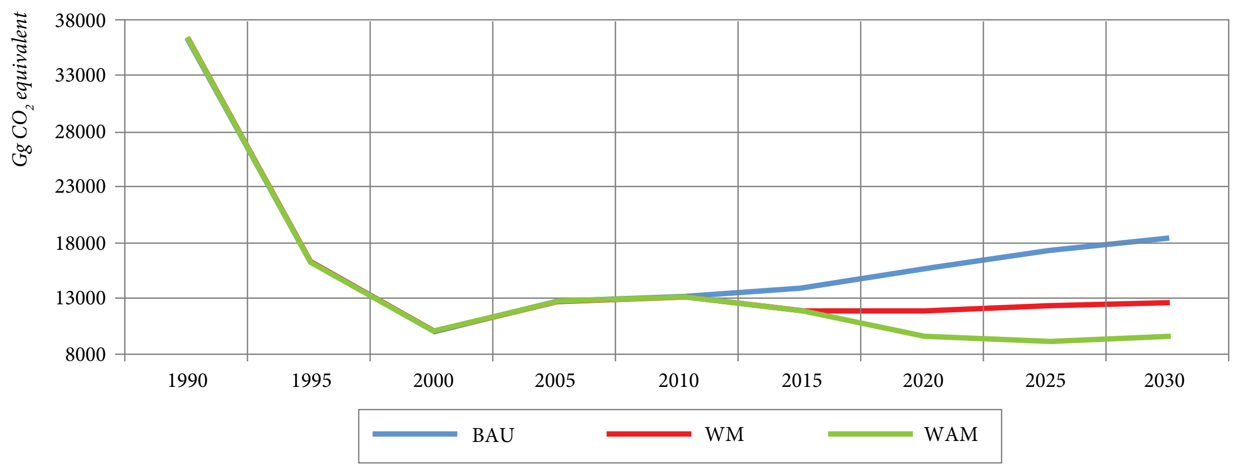


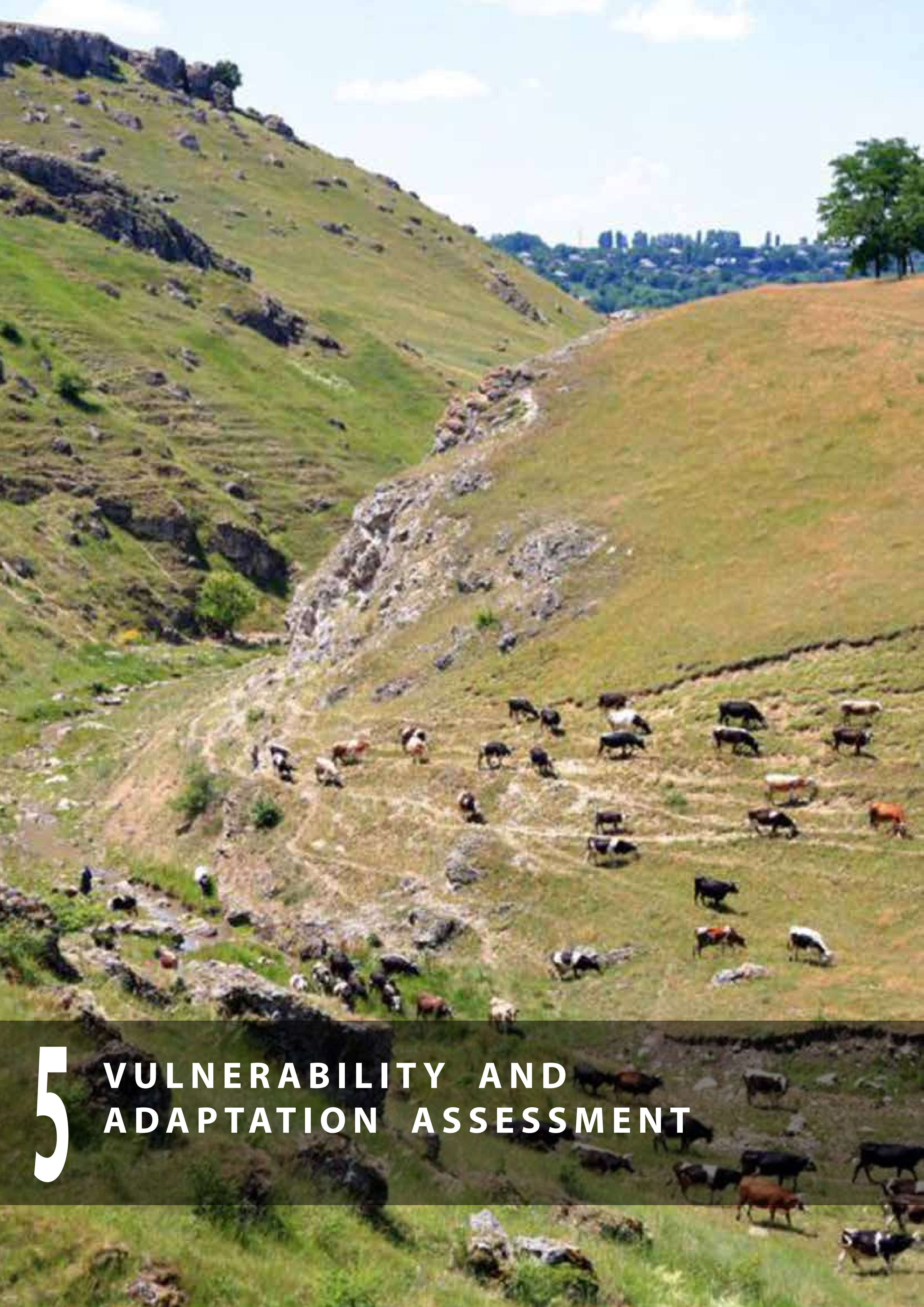
Figure 4-23: Projections of net GHG emissions (with LULUCF) under the considered scenarios in the Republic of Moldova for the period until 2030

Table 4-34: Breakdown of total greenhouse gas emissions, by gas, under the considered scenarios in the Republic of Moldova, for the period until 2030, %

	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
CO_2 emissions	81.7	66.5	58.6	64.7	66.9	67.4	69.7	71.6	73.2
CH_4 emissions	10.6	21.9	28.5	22.2	20.2	20.8	19.2	17.6	16.5
N_2O emissions	7.7	11.5	12.8	12.8	12.1	10.7	9.6	8.9	8.2
F-gas emissions	NA	0.0	0.1	0.3	0.8	1.1	1.5	1.8	2.1
Total GHG emissions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Historical data					WM			
CO_2 emissions	81.7	66.5	58.6	64.7	66.9	64.0	66.2	67.2	68.2
CH_4 emissions	10.6	21.9	28.5	22.2	20.2	22.5	19.6	18.0	16.6
N_2O emissions	7.7	11.5	12.8	12.8	12.1	12.4	12.7	13.1	13.5
F-gas emissions	NA	0.0	0.1	0.3	0.8	1.1	1.6	1.7	1.7
Total GHG emissions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Historical data					WAM			
CO_2 emissions	81.7	66.5	58.6	64.7	66.9	63.8	65.1	65.7	66.8
CH_4 emissions	10.6	21.9	28.5	22.2	20.2	22.0	18.4	17.4	16.3
N_2O emissions	7.7	11.5	12.8	12.8	12.1	13.3	15.1	15.4	15.4
F-gas emissions	NA	0.0	0.1	0.3	0.8	1.0	1.5	1.5	1.5
Total GHG emissions	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 4-35: Projections of total greenhouse gas emissions, by gas, under the considered scenarios in the Republic of Moldova, for the period until 2030, Gg CO_2 equivalent

Years	1990	1995	2000	2005	2010	2015	2020	2025	2030
	Historical data					BAU			
CO_2 emissions	35356	11557	6390	8368	8885	9819	11180	12663	13973
CH_4 emissions	4588	3815	3109	2870	2681	3033	3076	3110	3142
N_2O emissions	3315	2007	1398	1662	1607	1566	1548	1580	1570
F-gas emissions	NO, NE	2	13	39	103	158	242	325	404
Total GHG emissions	43260	17381	10911	12940	13276	14576	16045	17678	19089
	Historical data					WM			
CO_2 emissions	35356	11557	6390	8368	8885	8607	9433	10253	11085
CH_4 emissions	4588	3815	3109	2870	2681	3023	2790	2747	2691
N_2O emissions	3315	2007	1398	1662	1607	1669	1803	1996	2185
F-gas emissions	NO, NE	2	13	39	103	152	226	261	281
Total GHG emissions	43260	17381	10911	12940	13276	13451	14252	15257	16242
	Historical data					WAM			
CO_2 emissions	35356	11557	6390	8368	8885	9030	8973	9523	10145
CH_4 emissions	4588	3815	3109	2870	2681	3115	2532	2524	2480
N_2O emissions	3315	2007	1398	1662	1607	1878	2078	2234	2340
F-gas emissions	NO, NE	2	13	39	103	141	209	218	234
Total GHG emissions	43260	17381	10911	12940	13276	14164	13792	14500	15199



5 VULNERABILITY AND ADAPTATION ASSESSMENT

5. VULNERABILITY AND ADAPTATION ASSESSMENT

5.1. Climate Vulnerability Index Use

Being a developing country, with a socio-economic system based on modest natural resources and great dependence on agriculture, the future of the country is likely to be more strongly affected by climate change effects. In this context, data on the current country's vulnerability to climate change, which can serve as a baseline for the future climate change vulnerability analysis and implementation of adaptation interventions, is rather important.

Vulnerability is a key concept in climate change adaptation research. It is perceived as a function dependent on a number of biophysical and socio-economic factors. The approach used is attributed to the IPCC typology (IPCC, 2001, p 995, Def. 1), where vulnerability is a function dependent on three determinants: *exposure, sensitivity and adaptive capacity*.

Assessment of vulnerability together with the adaptive capacity and its resilience component was needed to acquire the knowledge to prevent, moderate and adapt to the future climate change impacts. It is important to have knowledge about both the climate change impact and the society / country's capacity to meet this challenge in order to prioritize, on a national level, the adaptation interventions and better target the climate change research.

The results gained contribute to the country's vulnerability profiling by applying the Climate Vulnerability Index (CVI) at the national and sub-national levels. This approach was used as an express method to identify the strengths and weaknesses of the country, to identify structural causes of vulnerability and target the support sources.

Methodologies and approaches

Vulnerability and Resilience Indicator Model (VRIM) (Moss et al., 2001; Brenkert, Malone, 2005; Malone, Brenkert, 2008) is a CVI used by evaluators at the global evaluation level, as a holistic method of vulnerability assessment, that incorporates a lot of issues, allowing for comparative analysis of countries to identify their level of vulnerability and adaptive capacity, while international donors use this method to target financial resources. To assess climate change vulnerability, RM has developed an VRIM based CVI at national level (Figure 5-1), aiming at implementing an integrated assessment approach used to calculate the national index, a general numerical value, as well as numerical values of components that can be used for comparative analysis with other countries in the region, while allowing a comparative analysis of the country's evolution over the years.

Attempts to reproduce VRIM, as closely as possible were made, maintaining the original set of indicators, in some cases, the type of indicators being adjusted to the national level. This set of indicators has been developed taking into account their internal relationship, each indicator reflecting the vulnerability of the sector. This model is considered to

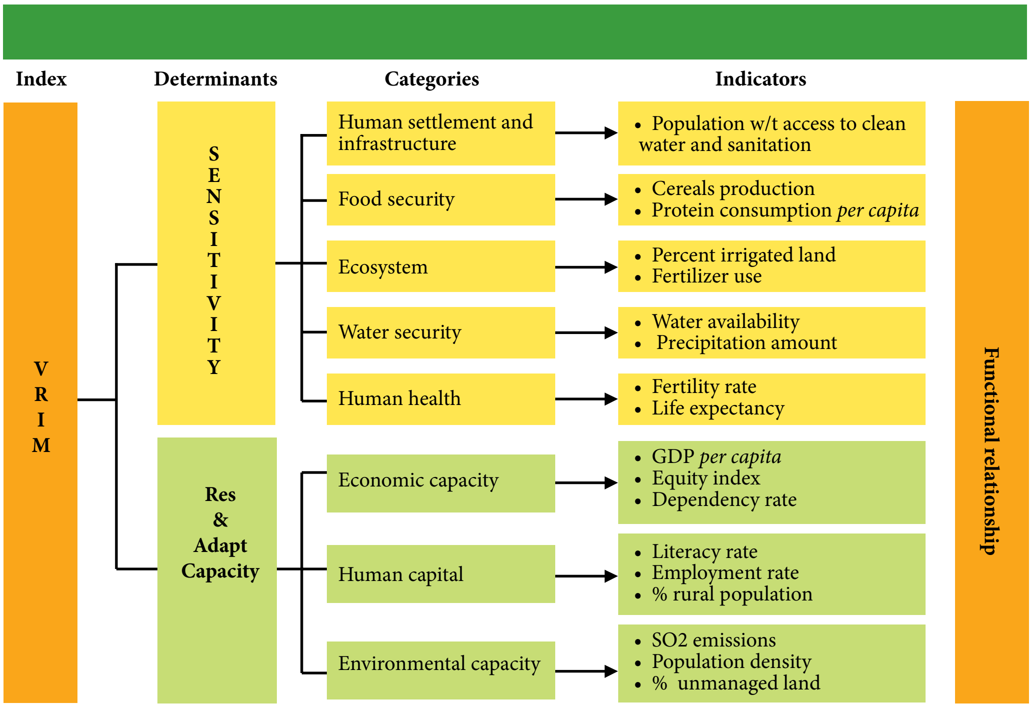


Figure 5-1: Vulnerability and Resilience Indicators Model (VRIM) used as prototype in developing the CVI for the Republic of Moldova

be a formative one and indicators should not be internally correlated. This index can be extended, modified and used in vulnerability predictions on the basis of climate scenarios. VRIM is a hierarchical model based on four levels. Vulnerability index (level 1) consists of two determinants (level 2): sensitivity (the degree of the adverse climate impact on the system) and adaptive capacity (the ability of the society to maintain, to minimize losses or to increase the welfare gains). In turn, the determinants are composed of other components (categories) (level 3) for the sensitivity they represent the *housing infrastructure, food security, agricultural ecosystems, water supply, human health* and for adaptive capacity - *the economic, human, environmental capacity* Each sector includes 2-3 indices (level 4). The CVIM is built on the principle of equal contribution of each indicator. The original model consists of 18 indicators, after adjustments made at the national level – 19 indicators. Input data were collected from national and international authorized sources for the period 2006-2011. Since each indicator has its own units of measurement and different scales, it was necessary to use the data standardization / normalization technique by using the Human Development Index (HDI) (UNDP, 2006) with final values between 0 and 1.

Calculations were made taking into account the indicators' relation to vulnerability, in other words, its increase or decrease (ICRISAT Manual, 2009), by applying the formulas:

$$X_{iM} = \frac{X_{iM} - Min\{X_{iM}\}}{Max\{X_{iM}\} - Min\{X_{iM}\}}$$

increase of vulnerability ↑

$$X_{iM} = \frac{X_{iM} - Min\{X_{iM}\}}{Max\{X_{iM}\} - Min\{X_{iM}\}}$$

decrease of vulnerability ↓

where, X_{iM}şi Y_{iM} are indicators *i* which are suitable for the Republic of Moldova.

The mean values for the years under review 2006-2011 and the graphs have been calculated and built in MS Excel.

In specialized literature vulnerability assessment community/ district level is based on methods which allow integrating and examining the interaction between people and their physical environment. A common trend is to quantify multi-dimensional problems using the *Livelihood Vulnerability Index (LVI)* calculated according to the methods described by Hahn et al., 2009, Sullivan et al., 2005, where the LVI represents a weighted balanced average and each subcomponent has an equal contribution to the overall index value. The RM has followed the approach that on the one hand expresses the LVI as a complex and hierarchical index, and on the other hand, incorporates the 3 determinants of vulnerability: *exposure, sensitivity* and *adaptive capacity.*

Selection of components and subcomponents (indices) for developing the LVI was determined by their relevance to the sub-national (district) context, on the one hand, and the availability and accessibility of statistical data, on the other hand. So, the calculated LVI includes four major components: *demographic, climatic, agricultural and occupational*, and each major component consists of several indicators which are significant as contributors to estimate the LVI. A set of indicators was used to build the LVI to assess exposure to climate variability, social and economic characteristics of livelihood that affect adaptive capacity, health, food security, water resources capacity that determine the sensitivity to climate change impacts in order to identify the vulnerability and adaptive capacity features of administrative units (districts) of the country to climate change.

Vulnerability is characterized by dynamism, it changes over time and it is necessary to analyze a longer period of time to reveal specific features of the country, this being the reason for research into vulnerability during 2006-2011, a fairly diverse climatically, socially and economically wise period. This period served as the baseline scenario and in the national vulnerability assessment, using the CVIM.

One relative advantage of the LVI is low dependence on climate models, which typically are designed to a large scale. The LVI method is geared towards quantifying the livelihood capacity of communities and their ability to change as response to exposure to climate change. The LVI is intended to provide information to development organizations, policy makers, and public health authorities and is a practical tool for understanding of the demographic, social and health factors that determine vulnerability at community and / or district level. Since this index is flexible, certain changes have been made to incorporate peculiarities of Moldovan communities. The LVI is designed on the principle of equal contribution of each indicator; however each component may be composed of a different number of indicators.

According to the major components and the set of selected indicators a database for 32 districts and ATU Gagauzia was developed for the years 2006-2011. Subsequently the subnational vulnerability index for each year individually was determined, as well as the mean values for 2006-2011.

Calculations were based on formulas (1)-(4) in the order shown below.

Since subcomponent values are expressed in different measuring units, normalization of each sub-component as an index was made, according to the formulas (1) or (2):

$$index_{S_d} = \frac{S_d - S_{min}}{S_{max} - S_{min}}$$

(1), vulnerability increase ↑

$$index_{S_d} = \frac{S_d - S_{max}}{S_{min} - S_{max}}$$

(2), vulnerability increase ↓

where, S_d represents the subcomponent for district d, and S_{min} şi S_{max} represent the subcomponent's minimum and maximum values, selected in advance among the values of all districts for the respective year.

The values of each major component are calculated as the mean of the sub-components values, according to formula (3):

$$M_d = \frac{\sum_{i=1}^{n} index_{S_d i}}{n} \quad (3)$$

where, M_d is the value of one of the major components (demographic, climatic, agricultural occupational) for district *d*, $index_{Sd}i$ represents the subcomponent i and n - the number of sub-components of one of the major components for district *d*.

LVI_d values shall be calculated according to formula (4):

$$M_d = \frac{\sum_{i=1}^{n} w_{M_i} M_{di}}{\sum_{i=1}^{n} w_{M_i}} \quad (4)$$

where, LVI_d represents the vulnerability index for district *d*, w_{Mi}–number subcomponents of the major component, M_{di} –the value of the major component (demographic, climatic, agricultural, occupational).

For mapping the LVI, GIS technologies were used in conjunction with the MS Office package. The map of the LVI mean value distribution across the districts of RM in years 2006-2011 was drafted, along with the LVI maps for each year under review, separately.

The assessment and analysis of the *sensitivity* using the LVI method were made by categories and based on indicators that comprise the components (Table 5-1).

Table 5-1: Categories of indicators used in hierarchy of the Climate Vulnerability Index at national level for the Republic of Moldova (CVIM)

Categories	Indicators	Indicators significance in the climate change context	Sources
Housing infrastructure	Access to water by all consumers (mln m^3)	Water supply	http://www.statistica.md/newsview.php?l=ro&id=2997&idc=168 http://www.statistica.md/libview.php?l=ro&id=4086&idc=168
	Percentage of population having access to sanitation services (%)	Access of population to basic services to mitigate variability and climate change.	UN Data RetrievalSystemhttp://data.un.org/ http://statbank.statistica.md/pxweb/Dialog/Saveshow.asp
Food safety	Grain productivity (q ha^{-1})	Degree of modernization in agriculture, farmers' access to sources that can be used to mitigate variability and climate change	http://www.statistica.md/newsview.php?l=ro&id=3963&idc=168
	Amount of protein *per capita* (aggregated indicator)	Access of population to agricultural markets and other mechanisms (e.g., consumption change) to compensate for the products deficit. This indicator is presented episodically in the national statistics and was aggregated from the data on the amount of meat, milk and eggs produced in the country, the basic products for protein in the country.	http://www.statistica.md/public/files/publicatii_electronice/Moldova_in_cifre/2011/Moldova_in_cifre_2011_rom_rus.pdf http://faostat.fao.org
Agricultural Ecosystems	Percent of managed Lands (cultivated areas, %)	The degree of human intrusion in the natural landscape and land fragmentation	Natural Resources and the environment in the Republic of Moldova, 2010 p.17-18. http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=GEO0501&ti=Fondul+funciar%2C+la+1+ianuarie%2C+2001-2013&path=../Database/RO/01%20GEO/GEO05/&lang=1
	Amount of fertilizers used (kg ha^{-1})	Amount of fertilizers per unit of agricultural area. Ecosystems charge with fertilizers and stress from pollution	http://www.statistica.md/pageview.php?l=ro&id=2279&idc=315
Water supply	Water supplied/ consumption ratio	Abstraction of water from natural pools/ water consumption. Water supply from domestic renewable sources and inputs from rivers, relative to consumption to satisfy current needs	Statistics Yearbook of the Republic of Moldova, 2012 p.23, http://www.statistica.md
	Annual average amount of rainfall, (mm)	Overall water supply index. Water supply proxy.	http://www.meteo.md/kartiarhiv.htm
Human health	Fertility rate	The average number of children born to a woman during her fertile life, in fertility conditions for the respective year. Proxy for the human health sector	http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=POP0313&ti=Rata+de+fertilitate+si+de+reproducere+pe+medii%2C+1978-2012&path=../Database/RO/02%20POP/POP03/&lang=1
	Life expectancy at birth	The average number of years that a group of people born in the same year would live, if mortality at each age remains constant in the future, is an indicator of overall quality of life	http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=POP0205&ti=Speranta+de+viata+la+nastere+pe+medii%2C+1958-2012&path=../Database/RO/02%20POP/POP02/&lang=1

Categories	Indicators	Indicators significance in the climate change context	Sources
Economic capacity	Gross Domestic Product (GDP) *per capita*	The value of goods and services produced by the resident production units for final consumption. Proxy for economic development and wellbeing	Moldova in figures, 2011, 11(13 http://www.statistica.md/public/files/publicatii_electronice/Moldova_in_cifre/2011/Moldova_in_cifre_2011_rom_rus.pdf
	GINI Coefficient of income inequality	Extent of statistical dispersion used mainly to represent disparities in the distribution of income or wealth	http://data.worldbank.org/indicator/
Human resources	Number of students enrolled in schools	Number of students in primary and secondary educational institutions.	http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=INV0102&ti=Elevi%2Fstudenti+pe+tipuri+de+institutii+de+invatamint%2C+1992%2F932012%2F13&path=../Database/RO/07%20INV/INV01/&lang=1
	Occupancy rate	Represents the share of employed population aged 15 years and over in the population of the same age. Willingness and ability of people to adapt to climate change	Labor force in the RM: employment and unemployment in 2012. http://www.statistica.md/public/files/publicatii_electronice/ocupare_somaj/Forta_Munca_2012_rom.pdf
Environmental capacity	Area of unmanaged lands (thousand ha)	Fallow land areas, lands withdrawn from agricultural use. Indicator of land fragmentation	http://www.statistica.md/public/files/publicatii_electronice/Mediu/Resurse_naturale_2012.pdf
	SO_2 emissions (thousand tones)	Air pollutant, environmental pollution indicator.	http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=GEO0301&ti=Degajarea+substantelor+daunatoare+in+aerul+atmosferic+de+catre+sursele+stationare++pe+ingrediente%2C+2001-2012&path=../Database/RO/01%20GEO/GEO03/&lang=1
	Population density (inhabitants per km^2)	Number of inhabitants per km^2	http://data.worldbank.org/country/moldova

Agricultural ecosystems sensitivity has been assessed by *the percentage of managed lands* (agricultural lands area) and *amount of fertilizer used*. The percentage of agricultural land in the country varies between 73.8 % and 74.1 %[110]. The agricultural sector has a special significance for the RM in the context of climate change, on the one hand, due to its share in the national economy (~ 25 % contribution to GDP) and on the other hand is one of the most exposed sectors, respectively with high sensitivity (M = 0.58).

Current climate variability strongly affects the whole country due to high dependence of the economy on the agricultural sector, especially on crop production, in its turn the crop productivity depends on environmental conditions, in particular, on the amount and distribution of rainfall and soil fertility. The land reserves of the RM are limited and the land intensively used in the recent past requires special attention in terms of improving soil fertility. The effect of multiple stresses in agriculture, ineffective reforms, and bad management of land resources is and will further be enhanced by access to and management of water resources under climate change conditions. Not only the wellbeing, but the survival of population of RM in climate change conditions will depend on the quality and management of natural resources, land in particular. Large scale application of sustainable soil management technologies for adaptation is an option that would reduce negative human impact on agricultural and natural ecosystems of the country.

[110] http://statbank.statistica.md/pxweb/Database/RO/databasetree.asp

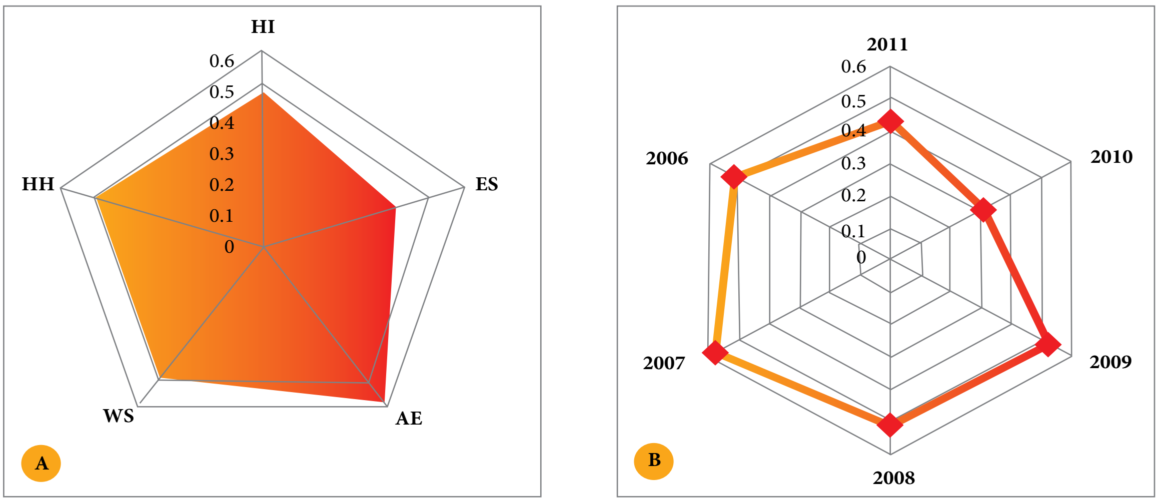


Figure 5-2: Sensitivity components index, mean for 2006-2011 (A) and sensitivity by years assessed at the national level (B), where: HI – *housing infrastructure*, HH – *human health*, FS – *food safety*, WS – *water supply*, AE –*agricultural ecosystems*

The *amount of fertilizer* indicator is negatively correlated to vulnerability up to optimal dosage of fertilizers for soil, and then the correlation is positive, with negative impact for soil and environment. By their composition and fertility rate the soils of the RM are among the most valuable types of rich in humus black soils, however in the past 50 years the country has been through extreme situations of over-fertilization and soil degradation - from over-fertilization with high soil and groundwater pollution during the Soviet era, to the total lack of fertilizers in soil at present, due to poverty of landowners. For this reason in the 1991-1998 the supply of fertilizers per hectare decreased by 4.3 times and continued to decrease until the impoverishment of the soil, which is manifested by physiological gaps and disturbances in crops, smaller yields per hectare and deteriorative effects of soil structure[111]. Failure of crop rotation, with the share of leguminous crops decreased by 4-5 times, reduction of chemical fertilizers use by 15-20 times and organic fertilizers by 10-15 times entailed the current situation, when the vulnerability is caused by insufficient use of fertilizers (the mean value of this indicator in LVI, M = 0.50). Implementation of soil conservation, soil fertility enhancing technologies, efficient use of fertilizers are the needed as medium and long term adaptation interventions.

W*ater resources* are another area in the context of better management. In the VRIM the water supply aspect is a strong one, as a category as such, but also being attributed to *human health* and *housing infrastructure*. This is due to the fact that climate variability changes the natural resources, especially water supply/demand ratio. If both components are very close in this ratio, then changes can distort the balance and the source is considered sensitive[112]. Such a situation can be observed in the water supply/consumption indicator (abstraction of water from natural pools/water consumption) of the water supply component, which ranges between (1.07-1.09) during the years under review. The *average annual rainfall* is a general indicator of the main source of water supply, especially for the agricultural sector, where 90% of water consumption is on the account of rainfall and allows the comparison rainfall availability between the years. This indicator with high values in 2007 (M = 0.68), in 2009 (M = 0.95), in 2011 (M = 0.97) significantly contributed to the overall vulnerability of the country in those years.

It is well known that the RM suffers from water shortage due to underdeveloped irrigation system and agricultural production potential is underused, and a large part of the agricultural products are imported, and this reflects the import of water. Water supply is a major restrictive factor not only for agricultural production; it is compelling for the entire system society - economy - environment of the country. If this dependence will persist in the future, the development of the agricultural sector and the entire economy will depend on the water supply strategy of the country. Water resources is the areas where adaptation interventions should be a top priority with a strong orientation towards efficient management along with a detailed sector planning that would ensure even water supply throughout the year, as climate change can push area into challenging situations that did not occur until now. Relevant institutions should encourage water conservation and effective management by developing and implementing effective policies, to make quality drinking water accessible to the population.

Improved water management contributes to improving *housing infrastructure*, because this category indicators *total amount of water supplied to all consumers* and the *percentage of population having access to health services* are dependent on water supply. Facilitation of public access to basic services contributes to mitigating the impact of climate variability and change. The water demand grows during periods of hot temperatures often accompanied by droughts. Approximately 44% of the population has no access to quality drinking water[113]. Currently, all towns and cities and over 65% of rural communities have centralized drinking water supply systems, but only 50% of them are in satisfactory condition[114]. The systems that survived from the Soviet era need repairs, rehabilitation or reconstruction. Under climate change conditions, the demand for water will increase due to irrigation needs, population growth, economic development, which can cause acute competition between consumers.

Access to *sanitary services* is an eloquent indicator of the country and communities development. According to the statement of the UN Secretary General *Ban Ki-moon*[115], there is a close interdependence between this indicator and environmental management, education, gender equity, reduced child mortality and poverty. Improved sanitation also brings advantages to public health, livelihood, and dignity advantages reflected on communities. Extreme situations associated with climate change such as floods, droughts, storms have devastating consequences for the basic water supply and sanitation infrastructure in the RM. Damages caused to sewage systems increase the risk of contamination with infectious diseases (hepatitis, diarrhea, etc.) of the population. The urban population of the country has access to basic sanitation services at a rate of 88-89%, while in rural areas this rate is 78-82%. To increase resilience, the basic water supply services to population have to be significantly improved, since the current consumption of water *per capita* is low 2712 m^3, and only 690 settlements have centralized water supply systems, while sewage systems are old and deteriorated. About 130,000 local water sources (drilled wells, springs) are used in rural areas and about 75-78% of them

[111] Soil degradation and desertification, Chisinau, 2000.

[112] <http://cses.washington.edu/db/pdf/snoveretalgb574ch8.pdf>.

[113] <www.sanatatea.com>

[114] Improving the environmental quality of the Black Sea through better waste water treatment & climate change adaptation of the water sector in Moldova. Final Report, January, 2013.

[115] <http://www.un.org/water for life decade/sanitation.shtml>.

do not comply with sanitary requirements and this percentage is growing[116]. The mean value of the *housing infrastructure* component over the years under review was 0.47, with a peak in 2006 (1), caused by small (71 million m^3 of water) values, compared with other years, of water supplied to consumers and the low percentage (83%) of the population with access to basic sanitation services.

The *food safety* category in the CVI is assessed by *grain productivity per area unit*. Cereals are dominant crops in the RM (894-1005 thousand hectares), but with a relatively low productivity (9-32 quintals/ha) due to insufficient effective adaptation to restrictive indices, mainly to insufficient soil moisture. Food calories needed by population are gained from these food sources, along with *animal protein* gained from meat, milk and eggs. It is believed that countries with high consumption of protein are more resilient to climate variability (Moss et al., 2001). In some years 2006, 2010, 2011 these needs were satisfied at a relatively good level, with the mean value of indicators 0.15, 0.17, 0.28. In such years, Moldovan agriculture can diversify its agricultural output and reduce imports, what significantly contributes to increasing resilience to climate variability. Comparison by years revealed a low food security in 2007 (indicator value - 1), because of low grain yield due to the drought. The highly productive years 2008, 2010 and 2011 contributed to reducing the country's sensitivity. This category is important for the country in every aspect, but becomes critical in the context of climate change associated with extreme weather events. Sporadic, temporary measures do not ensure food security, adaptation interventions have to be implemented as a complex set of measures, in a sustainable adaptation framework, on the background of a strong political and decision making support. Like *access to health services*, *calories* assimilated by population of the RM influence the public health, and is an indicator underlying the health of the country's population.

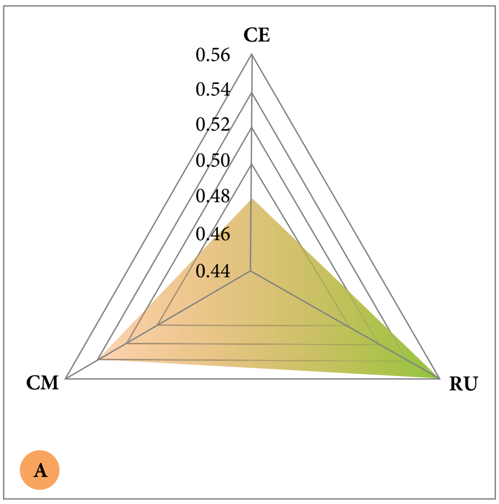
[116] *National Bureau of Statistics, 2012.*<http://www.statistica.md>

The *human health* category includes such indicators as *fertility rate* and *life expectancy at birth*, which reflect qualitative aspects of life and allow the assessment of the health status and wellbeing of population. Although during the period under review *life expectancy at birth* has been steadily increasing (in 2011 it reached 70.88 years for both sexes, 66.82 years for men and 74.92 years for women)[117], however, compared to the EU, this indicator remains low. The birth rate in RM (11.0 births per 1000 inhabitants) is slightly above the EU average (10.7‰), but is still low[118]. The low health indicators of the country are an overall diagnostic of the health status, health care efficiency, access to health services, food quality. The mean value of the analyzed category index was 0.50, indicating a high vulnerability. A population in poor health condition will not be resistant to recurring impacts of extreme weather events.

Adaptive capacity. The ability to adapt to the environment is an essential feature of living organisms, and it is inherent to human population as well. Yohe and Tol (2002) considered that the *GDP per capita* indicators, *access to health services* and *access to information/knowledge (education level)* are critical adaptive capacity factors. These indicators were taken into consideration when developing adaptive capacity index (Figure 5-3). Adaptation occurs at the level of socio-economic system and depends heavily on access to resources and collective organization. As mentioned, adaptation takes place more actively if the system is resilient to climate change effects, lack of resources may strongly affect the resilience and recovery capacity of the country during the period after the extreme weather events impact.

The *economic capacity* category is part of the generic vulnerability assessment factors, or the opposite aspect, adaptive capacity. The *Gross Domestic Product (GDP) per capita* indicator is an important indicator because it shows the ability of

[117] *National Bureau of Statistics, 2012.* <http://www.statistica.md>
[118] *National Bureau of Statistics, 2012.*<http://www.statistica.md>



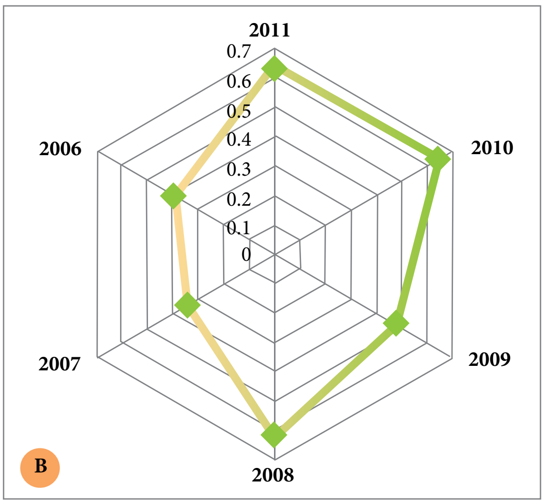


Figure 5-3: Adaptive capacity index by category (A), average for 2006-2011 and adaptive capacity by years (B) evaluated at national level, where: CE – *economic capacity*, CM – *environmental capacity*, RU – *human resources*

individuals to access resources. The low income of the population is associated with low resilience to natural hazards.

For the RM the *GDP per capita* ranges from US$ 803-1,007 per year during the years under review and is considered to be low. This indicator has a direct impact on the adaptive capacity of the entire population, especially the rural areas, as farmers are unable to invest in adaptive technologies to diversify agricultural production, improve housing constructions, etc. The values of *Gini coefficient of income inequality* – 33-36[119] showing social equity, indicate that during the period under review groups of increased vulnerability that are financially and socially marginalized and do not have access to adaptation resources, appear. Such groups mostly comprise elderly population in rural areas of RM, whose livelihoods and living standards are below average. Obviously these vulnerable groups will not be able to withstand the climate hazards and poor rural communities are unable to implement the prevention adaptation actions. Combating poverty in RM is a prerogative to reduce vulnerability and increase adaptive capacity.

Human Resources. Education is an important demographic dimension; it is a social achievement of the country and represents the available social resources to adapt to climate change phenomena. The education index of the RM in a global context is relatively good (0.90)[120], however the evolution of *the number of students enrolled in schools (primary and secondary educational institutions)* is decreasing due to both low birth rate and emigration. If in 2006/2007 school year the number of teachers was about 40,000 and the number of students about 500,000, then in the following years, both the number of teachers and as the number of students decreased, with the number of students decreasing more substantially than the number of teachers, so in the 2010/2011 school year the number of teachers decreased by about 3,000, and the number of students decreased by about 100,000. In 2006/2007 the student / teacher ratio was 12.3 and in 2010/2011 - 10.5 respectively.[121]

In the climate change context, lack of education is associated with poverty and marginalization, uneducated members of society, with low professional skills, limited knowledge on natural hazards, with limited political skills would be a low priority for the government in terms of their protection. Adapting to climate change will depend a lot on the population's capacity to supply and assimilate information on climate change, on its management at local level, the degree of competence of the authorities that will assume responsibility for adaptation. Educated people have greater adaptation potential, are more flexible in assimilation of new opportunities due to climate change. Unfortunately, the analyzed indicators are quantitative and do not reflect the quality of education in the country, which is low[122] and diminish the importance of education and the society's efforts to have generations able to assimilate information on climate change and adapt to better to the new circumstances of life.

Employment of the population was assessed by *occupancy rate* indicator, which represents the share of employed population aged 15 and more in the population of the same age, and the capability to adapt to climate change. The country's economically active population is 35.3-37.8% and is decreasing, while the economically inactive population accounts for 62.2-64.7%, what can be interpreted as reduced adaptability. Over the period under review the employment rate increased slightly ~ 0.09%. The percentage of population employed in agriculture over the period under review was 32.8-27.5% and is decreasing. The percentage of rural population to the total population is higher than 58-59%, compared to 41-42% of urban population, what matters in the vulnerability perspective, because the rural population is considered to be more vulnerable.

The *environmental capacity* category was assessed based on *unmanaged land surface, SO_2 emissions, and population density* indicators. Unmanaged land surface is explained by land fragmentation. In the study this indicator ranged between 15.8-34.2 hectares per year over the period under review, showing a growing trend. The country's territory is an important source that allows people to move, expand settlements, agricultural lands. However, in the RM expansion of arable lands on the account of natural ecosystems and the excessive fragmentation of agricultural land lead to ecological imbalance with serious consequences for the territories. Use of natural resources (soil, forests, grasslands, species of plants and animals) exceeded the regenerative capacity of natural ecosystems. The necessary adaptation interventions should be targeted towards restoring the ecological balance and enhancing the adaptive capacity. However, by using soil fertility restoration, irrigation and others technologies on currently unused lands can turn them into a land source and in the long run such lands can be viewed as a reserve in food security enhancement.

Sulphur dioxide is eliminated mainly from fossil solid fuel plants, including heat and power plants, certain industrial processes, by cellulose and paper industry, Diesel engines, and heating systems used by people without access to natural gas. Production of cellulose, paper and paper products, chemicals and chemical products, synthetic and artificial fibers and yarns, other non-metallic mineral products, metal works, electrical and optical equipment industry, electricity and thermal energy production, land transport, transport via pipelines, waterborne transport, households heating systems[123], etc. are primary emission sources. This diver-

[119] <http://data.worldbank.org/indicator/>.

[120] <http://www.statistica.md/public/files/publicatii_electronice/Educatia/Education08_09.pdf>.

[121] National Bureau of Statistics, 2012.<http://www.statistica.md>.

[122] The Economy of the Republic of Moldova between challenges and solutions. IEFS, 2011. P.28-31.

[123] NBS, Natural Recourses and the Environment of the Republic of Moldova, 2010.

sity of sulfur dioxide generation sources places it within the range of harmful air pollution substances. In the RM these emissions have been decreasing, however, in 2006 they accounted for 1.9 thousand tons, in 2010 only 1.1 thousand tons, but in 2011 there has been an increase up to about 1.3 thousand tons, and probably is associated with animation in the economic activity of the country in 2011.

In the context of environmental pollution, it should be mentioned that in the recent past the RM practiced intensive agriculture what has led to increased productivity of some crop varieties dependent on significant application of synthetic fertilizers, pesticides and other substances. Due to inadequate storage infrastructure in some rural areas they are kept in improper conditions and as a result became a dangerous source of environmental pollution and intoxication for population.

Population density. In the context of climate change a resilient society will be an overpopulated one. The high population density in areas exposed to the negative impact of climate change has serious consequences due multiple effects of climate disaster: contamination through diseases, excessive environmental pollution, especially of water sources. At the same time lack of favorable living conditions associated with the risk of exposure to natural hazards reduces the level of demographic security. In the years under review the density of population in the RM ranged from 117.20 to 117.62 inhabitants per km^2 (mean value of the indicator 0.40) and placed the country in the group of countries with high population density[124], with more than half (58.6%)[125] of the population living in rural areas. Over the last decade, the demographic decline continued due to low fertility rates and emigration. The years under review showed a negative natural growth, but in 2011, for the first time in the last 20 years, the demographic decline lessened. In the largest, by number of administrative territorial units cities, i.e. in Chisinau, Balti, ATU Gagauzia and Cahul, the number of population has been increasing, which is explained both by positive natural growth and by positive migration balance. The demographic structure of the country reflects the reaction of inhabitants to living conditions, inequality and vulnerability of the population, including climate change. Demographic changes should be seen as challenges to economic development of the country, particularly in rural areas.

In generalized terms the Climate Vulnerability Index (CVIM) of the RM, based on the assessment of the set of indicators considered above, equals to 0.44 and the vulnerability of the RM is explained by excessive exposure of the agricultural sector, low economic capacity, inefficient water supply and low quality of health protection (Figure 5-4).

Livelihood Vulnerability Index (LVI)

Integrated assessment gives the opportunity to analyze the problems on which the communities/ districts' climate change adaption skills depend on. Making this assessment is important in the aspect that the current vulnerability can serve as a baseline scenario for future vulnerability assessment. This is a snapshot of the situation today and determines the level of natural hazards impact on the administrative units of the RM.

In addition to large-scale, global and national factors, local factors proved to influence the vulnerability at the population livelihood level. Although RM is a small country, the administrative units, districts are geographical delimitations displaying the peculiarities of response to climatic factors at the local level. Districts formed of villages / rural communities have to respond to a large number of socio- economic and climate challenges that cause vulnerability. Largely dependent

[124] <http://www.indexmundi.com/g/r.aspx?v=21000>.
[125] <http://www.statistica.md/public/files/publicatii_electronice/populatia/Populatia_Republicii_Moldova_2010.pdf>.

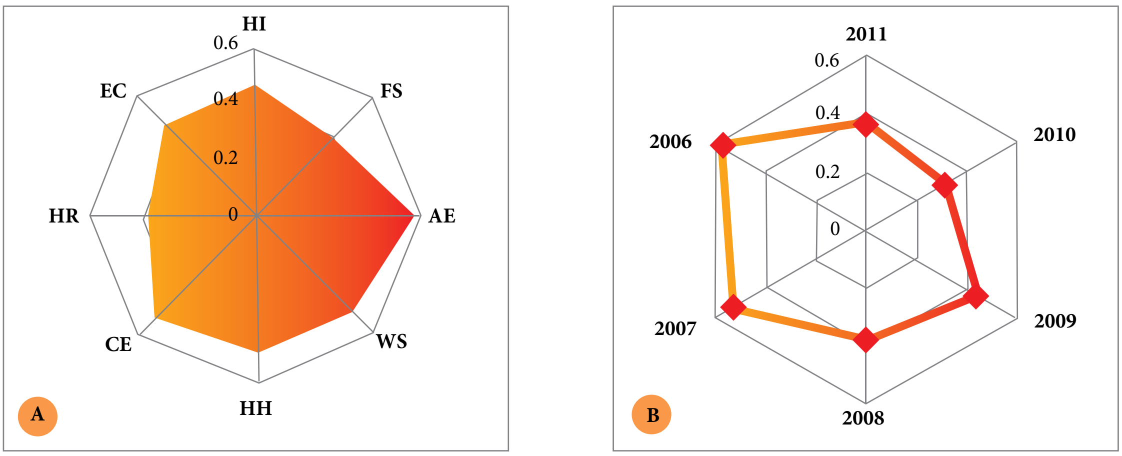


Figure 5-4: Climate Vulnerability Index of the RM (CVIM) for 2006-2011 at national level on the basis of categories (A) and values for each year (B), where: HI – *housing infrastructure,* HH –*human health*, FS – *food safety*, WS– *water supply*, AE – *agricultural ecosystems*, EC – *economic capacity*, EC – *environmental capacity*, HR – *human resources*

on the agricultural sector and insufficient water supply, make the rural population, especially farmers, vulnerable to climate variability. Understanding the specifics of the communities' vulnerability is important in terms of adopting more effective decisions, planning and social and natural resources management and resource allocation to enhance the resilience of rural population, especially vulnerable groups, to natural hazards. It should be mentioned that adaptation actions are often implemented locally, so the local level should be the key level to promote adaptation interventions.

Livelihood Vulnerability Index (LVI) is based on the *concept of sustainable livelihood* and incorporates major components such as socio-demographic profile, water supply, environment, financial assurance, climate variability, disasters and other (Chambers, Conway, 1992). This approach includes exposure, sensitivity and adaptive capacity to climate change. The set of indicators, organized by components is presented in Table 5-2.

Exposure of population in the districts to climate variability was assessed based on *climate* component indicators: variation in rainfall (mm), maximum temperature (°C) minimum temperature (°C). The means values of standard deviations from the mean monthly values of the indicators during the years 2006-2011 characterized the climatic peculiarities at the local level. The *agricultural* component is the one with great contribution to the districts' sensitivity. As revealed in the national LVI 58.3% of the population in the RM is directly or indirectly engaged in agriculture, which is highly vulnerable to current climate variability. The 12 indicators of the agricultural component reflect the key aspects of the rural population livelihoods, the cultivated and uncultivated areas, the cultivation intensity, irrigated areas, the amount of grain and productivity of major crops, livestock, milk production (Table 5-2).

The mean values of this component in the period under review ranged within 0.42-0.79, what shows high variability among districts, based on the indicators analyzed (Figure 5-5).

Drought has been a persistent problem for the country over many years, and became more acute in recent decades.

Irrigation intensity indicator shows a high mean annual value of 0.75-0.80 in all the years under review. Researchers in different fields have worked on solutions to this problem, especially the plant breeders and physiologists who have developed different varieties of drought resistant crops which became a national scientific treasure. Therefore varieties, hybrids, local varieties are an important source to be considered and further used. Unfortunately, the transition to a market economy has negatively affected all areas of research and related industries, but lack of research in natural sciences is the worst. There is an acute need to foster this research on the background of climate change, to develop and implement sustainable technologies, to use the potential of indigenous

Table 5-2: The Livelihood Vulnerability Index (LVI) indicators, used to assess the vulnerability of administrative-territorial units of the RM for the period 2006-2011

Major Component	Indicators	Description
Demographic	Population density (inhabitants/km^2)	Number of persons per area unit
	Natural growth (per 1000 inhabitants)	Birth rate related to death rate
	Enrollment rate	Number of students enrolled in schools
Climatic	Variation of the amount of rainfall (mm)	Standard deviations of the daily amount of rainfall from the monthly average
	Variation of maximum temperatures (°C)	Standard deviations of the daily maximal temperatures from de average monthly maximal temperatures
	Variation of minimum temperatures (°C)	Standard Deviations of daily minimal temperatures from de average monthly minimal temperatures
Agricultural	Irrigation intensity (mln m^3)	Amount of water used for irrigation of agricultural lands
	Total area under food crops (%)	[Area of arable lands and perennial plantations] and [Area of agricultural lands] ratio
	Total area under non-food crops (%)	[Area of pastures, hayfields and fallow lands] and [Area of agricultural lands] ratio
	Cultivation intensity	[Area of agricultural lands] and [Area of arable lands and perennial plantations] ratio
	Total amount of cereals (tons)	Total yield of cereals and leguminous crops for grain in agricultural enterprises and farms
	The average productivity of cereals and leguminous crops for grain (q/ha)	The average productivity of cereals and leguminous crops for grain (except maize) in agricultural enterprises and farms
	Wheat productivity (q/ha)	Wheat productivity in agricultural enterprises and farms
	Barley productivity (q/ha)	Barley productivity in agricultural enterprises and farms
	Maize productivity (q/ha)	Maize productivity in agricultural enterprises and farms
	Sun-flower productivity (q/ha)	Sun-flower productivity in agricultural enterprises and farms
	Milk output (tons)	Cow milk output in farms of all types
	Livestock (thousand heads)	Livestock (cattle, pigs, sheep goats, poultry) in agricultural businesses and cattle breeding farms
Occupational	Total number of workers	Total number of workers
	Number of farmers	Number of agricultural businesses, large and small farms
	Number of workers in agriculture	Average number of workers in agriculture
	Number of workers in industry	Average number of employees in industry
	Number of unemployed	Number of unemployed

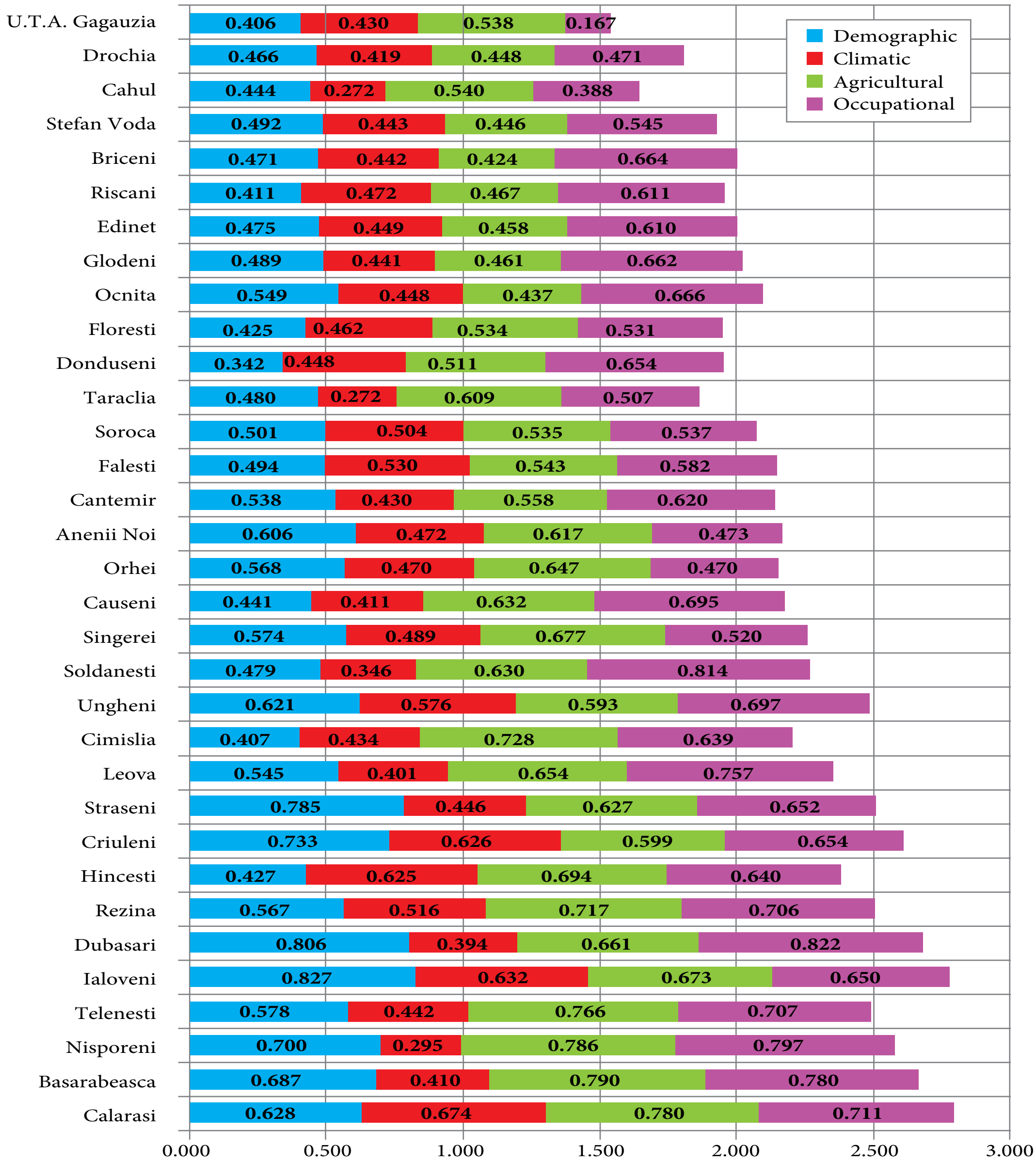


Figure 5-5: The components contribution to the general value of the Livelihood Vulnerability Index of each district of the RM, mean value for the period 2006-2011

knowledge and practices, as they may have a more efficient adaptation effect than many of the external solutions. The increase in productivity of existing crops under climate change conditions will increase the food security of communities, consequently, their resilience and will enable them to pay greater attention to sustainable management of natural resources of the communities. Natural resources conservation and restoration management is a significant contribution to reducing the vulnerability of rural communities and an important component of sustainable adaptability.

The adaptive capacity of Moldovan communities could be increased by integrating climate change response into local policies, what would generate interest and local decision-making action. Establishing a common institutional platform that would integrate the institutions responsible for disaster risk reduction, natural resources management, adaptation and poverty alleviation interventions with activities targeted towards vulnerable populations of poor communities, would be a great benefit in terms of adaptive capacity. In recent years the Ministry of Agriculture and Food Industry promotes a decentralized and participatory management of natural resources, however, such measures are sporadic and insufficient.

The *adaptive capacity* was quantified through the socio-demographic profile of the district, type of livelihood strategy (agriculture is the dominant occupation).

The *socio-demographic* assessment has been based on the following indicators: population density, natural growth of population, level of schooling. Using these data it is possible to estimate the level of human and social capital in rural districts. Some authors (Adger, 2006) believe that such indicators are guidelines for future capacity potential and livelihood.

Traditionally, the share of rural population in the country was large (in the Soviet period up to 76.6 %) and continues to large be today, accounting for 58.3 % of total population (without Transnistria) (Buciuceanu-Vrabie, 2013), however, the number of rural population is decreasing, which in the country is viewed as a negative phenomenon (Stratan et al., 2012). In the context of climate change vulnerability, high population density is not perceived positively, as high density means intensive exploitation of natural resources and a large number of people exposed to natural hazards. The communities in the RM lack the strategies and action plans that increase resilience to natural disasters. At the same time, changes in the demographic structure of the population indicate aging of the population in rural communities due to small or negative natural growth, and long lasting emigration, so the aging coefficient is increasing 13.5-14.8. Some authors (Buciuceanu-Vrabie, 2013) found that in villages, among people of 60 years old and older, women account for18.4% and men for 12.4%. Compared to 1959, the share of population aged 60 and over increased by over 98% in 2012, the share of young population (0-14 years) decreased almost twice, and the number and share of the adult population (15-59 years) increased over the period 1959-2012 by 16%. These changes in the demographic structure of the rural population in the context of climate change mean an increasing number of people with high degree of vulnerability. Typically, central districts have a population of 6.0-40.7 thousand inhabitants, while towns such as Cahul, Ungheni, Soroca: between 33.6 and 39.9 thousand inhabitants[126].

As mentioned previously, the RM can boast a high enrolment rate, however, the number of students over the years under review changes considerably. According to the demographic component indicators, high values of vulnerability are attributed to *enrolment rate* indicator, which is the total number of students enrolled in schools in the districts concerned. During the period under review the number of students was decreasing due to the well-known reasons: low birth rate and emigration. These trends, on the background of low quality education have a negative impact on the human potential of localities in the RM.

One important aspect related to the climate change phenomenon of is training on this phenomenon at all levels of the population, starting from incorporation into school curricula and further with adult education and stimulating research at community level into climate change related issues.

[126]<http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=POP0103&ti=Populatia+stabila+pe+orase+si+raioane%2C+la+1+ianuarie%2C+2005-2013&path=../Database/RO/02%20POP/POP01/&lang=1>.

The sense of social collectivism is well developed in villages of the RM, an important aspect that allowed surviving in the face of natural hazards. Given the historical age (600-800 years) of communities in the RM, they are characterized by a relatively good adaptive capacity both to social disturbances and natural hazards. The settlements have developed on the basis of natural resources, the most important one being the fertile soil. Over exploitation of land resources in the Soviet period led to the expansion of villages in RM, so the agricultural activity became dominant in rural areas, with intensive production that led to degradation of the soil productive capacity with negative changes in physical and chemical properties of the soil, pollution of environment and a limitation of other economic activities. The current vulnerability of communities is determined not only by the current situation, but also by the adaptive capacity in the recent past.

The *occupational component* incorporates these features of settlements in the RM and contributes to the current adaptive capacity of districts, and also characterizes their sensitivity. The vulnerability of this component was assessed based on the following indicators: total number of employees, number of farmers, number of workers in agriculture, number of workers in industry, number of rural unemployed. In their livelihood strategy, the communities of the RM mostly rely on agriculture, in particular crop production, which, however, is unstable and highly influenced by climatic fluctuations, in particular extreme weather events. This strong dependence decreases the economic viability of villages and poor communities are likely to be more vulnerable, with destructive consequences from hazards of even medium intensity. Villages and districts need diversification of activities, because given the current density of population; agriculture alone cannot ensure the wellbeing, or even subsistence of population.

The comparative analysis of LVI values for each of the years in the period 2006-2011 and the mean values of the LVI of the geographical areas of the RM, on the basis of the set of proposed indicators, highlighted the increased vulnerability of districts in the Centre of the RM, compared with the North and South (Figure 5-6). The contribution of each component in the overall vulnerability of the district shows the differences between districts. Depending on the year, the order of the districts (i.e., increase or decrease of LVI values) may change, but most often, the above mentioned districts show higher values.

The components ratio is different for every district; however, it opposing trends in vulnerability can be highlighted in some of the districts (Figure 5-7 and 5-8). Ialoveni, Teleneşti Nisporeni Basarabeasca Calarasi districts showed increased vulnerability mainly due to *agricultural* and *occupational* components. The analysis of the *agricultural* component's set of indicators shows that Basarabeasca district had low productivity in cereals (maize, sunflower, wheat) and numerically reduced livestock over the years under review.

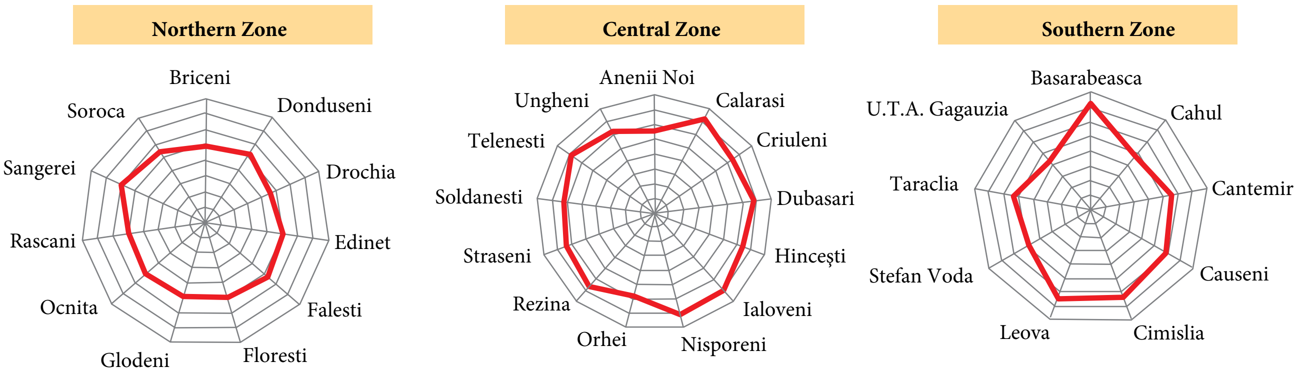


Figure 5-6: Livelihood Vulnerability Index for the districts of the three geographical zones of the RM: North, Centre and South

For the *occupational* component, the indicators referring to the number of workers in agriculture and industry have been quite modest. Ialoveni district had a higher population density, greater fluctuations in minimal temperatures, reduced livestock, smaller number of workers in agriculture, and reduced grain productivity. Nisporeni and Telenesti districts had low milk productivity, low irrigation intensity, low grain productivity and small yields, large number of unemployed, small number of industrial and agricultural workers.

Districts with lower LVI (Briceni, Drochia, Stefan Voda, Cahul, UTA Gagauzia) had higher grain productivity, good numbers of livestock, good employment both in agriculture and in industry.

The final aspect of the LVI, which is the current vulnerability and which can serve as a baseline (years 2006 to 2011) for all the districts for each year, and its mean values are shown in Figure 5-9. The graph revealed high vulnerability

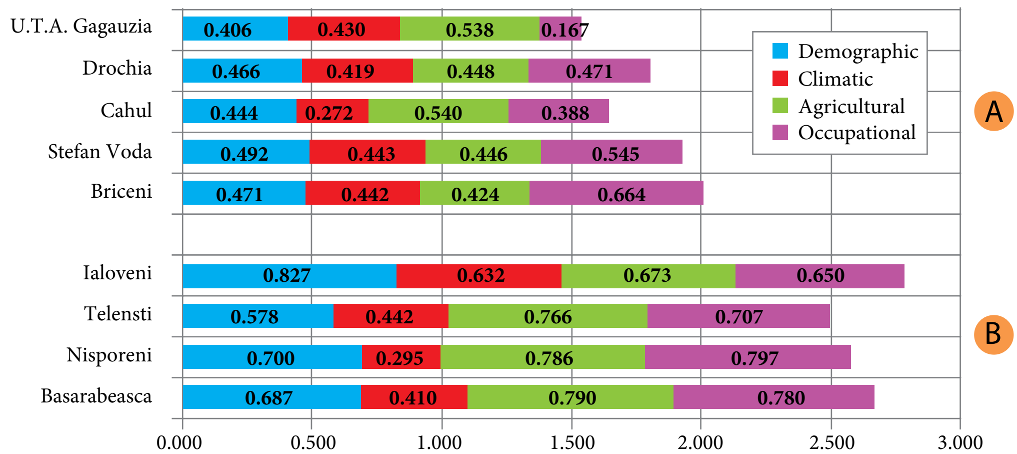


Figure 5-7: Components contribution to the LVI in five districts with the lowest vulnerability (A) and highest vulnerability (B)

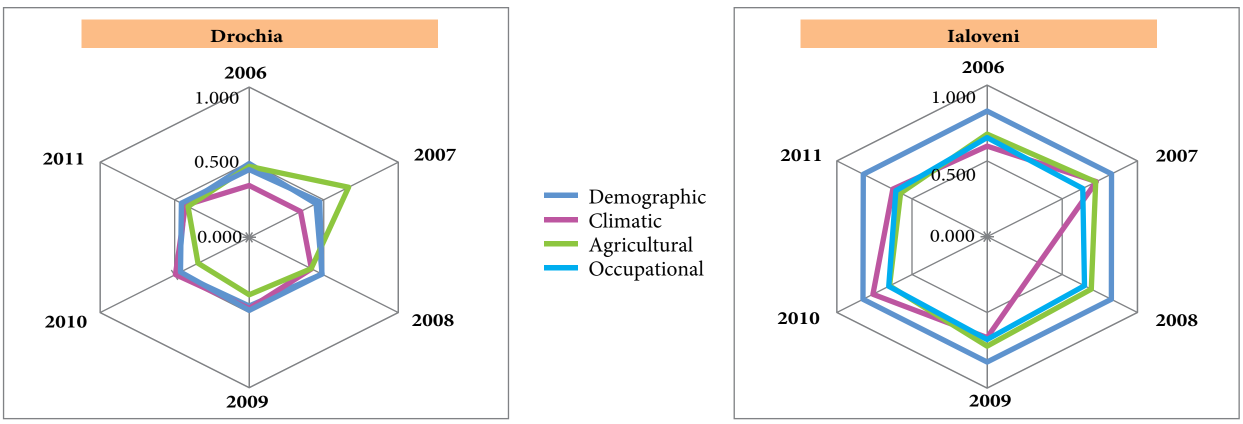


Figure 5-8: The LVI chart by components for Drochia district, as example of a district with low vulnerability, and for Ialoveni district, as an example of a district with high vulnerability.

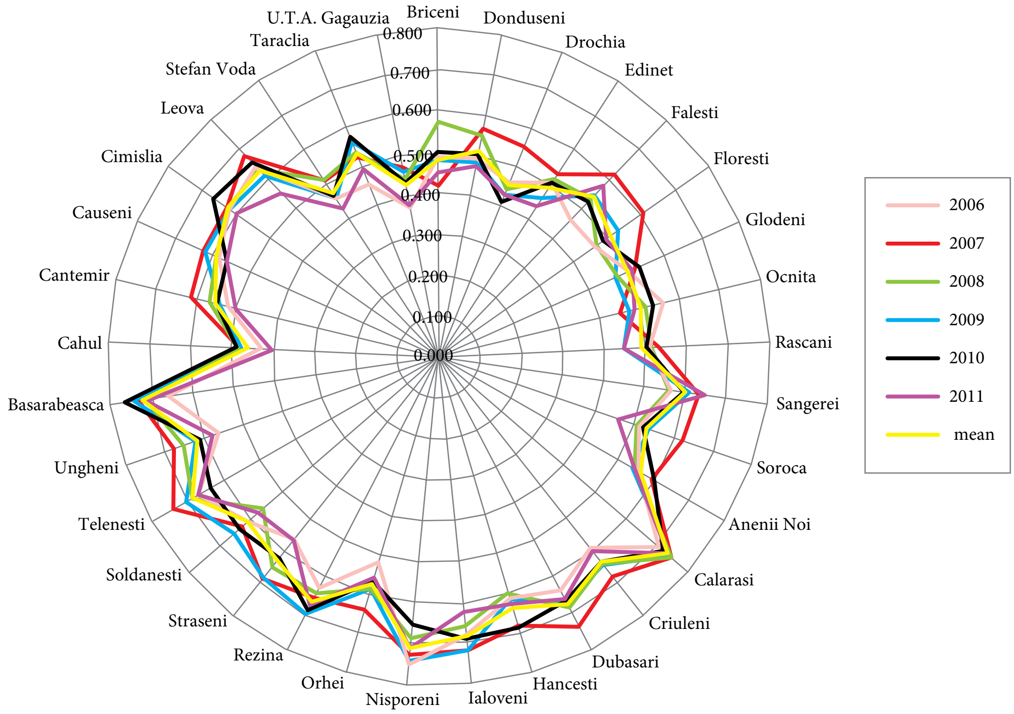


Figure 5-9: The Livelihood Vulnerability Index of the administrative-territorial units of the RM, annual values, and the mean value for the period 2006-2011

in 2007 (red) for most districts. Year 2011 was relatively good for the districts in the North and UTA Gagauzia. Districts in the Centre had lower vulnerability in 2006. Ialoveni, Basarabeasca, Nisporeni districts stand out due to high values of the LVI in most years under review because of the reasons stated above.

Integration of local knowledge and life experience of local communities into the changing environmental conditions is essential for adaptation policies at community level and development of adaptive capacities.

In the study carried out the mapping technique was applied to integrate information about the vulnerability aspects of administrative–territorial units of the RM. This technique gives the possibility to visualize the distribution of vulnerability and identify the districts with high vulnerability and better adaptive potential. This method has been used in similar assessments in other countries (O'Brien et al., 2004; Yohei et al., 2006) as a way of communicating vulnerability which illustrates the spatial distribution of capacity, sensitivity and exposure of the regions, settlements.

Figure 5-10 presents the distribution map of the mean value of the LVI by districts for the period under review (2006-2011). The map provides useful information for the population of districts and communities, local public authorities and decision-makers at all levels.

The color intensity is adjusted to the level of vulnerability of each district, which can be grouped as follows:

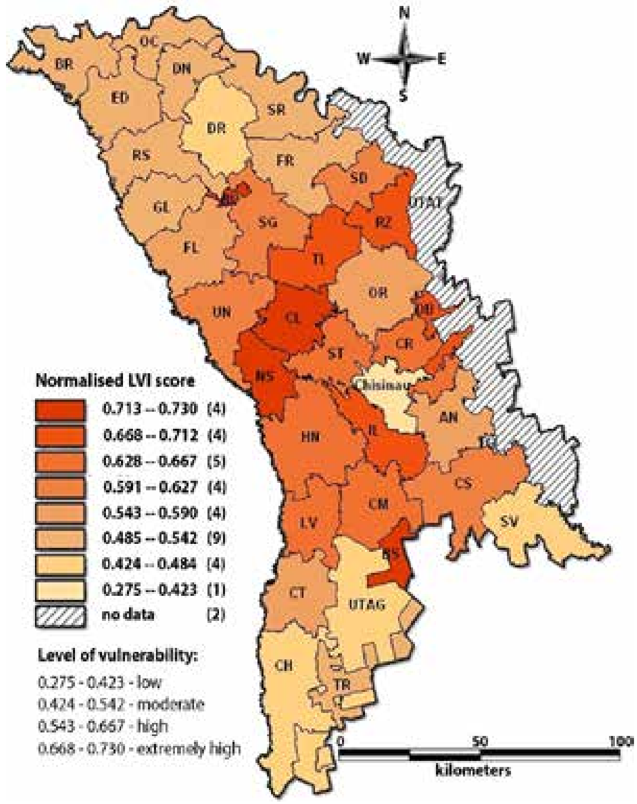


Figure 5-10: The map of the LVI mean value distribution for the period 2006-2011, by the administrative-territorial units of the RM

- 0.27-0.42 – low vulnerability
- 0.42-0.54 – moderate vulnerability
- 0.54-0.67 – high vulnerability
- 0.67-0.75 – extremely high vulnerability

Since vulnerability is a complex and dynamic situation, Climate Vulnerability Index at national (CVIM) and at district level (CVI) can be changed by adding / excluding indicators based on the assessment's needs, as this tool allows to quantify vulnerability integrally and by components.

5.2. Current Climate: Observed Trends and Variability

The character of observed changes to the Republic of Moldova's climate was identified through the trends and variability of individual climatic variables. The early 90's years of 20th century are usually taken as a "benchmark" for global warming, therefore the seasonal and annual temperature and precipitation data at Chisinau meteorological station (for which there are available the longest series of instrumental observation) have been studied and compared for two periods: 1887-1980 (for temperature) and 1891-1980 (for precipitation), respectively for 1981-2010 (Tables 5-3 and 5-4 and Figure 5-11). The climate change may be considered real if the parameters of the trends are statistically significant.

As can be seen from Table 5-3 and Figure 5-11, a slight growth in annual air temperature (at a 90 per cent level) in the Republic of Moldova, observed before the 90's years of 20th century (*0.05 ^{0}C per decade and/or ~ 0.5^{0}C per century*) is followed by a sharp increase (*about 0.63^{0}C per decade and/or ~6.3^{0}C per century*). Moreover, compared to the first period (1887-1980), the temperature trends in the last three decades (1981-2010) are statistically significant for summer and annual (at a 99 per cent confidence level) and for spring and autumn (at 95 per cent confidence level).

Absolutely during all season's precipitation trends for the two periods are positive, with the exception of spring of the 1891-1980 period and summer of the 1981-2010 period, where the trends was negative. However, the precipitation trends in these periods are not statistically significant with the exception of annual trend for 1891-1980 years ($p \leq 0.1$), so it can be noted just a tendency to a slight increase in the precipitations (Table 5-3; Figure 5-11).

The comparison of the mean air temperatures and standard deviations for two referred periods, both season and annual, have confirmed substantial changes in the temperature regime mentioned above (Table 5-4).

It may be stated with *high level confidence* that the mean values of the seasonal (except autumn) and annual temperatures in last three decades are different from the previous time period while the variability remains practically the same (except annual temperature for which there was identified a significant increase in the inter-annual variability of mean annual temperatures for the last three decades).

The comparison of the mean values of the total amount of precipitation (Table 5-4) shows the lack of statistically significant difference, however slight increase of average annual precipitation (mainly due to the fall) cannot be regarded as statistically significant, it may be explained by inter-annual fluctuations. Also, there aren't revealed any statistically significant differences in the variability of precipitation, with the exception of spring season.

Table 5-3: Average air temperature (^{0}C/year) and precipitation trends (mm/year) and their statistical significance of change (*p-value*) for two time periods at Chisinau meteorological station in the Republic of Moldova

Season	Average Air temperature				Precipitation			
	1887-1980		1981-2010		1891-1980		1981-2010	
	Trend	p-value	Trend	p-value	Trend	p-value	Trend	p-value
Winter	0.010	0.214	0.039	0.300	0.472	0.108	1.234	0.258
Spring	0.005	0.352	0.061	**0.028**	- 0.059	0.823	0.187	0.873
Summer	0.002	0.578	0.097	**0.000**	0.619	0.291	- 1.406	0.392
Autumn	0.003	0.545	0.048	**0.032**	0.412	0.256	1.291	0.412
Annual	0.005	0.097	0.063	**0.001**	1.448	0.073	1.301	0.578

Note: Bold is used to mark statistically significant values.

Table 5-4: Comparison of the mean (x) and standard deviation (σ) of the seasonal and annual air temperatures and precipitation for the period before 1981 year (x_1, σ_1) and beyond (x_2, σ_2)

Season	Average Air temperature						Precipitation					
	x_1	x_2	p	σ_1	σ_2	p	x_1	x_2	p	σ_1	σ_2	p
Winter	-2.2	-1.1	**0.009**	1.96	1.77	0.539	100.6	105.6	0.638	47.42	48.26	0.615
Spring	9.4	10.2	**0.006**	1.25	1.33	0.651	121.5	123.7	0.829	42.02	54.16	**0.090**
Summer	20.5	21.3	**0.001**	1.06	1.17	0.465	185.9	186.1	0.992	94.38	76.31	0.207
Autumn	10.1	10.3	0.444	1.34	1.08	0.189	113.1	132.2	0.170	58.55	55.29	0.130
Annual	9.5	10.2	**0.001**	0.71	0.97	**0.024**	521.1	547.6	0.333	130.79	108.22	0.261

Note: Bold is used to mark statistically significant values.

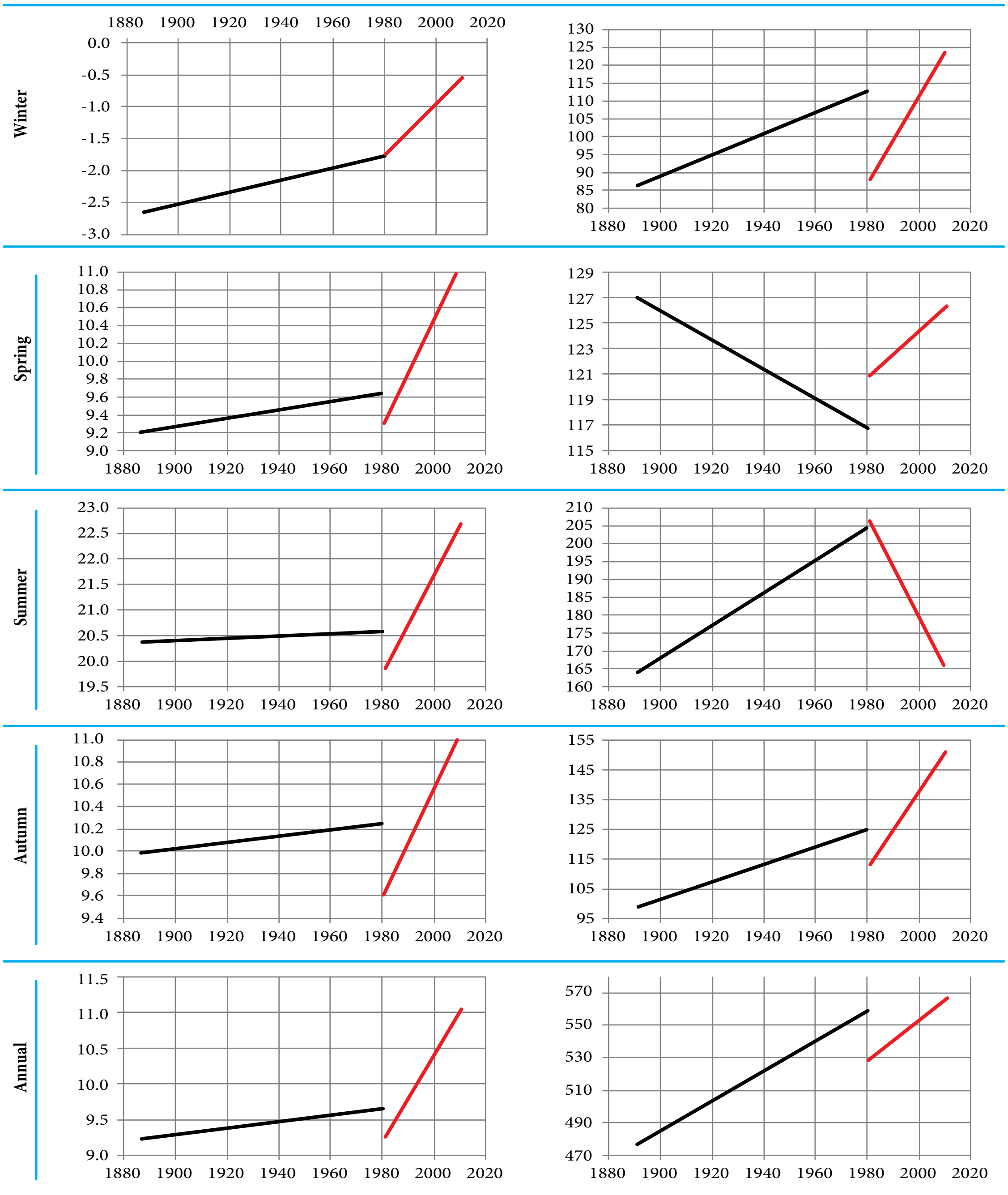


Figure 5-11: Trends in average air temperature (⁰C/year) – left side, and precipitation (mm/year) – right side, for the period before 1981 year and beyond, at the Chisinau Meteorological Station

The Figure 5-12 present trends in annual mean temperature (⁰C) and precipitation (mm) for the recent past and projected future. All values shown are anomalies, relative to the 1961-1990 mean climate. Black curves show the mean of observed data anomalies from 1961 to 2010, brown curves show the average ensemble (solid line) and range (shading) of model simulations of recent climate across an ensemble of 10 GCM. Colored lines from 2010 onwards show the average (solid line) and range (shading) of the ensemble projections of climate under three emissions scenarios (A2 - red, A1B – blue, and B1 – green). Colored bars on the right-hand side of the projections summarize the range of mean 2080s climates simulated by the 10 models for each emissions scenario.

5.3. Climate Change Scenarios

5.3.1. Developing Climate Scenarios

The model simulations for precipitation and temperature used in this report stem from 10 of the global coupled

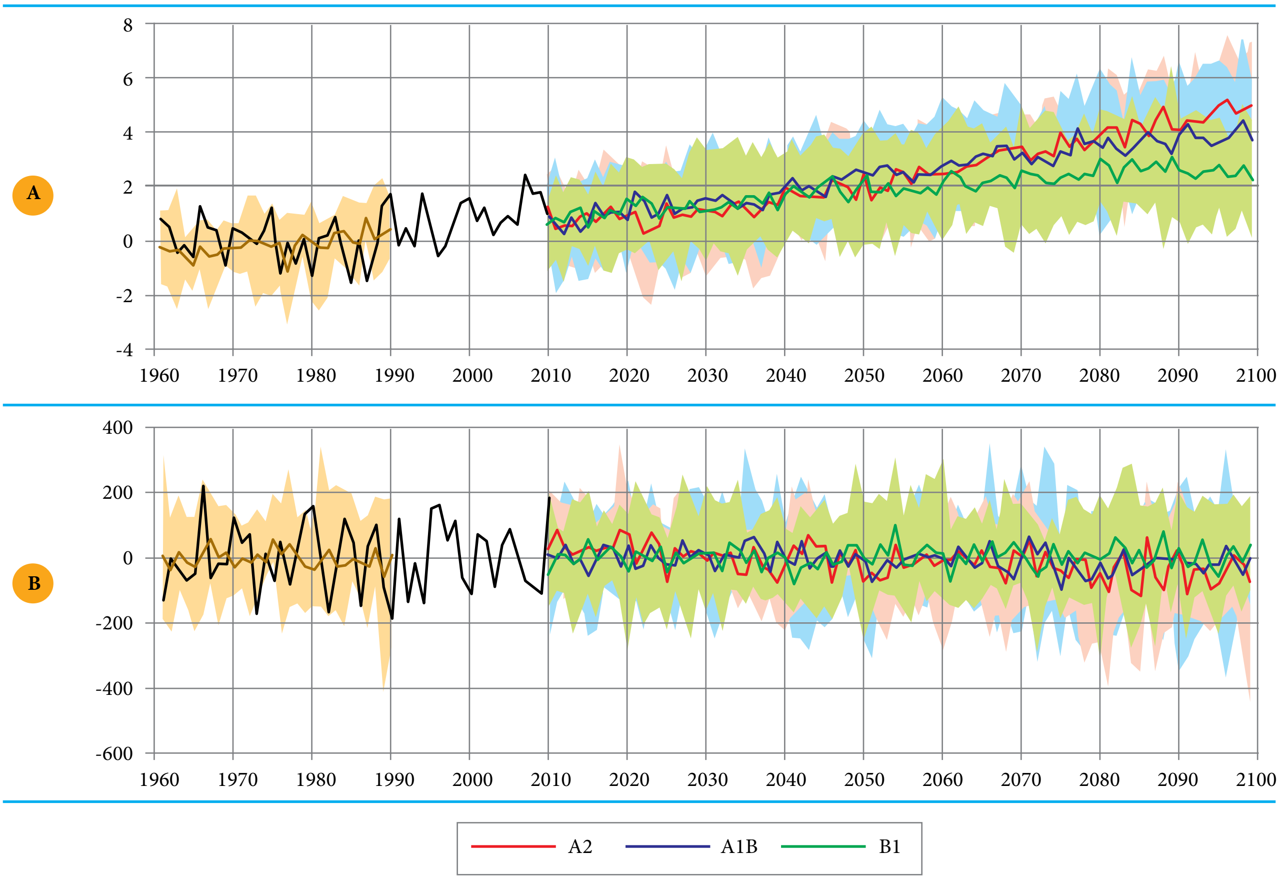


Figure 5-12: Trends in (A) Annual Mean Temperatures (°C) and (B) Precipitation (mm) Anomalies for the Recent Past and Projected Future

atmosphere ocean general circulation models (AOGCMs) made available by the World Climate Research Program (WCRP) Coupled Models Intercomparison Program Phase 3 (CMIP3) (Meehl et al., 2007a) (see Figure 5-3): CSIROMk3 (Australia's Commonwealth Scientific and Industrial Research Organization, Australia), ECHAM5-OM (Max-Planck-Institute for Meteorology, Germany), HadCM3 (UK Met. Office, UK), BCCR_BCM2.0 (Bjerknes Centre for Climate Research, Norway), CCCma_CGCM3_T63 (Canadian Center for Climate Modeling and Analysis, Canada), NIES_MIROC3.2_medres, NIES_MIROC3.2_hires (National Institute for Environmental Studies; Japan), MRI_CGCM2.3.2 (Meteorological Research Institute, Japan), NCAR_CCSM3 (National Centre for Atmospheric Research, USA), GFDL_CM2.1 (Geophysical Fluid Dynamics Laboratory, USA) model experiments for SRES A2, A1B and B1 were downloaded from: (<http://www.ipcc-data.org/gcm/monthly/SRES_AR4/index.html>).

The A2, A1B, and B1 emissions scenarios provide GHG concentrations determined by particular developmental storylines (Nakicenovic, N., et al. 2000). While it is unlikely than any single emissions scenario or GCM projection will occur exactly as described, a suite of GCM simulations and GHG emissions profiles provides a range of possible climate outcomes that reflects the current level of expert knowledge. This approach to climate change scenarios was developed by the IPCC in 2007 and provided the basis for its 4th Assessment Report.

In order to predict regional climate change for validation and downscaling procedure there were used the observed climate data for 1961-2010 time periods, recorded from 5 meteorological stations (Briceni, Balti, Chisinau, Tiraspol, Cahul) by State Hidrometeorological Service, which include: daily and monthly total precipitation; mean, minimum, maximum temperatures and relative air humidity.

Although it is not possible to predict the temperature or precipitation for a particular day, month, or even specific year because of fundamental uncertainties and natural variability in the changing climate system, GCMs are a valuable tool for projecting the likely range of changes over decadal to multidecadal time periods of GCMs. These projections, known as time slices, should be expressed relative to the baseline period, 1961–1990. The time slices were centered around a given decade, for example, the 2020s time slice refers to the period from 2010–2039. Thirty-year time slices were used to provide an indication of the climate "normals" for those decades; by averaging over this period, much of the random year-to-year variability, or "noise," is cancelled out, while the long-term influence of increasing greenhouse gases, or "sig-

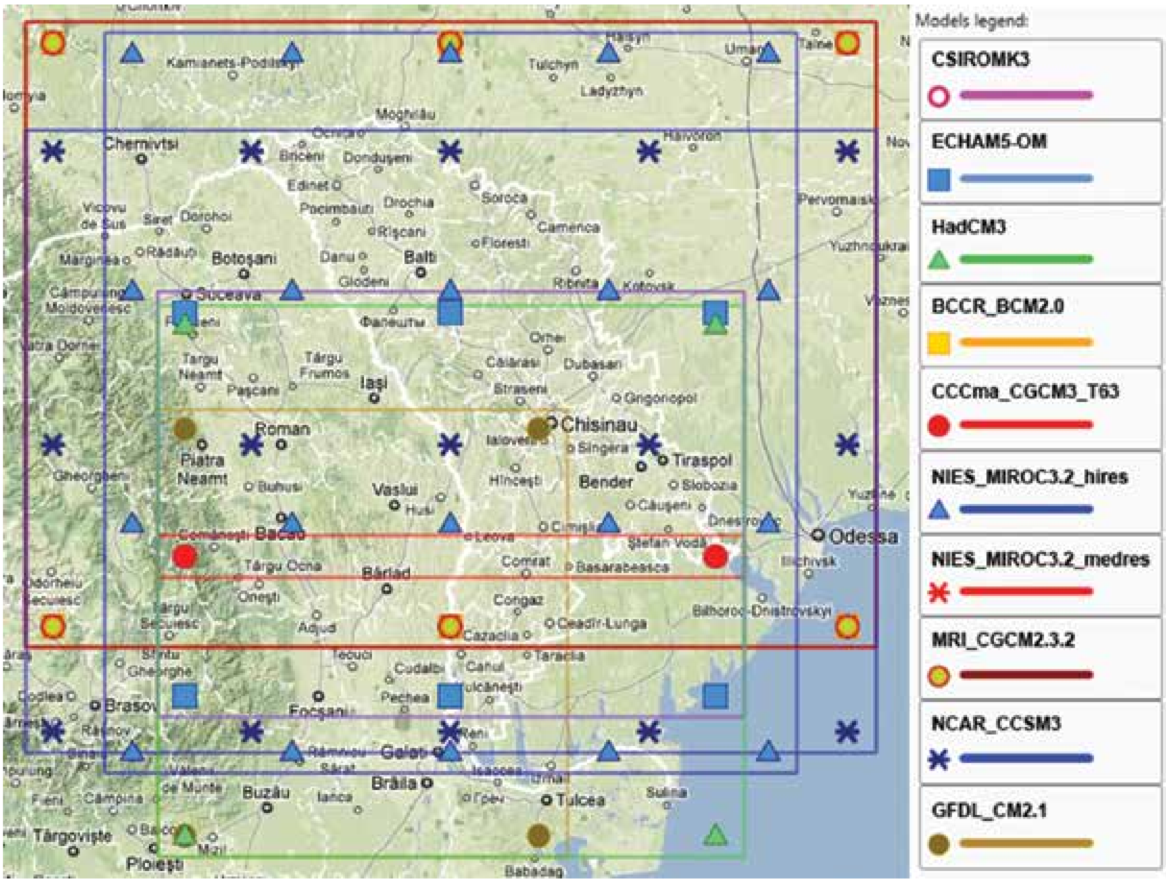


Figure 5-13: The Number of Grid Points and Corresponding AOGCM Climate Prediction Area (Frame) for the Territory of the Republic of Moldova

nal," remains. Thirty-year averaging is a standard used by meteorological and climate scientists (WMO, 1989).

The projections of future climate were obtained conform methodology described by (Wilby et al. 2004; Carter, 2007). Firstly, the baseline climatology was established for the site or region of interest. Secondly, changes in mean temperature for the GCM grid–boxes closest to the target site were calculated as the difference between each model's future simulation and the same model's baseline simulation, whereas mean precipitation were based on the ratio of a given model's future precipitation to the same model's baseline precipitation (expressed as a percentage change). For example, a difference of 2.5˚C might occur by subtracting the mean GCM temperatures for 1961-1990 from the mean of the 2050s. Thirdly, the temperature change suggested by the GCM (in this case, +2.5˚ C) is then simply added to each day in the baseline climatology.

For a given time slice and a given emissions scenario, projections from the 10 different GCMs (SRES A1B, B1) and the six GCMs (SRES A2) are considered in the analysis as equally likely representations of future climate. One ensemble member of each model of the temperature and precipitation field from the simulation of the 20th century and the scenarios A2, A1B, and B1 was used, and they are equally weighted for the multi-model (ensemble) average. Consequently, ensemble monthly, seasons and annual statistics (average, max, min and standard deviation) were computed directly from 7 x 30 (SRES A2) or 10 x 30 (SRES A1B, B1) year time series. In terms of temporal aggregation, the following seasons have been considered: December–February (DJF), March–May (MAM), June–August (JJA) and September–November (SON). The next sections highlight some of the obtained results.

5.3.2. Description of Climate Scenarios

a) Air Temperature

The three SRES emissions scenarios project similar temperature in the near-term decades +1.2 - 1.4^{0}C over the Republic of Moldova. Only beginning around the 2050s the three emissions scenarios produce temperature patterns that are distinguishable from each other. This is due to both the large inertia of the climate system it takes centuries for the full climate effects of greenhouse gas emissions to be felt and, the fact that it takes time for the different emissions scenarios to produce large differences in greenhouse gas concentrations.

Annual changes for temperatures are very homogeneous over the Republic of Moldova's AEZs. By the 2080s, the rate of warming is higher under A2 ensembles, average reach +4.3 ^{0}C; medium under A1B, +3.8 ^{0}C, and smaller under the B1 scenario, ensembles average would be +2.7 ^{0}C (see Figure 5-14, Table 5-5).

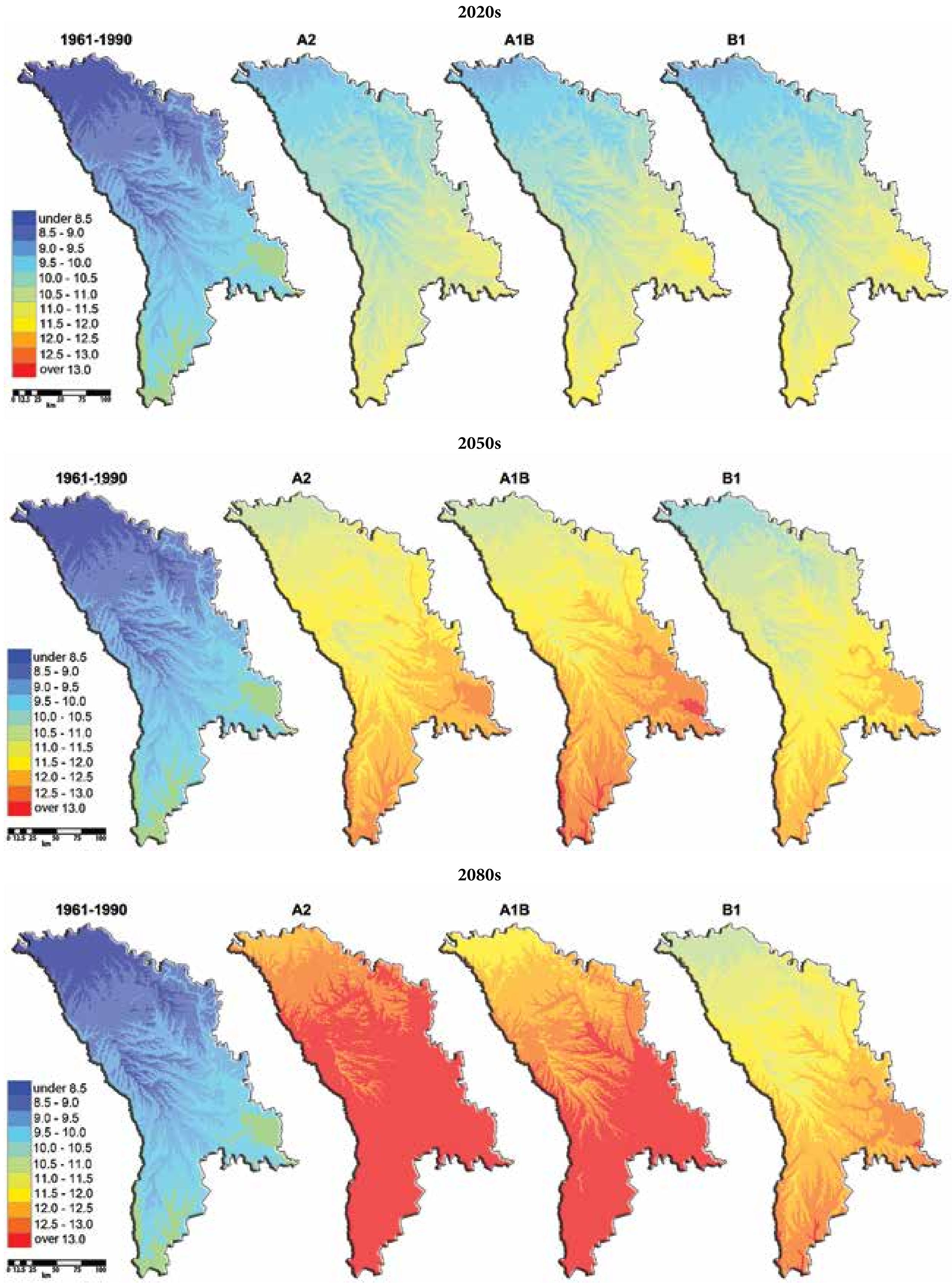


Figure 5-14: Projected Multi - Model Ensemble Annual Mean Air Temperature, °C throughout the Republic of Moldova[1]

[1] Climate Change Office, 2012: <http://www.clima.md/public/files/ProiectiiClima/en/ClimateMaps.html>.

Table 5-5: Projected Ensemble Annual and Seasons Mean Air Temperature Changes (ΔT, °C) Presented for Three 30 Year Time Slices in the Future, Centered on the 2020s, 2050s and 2080s for SRES A2, A1B and B1 Emission Scenarios Relative to the 1961-1990 Climatological Baseline Period

Season	Average 1961-1990	SRES	Projected changes by the 2020s			Projected changes by the 2050s			Projected changes by the 2080s		
			Min	Average	Max	Min	Average	Max	Min	Average	Max
Northern AEZ											
Annual	7.8	**A2**	0.4	**1.3**	2.6	1.8	**2.7**	4.5	2.9	**4.3**	6.2
		A1B	0.5	**1.3**	2.0	1.2	**2.7**	3.7	2.3	**3.7**	5.0
		B1	0.7	**1.3**	1.9	1.5	**2.1**	3.3	1.7	**2.7**	3.6
DJF	-3.5	**A2**	0.5	**1.4**	3.4	2.0	**3.4**	6.4	3.3	**4.9**	8.0
		A1B	0.0	**1.2**	2.2	0.9	**2.8**	4.3	2.2	**4.0**	5.7
		B1	0.8	**1.4**	2.6	1.5	**2.3**	4.3	1.4	**3.0**	4.5
MAM	8.1	**A2**	0.3	**1.2**	3.1	1.3	**2.2**	4.7	2.5	**3.6**	5.9
		A1B	0.4	**1.3**	2.2	1.1	**2.5**	3.9	1.9	**3.4**	5.4
		B1	0.5	**1.3**	2.0	1.1	**2.0**	3.1	1.2	**2.4**	3.6
JJA	18.1	**A2**	0.5	**1.2**	2.4	1.4	**2.5**	3.5	2.2	**4.5**	6.1
		A1B	0.7	**1.6**	2.4	1.4	**3.0**	4.7	1.9	**4.1**	6.7
		B1	0.7	**1.5**	2.3	1.2	**2.3**	3.6	1.5	**2.9**	4.5
SON	8.4	**A2**	0.7	**1.5**	2.8	1.8	**2.6**	4.6	3.2	**4.6**	6.5
		A1B	0.7	**1.3**	2.0	1.1	**2.7**	3.8	1.9	**3.6**	5.3
		B1	0.6	**1.2**	1.9	0.9	**2.0**	3.4	1.3	**2.6**	3.8
Central AEZ											
Annual	9.6	**A2**	0.4	**1.2**	1.9	1.8	**2.5**	3.4	3.0	**4.3**	5.2
		A1B	0.5	**1.4**	2.0	1.2	**2.8**	3.7	2.4	**3.8**	5.1
		B1	0.8	**1.4**	2.0	1.5	**2.2**	3.5	1.7	**2.7**	3.9
DJF	-1.8	**A2**	0.2	**1.0**	2.4	1.9	**2.8**	4.2	3.3	**4.3**	5.4
		A1B	-0.2	**1.2**	2.2	0.8	**2.7**	4.1	2.1	**4.2**	6.8
		B1	0.9	**1.4**	2.6	1.5	**2.3**	3.7	1.5	**2.9**	4.3
MAM	9.7	**A2**	0.0	**0.9**	1.3	1.4	**1.9**	2.7	2.7	**3.4**	4.2
		A1B	0.4	**1.2**	2.1	1.0	**2.5**	3.7	2.0	**3.6**	6.7
		B1	0.5	**1.3**	2.1	1.2	**2.0**	3.2	1.2	**2.4**	3.7
JJA	20.3	**A2**	0.5	**1.4**	2.4	1.4	**2.9**	4.5	2.3	**5.1**	7.0
		A1B	0.6	**1.7**	2.6	1.4	**3.1**	5.0	1.8	**4.1**	6.9
		B1	0.7	**1.6**	2.5	1.2	**2.4**	3.8	1.5	**3.0**	4.8
SON	10.2	**A2**	0.8	**1.3**	2.0	1.8	**2.5**	3.1	3.3	**4.4**	5.0
		A1B	0.7	**1.4**	2.2	1.2	**2.7**	3.9	1.1	**3.5**	5.3
		B1	0.7	**1.3**	2.2	1.0	**2.1**	3.7	1.4	**2.7**	3.9
Southern AEZ											
Annual	9.8	**A2**	0.4	**1.2**	1.9	1.9	**2.5**	3.4	3.0	**4.2**	5.1
		A1B	0.4	**1.4**	2.0	1.2	**2.8**	3.8	2.3	**3.8**	5.1
		B1	0.8	**1.4**	2.0	1.5	**2.2**	3.4	1.7	**2.7**	3.9
DJF	-1.5	**A2**	0.1	**0.9**	2.3	1.4	**2.5**	3.9	3.2	**3.9**	5.0
		A1B	-0.3	**1.1**	2.1	0.4	**2.4**	3.8	1.7	**3.5**	5.0
		B1	0.8	**1.2**	2.4	1.2	**2.0**	3.4	1.4	**2.6**	4.0
MAM	9.8	**A2**	0.0	**0.8**	1.2	1.5	**2.8**	2.6	2.7	**3.3**	4.0
		A1B	0.2	**1.2**	2.0	0.8	**2.4**	3.5	1.9	**3.3**	4.7
		B1	0.4	**1.2**	2.0	1.1	**1.9**	3.0	1.2	**2.3**	3.6
JJA	20.4	**A2**	0.5	**1.4**	2.3	1.4	**3.0**	4.3	2.3	**5.2**	6.9
		A1B	0.6	**1.7**	2.6	1.4	**3.2**	4.8	2.0	**4.3**	6.9
		B1	0.7	**1.5**	2.4	1.2	**2.5**	4.0	1.5	**3.1**	4.8
SON	10.8	**A2**	0.7	**1.3**	2.0	1.6	**2.4**	3.0	3.2	**4.7**	4.9
		A1B	0.6	**1.4**	2.1	1.1	**2.7**	3.8	1.8	**3.6**	5.3
		B1	0.7	**1.3**	2.1	2.0	**2.1**	3.6	1.3	**2.6**	3.9

Individual GCMs show an increase of up to 5.1 - 6.2°C (see Figure 5-15).

All the GCM models used agree that for the three future periods (2020s, 2050s and 2080s) there will be an increase of the winter temperature, with respect to the 1961-1990 reference periods. As it was expected, the magnitude of the positive found differences is increasing with increasing greenhouse gas forcing. It can be seen that the temperature rise will be larger over the northern and central parts of the country (see Figure 5-16).

More specifically, the ensembles, driven by the A2 emission scenario, estimate that the North AEZ will experience the most significant warming during winter, with average temperatures rising up to 4.9^{0}C by the 2080s. For the rest of the study area the winter temperature increase will be 0.5 to 1.0 degrees lower. The pattern of change derived from the ensembles B1 models is quite similar, but the magnitude of change is lower (increase about 2.6 to 3.0^{0}C over the Republic of Moldova) with the maximum warming seen again in Northern and Central AEZs (Table 5-5).

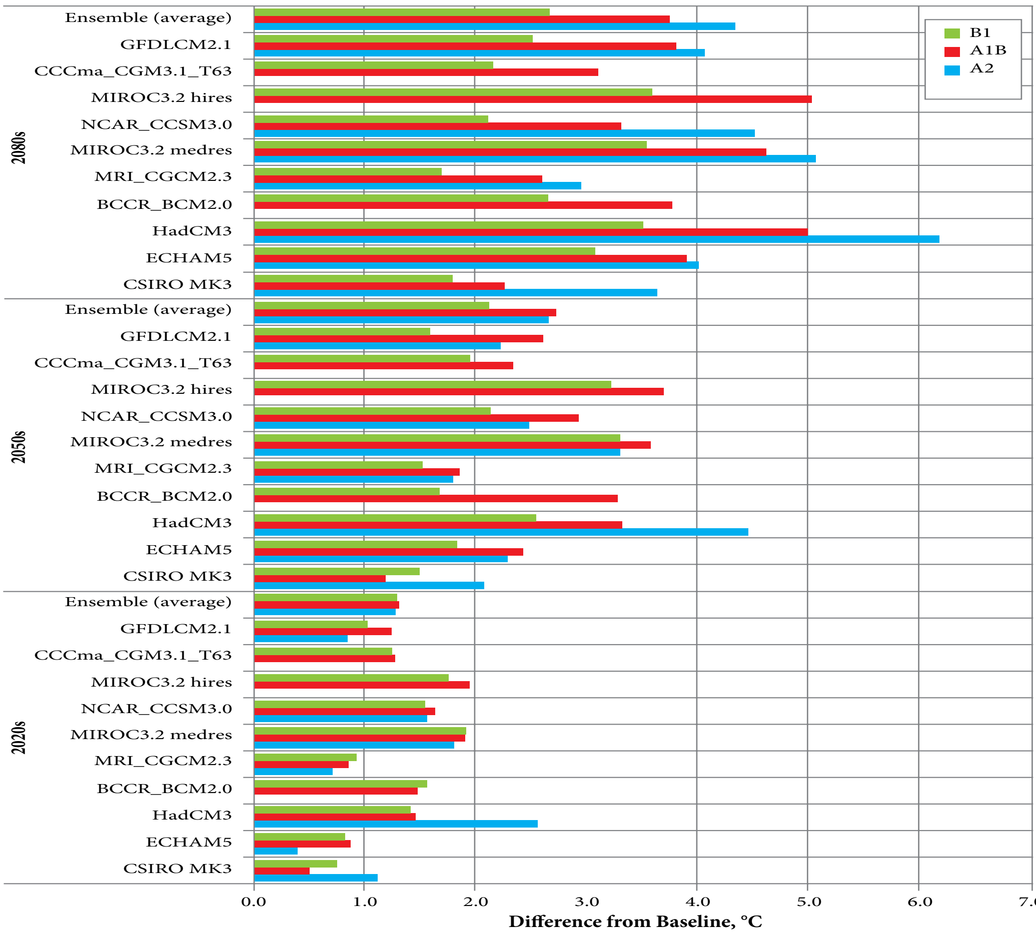
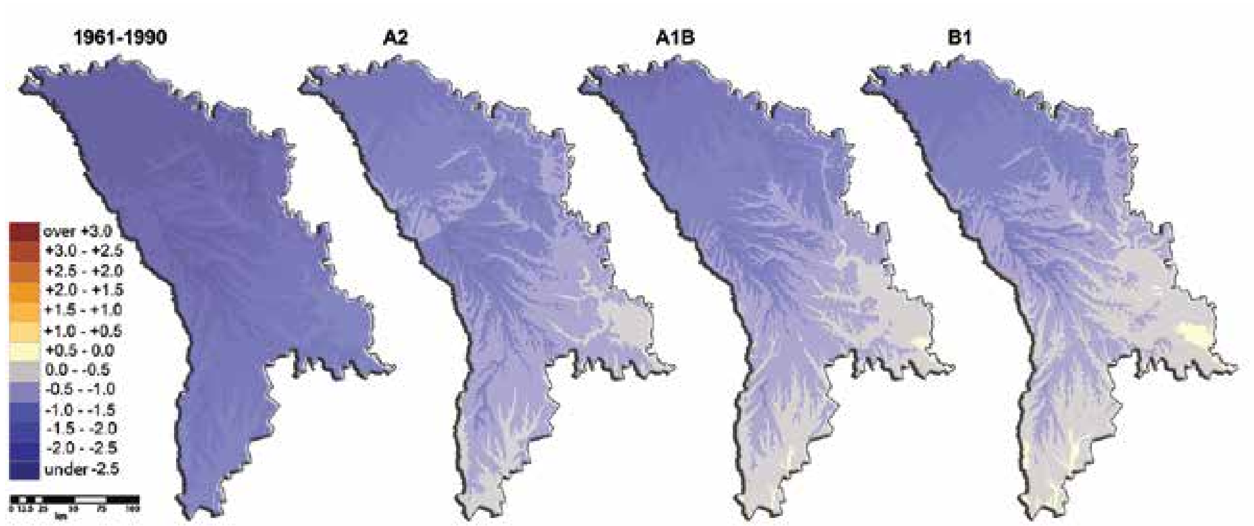


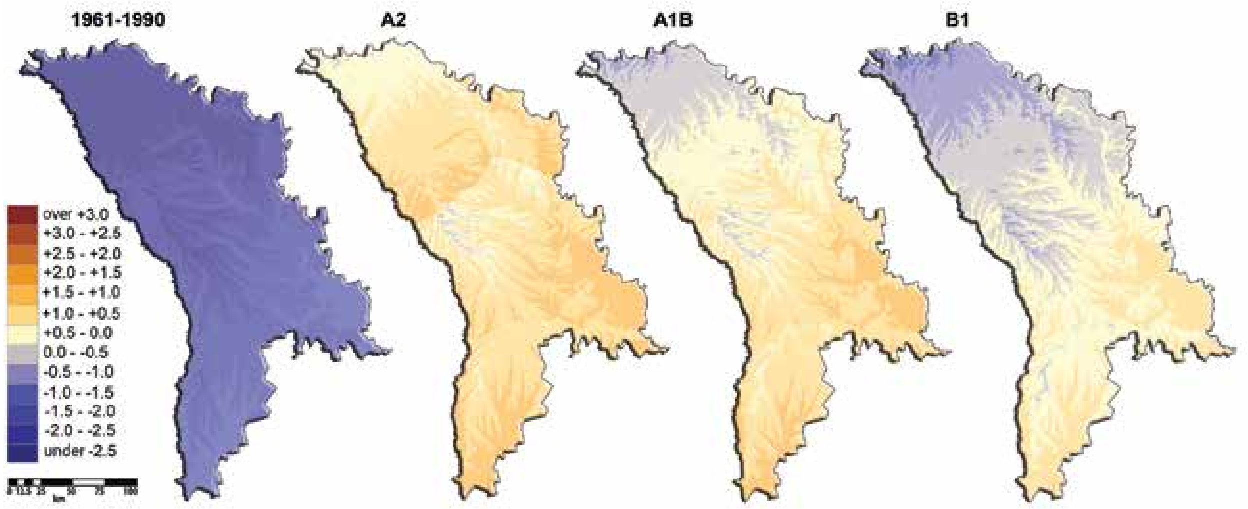
Figure 5-15: Projected Ensemble and Individual GCMs Annual Mean Air Temperature (ΔT, °C) Presented for Three 30 Year Time Slices in the Future, Centered on the 2020s, 2050s and 2080s for SRES A2, A1B and B1 Emission Scenarios to the 1961-1990 Climatological Baseline Period in the Northern AEZ

The summer warming is found to be even larger than winter, but the spatial distribution of the changes is quite different. The strongest temperature rise occurs over the Southern and Central AEZs. The climate change experiments from the ensembles project an increase up to 5.1-5.2^{0}C over the Central and Southern AEZs, according to the A2 scenario. The Northern AEZ's summer temperature rise will be lower up to 4.5^{0}C. The corresponding results from the

2020s



2050s



2080s

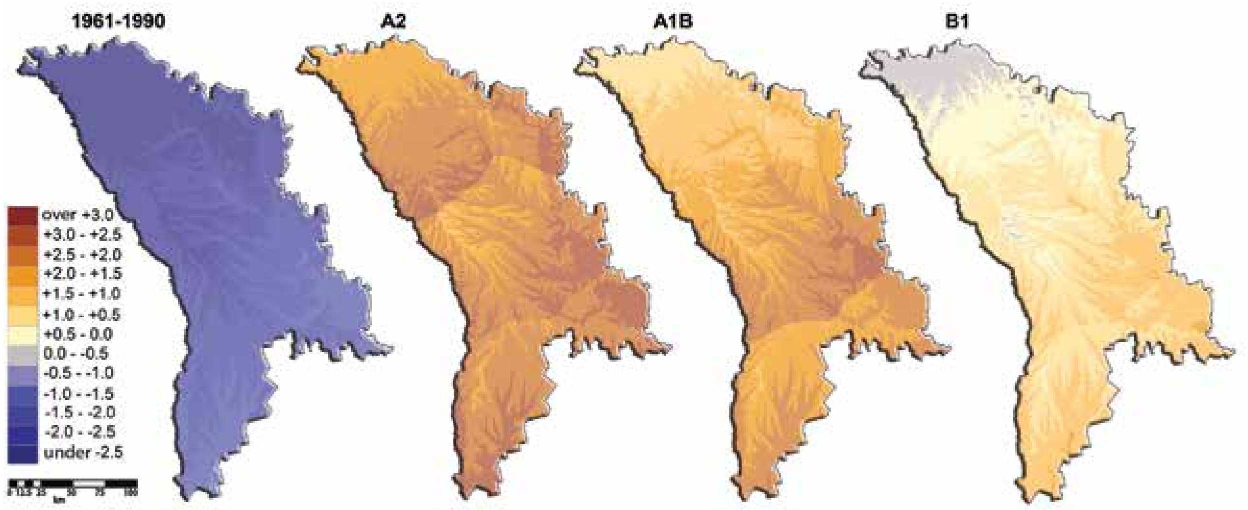


Figure 5-16: Projected Multi - Model Ensemble DJF Mean Air Temperature, °C throughout the RM[1]

[1] Climate Change Office, 2012: <http://www.clima.md/public/files/ProiectiiClima/en/ClimateMaps.html>.

B1 scenario show less intense differences in temperature increase. Estimations of simulations from the ensembles show that the warming will be quite uniform from 2.9^{0}C to 3.1^{0}C over whole RM's AEZs (Figure 5-17).

b) Precipitations

The A2, A1B and B1 SRES emissions scenarios project similar slight precipitation increase around 2% over all of the RM's AEZs by 2020s (Tables 5-6). But beginning from 2050s the three emissions scenarios project annual precipitation patterns that are distinguishable from each other.

Annual changes for precipitation became much differentiated over the RM's AEZs. The multi-model projections from the A2, A1B forcing scenarios show that the domain of study would exhibit a general annual decrease in precipitation. Accordingly, the rate of decreasing in precipitation is higher under A2 ensembles average varying from -13.5% over the Southern to -5.7% over the Northern AEZs, and smaller under the A1B scenario from -4.4% in the Southern to -1.5% in the Northern AEZs. Controversially, according to B1 scenario slight decrease in precipitation by -1.8% is projected only for Southern area while moderate increases by +0.6-1.7% are expected in the Central and Northern AEZs in comparison to the reference time period 1961-1990 by 2080s (Table 5-6; Figure 5-18).

The multi-model projections from the A2, A1B and B1 forcing scenarios show that the RM would exhibit a general increase of precipitation during winter and spring. This increase becomes progressively more intense towards the north. In details, the ensemble models simulate the largest increase in precipitation from 5.3 % (B1) to 7.5% (A2) in winter and from 6.8% (A2) to 10.9% (B1) in spring over the northern

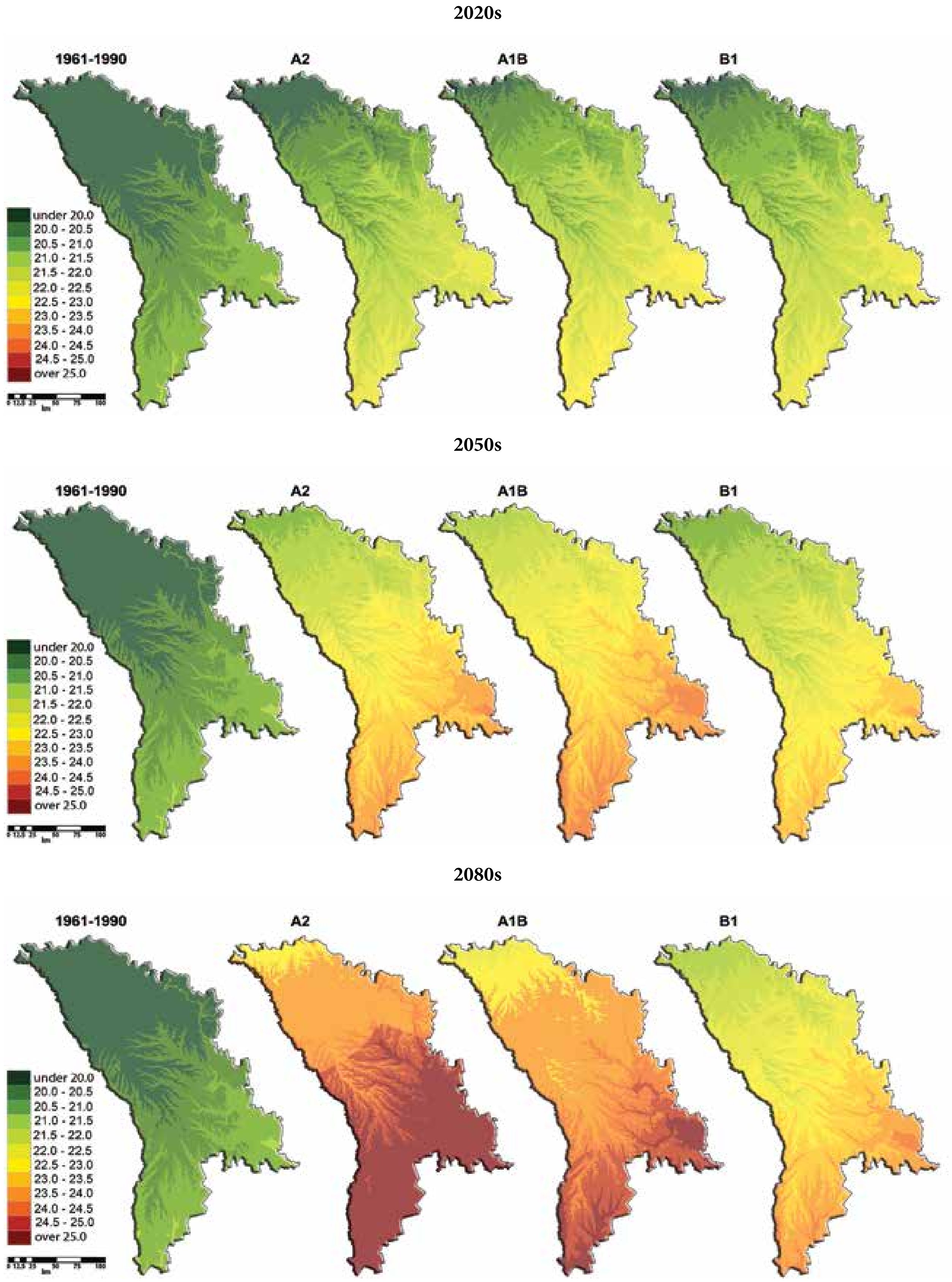


Figure 5-17: Projected Multi - Model Ensemble JJA Mean Air Temperature, °C throughout the RM

Table 5-6: Projected Ensemble Annual and Seasons Total Precipitation Changes (ΔP, mm) Presented for Three 30 Year Time Slices in the Future, Centered on the 2020s, 2050s and 2080s for SRES A2, A1B and B1 Emission Scenarios Relative to the 1961-1990 Climatological Baseline Period

Season	Average 1961-1990	SRES	Projected changes by the 2020s			Projected changes by the 2050s			Projected changes by the 2080s		
			Min	Average	Max	Min	Average	Max	Min	Average	Max
Northern AEZ											
Annual	612.7	**A2**	-6.8	**2.1**	7.2	-16.8	**-1.4**	7.0	-26.2	**-5.7**	4.0
		A1B	-9.1	**0.2**	8.2	-11.0	**-1.0**	9.4	-23.0	**-1.5**	16.2
		B1	-4.4	**2.0**	6.6	-7.5	**3.1**	16.7	-8.2	**1.7**	12.7
DJF	110.3	**A2**	-0.5	**4.5**	9.0	-29.0	**-0.5**	18.7	0.7	**7.5**	20.0
		A1B	-18.8	**3.6**	32.8	-22.8	**6.2**	44.7	-14.9	**6.5**	40.8
		B1	-18.3	**2.2**	10.3	-17.2	**2.2**	10.0	-22.5	**5.3**	17.6
MAM	154.3	**A2**	-3.0	**5.3**	17.6	-39.6	**1.7**	21.9	-14.0	**6.8**	33.1
		A1B	-2.2	**4.1**	10.6	-12.7	**1.7**	11.6	-7.0	**8.5**	23.6
		B1	-0.1	**5.0**	11.9	1.2	**8.6**	16.6	1.1	**10.9**	19.9
JJA	238.3	**A2**	-15.6	**0.6**	10.9	-30.8	**-2.7**	7.5	-46.4	**-16.1**	2.1
		A1B	-40.6	**-4.9**	31.8	-45.5	**-7.3**	37.8	-46.7	**-10.1**	35.2
		B1	-13.0	**3.2**	25.4	-28.0	**1.5**	28.8	-36.6	**-4.6**	34.7
SON	109.8	**A2**	-9.6	**1.2**	4.8	-21.5	**-3.8**	15.2	-33.3	**-13.7**	8.3
		A1B	-9.0	**2.8**	47.3	-15.4	**2.0**	37.0	-22.7	**-5.3**	24.4
		B1	-18.1	**-5.3**	7.2	-24.3	**0.1**	22.8	-11.2	**-1.2**	22.0
Central AEZ											
Annual	544.2	**A2**	-6.5	**2.0**	6.9	-12.2	**3.2**	2.8	-34.5	**-9.2**	1.3
		A1B	-12.4	**1.1**	10.0	-13.5	**-1.9**	10.3	-30.1	**-3.1**	13.4
		B1	-8.1	**0.7**	6.4	-9.8	**0.6**	9.8	-13.0	**0.6**	14.2
DJF	114.1	**A2**	2.8	**7.0**	11.3	-11.9	**2.4**	11.6	-4.7	**4.4**	21.3
		A1B	-12.1	**4.2**	29.6	-18.7	**4.6**	35.6	-8.3	**4.3**	33.6
		B1	-7.8	**3.3**	9.1	-12.5	**1.3**	10.7	-18.0	**3.6**	15.7
MAM	128.0	**A2**	-6.9	**4.0**	16.4	0.2	**6.3**	20.6	-20.0	**3.1**	31.0
		A1B	-6.9	**5.3**	13.3	-11.4	**3.3**	14.7	-17.6	**5.8**	27.4
		B1	-6.9	**4.1**	12.5	-2.3	**7.3**	18.5	-4.1	**9.3**	25.2
JJA	189.6	**A2**	-17.3	**-1.1**	11.0	-35.1	**-11.0**	1.6	-60.2	**-21.9**	0.7
		A1B	-31.9	**-4.8**	37.7	-36.6	**-7.9**	48.6	-57.6	**-11.3**	46.2
		B1	-17.5	**0.1**	28.8	-33.0	**-2.3**	19.9	-38.5	**-5.8**	34.4
SON	112.5	**A2**	-7.8	**0.1**	7.2	-17.6	**-6.3**	6.0	-37.8	**-15.5**	5.2
		A1B	-8.5	**3.2**	45.2	-19.1	**-4.1**	34.0	-23.2	**-6.9**	17.5
		B1	-22.2	**-4.6**	15.6	-26.0	**-2.8**	22.6	-12.8	**-1.7**	17.9
Southern AEZ											
Annual	550.2	**A2**	-7.9	**2.0**	8.4	-16.3	**-6.9**	1.9	-35.9	**-13.5**	-1.2
		A1B	-11.6	**2.4**	26.4	-16.3	**-3.3**	19.6	-31.6	**-4.4**	13.3
		B1	-9.5	**-0.1**	6.1	-13.6	**-1.1**	6.5	-12.8	**-1.8**	14.5
DJF	113.2	**A2**	4.7	**7.0**	9.6	-7.3	**-0.3**	11.4	-6.6	**1.5**	18.7
		A1B	-19.6	**4.5**	27.9	-28.5	**1.2**	30.1	-19.4	**0.3**	27.4
		B1	-14.8	**1.0**	8.2	-15.9	**-1.3**	11.8	-25.0	**0.2**	13.4
MAM	127.9	**A2**	-13.8	**1.6**	13.0	-3.6	**0.8**	5.6	-21.9	**-2.7**	15.3
		A1B	-6.1	**5.8**	24.8	-11.8	**3.0**	20.9	-22.1	**3.1**	25.2
		B1	-7.3	**3.7**	12.3	-11.3	**6.2**	21.6	-6.4	**7.3**	22.1
JJA	195.8	**A2**	-17.9	**-0.6**	14.6	-37.6	**-15.9**	3.0	-57.9	**-26.4**	-2.7
		A1B	-25.8	**-1.4**	33.3	-38.5	**-8.4**	40.5	-54.9	**-9.1**	37.7
		B1	-21.3	**-1.0**	22.1	-35.2	**-3.3**	13.3	-40.6	**-8.4**	23.2
SON	113.3	**A2**	-9.0	**1.7**	27.4	-21.4	**-6.6**	4.4	-48.3	**-23.8**	1.8
		A1B	-11.1	**3.1**	46.3	-22.1	**-6.2**	33.9	-24.9	**-9.6**	12.2
		B1	-20.9	**-5.1**	9.2	-29.2	**-4.3**	11.3	-14.0	**-2.8**	13.0

and the lowest ones from 1.5% (A2) to 0.2% (B1) and/or from -2.7% (A2) to 7.3% (B1) respectively over the southern parts of the country in comparison to the reference time period 1961-1990 by 2080s (Table 5-6).

Conversely, it can be noted that the individual model's climate signal, forced by the A2, A1B and B1 emission scenarios, presented quite different estimations. For example, the individual models estimation of precipitation change in winter over Northern AEZ varying from +0.7% (CSIRO Mk3) to +20.0% (HadCM3) for the A2 emission scenario, from -14.9% (MIROC3.2 hires) to +40.8% (MRI_CGCM2.3) for A1B and from -22.5 (MIROC3.2 hires) to +17.6% (MRI_CGCM2.3) for the B1 scenario in comparison to the control time period 1961-1990 by 2080s. The range of the changes projected over the Southern AEZ is higher varying from -6.6 (GFDLCM2.1) to +18.7% (HadCM3) for the A2 scenario, from -19.4 (MIROC3.2 hires) to +27.4% (MRI_CGCM2.3) for A1B and from -25.0 (MIROC3.2 hires) to +13.4% (CCCma_CGCM3.1_T63) for the B1 scenario (Figure 5-19).

The ensemble averages for the three SRES scenarios agree that the precipitation reduction will be much more extended

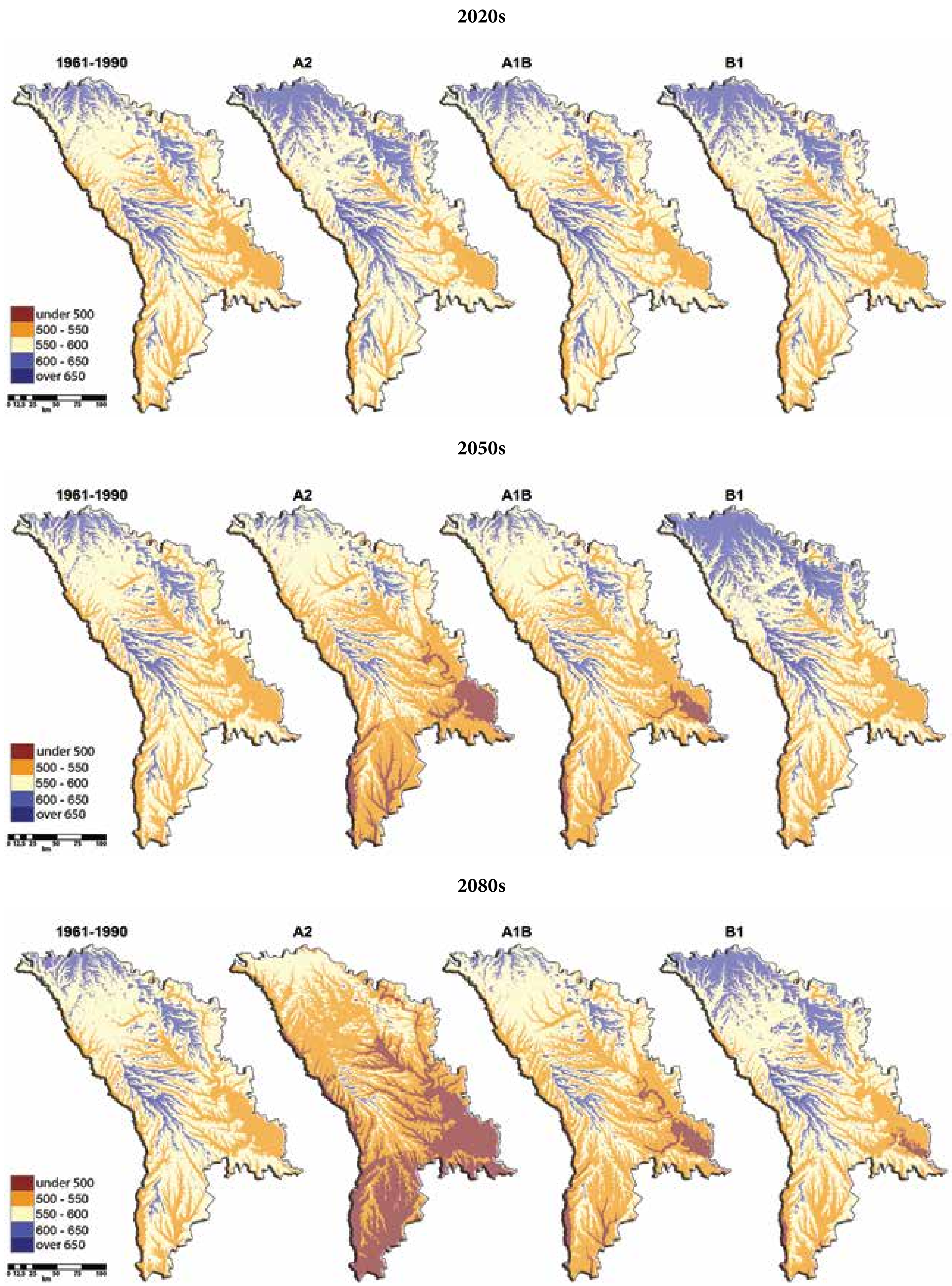


Figure 5-18: Projected Multi - Model Ensemble Annual Precipitation, mm over the RM[1]

[1] <http://www.clima.md/public/files/ProiectiiClima/ro/ClimateMaps.html>.

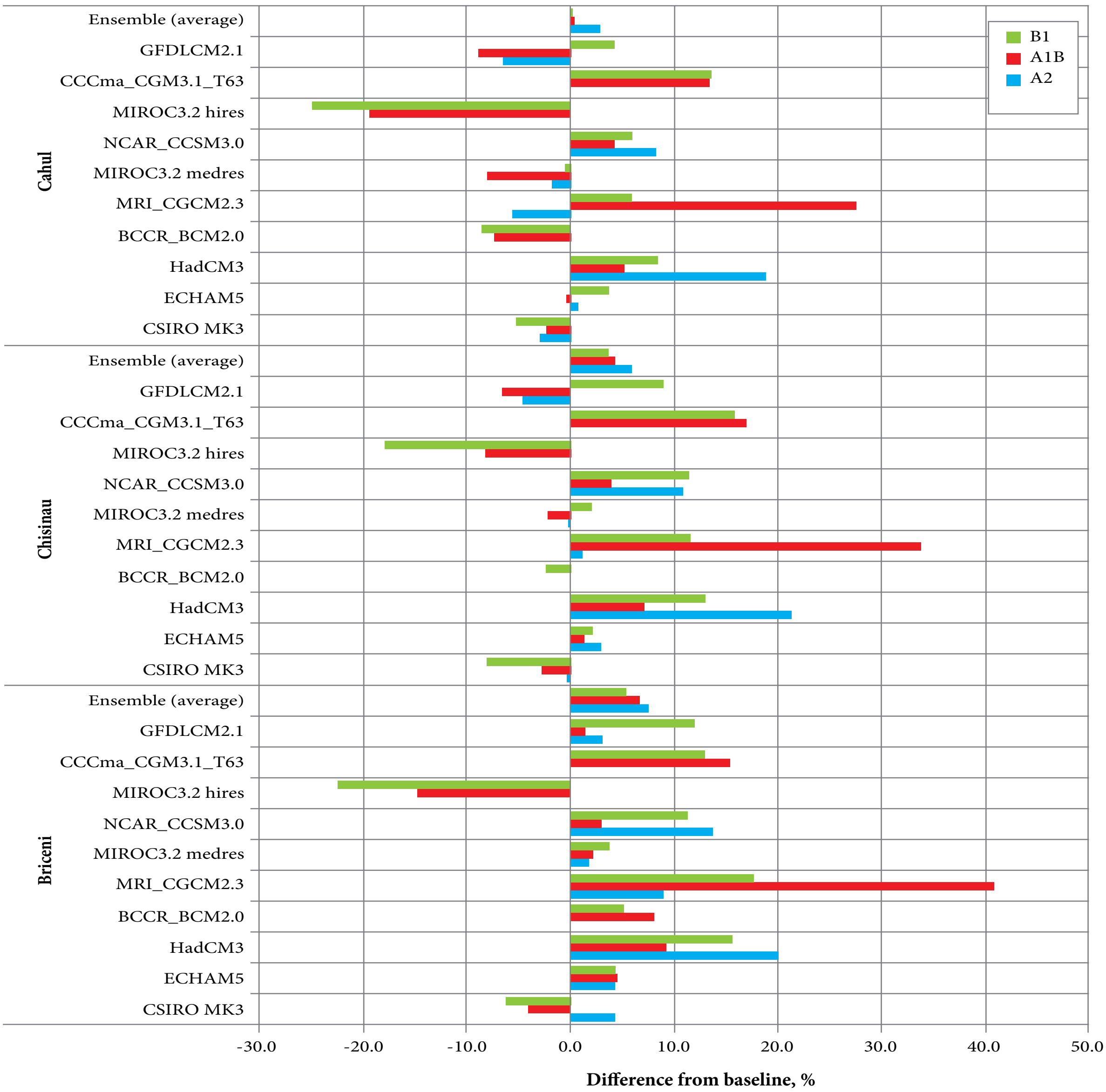


Figure 5-19: Projected Total DJF Precipitation Changes (ΔP, %), According to an Ensemble and 10 Individual GCMs for SRES A2, A1B, and B1 Emission Scenarios by the 2080s Relative to the 1961-1990 Climatological Baseline Period

in the Republic of Moldova during summer and autumn. The drying conditions are expected to characterize all country regions. The ensemble projections forced by A2 emission scenario project the greatest summer rainfall reduction by 26.4% in the southern and the lowest one by 16.1% in the northern areas. The pattern for ensemble projection forced by B1 is quite similar but the magnitude of changes is lower decrease from 8.4% to 4.6% with maximum seen again over the Southern and the minimum one over Northern AEZs in comparison to the reference time period 1961-1990 by 2080s (Table 5-6).

As shown above, large uncertainties are associated with changes in the winter precipitation patterns over the Republic of Moldova climate persist also for summer pattern since model agreement is poor compared to temperature. As example can serve the ensembles members individual *max* and *min* estimates of precipitation change in summer over Northern AEZ (the least vulnerable region conform projections for all SRES scenarios) varying from -46.4% (GFDLCM2.1) to +2.1% (MRI_CGCM2.3) for the A2 emission scenario, from -46.7% (GFDLCM2.1) to +35.2% (MIROC3.2 hires) for A1B, and from -36.6% (HadCM3) to +34.7% (MIROC3.2 hires) for the B1 scenario in comparison to the reference time period 1961-1990 by 2080s. The range of the changes projected over the Southern AEZ the most vulnerable area is higher varying from -57.9% (GFDLCM2.1) to -2.7% (MRI_CGCM2.3) for the A2 emission scenario, from -54.9% (GFDLCM2.1) to +37.7% (MIROC3.2 hires) for A1B and from -40.6% (HadCM3) to +23.2% (MIROC3.2 hires) for the B1 scenario (Figure 5-20).

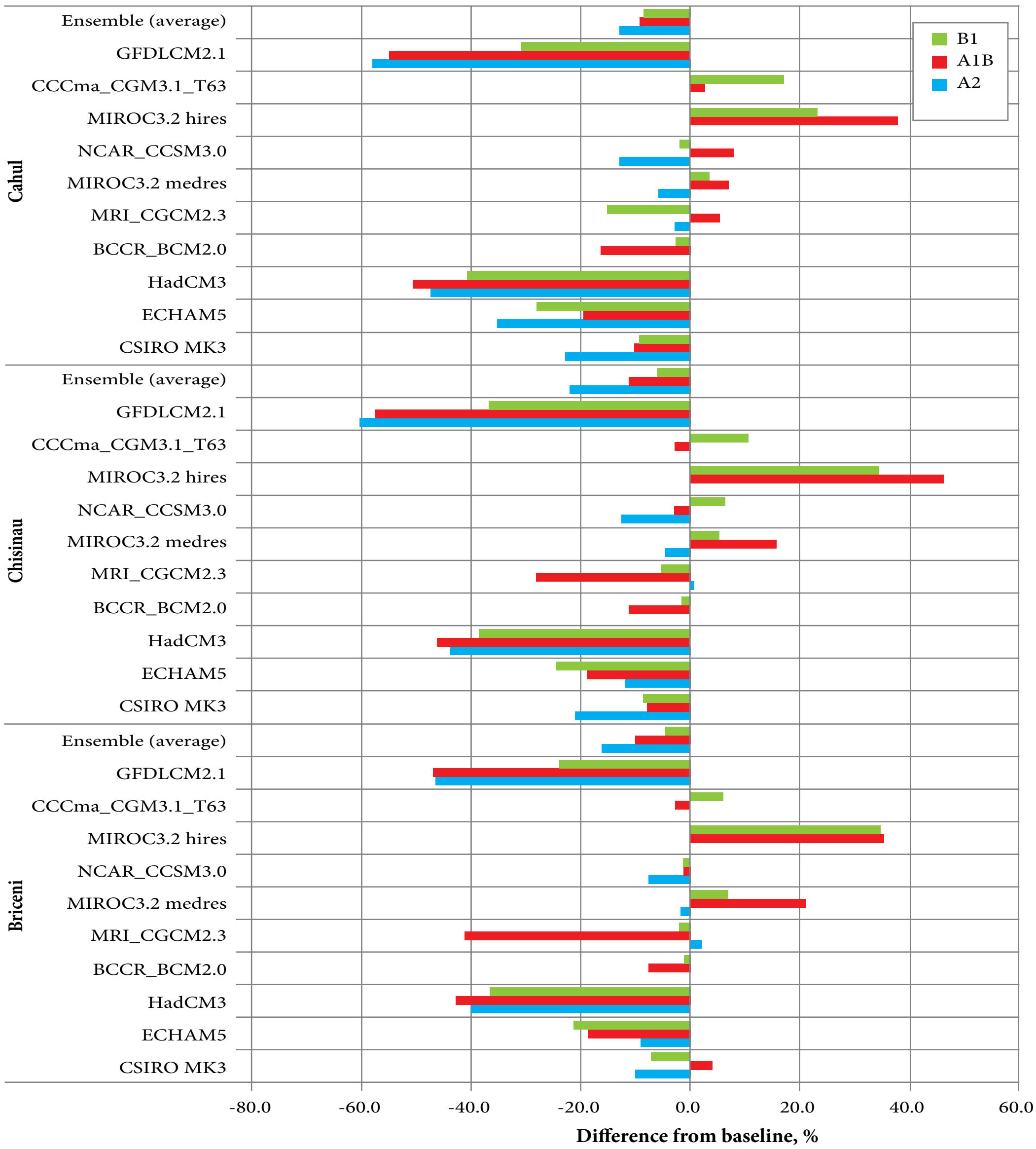


Figure 5-20: Projected Total JJA Precipitation Changes (ΔP, %), According an Ensemble and 10 Individual GCMs for SRES A2, A1B and B1 Emission Scenarios by the 2080s Relative to the 1961-1990 Climatological Baseline Period

c) Level of Supply with Heat and Humidity

For evaluating the thermal heat resources were calculated amount of active and effective temperatures above 0ºC, 5ºC, 10ºC and 15ºC for baseline climate (1961-1990), the current climate (1991-2010), as well as their projections of possible changes and deviations from the baseline climate (ºC), for three future time periods 2020s, 2050s and 2080s according to the ensembles of 10 GCMs for three SRES A2, A1B and B1 emission scenarios for the Northern, Central and Southern AEZs.

In the future RM's climate due to the earlier onset of spring and autumn elongation can be expected a substantial increase in the duration of the warm period. The duration of the warm period with temperatures above 0ºC for baseline climate varies from 260 days in the north of the country to 282 days in the south. As a result of climate change by the 2020s the duration of the warm period may increase from 17 days (under A2) to 14 days (accorSding to the scenario B1) in the Northern AEZ. In the Central and Southern AEZs the duration of the period with temperatures above 0ºC will increase in both scenarios for 9-11 days, respectively. To be noted, that actually observed growth over the last two decades (1991-2010) was for the Northern AEZ ↗ +18 days, for the Central AEZs ↗ +14, respectively for the Southern AEZs ↗+11 days, compared to baseline climate.

By the end of 2080s, duration of the period with temperatures above 0ºC in the Central and Southern AEZs will increase significantly from 37-40 days (for the scenario B1) to 66-68 days (for the A2 scenario). The lowest growth is expected in the Northern AEZ from 33 to 62 days (Table 5-7).

Table 5-7: Projected Ensemble Changes of the Dates when Average Daily Air Temperature is above 0ºC and Length of the Period with the Average Daily Air Temperature is above 0ºC (days) for SRES A2, A1B and B1 Emission Scenarios to the 1961-1990 Climatological Baseline Period in XXI Century

AEZ	A2			A1B			B1		
	Spring	Autumn	(+/-)	Spring	Autumn	(+/-)	Spring	Autumn	(+/-)
2020s									
Northern	08/03	10/12	**+17**	07/03	06/12	**+15**	07/03	06/12	**+14**
Central	01/03	15/12	**+9**	29/02	18/12	**+12**	01/03	17/12	**+11**
Southern	27/02	14/12	**+9**	26/02	16/12	**+11**	27/02	14/12	**+10**
2050s									
Northern	01/03	15/12	**+30**	27/02	15/12	**+31**	05/03	08/12	**+21**
Central	18/02	31/12	**+36**	13/02	01/01	**+42**	15/02	24/03	**+30**
Southern	07/02	31/12	**+45**	06/02	30/12	**+44**	14/02	25/12	**+32**
2080s									
Northern	15/02	04/01	**+62**	17/02	24/12	**+51**	27/02	16/12	**+33**
Central	24/01	07/01	**+68**	28/01	06/01	**+62**	15/02	01/01	**+40**
Southern	23/01	07/01	**+66**	31/01	07/01	**+57**	15/02	01/01	**+37**

Note: *The observed mean for baseline period 1961-1990: the date when average daily air temperature is above 0ºC (spring) - Briceni (16/03); Chisinau (06/03); Cahul (03/03); the date when average daily air temperature is above 0ºC (autumn) - Briceni (30/11); Chisinau (10/12); Cahul (09/12); length of the period with the average daily air temperature is above 0ºC, days - Briceni (260); Chisinau (280); Cahul (282).*

The growing season with temperatures above 5ºC for basic climate varies from 220 days in the north of the country up to 236 days in the south. Analysis of the data presented in the Table 5-8 shows that the growing season with temperatures above 5ºC will elongate, and its increase in the 2020s for the Northern and Southern AEZs can be from a week on the A2 up to 5-9 days for scenario B1, respectively. In the central region the duration of the growing season will increase in both scenarios, by 12 days.

In fact, the observed changes in the duration of the period with temperatures above 5ºC over the last 20 years were as follows: for the Northern ↘ -2 days, in Central ↗ +3 days, and Southern AEZs ↗ +8 days.

By the end of the 21th century the length of the period with the average daily temperatures above 5ºC will increase substantially from 14-21(B1) to 30-32 (A2) days in the Northern and Southern regions. The tendency to maximum increase of the growing season with temperatures above 5ºC in the Central region will persist, and by the 2080-s is expected that such periods will be 24-36 days longer (Table 5-8).

For all agro-ecological zones by the end of the century the growing season with temperatures above 5ºC will increase, mainly due to a late finish in the autumn (from 7 to 20[127] days in the Northern; 14 to 23 days in Central; and 14 to 20 days later in Southern AEZs), while the spring vegetation will start earlier than usual from 7 to 12 days in the Northern; from 9 to 13 days in Central; and from 7 to 10 days before in Southern AEZs.

The growing period with temperatures above 10ºC for the baseline climate varies from 172 days in the North of the

[127] Here and throughout the text the first number corresponds to the B1 scenario, the second to A2 scenario.

Table 5-8: Projected Ensemble Changes of the Dates when Average Daily Air Temperature is above 5ºC and Length of the Period with the Average Daily Air Temperature is above 5ºC (days) for SRES A2, A1B and B1 Emission Scenarios to the 1961-1990 Climatological Baseline Period in XXI Century

AEZ	A2			A1B			B1		
	Spring	Autumn	(+/-)	Spring	Autumn	(+/-)	Spring	Autumn	(+/-)
2020s									
Northern	25/03	08/11	+7	25/03	07/11	+6	26/03	07/11	+5
Central	22/03	18/11	+12	21/03	18/11	+13	20/03	17/11	+12
Southern	21/03	18/11	+7	19/03	20/11	+11	20/03	18/11	+9
2050s									
Northern	22/03	14/11	+16	22/03	13/11	+16	23/03	10/11	+11
Central	19/03	23/11	+19	16/03	25/11	+24	19/03	21/11	+19
Southern	17/03	25/11	+13	14/03	27/11	+22	17/03	23/11	+16
2080s									
Northern	17/03	25/11	+32	18/03	18/11	+25	22/03	12/11	+14
Central	13/03	04/12	+36	08/03	30/11	+37	17/03	25/11	+24
Southern	12/03	02/12	+30	10/03	28/11	+28	15/03	26/11	+21

Note: *The observed mean for baseline period 1961-1990: the date when the $T_{avg>5ºC}$ (spring) - Briceni (29/03); Chisinau (26/03); Cahul (22/03); the date when the $T_{avg>5ºC}$ (autumn) - Briceni (05/11); Chisinau (11/11); Cahul (12/11); length of the period with the $T_{avg>5ºC}$, days - Briceni (222); Chisinau (231); Cahul (236).*

country up to 182 days in the South. In connection to climate change is expected that the growing season with temperatures above 10°C will increase by 2020s from 21 to 22-23 days in the Southern and Central AEZ. The lowest growth by 7-10 days is possible in the Northern AEZ.

In fact, the observed changes in the length of the period with temperatures above 10°C over the last 20 years were as follows: for the Northern ↘ -1 day, in Central ↗ +6 days, and Southern AEZs ↗ +5 days.

By the end of 2080s length of the growing season with temperatures above 10°C will increase substantially from 42-41 to 32-34 days in the Central and Southern AEZs. The tendency to minimum increase of the growing season with temperatures above 10°C in the Northern areas will persist, and by the 2080-s would be expected that such periods will be only 37-25 days longer (Table 5-9).

The sum of active $\Sigma T_{ac > 5°C}$ and effective $\Sigma T_{ef > 5°}$ temperatures (lower limit of the grain crops development) will increase consistently on the territory of the Republic of Moldova. According to all three scenarios in the 2020-s is expected a small increase in the sum of active $\Sigma T_{ac > 5°C}$ and effective $\Sigma T_{ef > 5°}$ temperatures, about 9-11% and 12-16%[128].

By the end of 2080s the sum of active $\Sigma T_{ac > 5°C}$ and effective $\Sigma T_{ef > 5°}$ temperatures would increase significantly under high emission scenario A2 by 34-37%, respectively by 45-50%, and will make from 4267 and 2996°C for the Northern to 4911 and 3575°C for the Southern AEZs; slightly lower growth is expected according to low emission scenario B1 by 21-23% and respectively by 28-30%, varying from 3779 and 2599°C for the Northern, to 4434 and 3155°C for the Southern AEZs, relative to the baseline climate (Table 5-10; Figure 5-21).

For the majority of the cultivated plant species in the Republic of Moldova the biologically active air temperatures mean the sum of air temperatures values above 10°C. Already by 2020s the sum of biologically active and effective

[128] Here and throughout the text the first pair of numbers corresponds to the $\Sigma T_{ac > 5°C}$, the second one $\Sigma T_{ef > 5°C}$

Table 5-9: Projected Ensemble Changes of the Dates when Average Daily Air Temperature is above 10°C and Length of the Period with the Average Daily Air Temperature is above 10°C (days) for SRES A2, A1B and B1 Emission Scenarios Relative to the 1961-1990 Climatological Baseline Period in XXI Century

AEZ	A2			A1B			B1		
	Spring	Autumn	(+/-)	Spring	Autumn	(+/-)	Spring	Autumn	(+/-)
2020s									
Northern	18/04	16/10	+10	20/04	15/10	+7	20/04	15/10	+7
Central	04/04	21/10	+21	02/04	22/10	+23	03/04	21/10	+23
Southern	05/04	23/10	+21	04/04	23/10	+21	03/04	23/10	+22
2050s									
Northern	11/04	20/10	+20	08/04	19/10	+24	13/04	17/10	+16
Central	31/03	25/10	+28	30/03	27/10	+33	31/03	25/10	+29
Southern	31/03	29/10	+31	29/03	29/10	+33	31/03	28/10	+30
2080s									
Northern	01/04	27/10	+37	04/04	23/10	+31	07/04	19/10	+25
Central	28/03	04/11	+42	26/03	31/10	+40	30/03	27/10	+32
Southern	27/03	05/11	+41	27/03	02/11	+40	30/03	30/10	+34

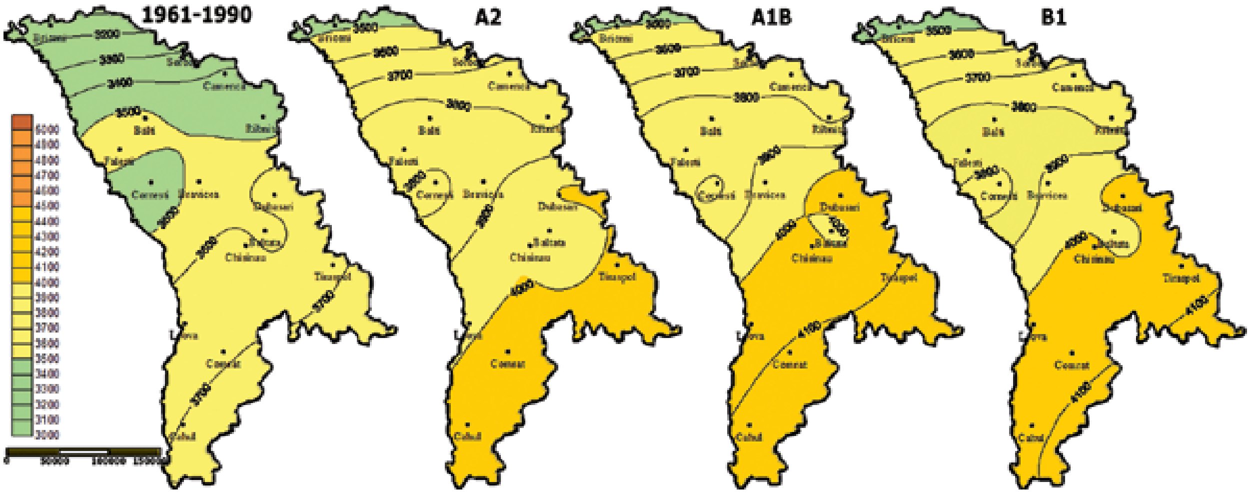
Note: *The observed mean for baseline period 1961-1990: the date when $T_{avg > 10°C}$ (spring) - Briceni (22/04); Chisinau (20/04); Cahul (21/04); the date when $T_{avg > 10°C}$ (autumn) - Briceni (10/10); Chisinau (16/10); Cahul (19/10); length of the period with the $T_{avg > 10°C}$, days - Briceni (172); Chisinau (180); Cahul (182).*

Table 5-10: Projected Ensemble Changes in the Amounts of Active and/or Effective Air Temperatures above 5°C for SRES A2, A1B and B1 Emission Scenarios Relative to the 1961-1990 Climatological Baseline Period in XXI Century

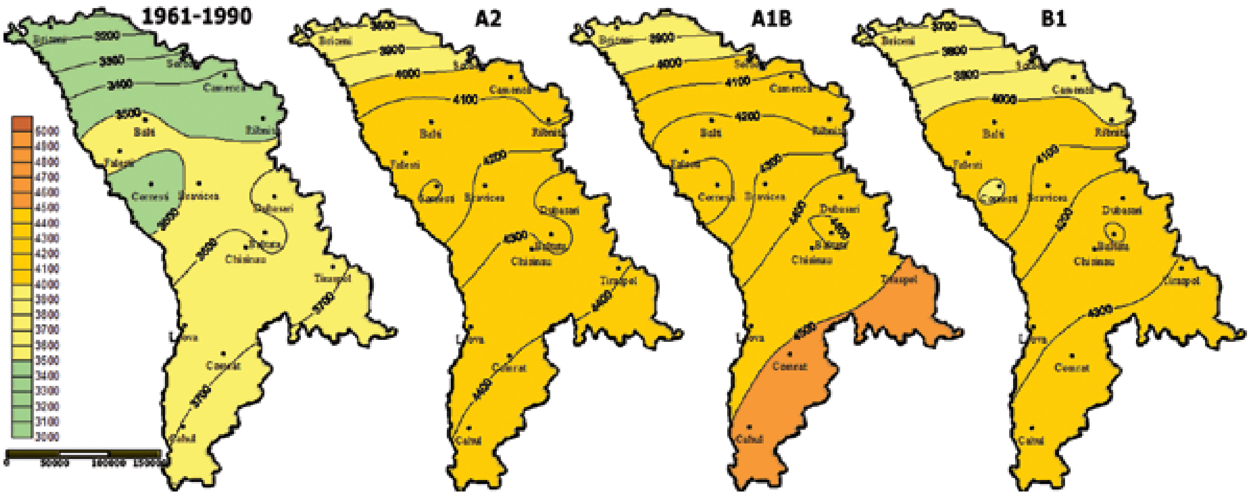
AEZ	A2				A1B				B1			
	$\Sigma T_{ac>5°C}$	%	$\Sigma T_{ef>5°C}$	%	$\Sigma T_{ac>5°C}$	%	$\Sigma T_{ef>5°C}$	%	$\Sigma T_{ac>5°C}$	%	$\Sigma T_{ef>5°C}$	%
2020s												
Northern	3437	11	2291	15	3453	11	2312	16	3430	10	2295	15
Central	3930	10	2720	12	3991	11	2773	14	3973	11	2759	14
Southern	3986	9	2770	12	4065	11	2828	14	4035	10	2811	14
2050s												
Northern	3757	21	2570	29	3803	22	2617	31	3654	18	2486	25
Central	4282	20	3033	25	4389	23	3113	28	4206	17	2957	22
Southern	4358	19	3091	25	4467	22	3175	28	4275	17	3016	22
2080s												
Northern	4267	37	2996	50	4103	32	2872	44	3779	22	2599	30
Central	4843	35	3508	45	4657	30	3322	37	4403	23	3126	29
Southern	4911	34	3575	45	4754	30	3433	39	4434	21	3155	28

Note: *The observed mean annual sum of active and effective temperatures for reference period (1961-1990) were as following: ΣT_{ac} >5°C - Briceni (3105°C); Chisinau (3581°C); Cahul (3652°C). ΣT ef >5°C - Briceni (1995°C); Chisinau (2426°C); Cahul (2472°C).*

2020s



2050s



2080s

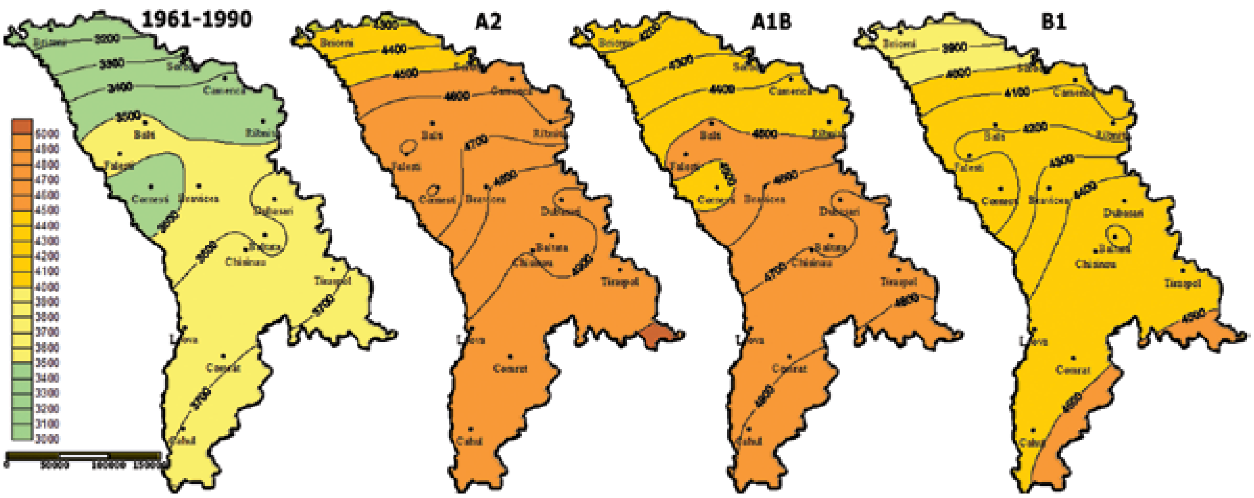


Figure 5-21: Projected Multi - Model Ensemble Sum of Active $\Sigma T_{ac > 5°C}$ Temperature, °C Development throughout the Republic of Moldova[1]

[1] Climate Change Office, 2012: <http://www.clima.md/public/files/ProiectiiClima/en/ClimateMaps.html>.

temperatures above 10°C will grow by 12-14 and 18-22%[129] under high emission scenario A2; and by 11-16 and 23-20% according to the low emission scenario B1.

By the end of 2080s the sum of active $\Sigma T_{ac>10°C}$ and effective $\Sigma T_{ef>10°}$ temperatures will increase essentially by 42-43 and 79-67% under the high emission scenario A2, and will make from 3930 and 1834°C for the Northern to 4600 and 2347°C in the Southern AEZs; slightly lower growth is projected according to the low emission scenario B1 by 27-28 and 48-41%, and will make from 3481 and 1514°C for the Northern to 4128 and 1983°C in the Southern AEZs relative to the baseline climate (Table 5-11).

Figure 5-22 present the multi-model ensemble estimation of spatial distribution of the Republic of Moldova's heat supply development (sum of active $\Sigma T_{ac>10°C}$) for SRES A2, A1B and B1emission scenarios relative to the baseline climate 1961-1990 in the XXI century.

[129] Here and throughout the text the first pair of number corresponds to the $\Sigma T_{ac>10°C}$, the second one $\Sigma T_{ef>10°C}$

If in the baseline climate the growing degree days of active vegetation with $\Sigma T_{ac>10°C}$ varies across the territory from 2800 to 3300°C then by the end of 2080 these values could rise according to the high emission scenario A2 from 4000 to 4700°C and/or from 3500 to 4300°C under the low emission scenario B1.

Ivanov's aridity index (AI) (Ivanov, 1962) was used to perform a more ample analysis of the temperature/humidity ratio development. AI = P/E, where P is the sum of precipitation values (mm) and E is the potential evaporation (mm). The indicator allows assessing the development of the climate aridity rate throughout the year or during certain periods which are crucial for certain crops or species.

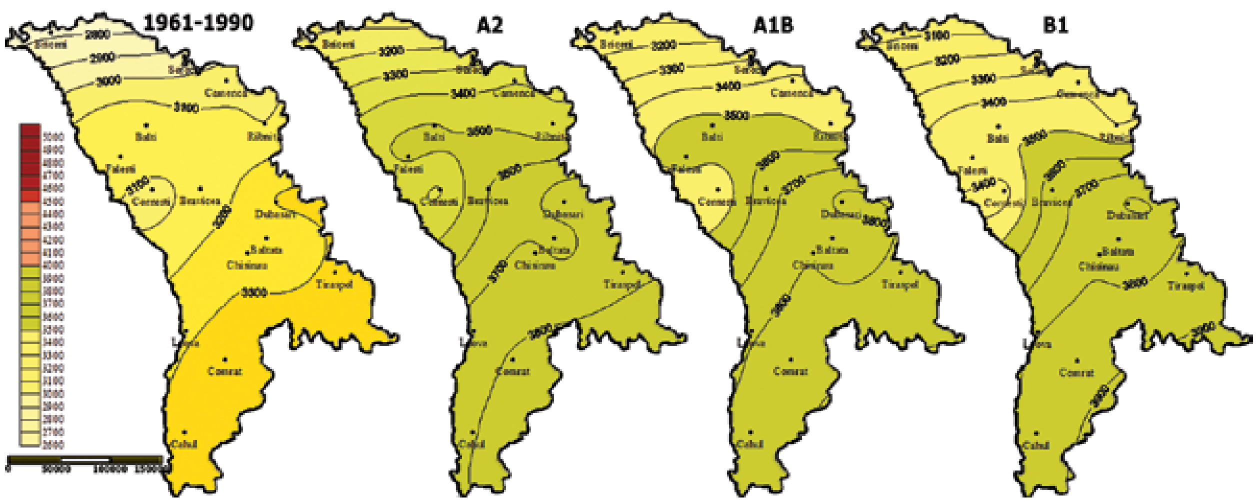
The aridity rate was assessed using the following assessment scale: AI ≤ 0.05 – hyper-arid climate; AI = (0.05 – 0.20) – arid climate; AI = (0.21 – 0.50) – semi-arid climate; AI = (0.51 – 0.65) – dry-sub-humid climate; and AI ≥ 0.65 – sub-humid and humid climate.

Table 5-11: Projected Ensemble Changes in the Amounts of Active and/or Effective Air Temperatures above 10°C for SRES A2, A1B and B1 Emission Scenarios Relative to the 1961-1990 Climatological Baseline Period in XXI Century

AEZ	A2				A1B				B1			
	$\Sigma T_{ac>10°C}$	%	$\Sigma T_{ef>10°C}$	%	$\Sigma T_{ac>10°C}$	%	$\Sigma T_{ef>10°C}$	%	$\Sigma T_{ac>10°C}$	%	$\Sigma T_{ef>10°C}$	%
2020s												
Northern	3074	12	1253	22	3101	13	1278	25	3049	11	1262	23
Central	3627	14	1620	18	3692	16	1662	21	3679	16	1653	20
Southern	3682	14	1652	18	3724	16	1699	21	3732	16	1689	20
2050s												
Northern	3833	40	1480	44	3481	27	1526	49	3292	20	1416	38
Central	3975	25	1891	38	4078	28	1951	42	3906	23	1817	32
Southern	4064	26	1932	38	4147	29	1999	43	3980	24	1859	33
2080s												
Northern	3930	43	1834	79	3772	37	1742	70	3481	27	1514	48
Central	4516	42	2293	67	4308	36	2123	54	4096	29	1964	43
Southern	4600	43	2347	67	4439	38	2224	59	4128	28	1983	41

Note: *The observed mean annual sum of active and effective temperatures for reference period (1961-1990) were following: ΣTac >10°C - Briceni (2745°C); Chisinau (3175°C); Cahul (3222°C); ΣT ef >10°C - Briceni (1025°C); Chisinau (1375°C); Cahul (1402°C).*

2020s



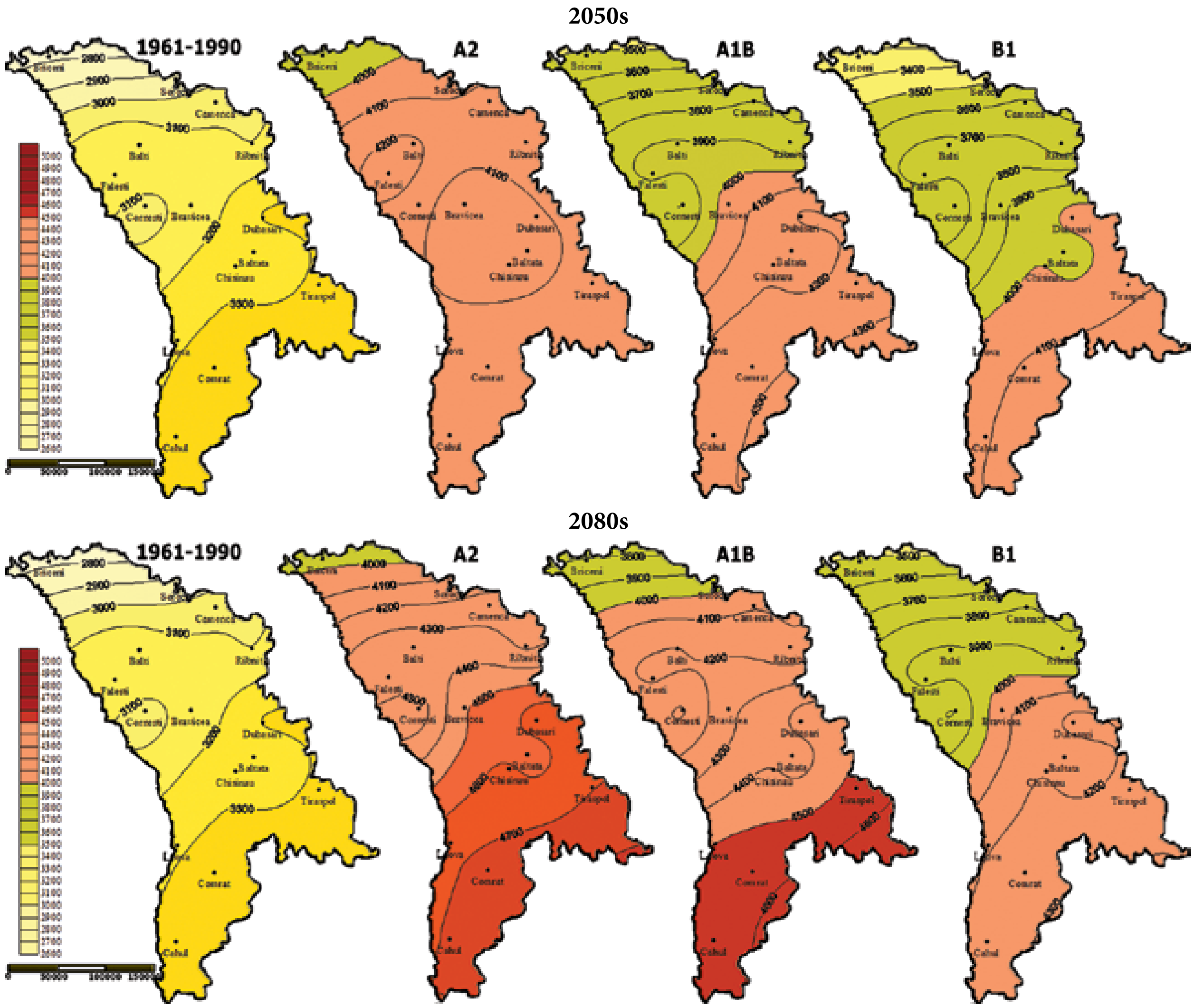


Figure 5-22: Projected Multi - Model Ensemble Sum of Active $\Sigma T_{ac>10^{\circ}C}$ Temperature, °C Development throughout the Republic of Moldova [1]

[1] Climate Change Office, 2013: <http://www.clima.md/public/files/ProiectiiClima/en/ClimateMaps.html>.

According to the above classification, most of the Republic of Moldova's territory is characterized currently with dry or sub-humid climate (0.50 ≥ AI ≤ 0.65). Certain areas in the South-East have semi-arid climate (AI ≥ 0.48), and the Northern zone and the areas with altitudes above 350-400 meters above sea level have sub-humid and humid climate (AI ≥ 0.65).

The dynamic of changes in humidity conditions over the century, expressed in annual AI is shown in Figure 5-23. It is evident that the Republic of Moldova is moving towards a dryer climate, from dry or sub-humid climate to dry sub-humid and semi-arid climate.

For all three SRES emission scenarios are expected worsening of the humidity conditions throughout the territory of the Republic of Moldova. Reduced rainfall in the summer and autumn period (not compensated by a slight increase in winter and spring precipitation) against a background of rising temperatures will cause the strong moisture deficit and sequential increase of the potential evaporation during the XXI century.

Potential evaporation is likely will increase by 9-13 per cent during the growing season over the 2020s, and run up to 40-45 per cent by the 2080s and make from 810 mm[130] for the Northern to 1074 mm in the Southern AEZs under the high emission scenario A2; slightly lower growth is projected according to the low emission scenario B1, by 22-27 per cent, from 713 mm for the Northern, to 942 mm in the Southern AEZs, relative to the baseline climate (Table 5-12).

The obtained results allow conclude that in the future the climate aridization process during the growing season may accelerate considerably on the territory of the Republic of

[130] For comparison purposes, it is worth noting that the observed mean PE during the growing season in the reference period (1961-1990) was as following: Briceni – 562 mm; Chisinau – 770 mm; Cahul – 742 mm.

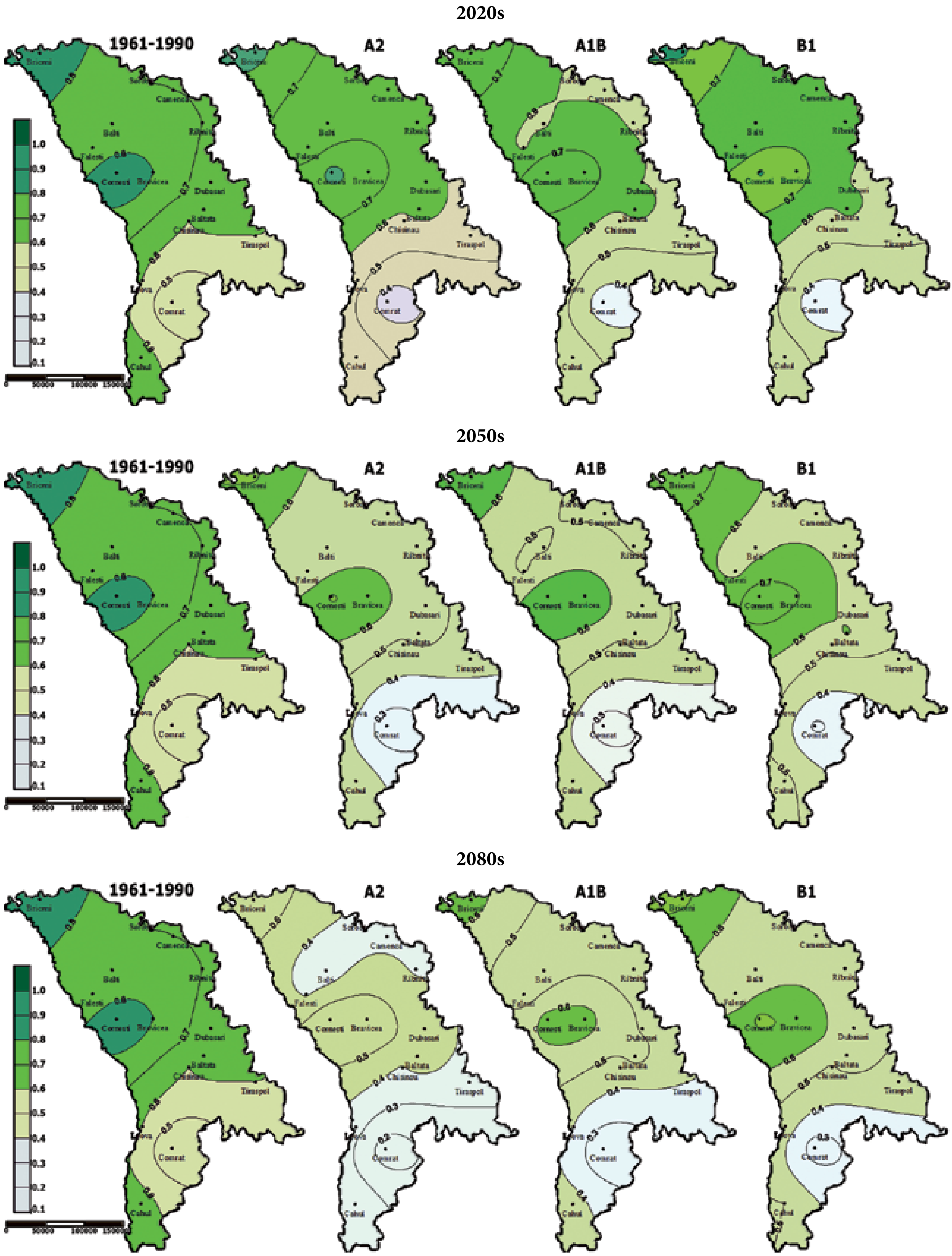


Figure 5-23: Projected Multi - Model Ensemble Annual Aridity Index (AI) Development throughout the Republic of Moldova[1]

[1] Climate Change Office, 2013: <http://www.clima.md/public/files/ProiectiiClima/en/ClimateMaps.html>.

Table 5-12: Projected Ensemble Changes in the Potential Evaporation (PE) and Ivanov's Aridity Index (AI) during the growing season for SRES A2, A1B and B1 Emission Scenarios Relative to the 1961-1990 Climatological Baseline Period in XXI Century

AEZ	A2				A1B				B1			
	PE		AI		PE		AI		PE		AI	
	mm	%	Index	%	mm	%	Index	%	mm	%	Index	%
2020s												
Northern	633	+13	0.69	-9	644	+15	0.66	-13	637	+13	0.69	-9
Central	843	+9	0.42	-9	856	+11	0.41	-11	853	+11	0.42	-9
Southern	831	+12	0.44	-12	845	+14	0.44	-12	842	+13	0.44	-12
2050s												
Northern	704	+25	0.60	-21	644	+29	0.57	-25	679	+21	0.66	-13
Central	948	+23	0.35	-24	856	+24	0.35	-24	904	+17	0.39	-15
Southern	935	+26	0.35	-30	845	+28	0.36	-28	900	+21	0.40	-20
2080s												
Northern	810	+44	0.48	-37	782	+39	0.53	-30	713	+27	0.60	-21
Central	1080	+40	0.28	-39	1014	+32	0.33	-28	942	+22	0.37	-20
Southern	1074	+45	0.28	-44	1024	+38	0.34	-32	942	+27	0.38	-24

Note: *The observed mean PE and AI during the growing season for reference period (1961-1990) were as following: PE - Briceni (562mm); Chisinau (770mm); Cahul (742mm); AI – Briceni (0.76); Chisinau (0.46); Cahul (0.50)*

Moldova. Thus, already in the early 2020s that process would intensify noticeably as compared to the reference period of 1961-1990 (Figure 5-24). That phenomenon will be more pronounced during July to October.

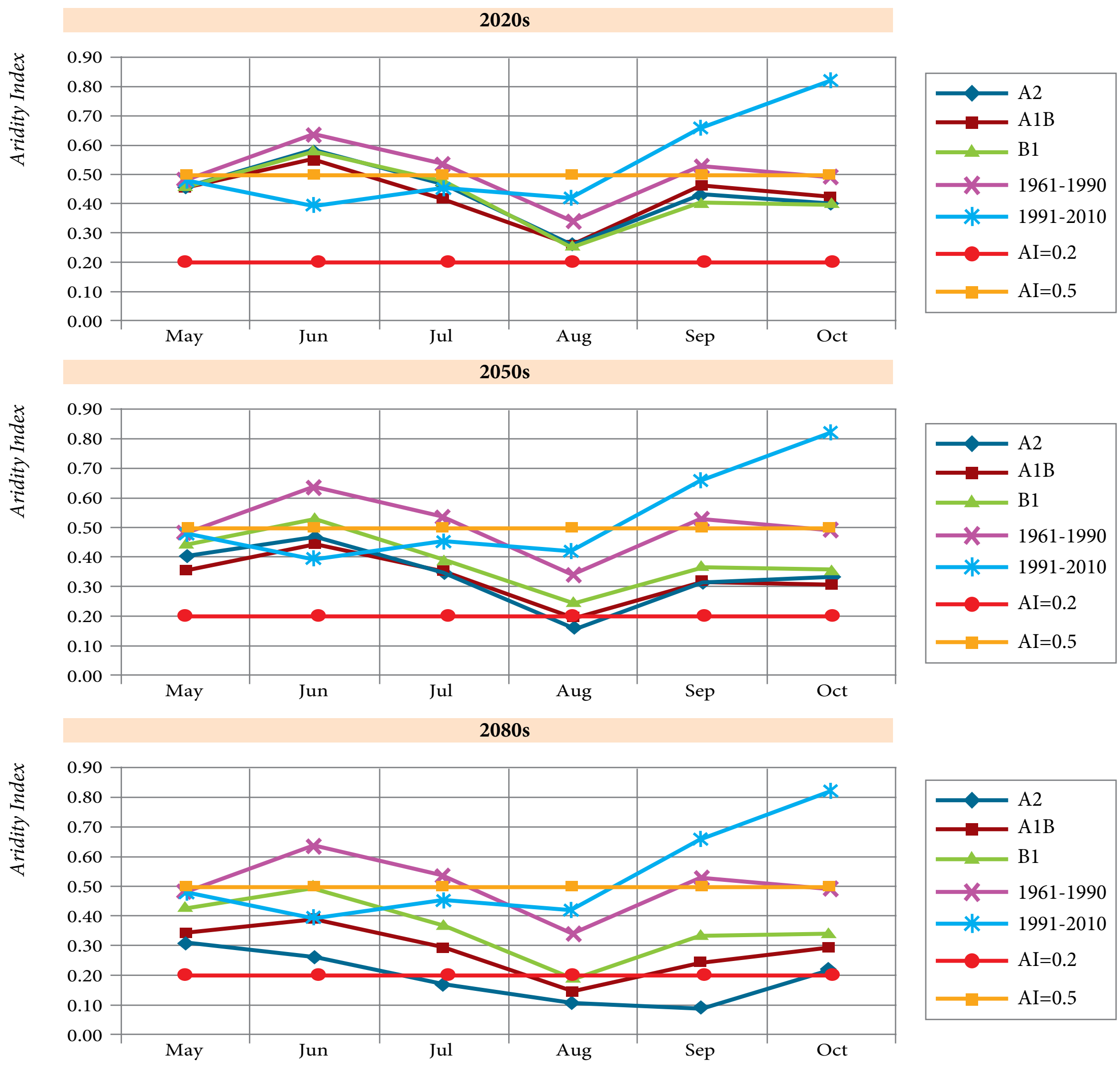


Figure 5-24: Projections of the Aridity Index (AI) Development Pattern for the Central AEZ of the Republic of Moldova from an Ensemble of 10 Global Models for the SRES A2, A1B and B1 Emission Scenarios, as Compared to the Reference Period Climate (1961-1990)

By the 2080s the climate aridization will be felt during the whole vegetation period (April to October); it will be much more pronounced and may result in values characteristic to the semi-arid climate (AI = 0.21-0.50). Compared to reference period (1961-1990), all climatic scenarios applied for the assessment purposes, have demonstrated that the aridity would be higher in August (in the case of A2 scenario, also in July, August and September), achieving in respective periods values characteristic to arid climate conditions (AI = 0.05-0.20).

An assessment of the hydro-thermal coefficient (HTC) was performed to identify the climate change patterns during the plant vegetation period. HTC is a relative empirical index, which reflects the humidity rate and which is calculated as the ratio between the sum precipitation level (R) expressed in millimeters for the period with the average daily air temperatures above 10°C and the sum of daily average temperatures above 10°C (Σ T) for the same period of time divided by 10, i.e.: $HTC = R/0.1\ \Sigma\ T_{>10°C}$, when the value of that index is 1.0 it means that the amount of the precipitations is equal to the amount of the evaporated moisture. HTC is frequently used for monitoring drought conditions during growing period.

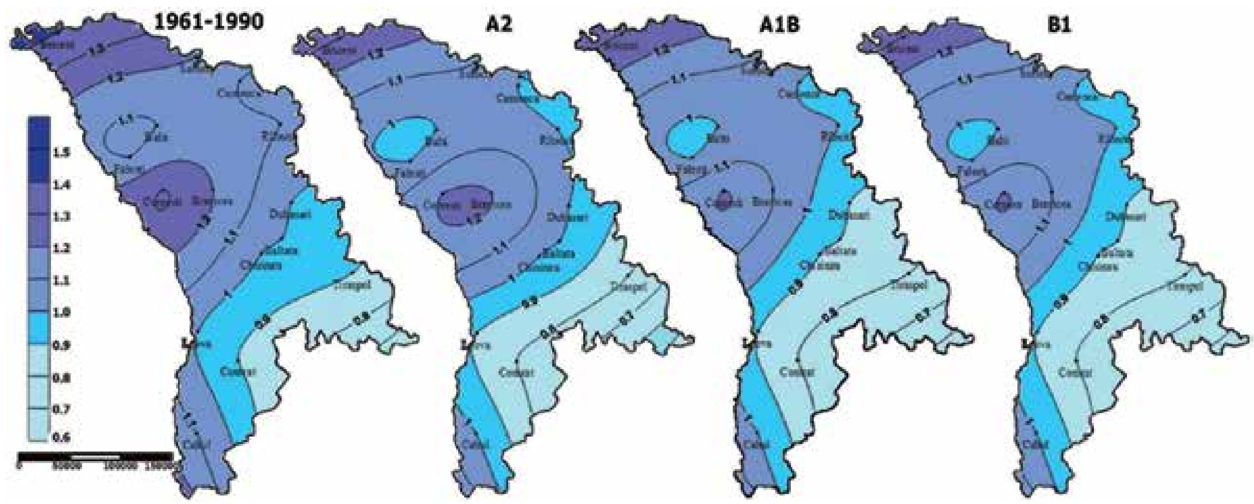
In the RM's the baseline climatic conditions HTC ranges from 1.4 in the North to 0.7 in the South-East of the country, i.e. registers the values characteristic of the moderately dry climate in the former case and of the dry climate in the latter case. The assessment of that index has shown that the insufficiency of moisture would become more pronounced in the future as compared to the climate of the reference period, Figure 5-25 clearly demonstrates the gradual aridization of the Republic of Moldova territory, including the northern areas, which today are still sufficiently wet.

In the Table 5-13 it is provided the characterization of humidity conditions during the plant vegetation period using the Selianinov hydrothermal coefficient (HTC) for the reference period, current climate and projected ensemble changes in the HTC during the growing season for SRES A2, A1B and B1 emissions scenarios relative to the 1961-1990 clima-

Table 5-13: Projected Ensemble Changes in the Selianinov Hydrothermal Coefficient (HTC) during the growing season for SRES A2, A1B and B1 Emission Scenarios Relative to the 1961-1990 Climatological Baseline Period in XXI Century

AEZ	Scenario	Month of the year							
		IV	V	VI	VII	VIII	IX	X	IV-X
1961-1990									
Northern	Baseline climate	1.9	1.6	1.7	1.5	1.1	1.1	1.0	1.4
Central		1.4	1.0	1.3	1.1	0.7	0.9	0.9	1.0
Southern		1.3	1.1	1.3	1.0	0.9	1.0	0.8	1.1
1991-2010									
Northern	Current climate	1.6	1.4	1.5	1.8	1.1	1.4	1.5	1.5
Central		1.2	1.0	0.9	1.0	0.9	1.2	1.3	1.1
Southern		1.2	0.9	1.1	0.9	0.8	1.0	1.2	1.0
2020s									
Northern	A2	1.8	1.6	1.7	1.4	1.0	0.9	0.8	1.3
	A1B	1.8	1.5	1.5	1.3	0.9	1.0	0.8	1.3
	B1	1.7	1.6	1.6	1.5	1.0	0.9	0.8	1.3
Central	A2	1.3	1.0	1.2	1.0	0.6	0.8	0.7	1.0
	A1B	1.3	1.0	1.2	0.9	0.6	0.9	0.8	0.9
	B1	1.2	1.0	1.2	1.0	0.6	0.8	0.7	0.9
Southern	A2	1.2	1.1	1.2	1.0	0.7	0.9	0.7	1.0
	A1B	1.2	1.1	1.3	0.9	0.7	0.9	0.7	1.0
	B1	1.2	1.1	1.3	0.9	0.7	0.9	0.7	1.0
2050s									
Northern	A2	1.5	1.4	1.5	1.3	0.9	0.8	0.7	1.2
	A1B	1.6	1.4	1.4	1.2	0.9	0.9	0.7	1.1
	B1	1.7	1.6	1.6	1.3	1.0	0.9	0.8	1.3
Central	A2	1.2	0.9	1.1	0.8	0.5	0.7	0.6	0.8
	A1B	1.2	0.9	1.0	0.9	0.6	0.7	0.6	0.8
	B1	1.2	1.0	1.2	0.9	0.6	0.8	0.7	0.9
Southern	A2	1.1	1.0	1.0	0.8	0.5	0.8	0.6	0.8
	A1B	1.1	1.0	1.1	0.8	0.6	0.8	0.6	0.9
	B1	1.1	1.1	1.2	0.9	0.7	0.8	0.7	0.9
2080s									
Northern	A2	1.5	1.4	1.3	1.0	0.7	0.6	0.6	1.0
	A1B	1.5	1.4	1.3	1.1	0.7	0.8	0.6	1.1
	B1	1.6	1.6	1.5	1.9	0.7	0.8	0.7	1.3
Central	A2	1.1	0.8	0.8	0.6	0.5	0.5	0.5	0.7
	A1B	1.1	0.9	1.0	0.8	0.5	0.7	0.6	0.8
	B1	1.2	1.0	1.1	0.9	0.5	0.8	0.7	0.9
Southern	A2	1.0	0.9	0.8	0.6	0.5	0.5	0.5	0.7
	A1B	1.0	1.0	1.0	0.8	0.6	0.7	0.6	0.8
	B1	1.1	1.1	1.1	0.8	0.6	0.8	0.6	0.9

2020s



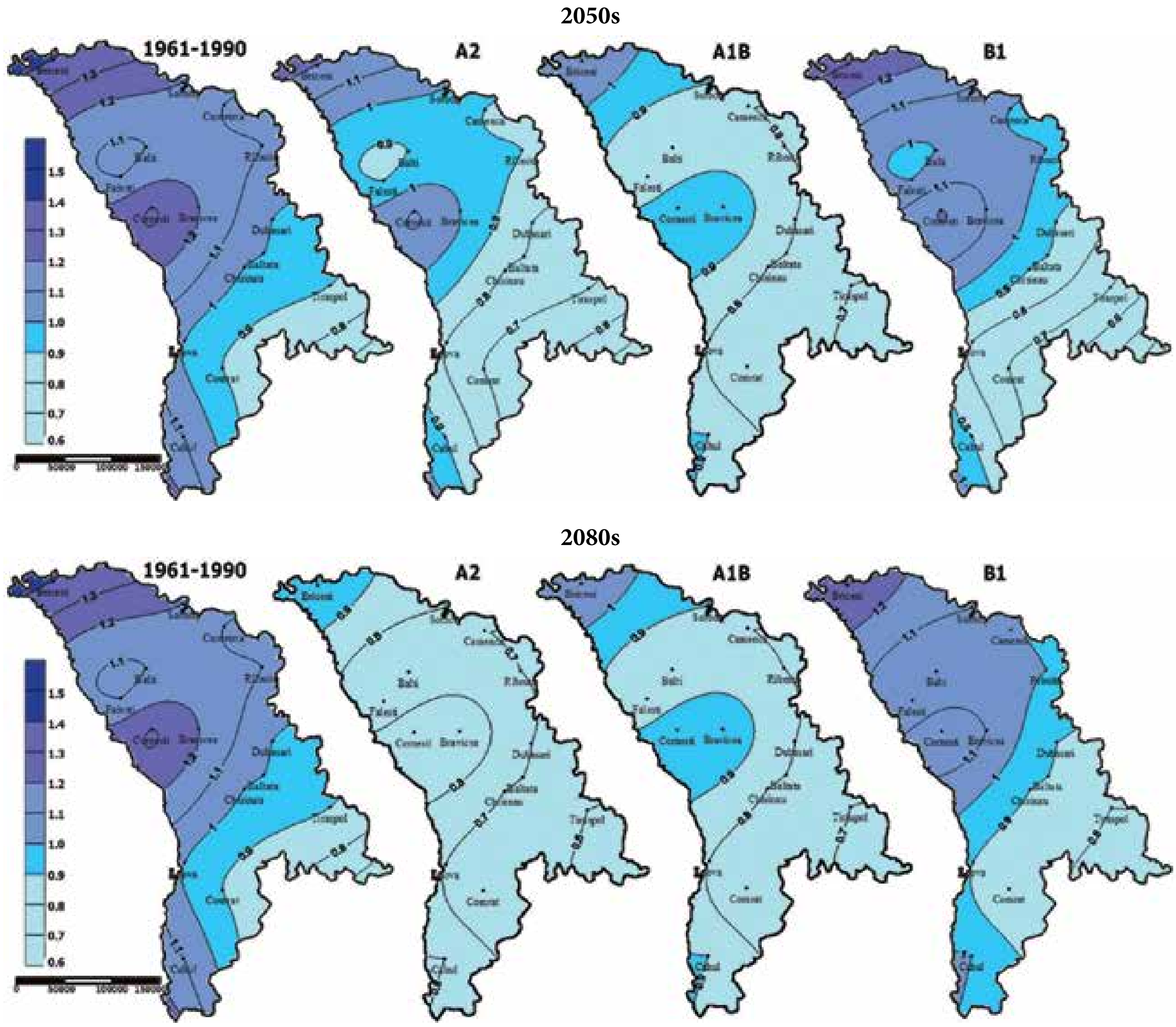


Figure 5-25: Projected Multi - Model Ensemble HTC Indices Development for the Vegetation Period throughout the Republic of Moldova[1]

[1] Climate Change Office, 2013: <http://www.clima.md/public/files/ProiectiiClima/en/ClimateMaps.html>.

tological baseline period in XXI century, where: *HTC> 1 - sufficient humidity; HTC ≤ 0.7 - drought conditions; HTC = 0.6 - medium drought; HTC ≤ 0.5 - strong drought*.

Analysis of data shows that by 2080s the drought conditions of HTC ≤ 0.7 will be observed on the whole territory of Moldova including the Northern AEZ and what is more in the Central and Southern AEZs under A2 high emission scenario in July, August, September, and October those levels can achieve even the values characteristic of the medium drought (HTC = 0.6) and strong drought (HTC ≤ 0.5).

In addition to AI to assess climate AEZs of the region was used another integral Ivanov's Index of the Biological Effectiveness of the Climate (IBEC). IBEC is a product of the sum of active temperatures above 10°C in hundreds of degrees:

$$IBEC = 0.01\sum T_{>10^{\circ}C} \ K$$

IBEC synthesizes the most important climatic variables: precipitation, temperature and relative humidity of the air, covered in their annual cycle, as well as the annual heat supply; and well expresses the general ecological background.

It is estimated that the area of ecological optimum corresponds to IBEC 22. The area with the corresponding value of IBEC is a kind of environmental axis or core, of which the natural habitat conditions deteriorate, on the one hand, to the north (due to the general reduction of the heat supply), on the other hand, to the south (due to reduced natural moisture availability of the territory and at the same time enhance of thermal discomfort due to excessive heat).

This clearly shows the latitude-zonal pattern of climate variability. The national projections Figure 5-26 clearly demonstrates the gradual worsening of optimal ecological-climatic characteristics for plant growing of the Republic of Moldova's territory, including the northern areas by the 2080s.

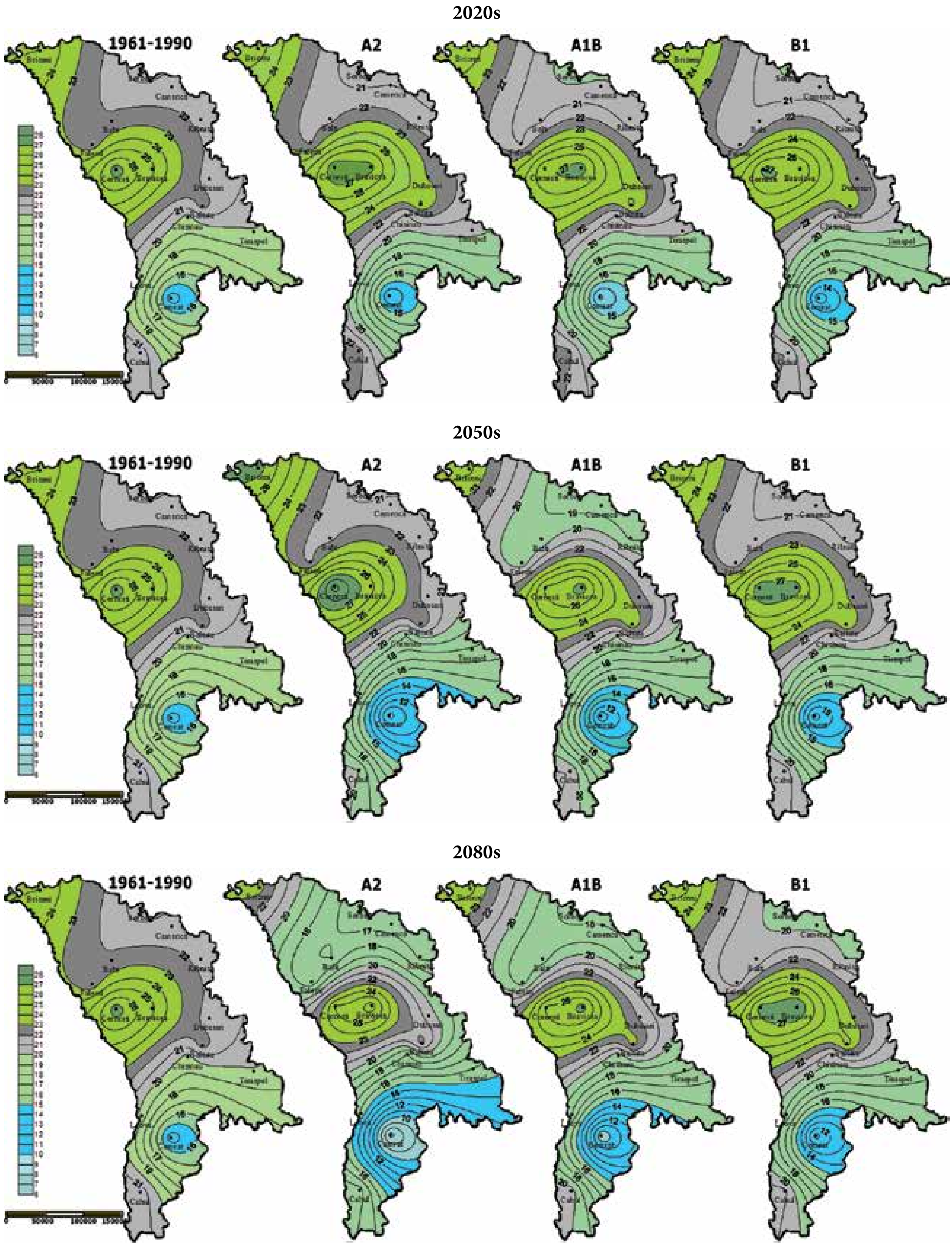


Figure 5-26: Projected Multi - Model Ensemble Ivanov Index of the Biological Effectiveness of Climate (IBEC) Development throughout the Republic of Moldova[1]

[1] Climate Change Office, 2013: <http://www.clima.md/public/files/ProiectiiClima/en/ClimateMaps.html>.

5.3.3. Generating High Resolution Climate Change Scenario

A regional climate model PRECIS (Providing Regional Climates for Impacts Studies)[131], developed by the UK Met Office Hadley Centre, was used to provide detailed maps and statistics of climate change across the RM during the 2020s, 2050s and 2080s. Three experiments were designed for our work in close collaboration with PRECIS team: two experiments were aimed to simulate present day climate (1961-1990) the first experiment was driven by **ERA-40_reanalyses, from ECMWF** and the second one by **ECHAM5 GCM**, and the last experiment planned for 21 century future climate simulation was driven with boundary conditions from **A1B-medium emission scenario.** The Figure 5-27 shows the main PRECIS window (A) and domain of study resolution 0.22º x 0.22º giving grid boxes of approximately 25 km x 25 km (B).

Annual temperature: all zones of the Republic of Moldova will get warmer. Under the PRECIS/ECHAM5 SRES A1B medium emission scenario mean annual temperature are projected to increase by 1.2-1.6^{0}C during the 2020s, 2.5-2.9°C by the 2050s and 4.1-4.5°C by the 2080s. Although mean annual temperatures will probably increase in all AEZs, the increase is likely to be the greatest in the Southern AEZ (Table 5-14; Figure 5-28 A).

Annual Precipitation: annual precipitation tends to decrease across the Republic of Moldova. Across the Republic of Moldova regional average annual precipitation decrease are projected to be between 2.5-21.5% by the 2080s (Table 5-14). Figure 5-28B shows estimates of annual precipitation change at the 25x25 km spatial resolution for the 2080s. Projections of average annual precipitation change in the RM get lower over time. Projected changes in average annual precipitation are from +1.8 % to -12.0% during the 2020s, from +7.8% to – 9.5% by the 2050s and from -2.5% to -21.5% by the 2080s.

[131] Jones, R.G., Noguer, M., Hassell, D.C., et al. (2004) Generating high resolution climate change scenarios using PRECIS, Met Office Hadley Centre, Exeter, UK, 40pp.

Table 5-14: Projected PRECIS/ECHAM5 Annual and Seasons Air Temperature, (°C) and Precipitation, (%) Changes Presented for Three 30 Year Time Slices in the Future, Centered on the 2020s, 2050s and 2080s for SRES A1B Emission Scenario Relative to the 1961-1990 Climatological Baseline Period

Season	Projected changes by the 2020s		Projected changes by the 2050s		Projected changes by the 2080s	
	T	P	T	P	T	P
Northern AEZ						
Annual	1.2	1.8	2.5	7.8	4.1	-2.5
DJF	2.2	3.1	4.0	10.4	5.3	0.7
JJA	0.3	-7.4	1.5	-4.3	3.8	-22.7
Central AEZ						
Annual	1.4	-8.1	2.7	-5.0	4.4	-17.7
DJF	2.2	-11.5	3.8	-5.8	5.1	-14.0
JJA	0.6	-7.7	1.9	-11.0	4.2	-30.5
Southern AEZ						
Annual	1.6	-12.0	2.9	-9.5	4.5	-21.5
DJF	2.3	-17.5	3.8	-12.3	5.1	-20.9
JJA	0.9	-16.8	2.3	-25.3	4.5	-34.2

Temperatures in winter can increase faster than those in summer for all climate zones. Projections of seasons average temperature change in the Republic of Moldova also get larger over time. Projected increases in average summer temperature are between 0.3-0.9°C during the 2020s, 1.5-2.3°C by the 2050s and 3.8-4.5°C by the 2080s (Table 5-14; Figure 5-29A).

The winter warming according to PRECIS/ECHAM5 SRES A1B medium emission scenario excepted to be even larger than summer, the projected increases in average winter temperatures are between 2.2-2.3°C during the 2020s; 3.8-4.0°C by 2050s and 5.1-5.3°C by the 2080s. The spatial distribution of the changes is quite different, the strongest temperature rise occurring over the Northern AEZ (Table 5-14; Figure 5-30A).

Figure 5-27: The main PRECIS window **(A)** and domain of study resolution 0.22º x 0.22º giving grid boxes of approximately 25 km x 25 km **(B)**

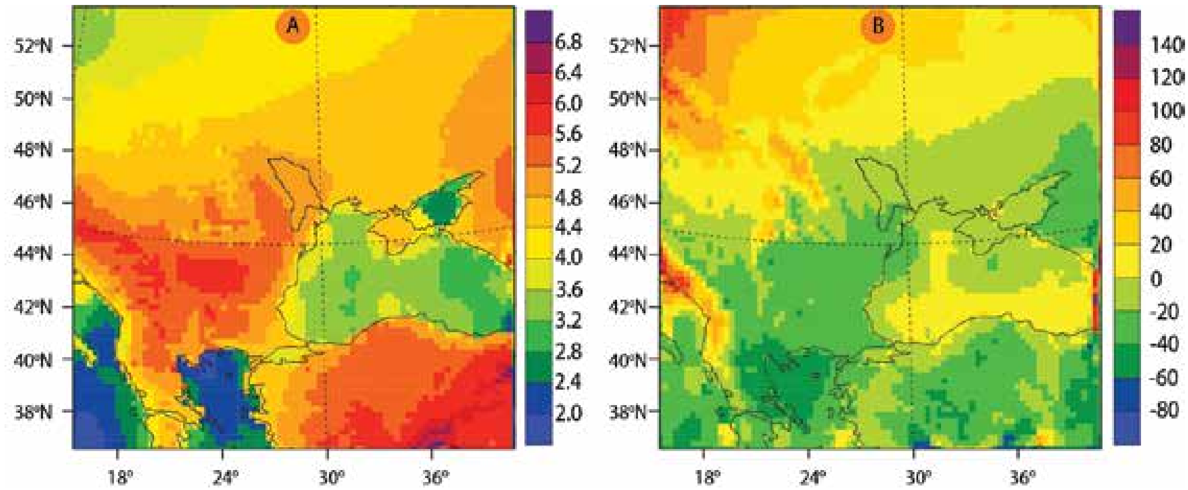


Figure 5-28: Projected PRECIS/ECHAM5 SRES A1B Future Changes in Annual **(A)** Mean Air Temperature (°C) and **(B)** Precipitation (%) by 2080s relative to 1961-1990 baseline periods

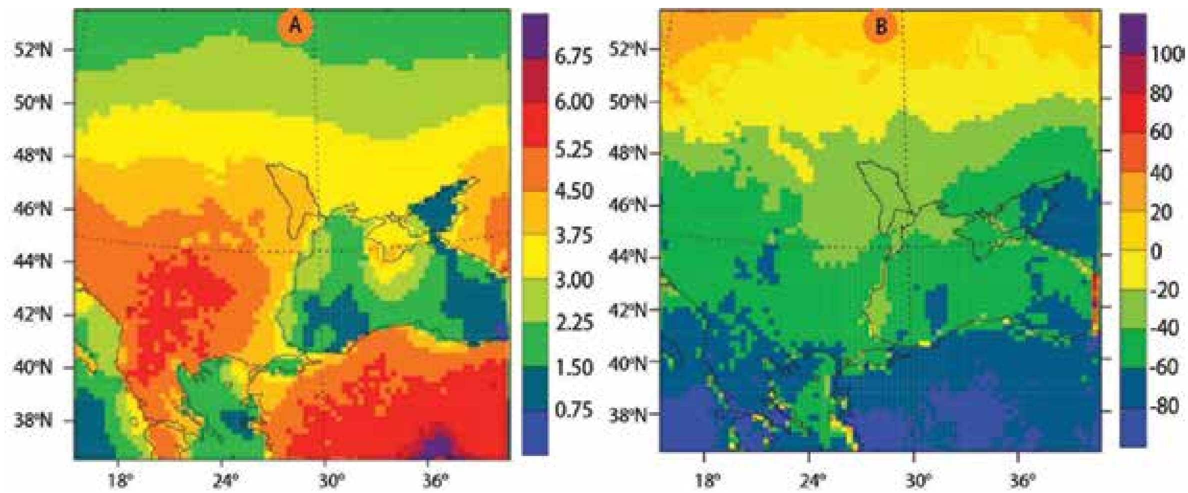


Figure 5-29: Projected PRECIS/ECHAM5 SRES A1B Future Changes in JJA **(A)** Mean Air Temperature (°C) and **(B)** Precipitation (%) by 2080s relative to 1961-1990 baseline periods

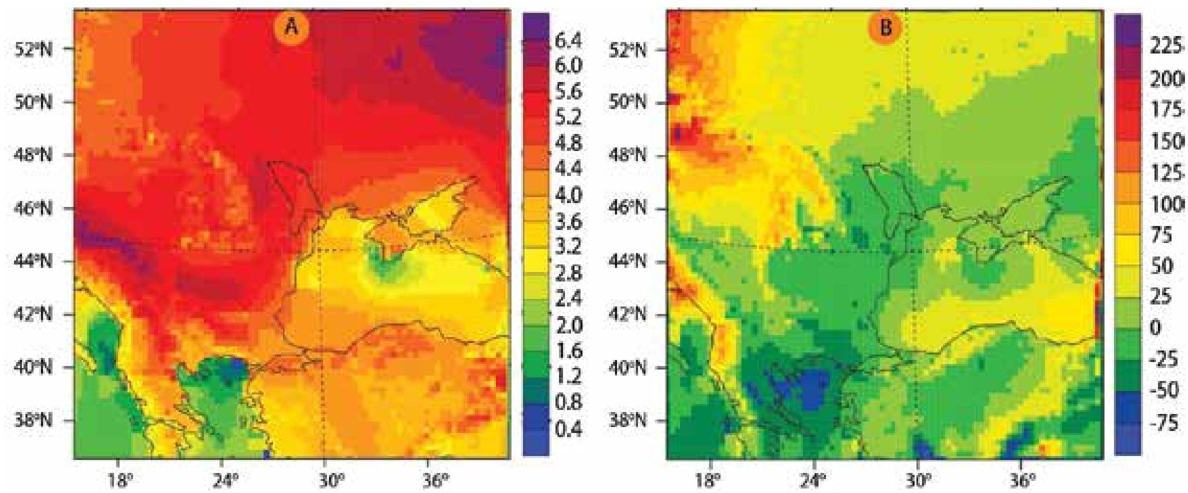


Figure 5-30: Projected PRECIS/ECHAM5 SRES A1B Future Changes in DJF **(A)** Mean Air Temperature (°C) and **(B)** Precipitation (%) by 2080s relative to 1961-1990 baseline periods

Season Precipitation: winter and summer precipitation tends to decrease across the Republic of Moldova. Across the Republic of Moldova regional average winter precipitation decrease are projected to be between 14.0-20.9% by the 2080s (Table 5-14). Figure 5-30B shows estimates of winter precipitation change at the 25x25 km spatial resolution for the 2080s. Projections of average winter precipitation changes in the Republic of Moldova differ over time. Projected changes in average winter precipitation are ranged from +3.1 % to -17.5% by the 2020s; from +10.4% to -12.3% by 2050s; and from +0.7% to -20.9% in by the 2080s.

Across the Republic of Moldova regional average summer precipitation decrease are projected to be between 22.7-34.2% by the 2080s. Figure 5-29B shows estimates of summer precipitation changes at the 25x25 km spatial resolution for the 2080s. The summer precipitation changes according to PRECIS/ECHAM5 SRES A1B medium emission scenario are expected to be larger than in the winter season, projected decrease in average summer precipitation being between 7.4-16.8% by the 2020s; from 4.3% to 25.3% by 2050s; and from 22.7% to 34.2% by the 2080s. The spatial distribution of changes is quite similar, the strongest seasonal precipitation decrease occurring over the Central and Southern AEZs.

5.4. Climate Change Impacts by Sector

The following section describes the projected impacts of climate change by sector for the RM. In addition to describing the physical and socio-economic implications by sector, each section includes a risk analysis of those risks and opportunities posed by climate change to specific regions of the country. This is helping to identify climate risk "hot spots", where more immediate action to adapt to these impacts is required.

In brief, the approach to the risk assessment included an identification of risks and opportunities related to climate change, by sector, based on existing literature; linking future projections of key climate-related variables to these risks and opportunities; assessing how each of the projections could affect risk using a weighting of 1, 2, or 3 (low, medium, high) and finally amalgamating the findings to qualitatively assess and define key risks for each sector, based on expert judgment. In this way, both the probability, as well as the potential impact of climate change, was taken into account in the risk assessment.

Different levels of risk are defined as follows:

- HIGH – high probability of risk due to possible climate change demands the urgent attention of decision makers to develop immediate measures for adaptation;
- MEDIUM – medium probability of risk due to possible climate change should be maintained under review; and
- LOW – low probability of risk due to possible climate change should be maintained under review. It is expected that existing adaptation measures will be sufficient and no further action will be required unless circumstances change.

The ranking for opportunities arising from climate change followed a similar approach and definitions:

- HIGH – high probability of opportunity as a result of climate change to develop new directions in a region;
- MEDIUM – medium probability of opportunity arising from climate change, should be maintained under review; and
- LOW – low probability of opportunity due to possible climate change.

5.4.1. Climate Change Impacts on Agriculture

Agriculture is the dominant sector of employment in RM. Following privatization reforms undertaken during the past decade, some 85% of Moldovan households today own agricultural land. The majority of the farms (400,000) are small with an average landholding size of only 1.6 to 1.8 hectares. Together they represent about 45 percent of the utilized land and an overall share of some 72 percent of the total agricultural produce.[132]

RM has seen a dramatic decline in agricultural output, in large part due to the change in subsidies and access to markets that were guaranteed in the Soviet era, as well as changes in the farming structure (growing share of subsistence, at the expense of commercial farming), land reform and productivity declines related to soil degradation and a lack of irrigation infrastructure. Unfavorable climate conditions, most notably the severe droughts of 2003, 2007 and 2012, have also negatively affected production. These conditions will persist and intensify even without climate changes. In 2011, agricultural production totaled MDL 22.6 billion in current prices, or only 59.0 percent of the 1990 level[133]. The contribution of the agricultural sector to GDP decreased from 31.2 per cent to 10.0 percent, in 2012. According the National Bureau of Statistics of the Republic of Moldova (2011), 27.5 percent of the active population is employed in agriculture[134].

A) Possible Impact of Climate Change on Agriculture in the RM

The combination of long-term changes and the greater frequency of extreme weather events are likely to have adverse impacts on the agricultural sector, and these changes often have many knock-on effects at the macro-economic level. For example direct impacts on agricultural production and declining yields as a result of increased pest and disease problems could further lead to fluctuations in market prices

[132] Suter, Rene (2008). "*Relief and Technical Assistance Response to the Drought in Moldova*". Programme Review Mission Report, UNDP/BCPR.
[133] Ministry of Economy of the Republic of Moldova, Department of Macroeconomic Analysis and Forecasts (2012).
[134] National Bureau of Statistics (2011), *Annual Statistical Yearbook of the Republic of Moldova, 2011*, Table 3.1.4 "Distribution of employment by economic activities" (page 73).

and changes in crops. The combined effect of changes to the water regime could result in insufficient water for irrigation, and increased water competition, which could ultimately result in higher prices and regulatory pressure. Drought will lead to soil degradation, which is a major threat to the sustainability of land resources and may impair the ability of RM's agriculture to successfully adapt to climate change. Increased salinity may result in land abandonment as it becomes unsuitable for cropping.

This section outlines direct climate change impacts and their potential socio-economic consequences that are relevant to agriculture, summarized in Table 5-15. These include: changes in temperature, and the effects of heat stress; changes in precipitation amounts, intensity and seasonal distribution; and an increase in extreme and potentially damaging weather events.

Climate change is expected to bring both advantages and disadvantages for agricultural crops in the RM. Although warmer temperatures would increase the length of the growing season, they could also increase crop damage due to heat stress, changes in precipitation patterns, and pest problems. Impacts would vary regionally and with the type of crop being cultivated. There are some potential benefits. The longer growing season will potentially increase grass yields, while increased temperatures will increase the potential for growing forage legumes. The longer growing season should also reduce the costs of housing livestock. There may also be benefits for horticulture, both with respect to reducing costs of indoor production and increasing the range of horticultural crops that can be grown outdoors[135].

However, in the RM, most of the impacts on agriculture are predicted to be adverse. Cropping patterns in RM have shifted with declines in the industry, with a move away from high value-added products such as fruit and meat, to an expansion of areas sown with wheat and sunflower, and sugar beet. Increased summer temperatures and drought risk could make it difficult to achieve the potential yield increases from increased concentrations of CO_2[136] and perhaps threaten current productivity levels. Some crops will be more vulnerable to hotter and drier summers.

Yields of vegetables and potatoes, both of which are frequently irrigated under current conditions, are likely to be reduced more than the yield of cereals. The summer growth of forage crops also appears likely to be reduced. An increased frequency of extreme weather events may also lead to crop damage or failure[137]. There may also be problems arising from the introduction of new pests and diseases. A large proportion of soils in Moldova's agro-climatic

[135] AEA Energy & Environment and Universidad de Politecnica de Madrid (2007), Adaptation to Climate Change in the Agricultural Sector. AGRI/2006-G4-05.Report to European Commission Directorate - General for Agriculture and Rural Development, December, 2007.

[136] Alexandrov, V.A., and Hoogenboom, G. (2000), *The impact of climate variability and change on crop yield in Bulgaria*. Agricultural and Forest Meteorology, 104, P.315-327.

[137] Cuculeanu, V., P. Tuinea, and D. Balteanu (2002), *Climate change impacts in Romania: Vulnerability and adaptation options*. Geo Journal, 57.P. 203-209.

Table 5-15: Summary of Socio-Economic Impact of Climate Change on Agriculture in RM

Climate Impact Category	Impact on Agriculture	Social/Economic Impact
Increased temperatures, heat stress	Changes in water requirements	Increased demand for irrigation; Decreased yield of crops; and Changes (positive and negative) in distribution, introduction of new varieties of crops.
	Changes in agricultural pests and diseases	Reduced water quality from increased use of pesticides; Decreased yield and quality of crops; Increased economic risk; and Loss of rural income.
	Changes in crop growth conditions	Pollution by nutrient leaching; Loss of indigenous crop varieties; and Changes (positive and negative) in seed production and seedling requirement.
	Changes in optimal conditions for livestock production	Changes in optimal farming systems; and Loss of rural income.
	Changes in crop distribution	Changes in crop and livestock production activities; Relocation of farm processing industry; Loss of rural income; and Increased economic risk.
Change in precipitation patterns	Changes in hydrological regime; Increased water shortages.	Risks of water quality loss; Increased risk of soil salinisation; Conflicts among water users; Increased groundwater abstraction, depletion; and decrease in water quality.
Extreme events – droughts, floods, hailstorms	Changes in soil fertility, salinity and erosion; Crop failure; Yield decrease; Competition for water; and Increased risk of desertification.	Decrease in water quality from nutrient leaching; Decreased income from crops; Land abandonment; Increased expenditure in emergency and remediation actions; Decreased food security in areas with low economic development; and Increased food prices.

zones are chernozems. These soils have large organic matter content and breakdown of Soil Organic Matter (SOM) is likely to increase with warmer temperatures. While this breakdown will increase soil fertility in the short term (via release of nutrients) in the longer-term soil fertility is likely to be reduced[138]. The result of long-term research undertaken at the national level[139] indicates that during the last 100 years, the content of SOM in arable soils in the Republic of Moldova has decreased, while the average annual air temperature has increased in the same period of time[140].

Changes in the frequency and intensity of extreme events (e.g., droughts, floods and heavy rains) have been identified as the greatest challenge that would face the agricultural industry as a result of climate change. Extreme events, difficult to both predict and prepare for, can devastate agricultural operations, as has been demonstrated several times in the past. Drought and extreme heat have also been shown to affect livestock operations. Model projections and observed trends suggest that warming would be greatest during the winter months. Although warmer winters would reduce cold stress, they would also increase the risk of damaging winter thaws and potentially reduce the amount of protective snow cover. Climate warming is also expected to increase the frequency of extremely hot days, which have been shown to directly damage agricultural crops. Future changes in moisture availability represent a key concern in the agricultural sector. Climate change is generally expected to decrease the supply of water during the growing season, while concurrently increasing the demand. In addition to the direct problems caused by water shortages, the benefits of potentially positive changes, including warmer temperatures and a longer growing season, would be limited if adequate water were not available. Water shortages are expected to be a main problem in several regions of Moldova in the future.

B) Assessing the Magnitude of Risk and Opportunities of Climate Change on Agriculture

An agro-climatic characterization of the Republic of Moldova was used to differentiate potential risks and opportunities from climate change on agriculture by characterizing RM into agro-climatic zones (Table 5-16). Farming systems determine the capacity to adapt to climate change and the optimal policy options. The farming systems are based on the typology of agricultural holdings: grain field crops, grazing livestock, horticulture and permanent crops. These were selected as they represent the standard national statistical reporting format. The identification of the farming systems assists in the discussion of the risks, opportunities and adaptation options in each zone.

According to the vulnerability assessment of the magnitude of the risk/opportunities of the climate change on agricultural production, the most vulnerable regions in the RM due to possible climate change will be South (the Plain of Southern Moldova, terraces of the inferior Prut and Dniester Rivers) and partly Center (Sub-zone II-a, the Plain of Central Moldova and Codrii region, and Sub-zone II, Terraces of the Dniester, Prut, Raut, Prut, Bic, Botna etc. rivers) for which as a result of expert judgment revealed the greatest amount of risks with high probability related to climate change (see Table 5-16).

For agriculture in the RM, five of the identified risks are considered to be of high priority:

- Increased risk of drought and water scarcity;
- Increased irrigation requirements;
- Soil erosion, salinisation, desertification;
- Increased risk of agricultural pests, diseases, weeds; and
- Wheat and maize yield decrease.

Three of these risks concern the consequences of potential changes in the precipitation pattern, with increased rainfall in winter and decreased water availability in summer. Hence strategies need to be considered to conserve as much water as possible over winter to maintain supply during the summer. Much of the adaptation research in the agricultural sector should be focused on strategies for dealing with future water shortages. Such adaptations as water conservation measures and adjustment of planting and harvesting dates could play a critical role in reducing the losses associated with future moisture limitations.

Other adaptation options being studied include the introduction of new species and hybrids, for example, those that are more resistant to drought and heat, and the development of policies and practices to increase the flexibility of agricultural systems. Better definitions of critical climate thresholds for agriculture will also be beneficial for adaptation planning. Of the two opportunities presented in the table, the potential for increased production of some crops, either as a result of the increased yield potentials under the new climatic regimes or an increase in the area over which new crops might be grown, was considered a high priority. Hence attention needs to be given to the promotion of crops that have the potential to flourish in the changed conditions.

Adaptation measures on water conservation for agricultural purposes could include:

- Achieving optimal irrigation methods (e.g. correct timing);
- Adapting plants to future climate conditions (e.g. growing less water-intensive crops);

[138] AEA Energy & Environment and Universidad de Politecnica de Madrid (2007), *Adaptation to Climate Change in the Agricultural Sector.* AGRI/2006-G4-05.Report to European Commission Directorate - General for Agriculture and Rural Development, December, 2007.

[139] Ursu, A. (2000), *Soils Degradation and Desertification (in Romanian).* Chisinau, 307 p.

[140] Taranu, M., Scorpan, V., Bicova, E. et. al., *National Inventory Report: 1990-2005. Greenhouse Gas Sources and Sinks in the Republic of Moldova.* Ministry of Environment and Natural Resources / UNEP, 2009. 352 p.

Table 5-16: Priority Risks and Opportunities for the RM's Agro-Climatic Zones

Detail of magnitude risk/ opportunity		North (moderately hot, semi-humid)		Centre (hot semi-humid)		South (hot-arid)
		Sub-zone I-a, the Plain of Northern Moldova*	Sub-zone I, the Plain of Northern Moldova, front Dniester hills**	Sub-zone II-a, the Plain of Central Moldova and Codrii region***	Sub-zone II, Terraces of the Dniester, Prut, Raut, Prut, Bic, Botna etc. rivers****	The Plain of Southern Moldova, terraces of the inferior Prut and Dniester Rivers*****
Risk	Crop area changes due to decrease in optimal farming conditions	LOW	LOW	MEDIUM	MEDIUM	HIGH
	Wheat and maize yield decrease	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH
	Grapevine general decrease in yields.		LOW[1]	MEDIUM	MEDIUM	MEDIUM
	Fruit general decrease in yields	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH
	Increased risk of agricultural pests, diseases, weeds	HIGH	HIGH	HIGH	HIGH	HIGH
	Crop quality decrease	LOW	MEDIUM	MEDIUM	MEDIUM	MEDIUM
	Increased risk of drought and water scarcity	LOW	LOW	MEDIUM	MEDIUM	HIGH
	Increased irrigation requirements	MEDIUM	HIGH	HIGH	HIGH	HIGH
	Soil erosion, salinisation, desertification	LOW	MEDIUM	HIGH	HIGH	HIGH
	Deterioration of conditions for livestock production	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH
	Flood increase in frequency and intensity	LOW	MEDIUM[2]	HIGH	HIGH[3]	MEDIUM[4]
Opportunity	Crop distribution changes leading to increase in optimal farming conditions	HIGH	HIGH	MEDIUM	MEDIUM	LOW
	Increasing the range of horticultural crops that can be grown outdoors	HIGH	HIGH	MEDIUM	MEDIUM	LOW
	Crop productivity increase	MEDIUM	MEDIUM			
	Grapevine increase in quality		MEDIUM	HIGH	HIGH	HIGH
	Lower energy costs for glasshouses	MEDIUM	MEDIUM	HIGH	HIGH	MEDIUM

**Sub-zone I-a, the Plain of Northern Moldova* include districts: Ocniţa, Briceni, Edineţ, Donduşeni.

***Sub-zone I, the Plain of Northern Moldova, front Dniester hills* include districts Râşcani, partial Glodeni, Bălţi municipality, Drochia, Sângerei, Soroca, Floreşti, Şoldăneşti, Rezina.

[1]Now grapevine is growing in Râşcani,Glodeni, Sângerei and Soroca.

[2] Flood increase in frequency and intensity: low - Râşcani and Drochia; high - Sângerei.

*** *Sub-zone II-a, the Plain of Central Moldova and Codrii region* include districts Ungheni, Nisporeni, Străşeni, Hînceşti.

**** *Sub-zone II, Terraces of the Dniester, Prut, Raut, Prut, Bic, Botna etc. rivers* include districts: the South –west of Glodeni, Făleşti, Ungheni, Nisporeni, Străşeni, Teleneşti, Orhei, Ialoveni, Dubăsari, Criuleni, Hînceşti, AneniiNoi, the NourthernCimişlia.

[3]Flood increase in frequency and intensity: medium - Glodeni, Făleşti, Orhei, Criuleni, AneniiNoi, Cimişlia and low - Dubăsari.

***** *The Plain of Southern Moldova, terraces of the inferior Prut and Dniester Rivers* include districts: Căuşeni, ŞtefanVodă, Ceadîr-Lunga, Taraclia, Leova, Cantemir, Cahul, UTA Găgăuzia and the Southern Cimişlia.

[4]Flood increase in frequency and intensity: high – Leova, low – Stefan-Voda.

- Modification of crop rotation according to the natural soil water regime (that is, introduction of a greater number of winter crops);
- Selection of proper drought-resistant crops, plant species and varieties;
- Awareness building in new technologies that address soil structure stability and soil treatment for expanding the active layer of the root zone for enhancing water uptake;
- Introduction of mulch technology for increasing infiltration into the soil and decreasing soil water loss by evaporation;
- Runoff reduction by agronomic practices (No till and cropping systems can reduce water runoff);
- Runoff depending on soil characteristics can also be delayed by tillage methods combined with plants with a high root density and lush surface cover;
- Development of new complex agricultural water management programmes (combining irrigation, fishery and excess inland water management);
- Promotion of indigenous practices for sustainable water use.

5.4.2. Climate Change Impacts on Water Resources

The water resources of the RM are represented by surface waters and sub-surface waters. With regard to surface waters, there are two major river basins in the RM: the Dniester (the largest) and the Prut (the second largest). The natural water regime of the rivers in these basins has been changed by the construction of dams and reservoirs, designed to prevent floods, trap sediment, and provide water for agricultural, industrial and household consumption as well as for fish farming. Ground waters for centralized household and industrial use are withdrawn from ten aquifer complexes.[141]

The sub-surface water grid includes circa 112,000 springs and wells (public and private) and more than 3,000 functional artesian wells. Sub-surface waters are the main source of potable water supply in the RM, for 100 percent of the rural population and 30 percent of the urban population, or 65 percent of the total population of the country. The remaining 35 percent of the population use surface waters as a source of potable water.[142] Approximately 44 percent of the population in the country does not have access to safe drinking water. At present all towns and municipalities and over 65 percent of rural settlements have centralized drinking water supply systems, but only 50 percent of this type of system is in satisfactory technical condition. The rest needs capital repairs or reconstruction.

According to the NHDR (2009), since 1990, because of economic decline, the decline of heavy industry and falling water use in industry and agriculture, the quality of surface water resources has improved in the major river basins – the waters of the Dniester and Prut Rivers are considered to be clean and moderately polluted. However, the waters of small rivers are highly polluted. Ground water does not comply with the national standard for drinking water; often, water hardness in wells exceeds the standards by 2 to 5 times and more. Furthermore, almost 90% of the samples taken from unconfined aquifers exceed the maximum permitted concentration for nitrate, attributed in large part to increased livestock production in households.

A) Possible Impact of Climate Change on Water Resources in the RM

Climate change is only one of many factors that will determine future patterns of water availability and use. Non-climatic factors could aggravate or attenuate the adverse effects of climate change on water availability and quality, as well as have a significant influence on water demand. Population growth and economic development (and, by extension, changes in lifestyles and diets) will play a dominant role (as highlighted above, economic decline is a significant factor in the stability of water resources to date, and hence water withdrawals will be expected to increase with economic recovery). According to the water-intensive target of national economic development, secure supply for all water users will be threatened by climate-related change in water resources already in the 2020s, when the intensity of surface water use will be close to 100 percent. However, taking into consideration ground water supply as well, the point when water scarcity will become a brake to development is likely to set in after 2030[143]. Non-climatic impacts could be generated through many realms—from policies and legislation to technologies and infrastructure to land-use patterns and agricultural activities/irrigation[144].

The main direct climate change impacts and their potential socio-economic consequences in the RM that are relevant to water resources are presented in Table 5-17.

B) Assessing the Magnitude of Risk/Opportunities of Climate Change on Water Resources

Although big rivers constitute the main source of water in Moldova, access is unequal. The greatest distance between a settlement and the closest water body in Moldova is about 6 km. Approximately one quarter of the population (1.03 mil people) live in the 6 km buffer zone of the Dniester and Prut Rivers; this zone constitutes one fifth of the national territory and contains 23 per cent of the settlements.

The rest of the country and population (about 3 mil. people) have to rely on various supply systems designed to transfer water from these rivers, or rely on local resources of poorer quality. The northern part of the country (and the central part to some extent) is, currently, more or less water secure, while the southern part suffers from a natural water deficit. At the same time, medium and long distance water transfer systems are almost non-existent in the south. This region is among the most exposed to water shortages.

Moreover, local surface water resources in the south (and, less frequently, in the central part of the country) are at high risk of depletion in drought years (such as 2007, when several reservoirs on the Isnovat River dried up). In such a way, the geographical location of water users will play the most decisive role in the future in ensuring access to a secure water supply. The area of water scarcity, as it extends northwards, has already reached the most populated areas, which place the biggest load on water resources and are most intensive in water use[145].

The paper available on: <http://www.meteo.md/metodf_karti.html> reveals the results of calculations and mapping of climate induced average annual runoff for the three time periods (2020s, 2050s and 2080s) based on multi-model ensemble for three SRES emissions scenarios A2 (high), A1B (medium) and B1 (low) in comparison to the baseline for the RM's AEZs (Table 5-18; Figure 5-31).

141 UNDP, 2009/2010.

142 Second National Communication of the Republic of Moldova under the UNFCCC, 2009.

143 UNDP, 2009/2010.

144 World Bank (2009), *Water and Climate Change: Understanding the Risks and Making Climate-Smart Investment Decisions*", 2009. 174 p.

145 Sîrodoev I.G., Knight C.G. (2007), *Vulnerability to Water Scarcity in Moldova: Identification of the Regions*. Buletinul Academiei de Stiinte a Moldovei. Stiintele vietii. 3 (303): 159-166.

Table 5-17: Summary of Potential Socio-Economic Impacts of Climate Change on Water Resources

Climate Impact Category	Impact on Water Resources	Social/Economic Impact
Increased temperatures, heat waves	Annual runoff decrease; Lowering of the groundwater table; and Changes to water quality*.	Reduced water availability for human use; Increase in demand for irrigation; Increased water pollution; Adverse health impacts in low income areas; and Requirement for additional treatment of water for drinking purposes.
Change in precipitation patterns	Changes in hydrological regime; Reduction in stream flow; and Increased water shortages.	Risk of water quality loss; Increased risk of soil salinization; and Conflicts among water users.
Extreme events: floods**, droughts***	Increased dilution and sediment loads; and Increased nutrients, pathogens, and toxins transport.	Increased erosion; Damage on infrastructure, land abandonment; and Increased expenditure in emergency and remediation actions.
	Low flows reduce the dilution capacity; Reduced dissolved oxygen; and Increased water shortages	Increased algal blooms, bacterial and fungi content affect human health, agriculture, ecosystems, and water supplies; and Increased risk of desertification.

* Winter, and especially, transitional months, will be the most affected by water temperature increases. Already by the 2020s, water temperature increases in the Dniester River could exceed 65 percent in March (under SRES B2 scenario). Summer months (especially August) are the most vulnerable to dissolved oxygen (DO). Decreases in DO levels, in combination with the increase in water temperature, affect the ecosystem composition by allowing the invasion of new thermophilic species and dangerous bacteria.[1]

** The coefficient of variation of the stream flow will rise; leading to an increase in the instability of annual flow and an increase in spring and flash floods (the most severe flash flood in August 2008 seems to confirm these assessments). These results are confirmed by European assessments as well[2]: flash floods on the big rivers will increase as an extension of the Central European trend; water stress will grow as a trend common to South-Eastern Europe.

*** The outcomes of climatic modelling[3] show that droughts will become longer and more severe (the drought in 2007 is characteristic in this regard).

[1] NHDR 2009/2010 report

[2] Bates B., Kundzewicz Z.W., Wu S., Palutikof J. (eds.) (2008): *Climate change and water*. Technical paper of the IPCC. Geneva, 210 p.

[3] Constantinov T., Nedealcov M. (2008), *Evaluation of extreme climatic phenomena*. In: T. Constantinov (ed.). Republic of Moldova: Regional Natural Hazards. Chişinau, 2008. p. 57-68.

The multi-model ensemble average changes in climate induced annual runoff will show consistently the same decrease sign across all scenarios, while their magnitude increases from the low GHG emission scenario B1 to the high GHG by the 2080s. The Southern AEZ will experience the most significant decrease in climate induced annual runoff, from -30.2 (B1) up to -64% by the 2080s.

Table 5-18: Baseline (mm) and Projected Multi-Model Ensemble Relative Changes of the Average Annual Runoff/Flow (%) over the Republic of Moldova AEZs

Time period	SRES	North	Center	South
2020s	A2	-5.2	-5.0	-5.3
	A1B	-11.3	-9.7	-5.8
	B1	-5.5	-11.1	-14,2
2050s	A2	-26.8	-31.4	-42.2
	A1B	-20.1	-21.9	-23.1
	B1	-9.1	-18.3	-24.4
2080s	A2	-46.6	-55.3	-64.0
	A1B	-33.6	-39.4	-44.0
	B1	-18.3	-22.2	-30.2

According to the vulnerability assessment of the magnitude of the impact with the probability of risks due to possible climate change on water resources the most vulnerable regions in the Republic of Moldova will be South, Center and Chisinau Municipality, for which as a result of expert judgment revealed the greatest amount of risks with high probability related to climate change (see Table 5-19).

For water resources in the RM, eight of the identified risks are considered to be of high priority:

- Increased risk of drought and water scarcity;
- Increased irrigation requirements;
- Flood increase in frequency and intensity;
- Decrease water availability from surface sources or ground water;
- Changes in water demand;
- Water quality affected by higher water temperatures and variation in runoff;
- Higher pollution with pesticides and fertilizers to water due to higher runoff; and
- Changes in river flows both increase and decrease

No opportunities associated with climate impacts on water resources could be identified.

RM's climate has been steadily moving toward drier conditions since the 1990's. Nine significant dry periods or droughts have been recorded since 1990, including two catastrophic droughts in 2007 and 2012 that resulted in losses of up to 75% for major crops such as wheat, maize and sunflower.

Drought is becoming endemic in many parts of the country and is increasingly affecting rural livelihoods and development.

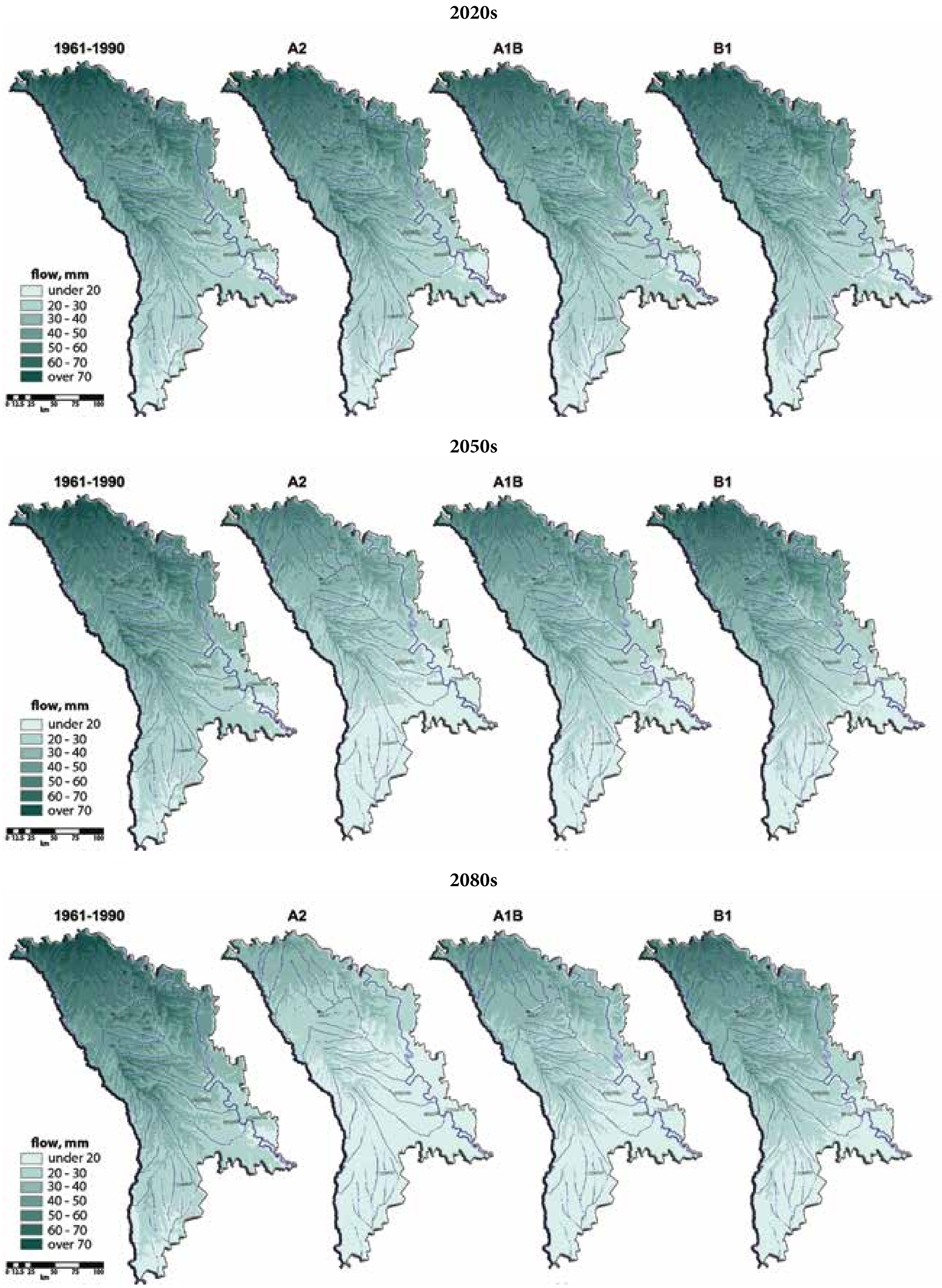


Figure 5-31: Projected Multi-Model Ensemble Average Climate Induced Annual Runoff/Flow (%) over the Republic of Moldova AEZs

Table 5-19: Priority Risks and Opportunities for Water Resources

	Detail of magnitude risk/ opportunity	North	Centre	South	Mun. Chisinau
Risk	Water quality affected by higher water temperatures and variation in runoff	LOW	MEDIUM	HIGH	HIGH
	Changes in water demand (increase as a result of population growth, economic development and irrigation requirements)	MEDIUM	HIGH	HIGH	HIGH
	Changes in river flows both increase and decrease	MEDIUM	HIGH	HIGH	HIGH
	Increased risk of drought and water scarcity	MEDIUM	HIGH	HIGH	HIGH
	Increased irrigation requirements	MEDIUM	HIGH	HIGH	HIGH
	Decrease water availability from surface sources or ground water	MEDIUM	HIGH	HIGH	HIGH
	Higher pollution with pesticides and fertilizers to water due to higher runoff	MEDIUM	HIGH	HIGH	HIGH
	Flood increase in frequency and intensity	MEDIUM	HIGH	HIGH	LOW

Adaptation measures for flood and drought impacts may include:

- Efficient operation of dams, dikes and open channels;
- Wetlands protection (one of the main positive functions of wetlands is to allow groundwater recharge and reduce peak discharges downstream);
- Measures for protection of the irrigation infrastructure from floods;
- Techniques to improve soil texture, aggregation, organic matter content and surface ground cover to manage water usage during dry periods;
- Improved flood forecasting;
- Installation of systems to provide dam break alerts;
- Technical assistance through agricultural extension in coordination with irrigation upgrades to assure dissemination to farmers of techniques to minimize their vulnerability to weather events; and
- Development of effective collaboration between Moldova, Ukraine, and Romania to monitor water discharges, improve weather/flood forecasting and early warning for all downstream countries[146].

5.4.3. Climate Change Impacts on Forests

Forestry ecosystems (represented by forestland and other forestry vegetation) cover only 450.9 thousand ha, or about 13.3% of RM's territory[147], and play an extremely important role in watershed protection, while at the same time providing a number of direct and indirect economic and environmental benefits to rural communities: fuel-wood, non-wood products, ravine stabilization, landscape beautification and other benefits. Fuel-wood is particularly salient for poorer households, which are unable to afford high household energy costs for gas and electricity.

The country's forests are primarily concentrated in the Central region (60% of the forest estate), with lower coverage in the Northern and Southern regions (26 and 14 % respectively) Table 5-20.[148]

Table 5-20: Forests Distribution in the Republic of Moldova

Geographic zone	Total surface of the zone, thousands ha	Surface coved with forest, thousands ha	Degree of the forestation, %
North	1149.4	92.9	8.1
Centre	1448.8	209.4	14.5
South	786.9	60.4	7.7
Total	3385.1	362.7	10.7

The following principle types of forests are represented: oak woods, durmast woods, beech woods, water meadows and mixed varieties woods. The forestry ecosystems are populated by circa 860 species of plants, which account for 43 percent of the total spontaneous floral biodiversity of the country. Of all species of vertebrate and invertebrate animals, about 60 percent can be frequently found in forestry biotic communities. It is also significant that more than 50 percent of all vegetal and animal species included in the Red Book of the RM are part of forestry biomes.

As stated in the Strategy for Sustainable Development of Forestry (2001), the main function of forest resources should be to maintain ecological balance, but the amount of forested area is insufficient to guarantee effective environmental protection. Low forestation has been a major cause of RM's high level of soil erosion, landslides and degradation of water resources; it also intensifies droughts. The main causes of forest degradation are: (1) the increase in illicit cutting due to higher prices for wood and fuel; (2) lack of efficient controls on the part of local administrations; (3) low levels of ecological knowledge and culture; and (4) excessive grazing and lack of adequate forest management[149]. A long–term, one-hundred year trend of deforestation has been reversed in the past 50 years and RM's current forest policy calls for a further increase in forest cover through afforestation and improved community management of forests for direct uses and watershed protection.

Protection of forests can deliver "triple wins", by (i) increasing food production and productivity, (ii) helping to lift people

146 Millennium Challenge Account – *Moldova: Transition to high value agriculture project*. Environment and Social Assessment. Project mission September 28-October 17, 2008. Authors: Sergiu Budesteanu, Jessica Ebbeler, Iurie Gotisan, Rita Klees. Version-final (21 December, 2008).-43p.

147 National Bureau of Statistics (2011), *Annual Statistical Yearbook of the Republic of Moldova, 2011*, Table 1.3.1 "Available Land, as of 1st of January 2011" (page 21).

148 Personal communication of the national expert, Mr. Ion TALMACI, Deputy-Director of the Forestry Management and Research Institute.

149 World Bank (2007), "*Integrating Environment into Agriculture and Forestry Progress and Prospects in Eastern Europe and Central Asia*", Volume II, Country Review, November 2007.

out of poverty, while at the same time (iii) supporting the global environment by storing carbon and conserving biodiversity.

A) Possible Impact of Climate Change on Forest Resources

Researchers expect that even small changes in temperature and precipitation could greatly affect future forest growth and survival, especially at ecosystem margins and threshold areas such as RM's forests.

Climate change would impact future moisture conditions in forests through changes in both temperature and precipitation patterns. As the temperature increases, water loss through evapotranspiration increases, resulting in drier conditions. Higher temperatures also tend to decrease the efficiency of water use by plants. In some areas of RM, future decreases in precipitation will accentuate the moisture stress caused by warming. Changes in the seasonality of precipitation and the occurrence of extreme events, such as droughts and heavy rainfalls, will also be important. For example, treering analysis of oak and ash trees stems in the center of RM revealed reduced ring growth to as little as 50% of the previous year and compared to the multiannual average of the past 10 years was associated with the 2007 drought[150].

This section outlines the main direct climate changes impacts and their potential socio-economic consequences in the RM that are relevant to forests, presented in Table 5-21.

B) Assessing the Magnitude of Risk/Opportunities of Climate Change on Forest Resources

The potential lack of summer precipitation with consequent droughts is the main constraint factor on forest growth and productivity. Temperature increase and changes in precipitation are the main factors predisposing forests to various insect pests and fungal diseases. The demand of water during the growing season is normally larger than the amount of rainfall. This indicates that if temperature increase is not coinciding with increased rainfall, water could limit growth to an even larger extent than today. The effect of climate change on individual species can be either positive or negative, depending on the site conditions and regional climate changes.

According to the vulnerability assessment of the magnitude of the impact with the probability of risk due to possible climate change on the forest sector, the most vulnerable regions in the RM will be: South (where there is already the lowest degree of forestation 7.7%), and partially Centre (where there is now the biggest surface coved with forest 209.4 thousands ha, or about 14.5% of the total geographic zone territory) for which as a result of expert judgment revealed the greatest amount of risks with high probability related to climate change (see Table 5-22).

For the forest sector in the RM, seven of the identified risks are considered to be high priority:

- Negative consequences for species sensitive to temperature changes;
- Changes in the regeneration rate;
- Changes in species sensitivity to water shortages;
- Changes in individual tree density;
- Changes in the phytosanitary conditions;
- Changes in species composition
- Possible increase in tree mortality.

In this case exist one opportunity associated with climate impacts on forest sector – increase in biomass production.

Adaptation measures in the temperate-continental bioclimatic zone, which also includes the RM's forests, are very versatile. On-going and planned research includes adapted seedlings, biotic and abiotic damages, biodiversity, especially genetic diversity, silviculture treatments, and protection functions of forests. Measures at stand level (forest regeneration, tending and thinning of stands, harvesting) are aimed at decreasing risks of abiotic disturbances, i.e. fire,

[150] Second National Communication of the RM under the UNFCCC, 2009.

Table 5-21: Summary of Socio-Economic Impacts of Climate Change on the Forest Sector in RM

Climate Impact Category	Impact on Forest Sector	Social/Economic Impact
Increased temperatures, heat waves	Longer growing season; Negative consequences for species sensitive to temperature changes; and Increases in vulnerability to forest fires.	Decrease in the volume of wood production; Transition to the other forms of energy; and Additional costs to the public.
Change in precipitation patterns	Change in the phytosanitary condition* Changes in species composition; and Changes in the types and incidence of pests and diseases.	Modification of forest habitat's capacity for biologic diversity maintenance, environmental protection and provision of specific socio-economic functions.
Extreme events: droughts, fires, wind storms and floods	Reduced growth and biomass production; Increases in forests fires; and Increased seed mortality rate.	Economic losses in forestry sector.

*Within the 2010-2039 period, it is expected that the phytosanitary condition (e.g. plant health) will change significantly in the Northern part of the country where areas with trees drying out will expand by circa 15-25%. In 2040-2069, the change of the phytosanitary condition determined by the trees drying level in the Northern part of the country will strongly aggravate expanding towards South and South-East. Significant changes under this aspect will take place between 2070 and 2099. In the Northern part the forests will dry out intensely[1].

[1] Second National Communication of the RM under the UNFCCC, 2009.

Table 5-22: Priority Risks and Opportunities for the Forest Sector

Detail of magnitude risk/opportunity		North	Centre	South
Risk	Changes in species composition *	LOW	MEDIUM	HIGH
	Possible increase in tree mortality	LOW	MEDIUM	HIGH
	Alterations in species competitiveness	MEDIUM	MEDIUM	HIGH
	Negative consequences for species sensitive to temperature changes	LOW	MEDIUM	HIGH
	Changes in the regeneration rate	MEDIUM	HIGH	HIGH
	Changes in species sensitivity to water shortages	MEDIUM	HIGH	HIGH
	Changes in individual tree density	MEDIUM	HIGH	HIGH
	Increase abiotic disturbances caused by fires, wind storms, flooding and drought	LOW	MEDIUM	MEDIUM
	Changes in the phytosanitary conditions	MEDIUM	HIGH	HIGH
Oppor-tunity	Change in biomass production **	HIGH	MEDIUM	LOW

* Decrease of mesophilic forests areas (beech trees stands, durmast trees stands and oak trees stands) in favour of thermophilic forests of durmast with wig trees and of xerofile pastures.

**Among the mix species the *Hornbeam* and the *Ash tree* may be the most vulnerable species in the new climate conditions determined by climate change. In the first half of the production cycle, starting 2010 the *Ash tree* may feature a 20-40% decrease in biomass growth.

wind, drought, as well as biotic disturbances, i.e. pests and pathogens. Building stable diversified forests is an on-going measure and it is planned to improve stand stability by selection of suitable species, provenances and genotypes.

Adaptation measures in forestry sector could be as follows:

- Review and development of (new) important components of the forestry regulatory basis, as integral parts of the forestry regime, focusing on the following areas: maintenance and conservation of forestry stations; conservation of forest genetic resources; ecological reconstruction of forests; certification of forests, forest products and management systems;
- Review of the regulatory framework for developing an appropriate financial mechanism in conservation and development of forestry resources, by imposing mandatory allocations from some extra budgetary funds (ecological, roads, etc.) and taxes (ecological tax on import of oil products, for landscaping, etc.) needed for expansion of lands covered with forestry vegetation, etc.;
- Development and approval of the regulation on implementation and assuring functionality of the principles of participatory management of public forest resources;
- Increasing the forest cover aimed at contributing to climate change mitigation and increasing the biodiversity;
- Development and implementation of projects aimed at planting protection forest belts (buffer zones) for agricultural lands protection, combating erosion, and for waters protection;
- Development and implementation of projects aimed at planting protection forest belts for agricultural land and water protection;
- Establishment of forest plantations for the needs of industry and energy; planting of energy forests to meet the needs of population in firewood for heating, wood for cooking, etc.;
- Agro technical analysis, selection and public production of plant types capable of adapting to different climatic conditions, research, development and application of production technologies for such plants, etc.

5.4.4. Climate Change Impacts on Energy Sector

Most of RM's installed capacity for energy is obsolete, and energy inefficiency is high. The losses of energy (electricity and heat) transmission and distribution have been excessive in the past and are still considerable, affecting adversely the energy sector's energy efficiency.

Due to organizational and technical measures, the losses in the electricity distribution networks dropped from over 39.9% in 2001 to 9.9-13.1% in 2011[151]. Losses of heat in Chisinau and Balti are as high as 19.8%[152]. Reducing losses of energy networks remains a priority for the energy sector and complies with EU policies.

Given the limited capacity to generate energy domestically, RM is heavily reliant on imports for its energy needs – imports made up almost 95% of total energy in RM in 2011[153]. This leaves country very vulnerable to disruptions and price

[151] Report on the Activity of the National Agency on Energy Regulations for 2010 year (see Table 8 on page 22): http://anre.md/upl/file/Rapoarte/Raport%20anual%20de%20activitate%20a%20ANRE%20pentru%20anul%202011.pdf

[152] Report on the Activity of the National Agency on Energy Regulations for 2010 year (see Table 9 on page 23): http://anre.md/upl/file/Rapoarte/Raport%20anual%20de%20activitate%20a%20ANRE%20pentru%20anul%202011.pdf

[153] National Bureau of Statistics (2011), Energy Balance of the Republic of Moldova, 2010: Statistical Book. Chisinau, 2011. – 73 p. See on: http://www.statistica.md/public/files/publicatii_electronice/balanta_energetica/Balanta_energetica_2011_rom.pdf.

hikes in foreign energy supply, and can have significant impacts on human development.[154]

The breakdown of final energy consumption per sector in 2010 is dominated by the residential sector (46.5 per cent), transport sector (25.2 per cent), industry sector (7.9 per cent), commercial and institutional sectors (10.4 per cent), agriculture sector (2.9 per cent) and others (7.0 percent). The breakdown of final fuel consumption per type in 2011 was dominated by natural gases (38.6 per cent), diesel oil (20.4 per cent), electricity (11.3 per cent), gasoline (10.3 per cent), coal (7.2 per cent), liquefied natural gases (3.6 per cent), firewood (2.7 per cent), residual fuel oil (1.4 per cent) and other types of fuels (4.6 per cent).[155]

The RM has the potential to employ a greater share of renewable sources, including biomass, solar, wind, hydro and geothermal, and these are governed by the National Programme on Energy Efficiency (NPEE) 2011-2020, approved by Government Decision No. 833 of 10.11.2011.[156]

A) Possible Impact of Climate Change on Energy Sector

As the climate of the world warms, the consumption of energy in climate-sensitive sectors is likely to change. Possible effects of warming, that could be relevant in the RM, include (1) decreases in the amount of energy consumed in residential, commercial, and industrial buildings for space heating and increases for space cooling; (2) decreases in energy used directly in certain processes such as residential, commercial, and industrial water heating, and increases in energy used for residential and commercial refrigeration and industrial process cooling (e.g., in thermal power plants); (3) increases in demand for energy used to supply other resources for climate-sensitive processes, such as pumping water for irrigated agriculture and municipal uses; (4) changes in the balance of energy use among delivery forms and fuel types, as between electricity used for air conditioning and natural gas used for heating; and (5) changes in energy consumption in key climate-sensitive sectors of the economy, such as transportation, construction, agriculture, and others.[157]

Changes in supply could also occur – extreme events extreme temperatures can cause damage to energy supply infrastructure, and development of renewable energy sources is very dependent on water, wind and biomass potential, all of which are expected to change under climate change.

The main direct climate change impacts and their potential social economic consequences in RM that are relevant to the energy sector are presented in Table 5-23.

B) Assessing the Magnitude of Risk/Opportunities of Climate Change on Energy Sector

Although RM mostly covers its energy needs through imports, the National Energy Strategy 2020 envisages strengthening local production capacities by modernizing and

[154] UNDP (2010), National Human Development Report 2009/2010, Climate Change in Moldova: Socio-economic Impact and Policy Options for Adaptation. Chisinau, 2010. – 222 p. (avalable on: http://www.undp.md/publications/2009NHDR/NHDR_eng_full.pdf).
[155] National Bureau of Statistics (2012), Energy Balance of the Republic of Moldova, 2011: Statistical Book. Chisinau, 2012. – 73 p. See on: http://www.statistica.md/public/files/publicatii_electronice/balanta_energetica/Balanta_energetica_2012_rom.pdf.
[156] http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=340940.
[157] Synthesis and Assessment Product 4.5. Report by U.S. Climate Change Science Program and the Subcommittee on Global Change Research: *Effects of Climate Change on Energy Production and Use in United States*. Authors: Thomas J. Wilbanks, Vatsal Bhatt, Daniel E. Bilello et.al. February, 2008. – 85 p.

Table 5-23: Summary of Socio-Economic Impact of Climate Change on the Energy Sector in the RM

Climate Impact Category	Impact on Energy	Social/Economic Impact
High Temperatures and Heat Waves	Greater demand for electricity for air conditioning. High temperatures reduce thermal generation efficiency Solar cell efficiency reduced by high temperatures Increased water needs for thermal power plants	Access to air conditioning only available to higher income households. Increased demand and peak demand, taxing transmission and distribution systems Reduced energy generated
Extreme events	Increased damage to supply grids. Alteration in wind speed frequency distribution	Threat to electricity transmission and distribution*. Increased uncertainty on energy output
Droughts	Reduced hydro-power production	Hydropower generation can be seriously affected by drought, 10-30% less electricity generation is expected.
	Decrease of biomass yield	Threat to energy production from biomass reduction. Potential competition between energy and non-energy crops for land and water resources
Low Temperatures and Freezing	Damage to electricity transportation lines	Loss of power; and Cost of repairing lines.
Decreased cloud cover	Increased potential for photovoltaic (PV) production of electricity	Diversification of energy supply; and Reduced pollution.
Rise in wind speed	Increased wind power generation	Diversification of energy supply; and Reduced pollution.

*Almost 300 localities suffered power supply disruptions in January 2009 because of strong winds and related events[1].

[1] NHDR 2009/2010.

enhancing the existing Combined Heat and Power Plants (CHPs 1 and 2 in Chisinau and CHP North in Balti) as well as constructing new mini-CHPs. Another focus of effort will be boosting production from renewable sources, such as biomass, solar and wind energy. However, climate and water availability projections show that some of these plans may be put at risk under climate scenarios. Currently 65 to 70 percent of total water is used in industrial heating and cooling and hydro-energy production. However, as has been shown, water quantity in RM is quite sensitive to climate change effects. Thus, water scarcity will start adversely affecting national development goals by 2020 if only surface water is taken into account. If ground water is added then water scarcity will become a development obstacle by 2030. Furthermore, one of the climate change effects on water supply will be growing instability in annual water flows: growing short-term oversupply due to spring and flash floods and scarcity due to longer and more severe droughts. Hence, growing water scarcity may become the main obstacle to enhancing local hydro- and cogeneration power production. Furthermore, the climate projections show that the anticipated worsening of humidity conditions and growing aridisation may result in a deterioration of the ecological-climatic conditions for plant growing towards the end of the century. In the longer run it represents a serious threat to energy production from biomass.

According to the NHDR, the anticipated rise in the number of days with temperature over 10°C will mean that building heating will be required for a smaller number of days (in Chisinau centralized heating season starts when daily temperature is below 8°C). At the same time, summers and autumns are expected to become hotter and drier. Therefore, demand for the electricity required to ensure air cooling in the buildings is likely to surge. Even without taking climate change effects into consideration, electricity consumption is expected to grow by over 15 per cent over the period from 2006 to 2020. Taking into the equation climate change effects on demand could push demand for electricity still higher.

According to the vulnerability assessment of the magnitude of the impact with the probability of risk due to possible climate change on the energy sector, the most vulnerable regions in the RM will be: Chisinau municipality, the Northern and partially Southern part of the country, for which it was revealed the greatest amount of risks with high probability related to climate change (Table 5-24).

Also, three opportunities associated with climate impacts on the energy sector exist: decrease in energy used in residential, commercial, and industrial water heating in Chisinau municipality, Central and Southern regions; wind speed and direction may increase wind generation potential and efficiency with high probability in the Southern and to a lesser degree in Central and Northern regions; and cloudiness, which may increase solar generation potential in Southern part of the country and in Chisinau municipality.

For the energy sector in the RM, five of the identified risks are considered to be high priority:

- Increase in energy used for residential and commercial refrigeration and industrial process cooling;
- Increase in damage to supply grids which present a threat to electricity transmission and distribution;
- Changes in the balance of energy use among fuel types;
- Growing water scarcity may become the main obstacle to enhancing hydro- and cogeneration power production; and
- Decrease of biomass yield.

Adaptation measures to reduce losses/risks in energy sector could be as follows:

- Supply:
  1). *Mined resources* (including oil and gas, thermal power) could include replace water cooling systems with air cooling, dry cooling, or recirculating systems; improve design of gas turbines (inlet guide vanes, inlet air fogging, inlet air filters, compressor blade washing techniques, etc.); (re)locate in areas with lower risk of flooding/drought; build dikes to contain flooding, reinforce walls and roofs; adapt regulations so that a higher discharge temperature is allowed; consider water re-use ad integration technologies at refineries;

Table 5-24: Priority Risks and Opportunities for the Energy Sector in RM

	Detail of magnitude risk/opportunity	North	Centre	South	Mun. Chisinau
Risk	Increase in damage to supply grids which present a threat to electricity transmission and distribution	HIGH	HIGH	HIGH	HIGH
	Increase in energy used for residential and commercial refrigeration and industrial process cooling	HIGH	MEDIUM	MEDIUM	HIGH
	Changes in the balance of energy use among fuel types	HIGH	MEDIUM	MEDIUM	HIGH
	Growing water scarcity may become the main obstacle to enhancing hydro- and cogeneration power production	HIGH	HIGH	HIGH	HIGH
	Decrease of biomass yield	MEDIUM	MEDIUM	HIGH	
Opportunity	Decrease in energy used in residential, commercial, and industrial water heating	MEDIUM	HIGH	HIGH	HIGH
	Wind speed and direction (wind generate potential and efficiency)	MEDIUM	MEDIUM	HIGH	MEDIUM
	Cloudiness (Solar generation potential)	MEDIUM	MEDIUM	HIGH	HIGH

2). *Hydropower* could include: build de-silting gates Increase dam height; construct small dams in the upper basins; adapt capacity to flow regime (if increased);adapt plant operations to changes in river flow patterns; operational complementarities with other sources (e.g. natural gas);

3). *Wind*: (re)locate based on expected changes in wind-speeds;

4). *Solar:* (re)locate based on expected changes in cloud cover; and

5). *Biomass*: introduce new crops with higher heat and water stress tolerance; substitute fuel sources; early warning systems (temperature and rainfall);support for emergency harvesting of biomass; adjust crop management and rotation schemes; adjust planting and harvesting dates; introduce soil moisture conservation practices.

- Demand: invest in high-efficiency infrastructures and equipment; invest in decentralized power generation such as rooftop PV generators; efficient use of energy through good operating practice.
- Transmission and Distribution**:** improve robustness of pipelines and other transmission and distribution infrastructure; burying or cable re-rating of the power grid; emergency planning; and regular inspection of vulnerable infrastructure such as wooden utility poles[158].

5.4.5. Climate Change Impacts on Transport Sector

Transport infrastructure is critical for human development, as it provides a lifeline for delivering key services, and access to markets. The transport sector plays a significant role in the national economy of the RM, its current contribution to the GDP being about 10.7 percent with an increasing trend (from 4.8 percent in 1990, to 10.7 percent in 2011)[159]. The transport sector provides jobs to 67 thousand persons, or to 5.7 percent of the employed population of the country.[160]

The RM's transportation sector comprises the following segments: road transportation, railway transport, air transportation and naval transportation. Because RM is geographically small and landlocked, roads are a key form of infrastructure. Currently 97.7 per cent of passengers and 84.7 per cent of freight is transported by road[161].

However, a number of indicators reveal a very low development standard and poor quality of the roads. Only 8.827 km of a total of 9,352 km of public roads have any capital pavement (either concrete or asphalt). The rest have a so-called "light pavement" and represent mainly the local roads[162]. As shown in a World Bank report, due to the inadequate condition of the road network, about 40 settlements have no year-round access to the national road network and, during the rainy and winter seasons, are virtually isolated from the rest of the country[163].

Long-lasting heat waves can worsen or even destroy the asphalt pavement of the national roads. This phenomenon has already been witnessed in 2003, 2007 and 2012, when longer periods of high temperatures were registered. The most serious damage was to the Chisinau–Balti highway. Even on the newly rebuilt Chisinau–Leuseni national highway, long portions of the road were deformed. The roads from Rabnita and Rezina were almost completely destroyed by trucks carrying cement from the local factories.

Heavy summer rains almost stopped vehicular circulation in downtown Chisinau in 2005, 2008 and 2009 causing additional damage to the pavement of city streets, pavement that is already in a poor condition. The rainfall water collection system is outdated and unable to accommodate heavy rain episodes[164].

A) Possible Impact of Climate Change on the Transport Sector in RM

The transport sector comprises roads, rail, ports and air, with very different types and ages of infrastructure. The transport sector is vulnerable to the predicted increase in frequency and intensity of storms (wind, rain, snow), which could result in raised costs related to the construction, maintenance, and operations of transportation infrastructure and vehicles. Furthermore, maintenance costs will increase for some types of infrastructure because they deteriorate more quickly at temperatures above 32°C. Construction costs could increase because of restrictions on days above 32°C, since work crews may be unable to be deployed during extreme heat events and concrete strength is affected by the temperature at which it sets. Increases in daily high temperatures would affect aircraft performance and runway length because runways need to be longer when daily temperatures are higher (all other things being equal)[165].

Table 5-25 outlines the main direct climate change impacts and their potential socio-economic consequences in Moldova that are relevant to the transport sector.

[158] WB (2011), "*Climate Impacts on Energy Systems: Key Issues for Energy Sector*" Authors: Jane Edinger, Walter Vergara, Irene Leino. January 28, 2011. 225p.

[159] NBS (2012), *Annual Statistical Yearbook of the Republic of Moldova, 2012*, Table 13.21 "Share of Main economic activities in the generation of Gross Domestic Product".

[160] NBS (2012), *Annual Statistical Yearbook of the Republic of Moldova, 2012*, Table 3.1.4 "Distribution of employment by economic activities".

[161] NBS (2012), *Annual Statistical Yearbook of the Republic of Moldova, 2012*, Table 18. 1 "Goods transport, by modes of transport" and Table 18.7 "Passenger transport, by modes of public transport".

[162] Expert-Group (2008), "*State of the Country Report*", 2008.

[163] World Bank (2002), "*Moldova: Transport Strategy Update with Emphasis on the Road Sector*", December 2002.

[164] UNDP, 2009/2010.

[165] National Research Council (U.S.), Committee on Climate Change and U.S. Transportation (2008), *Potential impacts of climate change on U.S. transportation* / Committee on Climate Change and U.S. Transportation, Transportation Research Board and Division on Earth and Life Studies, National Research Council of the National Academies, 2008.

Table 5-25: Summary of Socio-Economic Impact of Climate Change on the Transport Sector

Climate Impact Category	Impact on Transport	Social/Economic Impact
High temperatures and heat waves	Changes to pavement integrity, e.g. softening, traffic-related rutting, migration of liquid asphalt; Deformation of railroad lines; and Vehicle overheating.	Accelerated deterioration of transport infrastructure; Restricted transportation of heavy loads, speed limits; Raised fuel consumption; Limitations on periods of construction activity; and Increased costs of both capital investment and operation and maintenance costs in land transportation systems.
Increase in intense precipitation events	Increase in weather-related delays; Increase in traffic disruptions; Disruption of construction activities; and Disruption of safety and maintenance operations.	Damage transport infrastructure and restrict movement Decreased revenue from transport activities; Disruption to supply of goods; and Increased expenditures on transport maintenance and operation.
Decrease in precipitation	Reduced humidity of the roadbed, especially in spring and autumn; and Restricted development of river transportation.	Reduced risk of landslides and soil erosion; Circulation of vessels impaired; Increased operational costs; and Need for additional engineering works for adaptation.
Less precipitation and higher temperatures in the winter	Effect on local roads that are not covered with an asphalt surface and have shallow roadbeds.	Lower costs for snow and ice control measures on some roads; and Rural communities become separated from the rest of the country during the winter season or in rainy periods.

B) Assessing the magnitude of risk/opportunities of climate change on the transport sector

Projected climate changes are likely to have a particularly significant impact on transportation infrastructure because the RM's transportation system was specified to typical weather conditions, and expected changes in climate extremes could push environmental conditions outside the range for which the system was designed. All modes of transportation are vulnerable to climate change. The impacts will vary depending on the location, mode, and condition of the transportation infrastructure. For example, Southern areas will be subject to a high magnitude of risks such as highway asphalt rutting, health and safety risks from heat stress to highway maintenance personnel and passengers, as well as overheating of diesel engines, whereas the Northern area may experience lower magnitude of risks (Table 5-26).

Adaptation measures to reduce losses/risks in transportation sector[166] could be as follows:

In the case of increased temperatures and heat waves:

- Development of new, heat-resistant paving materials;
- Greater use of heat-tolerant street and highway landscaping;
- Proper design/construction, milling out ruts;
- Overlay with more rut-resistant asphalt;
- Increased on-going maintenance;
- Shifting construction schedules to cooler parts of day;

[166] National Research Council (U.S.), Committee on Climate Change and U.S. Transportation (2008), *Potential impacts of climate change on U.S. transportation* / Committee on Climate Change and U.S. Transportation, Transportation Research Board and Division on Earth and Life Studies, National Research Council of the National Academies, 2008.

Table 5-26: Priority Risks and Opportunities for Transport Sector

	Detail of magnitude risk/opportunity	North	Centre	South	Mun. Chisinau
Risk	Highway asphalt rutting	HIGH	HIGH	HIGH	HIGH
Risk	Health and safety risks from heat stress to highway, maintenance personnel and passengers	LOW	MEDIUM	HIGH	MEDIUM
Risk	Low water levels on inland waterways	LOW	MEDIUM	MEDIUM	
Risk	More airport runway length and fuel needed because of less dense air	MEDIUM			MEDIUM
Risk	Rail buckling due to derailment and malfunction of track sensors and signal sensors, increased travel time due to speed restrictions	LOW	MEDIUM	MEDIUM	MEDIUM
Risk	Thermal expansion of bridges, traffic disruptions	LOW	LOW	LOW	LOW
Risk	Overheating of diesel engines	MEDIUM	HIGH	HIGH	HIGH
Risk	Infrastructure deterioration, travel and schedule delays, loss of life and property, increased safety risks	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Risk	Flooding of roads, rails, airport runways, pipeline systems, bikeways and walkways (frequency and magnitude will increase)	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Risk	Loss of visibility from drifting snow, lane obstruction, treatment chemical dispersion	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Opportunity	Due to higher temperatures the costs of de-icing planes and removing of snow and ice from the runways may fall substantially	MEDIUM	HIGH	HIGH	HIGH

- Designing for higher maximum temperatures in replacement or new construction; and
- Adaptation of cooling systems.

In the case of increases in intense precipitation events:

- Improve flood protection;
- Conduct risk assessments for all new roads;
- Upgrading of road drainage systems;
- Pavement grooving and sloping;
- Improved asphalt/concrete mixtures;
- Greater use of sensors for monitoring water flows;
- Increases in the standard for drainage capacity for new transportation infrastructure and major rehabilitation projects; and
- Engineering solutions, increase warnings and updates to dispatch centers, crews and station.

5.4.6. Climate Change Impacts on Health Sector

Life expectancy is generally accepted as a key indicator of the overall state of a nation's health. In terms of life expectancy at birth, RM is presently in a slightly better position than in the pre-transition period (in 2012 it was 71.12 years for both sexes, 67.24 years for men and 74.99 years for women; compared with 1990, respectively 67.97 years for both sexes, 63.86 years for men and 71.92 years for women). At the same time, in 2012 life expectancy in rural areas was shorter than in urban ones (69.55 years for both sexes, 65.78 years for men and 73.46 years for women; respectively, 73.51 years for both sexes, 69.30 years for men and 78.00 years for women), and this is attributed to a variety of factors, including lower levels of access to health care, poor water quality, poverty and cultural factors in rural areas. While the overall health conditions of the Moldovan population have tended to improve in the last decade or so, the comparative statistics show that the situation in most of the transition countries improved to a greater extent than in RM.[167]

In 2011 the number of beds in hospitals was about 22.0 thousand, or 61.9 beds per 10,000 people; the total number of physicians was 12.91 thousand, or 36.3 physicians per 10.000 population. In 2011, healthcare expenditures accounted to about 13.3% of the State Budget[168].

The most frequent types of diseases (as a primary diagnosis per 1,000 population for 2010 are: (1) respiratory diseases (126.8 cases), (2) pregnancy, childbirth and post-natal complications (49.2 cases), (3) traumas, intoxications and other consequences of external causes (34.6 cases), (4) diseases of digestive organs (26.2 cases), and (5) infectious and parasitic diseases (25.8 cases). Other prevalent diseases relate to the nervous system and sense organs (23.8 cases), and skin and hypoderm diseases (20.0 cases)[169]. The most important causes of lethal events in the country are blood circulation diseases, trauma and intoxications, and malignant tumors, as well as digestive system diseases.

A) Possible Impact of Climate Change on Health in RM

It is clear that climate change and extreme weather events have a direct impact on health. However, they can also affect forestry, agriculture and the economy resulting in problems related to food security and poor sanitary conditions that can, in turn, lead to serious mid- to long-term health effects. The health effects of drought could, for example, cause a decrease in food production and result in nutritional problems in the population, making them more vulnerable to disease. In a UNICEF survey conducted in the RM[170], local leaders anticipated that the most severe impact of the 2007 drought would be its effect on the health of the population. In fact, eight out of ten respondents (and 91% of the medical personnel interviewed) considered that it had already done so. However, the long-term effects of drought may be even more devastating. The increasing competition for arable land may eventually result in migration to cities and abroad, and conflict as resources dwindle[171].This section outlines the main direct climate change impacts and their potential socio-economic consequences that are relevant to health, which are presented in Table 5-27.

B) Assessing the Magnitude of Risk and Opportunities of Climate Change Impacts on Health

Sub-populations that are most vulnerable to the health impacts of climate change depend on the region, the health outcome, and population characteristics, including human, institutional, social, and economic capacity[172]. Individual vulnerability depends on genetic, developmental, acquired, and socio-economic factors. In general, the most vulnerable are children, older adults, those with chronic medical conditions, socially disadvantaged individuals, those living in water-stressed and flood prone areas, and populations highly dependent on natural resources. Table 5-28 summarizes vulnerable populations by health outcome.

According to the vulnerability assessment of the magnitude of the risk/ opportunities of the climate change on health the most vulnerable regions in the Republic of Moldova due to possible climate change will be Chisinau Municipality, South, and partially Center for which it was revealed the greatest amount of risks with high probability related to climate change (Table 5-29).

[167] UNDP, 2009/2010.

[168] NBS (2012), *Annual Statistical Yearbook of the Republic of Moldova, 2012*, Table 22.2 "Structure of national public budget".

[169] NBS (2012), *Annual Statistical Yearbook of the Republic of Moldova, 2012,* Table 8.14 "Population morbidity, by main classes of diseases".

[170] UNICEF Moldova (2007), "*Drought after-effects upon population of the Republic of Moldova.*" Chisinau, 2007.

[171] WHO (2008), "*Assessment of health security and crisis management capacity*", Republic of Moldova, 2008.

[172] Ebi KL, Smith J, Burton I, Scheraga J. Some lessons learned from public health on the process of adaptation. Mitigation and Adaptation Strategies for Global Change 2006; 11: 607-620. doi: 10/1007/s11027-006-3257-7.

Table 5-27: Summary of Socio-economic Impact of Climate Change on Health in Moldova

Climate Impact Category	Impact on Health	Social/Economic Impact
Extreme air temperatures and heat waves	Excess mortality*; Worsened health conditions of people suffering from chronic diseases; Change in foodborne disease patterns; Change the distribution of infectious diseases; and Increase in the frequency of respiratory diseases.	Reduced economic growth; Increased burden of diseases and health conditions, including water borne diseases; Population displacement; Increased mental and behavioural disorders due to stress; and Loss of education.
Floods	Increased number of deaths and injuries; and Increased water borne diseases.	See above
Drought	Increased hunger and malnutrition.	See above

*Information on the heat waves of 2007 in Chisinau was used to study the relations between elevated temperatures and excess mortality caused by these events. The authors (Opopol, Corobov, 2010)[1] have revealed that the excess mortality in April-September totaled 190 deaths, or 6.5% of their number in the analogous period of reference years (2000-2008). The average daily excess deaths above the threshold hot temperatures (about 25°C, 31°C and 19°C for mean, maximum, and minimum daily temperatures, respectively) were in the range of 2.0-4.4% per 1°C temperature increase. Temperature–excess mortality relationships become stronger with an increasing time lag; maximal effects were mainly revealed after one-three days of a heat impact.

Table 5-28: Climate-Sensitive Health Outcomes and Particularly Vulnerable Groups[2]

Climate-Sensitive Health Outcome	Particularly Vulnerable Groups
Heat-related illnesses and deaths	Elderly, chronic medical conditions, infants and children, pregnant women, urban and rural poor, outdoor workers
Diseases and deaths related to air quality	Children, pre-existing heart or lung disease, diabetes, athletes, outdoor workers
Illnesses and deaths due to extreme weather events	The poor, pregnant women, people with chronic medical conditions, mobility and those with cognitive constraints
Water- and foodborne illness	The immunocompromised, the elderly, infants
Vectorborne illnesses	
Lyme disease	Children, outdoor workers
Hantavirus	The rural poor, some occupational groups
Malaria	Children, the immunocompromised, pregnant women, people with genetic disorders

[1] Opopol N., Corobov R., *Excess mortality in Chisinau during the hot summer of 2007*. Proceedings of the National Conference: Health in relation to the environment. Chisinau, 15 October 2010, p. 22-33.
[2] Ebi KL, Balbus J, Kinney PL, Lipp E, Mills D, O'Neill MS, Wilson M (2008), *Effects of global change on human health*. In: Gamble JL, editors. Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research. Washington, DC: U.S. Environmental Protection Agency, 2008, pp 2-1 to 2-78.

For health sector in the RM, six of the identified risks are considered to be of high priority:

- Increase in heat wave-related deaths;
- Increase in air pollution-related diseases;
- Increased risk of allergic disorders;
- Increased risk of drought and water scarcity; and
- Increase the burden of waterborne and foodborne diseases.

Also, one opportunity associated with climate impacts on health exists – reduction in winter mortality from cold.

However, within these regions, the analysis should take into account that climate changes do not hit different population

Table 5-29: Priority Risks and Opportunities for Health

	Detail of magnitude risk/ opportunity	North	Centre	South	Mun. Chisinau
Risk	Increase in heat wave-related deaths	LOW	MEDIUM	HIGH	HIGH
	Increase in air pollution-related diseases	MEDIUM	MEDIUM	MEDIUM	HIGH
	Changes in phenological phases and increased risk of allergic disorders	MEDIUM	MEDIUM	MEDIUM	HIGH
	Increased risk of drought and water scarcity*	LOW	MEDIUM	HIGH	LOW
	Flood increase in frequency and intensity**	MEDIUM	HIGH	HIGH	LOW
	Increase the burden of waterborne and foodborne diseases	MEDIUM	HIGH	HIGH	MEDIUM
Opportunity	Reduction in winter mortality from cold	HIGH	MEDIUM	LOW	MEDIUM

*Drought reduces water availability for hygiene; drought increases the risk of forest fires; drought reduces food availability in populations that are highly dependent on household agriculture productivity and/or economically weak.
**Flooding disrupts water supply and sanitation systems and may damage transport systems and health care infrastructure; floods may provide breeding sites for mosquito vectors and lead to outbreaks of disease; floods may increase post-traumatic stress disorders.

groups in the same manner: some groups are obviously more vulnerable than others. For example, the health care services infrastructure is much less accessible in rural areas, and the rural population has a much higher share of persons who are not registered with family physicians (62% of the total non-registered) as well as a much higher share of those not holding obligatory medical insurance (27.3% of the rural population vs. 19.9% of the urban population). Moreover, every third person who does not hold medical insurance is from the fifth poorest quintile. Secondly, the rural population (around 60% of the total) is much more dependent on the decentralized supply of water than the urban population, and the decline in the quality of water will affect the rural population (one of the most vulnerable group to intestinal diseases is children).

Another important vulnerability is the risk of malnutrition which appears when severe climate events, such as droughts, floods and hails may ruin crops, leaving small farmers with no food and no income meaning that rural populations will face serious nutrition risks.[173]

The WHO Regional Office for Europe[174] states that the prevention of and response to the health effects of climate change will require a portfolio of action at different levels: from health system preparedness coordinated with meteorological early warning systems to timely public and medical advice and improvements to housing and urban planning. Action within the health system could include: (1) strengthening health security; (2) advocating health to other sectors; (3) sharing good practices in inter-sectoral action; (4) building capacity in the health workforce; (5) providing intelligence; and (6) setting an example by "greening" the health services.

Adaptation measures in health sector may include:

- Develop integrated assessments of environmental, economic and health impacts of climate change.
- Discuss and design adaptation strategies for use by the health sector in identifying climate-related health risks in the country;
- Agree on a lead body to coordinate the public health preparedness for and response to climate change; define roles and responsibilities;
- Review and strengthen existing disease surveillance systems with a view to including further climate-related health outcomes, such as heat-related morbidity and mortality;
- Identify, monitor and target risk groups and vulnerable populations; develop treatment protocols for climate-related health problems;
- Raise the awareness of healthcare professionals, the public and the most vulnerable groups;
- Insure improved access of remote communities and vulnerable groups (e.g., elderly, obese, and disabled) to healthcare services;
- Provide training and guidance for medical professionals and advice for the public on measures to be taken during extreme weather events, such as heat-waves, floods and drought;
- Upgrade current education and communication programmes;
- Set up a monitoring system and evaluation mechanism to assess the effectiveness of preparedness and response measures;
- Apply new technology for scientific measurements (e.g. vector borne disease, water quality, climate change, etc.);
- Enhance understanding of risk for the emergence of new, unfamiliar diseases and health impacts;
- Consider the cost (and volumes) of energy and CO_2 emissions used by air-conditioning and advocate for alternative cooling methods to the public;
- Maintain international and regional cooperation[175].

5.5. Case Studies on Potential Impacts of Climate Change

5.5.1. Potential Impact of Climate Change on Agriculture Sector

The assessment of the climate change impact on agricultural sector was made based on projections of changes in temperature and precipitation received by regionalization of global experiments the most reliable in the Republic of Moldova 10 Global Climate Models (GCMs) for the three SRES A2, A1B and B1 emission scenarios of greenhouse gases and aerosols[176]. To assess the vulnerability of main agricultural crops to climate change was used the empirical-statistical approach, linking fluctuations of crops production yields to climate conditions during the growing season, conform to Taranu L., et al.[177].

Agricultural crop productivity is determined by the level of farming culture, by soil, climatic and weather conditions.

[173] NHDR, 2009/2010.

[174] Menne B. et al. (2008), *"Protecting Health in Europe from Climate Change."* Copenhagen, WHO Regional Office for Europe, 2008 <http://www.euro.who.int/Document/GCH/Protecting_health.pdf?language=French>, accessed on 8 August 2008.

[175] World Health Organization (2008), *"Assessment of health security and crisis management capacity"*, Republic of Moldova, 2008.

[176] Taranu L., Bercu I., Deveatii D. (2012), *Regional Climate Change Scenarios for the Republic of Moldova: Future Temperature and Precipitation Projections from Ensembles of 10 Global Climate Models*. Mediul Ambiant. Nr.3 (63), P. 33-42.

[177] Constantinov T., Taranu L., Mironova T., Toderas V. (2009), *Assessment of vulnerability some agricultural crops productivity in the Republic of Moldova, without adaptation measures, to new climate conditions according to the CSIRO-Mk2, HADCM2 and ECHAM4 general atmospheric models*. Bulletin of the Academy of Sciences of Moldova, Series of "Biological, Chemical and Agricultural Sciences". Republic of Moldova, Chisinau, 2009, Nr.2 (308). C. 124-132.

Following the generally accepted methodology[178], we have viewed crop productivity (*Yi*) as a sum of two elements:

$$Y_i = Y_i^{(T)} + \Delta Y_i^{(T)}$$

Where $Y_i^{(T)}$ is presented via dynamic average value, determined by the rate of farming intensification and climatic conditions close to average for many years, and the deviation from it $\Delta Y_i^{(T)}$ is explained by the anomaly of weather conditions of the latter.

In other words, the tendencies of crop productivity depend on the implementation of scientific and technical achievements into practice, increased investment into technical means, compliance with the agro technical measures and crop rotation, improved labor organization, better use of fertilizers, modification of varieties used, irrigation, etc. These tendencies are a consequence of gradual improvement in the culture of farming in average soil and climatic conditions.

Statistical analysis of the possible impact of climate change on yield of cereal (*winter wheat and grain maize*), oil (*sunflower*) and technical (*sugar beet and tobacco*) crops was carried out in several steps.

Step 1: According to the statistical data on productivity at agricultural enterprises of various categories were constructed linear and polynomial trends for crop yields in the Republic of Moldova over the two distinct time periods: 1961-1990 (baseline periods) and 1981-2010 (recent periods) (Figure 5-32).

The linear trends of major agricultural crops productivity variability on the territory of the Republic of Moldova for years 1961-1990 have been characterized by a sustainable increase of crop yield, by 7.3 q/ha per decade for winter wheat, 3.5 q/ha per decade for grain maize, 0.9 q/ha per decade for sunflower and 25.6 q/ha per decade for sugar beet (Table 5-30; Figure 5-32).

Owing to the implementation of intensive technologies and the use of irrigation in the 1981-1990 crop productivity increased significantly and has reached the maximum level for winter wheat – 35.0 q/ha; maize for grain – 39.0 q/ha; sunflower – 18.0 q/ha; and sugar beet – 272.5 q/ha.

Then, in the forthcoming three decades (1981-2010) there was a tendency for sharp decrease in crop productivity by 6.2 q/ha per decade for winter wheat, 11.2 q/ha per decade for grain maize, 2.5 q/ha per decade for sunflower. The greatest decrease in crop productivity was observed in the 1991 – 2010 years, for winter wheat reaching the level of 23.0 q/ha; for grain maize – 19.8 q/ha, while for sunflower – 12.6 q/ha.

Step 2: Multiple regression equations, linking yield variability with average monthly temperatures and precipitation during the agricultural crops growing season, with the highest level of statistical significance were calculated (using the statistical application package STATGRAPHICS Centurion and Microsoft Office Excel). The temperature and precipitation variables were selected in conformity with the step by step regression taking into account their contribution to the crops productivity and consecutive analysis of all possible combinations to find the most accurate (reliable) model. The regression coefficients of the remaining months show, in what direction and how much is modified the crops productivity in response to changes in the temperature and precipitation of the respective month.

The analysis of the data presented in the Table 5-31 shows that the influence of climatic conditions on winter wheat yield in the 1981-2010 years was statistically significant at 99.9% highest level of significance ($p \leq 0.001$). Coefficient of determination R^2 shows that the combined effect of precipitation and temperature defined about 65.3% of the variability of average annual productivity of winter wheat during this period. The regression equation characterizing the interrelation of crops (corn, sunflower, sugar beet and tobacco) yield variability with the temperature and precipitations during the vegetation period, revealed as well a high level of significance at 99% ($p \leq 0.01$). The combined effect of temperature and precipitation during the vegetation period determined the yield variability at the level of 66.4 per cent for sunflower, 64.1 per cent for corn, 53.2 per cent for tobacco and 49.9 per cent for sugar beet.

Step 3: The analysis of the impact of future climate changes, determined by temperature and precipitation conditions, on the yield of major cereal and industrial crops, without undertaken any adaptation measures, was carried out according to

[178] Daradur M. I. (2001), *Variability and risk assessment of extreme humidity conditions.* Chisinau, 2001. 160 p. (in Russian).

Table 5-30: Yield linear trends (q/ha/yr) of major crops and their statistical significance (*p-value*) for the three observation periods in the Republic of Moldova

Crop	Yield					
	1961-1990		1981-2010		1991-2010	
	Trend	p-value	Trend	p-value	Trend	p-value
Winter wheat	0.7288	**0.0000**	-0.6187	**0.0003**	-0.6958	**0.0297**
Grain maize	0.3480	**0.0011**	-1.1229	**0.0004**	-0.9956	0.0779
Sunflower	0.0862	**0.0123**	-0.2598	**0.0004**	-0.0038	0.9697
Sugar beet	2.5578	**0.0090**	0.5025	0.6956	0.5025	0.3392
Tobacco	-	-	-0.0687	0.2486	0.0030	0.9774

Note: Bold is used to mark statistically significant values.

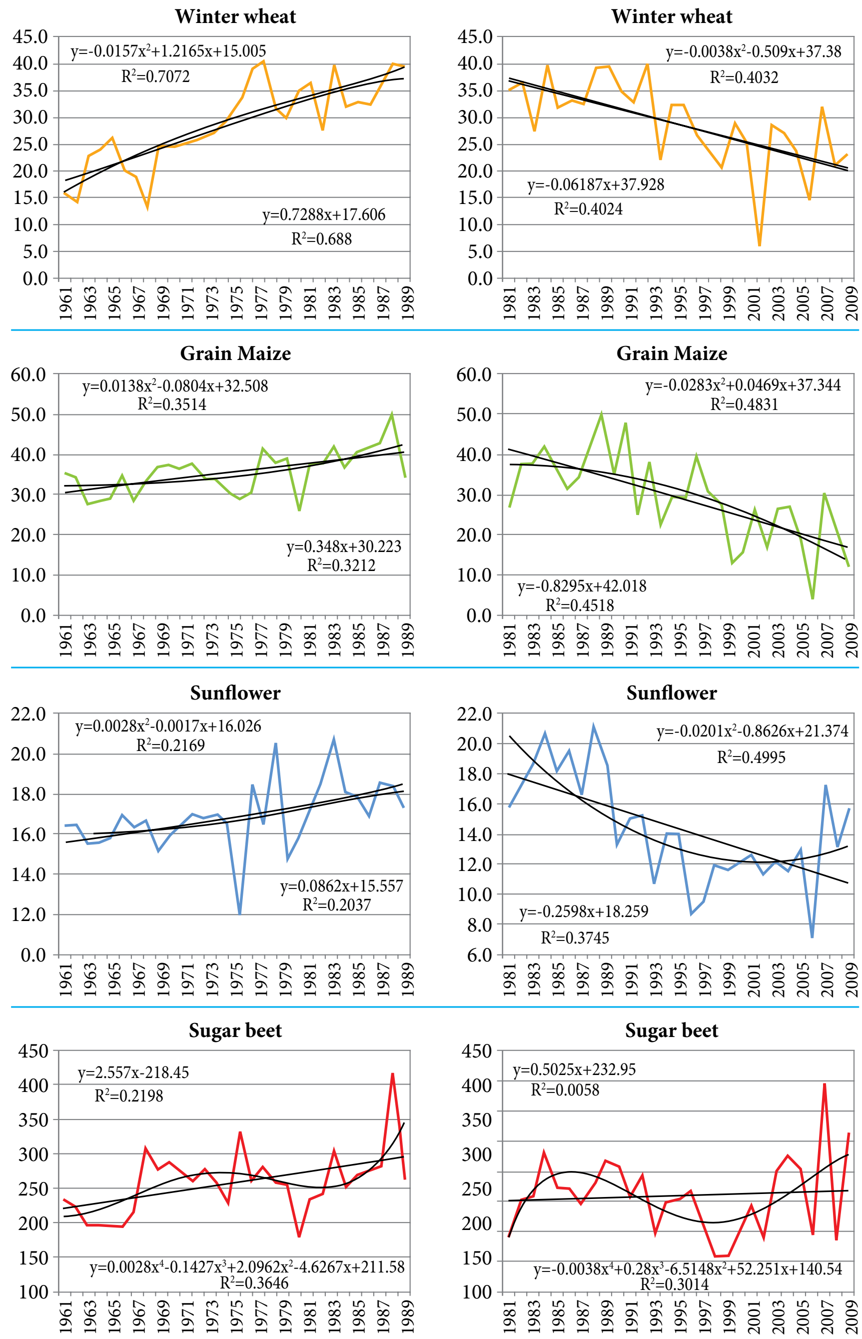


Figure 5-32: Yield Variability Trends for Main Crops and their Coefficients of Determination (R^2) for Two Observation Periods (left - 1961-1990, right - 1981-2010) in the Republic of Moldova

Table 5-31: The Interrelationship of Major Agricultural Crops Yield Variability with Temperature and Precipitation during the Vegetation Period within the 1981-2010 time periods

Crop	Regression equation	*p* – value	R^2,%
Winter wheat	$Y = 130.473 - 2.27358{*}T_{V} - 2.60312{*}T_{VII} - 0.815868{*}T_{X} + 0.0181492{*}P_{VI} + 0.0335445{*}P_{IX}$	**0.0003**	65.26
Grain maize	$Y = 161.118 - 2.79125{*}T_{V} - 3.30915{*}T_{VII} - 2.09824{*}T_{X} + 0.115611{*}P_{IV} + 0.0407194{*}P_{VII}$	**0.0033**	64.10
Sunflower	$Y = 41.6803 - 0.817938{*}T_{VIII} - 0.671806{*}T_{X} + 0.0242598{*}P_{VI} - 0.0415422{*}P_{VIII} - 0.0454977{*}P_{X}$	**0.0011**	66.36
Sugar beet	$Y = 431.527 - 16.9561{*}T_{VI} + 1.09464{*}P_{IV} + 0.338911{*}P_{V} + 0.241995{*}P_{VII} + 0.314864{*}P_{VIII}$	**0.0048**	49.92
Tobacco	$Y = 26.6589 - 1.05{*}T_{X} + 0.0488325{*}P_{V} - 0.0176172{*}P_{VIII} - 0.0229145{*}P_{IX} - 0.031975{*}P_{X}$	**0.0024**	53.20

Note: Y - yield, quintal/ha; T - average monthly air temperature, ^{0}C; P - average monthly precipitations, mm; with Roman numerals are noted the corresponding months of vegetation period: since April (IV) to October (X).

the methodological approach [179]. Using the regression equations interrelationship in the yield variability of major agricultural crops with the temperature and precipitation conditions of the growing season, there were calculated projections of future yield changes in the Republic of Moldova, (%/30 years) according to an ensemble from 10 Global Climate Models (GCMs) for the three SRES A2, A1B and B1 emission scenarios relative to 1981-2010 time periods.

The possible changes in the yield of major agricultural crops (winter wheat, grain maize, sunflower, sugar beet and tobacco), due to future climate changes in the Republic of Moldova, without undertaken any adaptation measures, is revealed in Figure 5-33.

As one of the most essential resources to world food supply, wheat yield is very sensitive to temperature changes (Lobell et al.2011[180]). Lobell and Field (2007) reported a 5.4 percent decrease in global mean wheat yield per 1°C increase in temperature. The analysis of the obtained results revealed that due to the impact of the main climate indicators (temperature and precipitation), productivity of the winter wheat by 2020s could decrease from 9% (SRES A2) to 12% (SRES B1). In comparison with the 1981-2010 time periods, by 2050s the crop productivity may decrease in dependence of the assessed emission scenario from 27% (SRES B1) to 34% (SRES A2). The maximum values of productivity decrease may be reached by 2080s. So, due to changes in values of main climate indicators – precipitation and temperature – the productivity of winter wheat may decrease from 38% (SRES B1) to 71% (SRES A2).

The sharp decline in the productivity of winter wheat can be explained by a shift of vegetation phases in a more unfavorable period due to temperature increase. The vegetation period of winter wheat (starting with temperatures higher than 5^0C in spring), according to an ensemble of 10 GCMs will start in the RM by 2020’ earlier by 1 - 4 days (under the SRES A2) and/or by 2 - 6 days (under the SRES B1).

By the 2080s, the vegetation period of winter wheat will start earlier by 7-9 days (under the SRES B1) and/or by 10-13 days (under the SRES A2), in dependence of the assessed emission scenario, with a maximum expected shift in the Central Agro-Ecological Zone (AEZ).

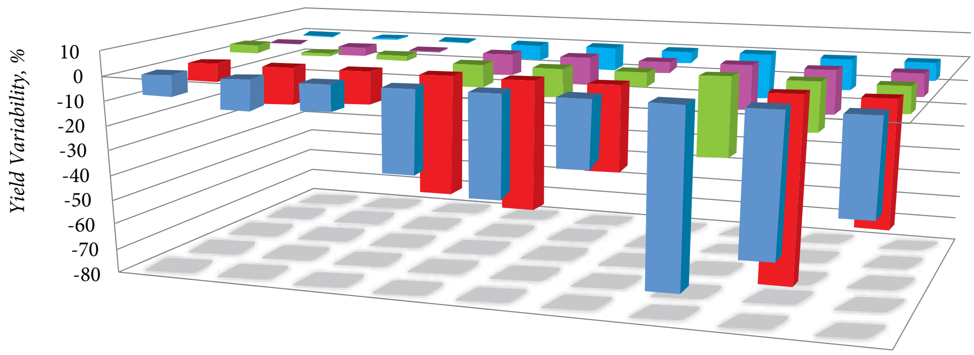
Change of phenology duration is an essential factor for wheat yield. Previous studies had found that warming will shorten wheat phenology duration and decrease wheat yield, mainly due to a shorter growing period, which decreases the duration of photosynthesis and wheat mass accumulation (Hatfield et al. 2011[181]).

By use of the index ‘sum of effective temperatures above 5^0C’ there were calculated for winter wheat, according to an ensemble from 10 GCMs for three SRES A2, A1B and B1 emission scenarios, the average initiating date of main development phases in the spring-summer period. Analysis of the data for the most vulnerable Central AEZ presented in the table below, revealed that by 2020s output in the tiller initiating phase at winter wheat may have shifted in average from 4 days (SRES A2) up to 6 days (SRES B1) (Table 5-32).

[179] T. Constantinov, L. Taranu, T. Mironova, V. Toderas (2009), *Assessment of vulnerability some agricultural crops productivity in the Republic of Moldova, without adaptation measures, to new climate conditions according to the CSIRO-Mk2, HADCM2 and ECHAM4 general atmospheric models*. Bulletin of the Academy of Sciences of Moldova, Series “Biological, Chemical and Agricultural Sciences”. Republic of Moldova, Chisinau, 2009, Nr.2 (308). C. 124-132.

[180] Lobell, D. B., W. Schlenker, and J. Costa-Roberts (2011), *Climate Trends and Global Crop Production since 1980*. Science 333: 616–620.

[181] Hatfield, J. L., K. J. Boote, B. A. Kimball, L. H. Ziska, R. C.Izaurralde, D. Ort, et al. (2011), *Climate impacts on agriculture: implications for crop production*. Agron.J. 103:351–370.



	2020s			2050s			2080s		
	A2	A1B	B1	A2	A1B	B1	A2	A1B	B1
Winter wheat	-9	-13	-12	-34	-41	-27	-71	-56	-38
Grain maize	-9	-16	-14	-48	-52	-35		-74	-49
Sunflower	4	2	3	-10	-13	-7	-33	-21	-11
Sugar beet	0	-5	-1	-10	-12	-5	-20	-19	-10
Tobacco	-1	-1	0	-8	-10	-6	-19	-14	-9

Figure 5-33: Projections of Future Changes in Productivity of Major Agricultural Crops in the Republic of Moldova, (%/30 years) relative to 1981-2010 Time Periods, according to an Ensemble from 10 GCMs for SRES A2, A1B and B1 Emission Scenarios in the XXI Century

Table 5-32: Projections on Shifting the Period of Initiation of Phenological Phases in Winter Wheat Depending on the Sum of Effective Temperatures According to an Ensemble from 10 GCMs for SRES A2, A1B and B1 Emission Scenarios in the Central AEZ of the Republic of Moldova

Scenario	Winter wheat			
	Sum of effective temperatures above 5°C necessary to initiate the phenological phase			
	Tiller initiating (125°C)	Jointing (455°C)	Kernel in milk (685°C)	Kernel in dough (945°C)
1960-1990	24/04	27/05	13/06	30/06
2020s				
A2	20/04	22/05	07/06	24/06
A1B	18/04	20/05	06/06	23/06
B1	18/04	20/05	06/06	23/06
2050s				
A2	15/04	17/05	02/06	18/06
A1B	13/04	16/05	31/05	17/6
B1	15/04	17/05	03/06	19/06
2080s				
A2	10/04	12/05	28/05	12/06
A1B	09/04	10/05	26/04	11/04
B1	14/04	15/05	31/04	18/06

By 2050s the shift in the respective phenological phases will account from 9 days (SRES A2) up to 11 days (SRES A1B), while by 2080s according to the SRES A2 и A1B emission scenarios the tiller initiating phase will start by 14 days early the onset of respective phase in the reference period (1961-1990).

According to the projections, by 2020s the phenological phase of jointing may come for winter wheat earlier from 4 days (SRES A2), up to 7 days (SRES B1). According to the performed assessment, the humidity conditions in this period will be close to optimal (HTC = 1.0). However, by 2080s this shift can already draw from 12 days (SRES B1) up to 15-17 days (SRES A2 and A1B). Humidity conditions for this period would be sufficient only in accordance with the SRES B1 low emission scenario (HTC = 1.0), while according the other two emission scenarios (SRES A2 and A1B) there will be recorded insufficient humidity conditions (HTC = 0.8-0.9), thus the critical period for jointing at winter wheat will take place in dryer conditions, which will impact a sharp decrease in the productivity.

The analysis of obtained results revealed, that due to changes in heat and water regime during the growing season, productivity of the maize for grain by 2020s may decrease from 15-18% (SRES A2 and B1) to 21% (SRES A1B). In comparison with the 1981-2010 time periods, by 2050s the crop productivity may decrease in dependence of the assessed emission scenario from 43% (SRES B1) to 53-62% (SRES A2 and A1B). The maximum values of productivity decrease may be reached by 2080s. So, due to changes in values of main climate indicators – precipitation and temperature – the productivity of maize for grain may decrease from 59% (SRES B1) to 87% (SRES A1B).

By use of the index 'sum of effective temperatures above 10°C' there were calculated for maize of different maturity groups, according to an ensemble from 10 GCMs for three SRES A2, A1B and B1 emission scenarios, the possible average initiating date of main development phases in the spring-summer period.

Analysis of the data for the most vulnerable Central AEZ presented in Table 5-33, revealed that by 2020s onset in the germination - tasseling phase at maize varieties may have shifted, in dependence from emission scenario and maturity group from 7 days (SRES A2) up to 9 days (SRES B1) for the early and intermediate; and from 8 days (SRES A2) up to 11 days (SRES B1) for late maturity groups. While by 2080s, according to SRES B1 и A2 emission scenarios, the germination - tasseling phase will start by 17-22 days (for the early and intermediate); and by 20-26 days (for late maturity groups) early the onset of respective phase in the reference period (1961-1990) (Table 5-33). In this regard, it is interesting to note that the actual observed changes in the occurrence of phenological germination - tasseling phase of maize due to the temperature increase over the last two decades (1991-2010) were by 5 days, for early and intermediate, and by 6 days, for late maturing hybrids.

According to the projections, by 2020s onset in the sowing – milky grain phase at maize varieties may have shifted, in dependence from emission scenario and maturity group from 9 days (SRES A2) up to 12 days (SRES B1) for the early-; and from 11 days (SRES A2) up to 14 days (SRES B1) for intermediate and late maturity groups. While by 2080s, according to the SRES B1 и A2 emission scenarios, the sowing – milky grain phase will start early the onset of respective phase in the 1961-1990 period by 21-30 days for the early-; and by 23-32 days for late maturity groups (Table 5-33). The actual observed changes in the occurrence of phenological sowing – milky grain phase at maize due to the temperature increase over past two decades (1991-2010) were by 7 days for early- and by 9 days for intermediate and late maturing hybrids.

According to the projections, in the 2020s the humidity conditions will be close to optimal (HTC = 1.2) during the sowing – tasseling phenological phase across all three scenarios for early- and intermediate hybrids, while for late maturity corn hybrids moisture conditions will be sufficient only under two scenarios SRES A2 and B1 (HTC = 1.0). The next phenological stage the flowering - milky ripening at maize will be ongoing in low humidity conditions (HTC = 0.9-1.0).

By the 2080s the humidity conditions would be close to optimal (HTC = 1.0) during the tasseling phenological stage under SRES A1B and B1 emission scenarios; and insufficient (HTC = 0.8) for the SRES A2 high emission scenario. The subsequent critical phenological phases as flowering and milk grain ripening at maize regardless of maturity group will take place in dryer conditions according to high emission SRES A2 (HTC = 0.6) and medium emission SRES

A1B (HTC = 0.8) scenarios; or in insufficient humidity conditions (HTC = 0.9) under the low emission scenario SRES B1, which along with an increase of temperatures will reduce dramatically the crop yield.

Table 5-33: Projections on Shifting the Period of Initiation of Phenological Phases in Maize Varieties of Different Maturity Groups Depending on the Sum of Effective Temperatures According to an Ensemble from 10 GCMs for SRES A2, A1B and B1 Emission Scenarios in the Central Part of the Republic of Moldova

Scenario	Maize varieties of different maturity groups (early, intermediate and late)		
	Sum of effective temperatures above 10°C necessary to initiate the phenological phase		
	Germination - tasseling		
	(320-410°C)	(400-510°C)	(520-660°C)
1960-1990	23/06	02/07	16/07
2020s			
A2	16/06	25/06	08/07
A1B	14/06	23/06	05/07
B1	14/06	23/06	05/07
2050s			
A2	09/06	18/06	29/06
A1B	06/06	15/06	27/06
B1	09/06	18/06	03/07
2080s			
A2	01/06	09/06	20/06
A1B	31/05	08/06	20/06
B1	06/06	15/06	27/06
Scenario	Sowing – milky grain		
	(720-770°C)	(820-870°C)	(880-930°C)
1960-1990	26/07	04/08	09/08
2020s			
A2	17/07	24/07	29/07
A1B	14/07	21/07	26/07
B1	14/07	22/07	27/07
2050s			
A2	08/07	15/7	19/07
A1B	05/07	12/07	16/07
B1	09/07	16/07	21/07
2080s			
A2	28/06	04/07	08/07
A1B	28/06	05/07	11/07
B1	05/07	12/07	17/07
Scenario	Sowing – milky dough grain		
	(770-820°C)	(870-920°C)	(970-1020°C)
1960-1990	31/07	08/08	17/08
2020s			
A2	20/07	28/07	05/08
A1B	18/07	26/07	02/08
B1	18/07	26/07	03/08
2050s			
A2	11/07	18/07	25/07
A1B	09/07	15/07	22/07
B1	13/07	20/07	27/07
2080s			
A2	01/07	08/07	14/07
A1B	01/07	08/07	15/07
B1	09/07	16/07	23/07

By the end of the XXI century, the cultivation of major cereal crops such as the winter wheat and maize will be either impossible according to the SRES A2 high emission scenario or economically not cost effective according to the SRES A1B medium and SRES B1 low emission scenarios (Figure 5-33), due to changes in climatic conditions without adaptation measures (*if maintaining the current cultivation technologies and used varieties*) in the Republic of Moldova.

For technical crops such as sunflower, which is relatively drought-resistant, there are projected more favorable climate conditions during the growing season than for cereal crops: winter wheat and grain maize. Slight increase in productivity by 2-4% it is possible for sunflower in the 2020s, which will be replaced in the future with consecutive decline in yield. By 2050s, the most severe decrease in productivity by 10-13% is projected under the SRES A2 high and SRES A1B medium emission scenario. While under the SRES B1 low emission scenario the projection is more favorable, it is expected a decrease of productivity only by 7%. In 2080s, the most severe yield reduction for sunflower will be observed according to SRES A2 high emission scenario - by 33%, while for SRES B1 low emission scenario the forecast is more favorable – a decrease by 11% (Figure 5-33).

For sugar beet by 2020s, when assessing the combined effect of temperature and precipitation during the growing season, it is expected a decrease in productivity by 1-5% under two assessed emission scenarios SRES B1 and A1B. By 2050s, there will persisting the decreasing trend in productivity due to climate changes. The most severe decrease in productivity, by 10-12% is predicted under the SRES A1B medium and A2 high emission scenario. While under the SRES B1 low emission scenario the projection is more favorable, it is predicted a decrease of productivity only by 5%. In 2080s, the most severe yield reduction for sugar beet will be observed according to SRES A2 high emission scenario – by 20%, while for SRES B1 low emission scenario the forecast is more favorable – a decrease by 10% (Figure 5-33).

For other high value technical crop – tobacco, similar changes are expected: a slight decrease in the yield by 1%, according to the SRES A2 and A1B scenarios in the 2020s. By 2050s, there will persisting the decreasing trend in productivity due to climate changes. The most severe decrease in productivity, by 8-10% is predicted under the SRES A1B medium and SRES A2 high emission scenarios. While under the SRES B1 low emission scenario the projection is more favorable, it is predicted a decrease of productivity only by 6%. In 2080s, the most severe yield reduction for sugar beet will be observed according to SRES A2 high emission scenario – by 19%, while for SRES B1 low emission scenario the forecast is more favorable – a decrease by 9% (Figure 5-33).

The impact assessment performed allow conclude that the negative effect of global warming, according to an ensemble from 10 GCMs for SRES A2 (high), A1B (medium) and

B1(low) emission scenarios in the XXI century will not be offset by increase of precipitations. In these circumstances, without undertaken any adaptation measures it can be expected by 2080s: a significant drop in the productivity for grain maize from 59% (SRES B1) to 87% (SRES A1B) and winter wheat from 38% (SRES B1) to 71% (SRES A2); a medium drop in the productivity for sunflower from 11% (SRES B1) to 33% (SRES A2), respectively for sugar beet from 10% (SRES B1) to 20% (SRES A2); and for tobacco from 9% (SRES B1) to 19% (SRES A2), in comparison with the average productivity of Republic of Moldova's main agricultural crops in the most recent period of 1981-2010.

5.5.2. Potential Impact of Climate Change on Livestock Sector

The assessment of the climate change impact on livestock sector was made based on projections of changes in temperature received by regionalization of global experiments the most reliable in the Republic of Moldova 10 GCMs for the three SRES A2, A1B and B1 emission scenarios of greenhouse gases and aerosols (see more in Taranu et al., 2012[182]) and projections of changes in productivity of main cereal crops (winter wheat and grain corn) in the Republic of Moldova (see more in Taranu, 2013).[183] To assess the livestock production (by categories) vulnerability to climate change, it was used the empirical-statistical approach, linking fluctuations of livestock production to climate conditions during the most recent time period (1981-2010). Statistical analysis of the possible impact of the climate change on livestock production by categories (*milk, eggs, wool, beef, pork, mutton and poultry*) was carried out in several steps.

Initially, according to the statistical data on livestock production at agricultural enterprises of various categories were constructed linear and polynomial trends for livestock production by categories in the RM over the two distinct time periods: 1965-1990 (baseline period) and 1981-2010 (most recent period).

Secondly, the Pearson correlations between livestock production by categories and predictor variables have been used for selection statistical significant variables. After that, multiple regression equations linking livestock production by categories with average monthly temperature and crop productivity during the most recent time period (1981-2010)[184], with the highest level of statistical significance were calculated (using the statistical application package STATGRAPHICS Centurion and Microsoft Office Excel).

The regression model used was the following:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + e$$

Where:

Y – Dependent variables (livestock production by categories);

X – Independent variables, inclusive:

X_1 – June average monthly air temperature (T_{Jun});

X_2 – July average monthly air temperature (T_{Jul});

X_3 – August average monthly air temperature (T_{Aug});

X_4 – cereal crop yield ($Y_{grain\ corn}$);

X_5 – cereal crop yield ($Y_{winter\ wheat}$);

a – Constant;

b – Regression coefficient;

e – Error.

The temperature and crop predictor variables were selected in conformity with the step by step regression analysis, by taking into account their contribution to the livestock production by categories, and the consecutive analysis of all possible combinations, with the purpose to find the most reliable model. The regression coefficients of the remaining months show, in what direction and how much may be modified the livestock production in response to changes in the temperature of the respective month and cereal crop yield.

Finally, the analysis of the impact of future climate changes, determined by projections of changes in temperature and productivity of main cereal crops ($Y_{grain\ corn}$ and $Y_{winter\ wheat}$) on the livestock production without undertaken any adaptation measures was carried out according to methodological approach proposed by Constantinov et al., 2009[185]. Using the regression equations relationship in the livestock production variability by categories with projections of changes in temperature and productivity of main cereal crops, there were calculated projections of future yield changes in the Republic of Moldova (%/30 years) for 2020s, 2050s and 2080s according to an ensemble from 10 Global Climate Models (GCMs) for the three SRES A2, A1B and B1 emission scenarios relative to the most recent time period (1981-2010).

Observed linear trends of variability in production of main livestock products at all categories of producers on the territory of the Republic of Moldova

The linear trends of variability in production of main livestock products at all categories of producers for years 1965-1990 have been characterized by a sustainable increase of the

[182] Taranu L., Bercu I., Deveatii D. (2012), *Regional Climate Change Scenarios for the Republic of Moldova: Future Temperature and Precipitation Projections from Ensembles of 10 Global Climate Models. Mediul Ambiant*. Nr.3 (63), P. 33-42.

[183] Taranu L. (2013), *Projections of changes in productivity of major agricultural crops in the Republic of Moldova according to an ensemble from 10 GCMs for SRES A2, A1B and B1 emission scenarios in the XXI century. Mediul Ambiant* (In press).

[184] In analysis a shift in one year have been used to cereal crop yield because for livestock feed is used the crop yield of the previous year.

[185] Constantinov T., Taranu L., Mironova T., Toderas V. (2009), *Assessment of vulnerability some agricultural crops productivity in the Republic of Moldova, without adaptation measures, to new climate conditions according to the CSIRO-Mk2, HADCM2 and ECHAM4 general atmospheric models*. Bulletin of the Academy of Sciences of Moldova, Series of Biological, Chemical and Agricultural Sciences. Republic of Moldova, Chisinau, 2009, Nr.2 (308). C. 124-132.

livestock production: by 355.2 kt per decade for milk; by 311 million pieces per decade for eggs; by 33.2 kt per decade for pork; by 26.9 kt per decade for beef; and by 20.3 kt per decade for poultry. Negative trend was observed only for wool production, by 173.4 t per decade (Table 5-34; Figure 5-34).

Table 5-34: Linear trends of livestock production and their statistical significance (*p-value*) for two observation time periods (1965-1990 and 1981-2010) in the Republic of Moldova

Livestock production	Yield			
	1965-1990		1981-2010	
	Trend	p-value	Trend	p-value
Milk, kt	35.52	**0.0000**	-34.86	**0.0000**
Eggs, million pieces	31.11	**0.0000**	-16.79	**0.0001**
Wool, t	-17.34	**0.0378**	-30.21	**0.0000**
Beef, kt	2.693	**0.0000**	-3.707	**0.0000**
Pork, kt	3.320	**0.0000**	-4.519	**0.0000**
Mutton, kt	0.009	0.5776	-0.090	**0.0000**
Poultry, kt	2.029	**0.0000**	-1.150	**0.0005**

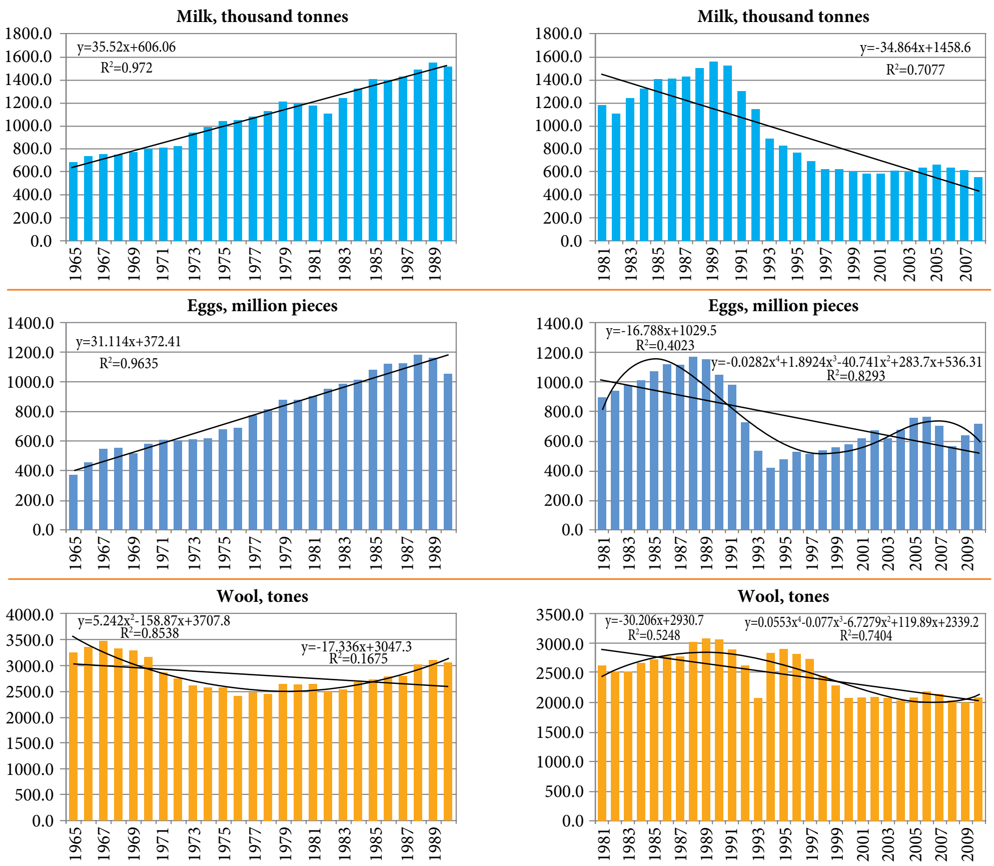
Note: Bold is used to mark statistically significant values.

Livestock production increased significantly due to the implementation of intensive technologies of animal growing in the 1981-1990 time periods, achieving the maximum average annual level: for milk – 1359.22 kt; eggs – 1051.2 million pieces; wool – 2761.9 tons; pork – 147.4 kt; beef– 94.3 kt; and poultry – 55.4 kt. Then, in the forthcoming three decades (1981-2010) there was a tendency for sharp decrease in livestock production: by 348.6 kt per decade for milk, by 167.9 million pieces per decade for eggs, by 302.1 tons per decade for wool, by 45.2 kt per decade for pork, by 37.1 kt per decade for beef, by 11.5 kt per decade for poultry, and by 0.9 kt per decade for mutton. The greatest decrease in the annual average livestock production was observed in the 2001 – 2010 years: for milk – 600.4 kt; wool – 2071.1 tons; pork – 45.4 kt; beef – 14.2 kt; mutton – 2.4 kt and in the 1991-2000 years for eggs – 583.9 million pieces; and poultry – 23.9 kt.

Pearson correlations between livestock production and predictor variables

The data presented in Table 5-35 reveals the Pearson correlations between livestock production by categories and predictor variables during the most recent time period (1981–2010).

The correlation coefficients (r) range between -1 and +1 and measure the strength of the linear relationship between the variables. The second number in each column of the table is a *p-value* which tests the statistical significance of the estimated correlations. Bold is used to mark statistically significant values: *p-value ≤ 0.001* indicate statistically significant non-zero correlations at the 99.9% confidence level, *p-value* ≤0.01 indicate statistically significant non-zero correlations at the 99.0%, and *p-value* ≤0.05 indicate statistically significant non-zero correlations at the 95.0% confidence level. The correlation coefficient between livestock production and temperature varies from r = - 0.40 to r = - 0.54 which indicate that temperature and livestock production has an



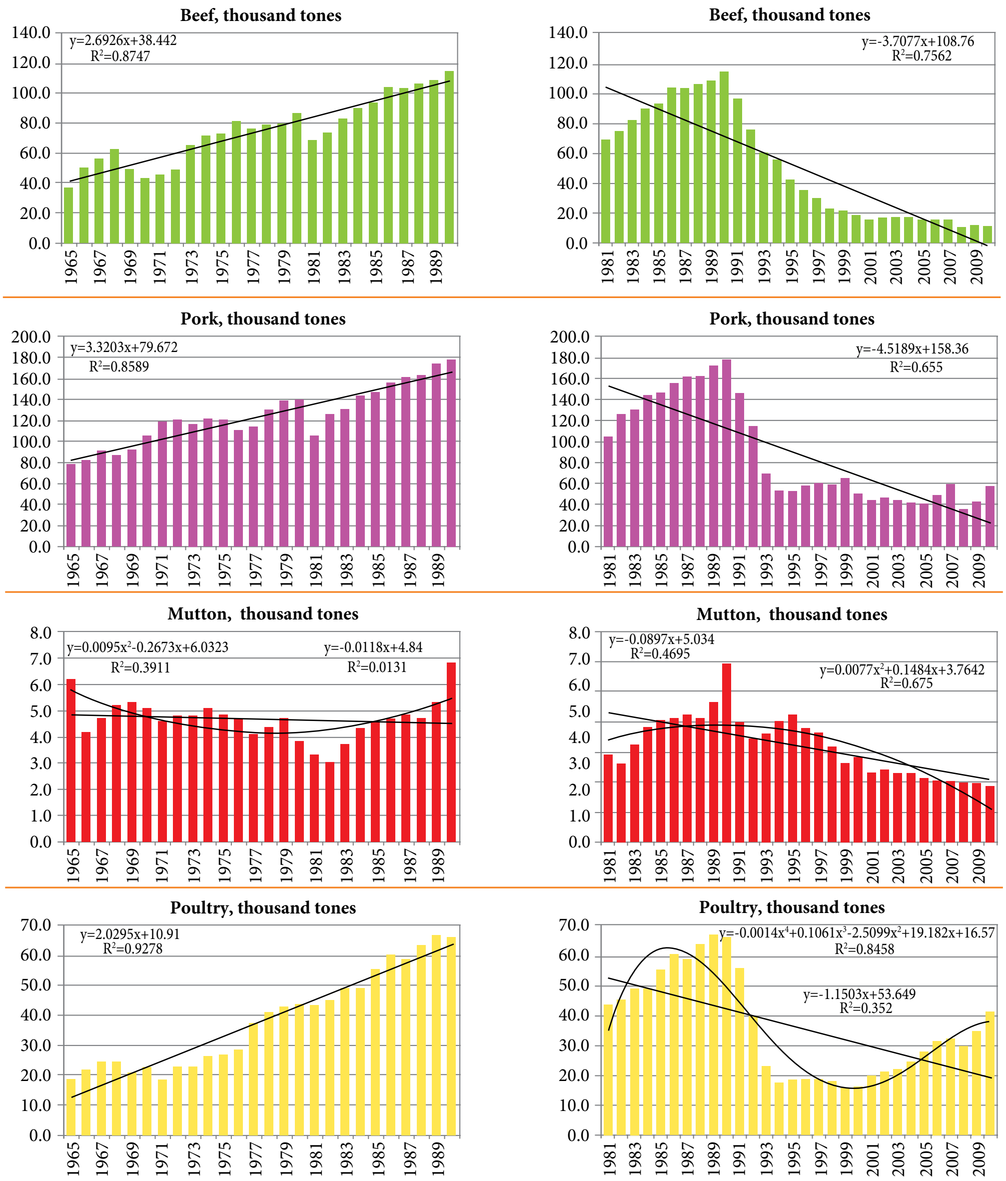


Figure 5-34: Livestock production variability trends and their coefficients of determination (R^2) for two observation periods (on the left: 1965-1990, on the right: 1981-2010) in the RM

inverse relationship, this means that as temperature increase, livestock production by categories will reduce. The correlation coefficient between livestock production and cereal crop yield varies from r = +0.42 to r = +0.69 which indicate that cereal crop yield has a direct relationship with livestock production, this means that as cereal crop yield increase, livestock production by categories also will increase.

Relationship of Livestock Production Variability with Predictor Variables during the 1981 – 2010 Time Period in the Republic of Moldova

A multiple linear regression analysis was used with June, July and August average monthly air temperatures (T_{Jun}, T_{Jul} and T_{Aug}) and cereal crop yields ($Y_{grain\ corn}$ and $Y_{winter\ wheat}$) as independent variables, and livestock production by categories (milk, eggs, wool, beef, pork, mutton and poultry) at the country level, as the dependent variable to quantify the separate effects of those factors. The influential climate predictor variables were not identical for each livestock production category.

The analysis of data presented in the Table 5-36 reveals that the influence of predictor variables on milk, wool, beef, pork, and mutton production in the 1981-2010 years was statistically significant at 99.9% highest level of significance ($p \le 0.001$) with exception for eggs and poultry production ($p \le 0.05$).

Coefficient of determination R^2 shows that the combined effect of T_{Jun}, T_{Jul} and T_{Aug} and cereal crop yield defined about 69.2% of the variability of average annual production of beef,

Table 5-35: The Pearson correlations between livestock production and predictor variables during the 1981 – 2010 time periods

Livestock production	Temperature						Yield			
	Jun		Jul		Aug		Corn		Winter wheat	
	r	*p*-value	r	*p*-value	r	*p*-value	r	*p*-value	r	*p*-value
Milk	-0.54	**0.0023**	-0.54	**0.0026**	-0.47	**0.0110**	0.69	**0.0000**	0.62	**0.0003**
Eggs	-0.48	**0.0089**	-0.46	**0.0112**	-0.40	**0.0325**	0.49	**0.0071**	0.42	**0.0227**
Wool	-0.32	0.0924	-0.27	0.1528	-0.40	**0.0309**	0.69	**0.0000**	0.63	**0.0003**
Beef	-0.53	**0.0030**	-0.53	**0.0030**	-0.48	**0.0082**	0.70	**0.0000**	0.66	**0.0001**
Pork	-0.48	**0.0089**	-0.50	**0.0053**	-0.43	**0.0202**	0.68	**0.0000**	0.61	**0.0004**
Mutton	-0.40	**0.0303**	-0.34	0.0682	-0.41	**0.0252**	0.69	**0.0000**	0.62	**0.0003**
Poultry	-0.42	**0.0228**	-0.42	**0.0229**	-0.29	0.1223	0.53	**0.0034**	0.47	**0.0098**

Note: Bold is used to mark statistically significant values: $p \leq 0.001$ indicate statistically significant non-zero correlations at the 99.9% confidence level; $p \leq 0.01$ indicate statistically significant non-zero correlations at the 99.0%, and $p \leq 0.05$ indicate statistically significant non-zero correlations at the 95.0% confidence level.

67.1% of the variability of milk, and 60.8% of pork and 41.6% of eggs production during this period. Approximately 57.1% of mutton production could be explained by a combination of the T_{Jun}, T_{Aug} and cereal crop yield. The combined effect of T_{Aug} and cereal crop yield determined the wool production variability at the level of 54.3%, and about 37.7% of poultry production could be explained by a combination of the T_{Jun}, T_{Jul} and cereal crop yield in the 1981-2010 time period.

Projections of future changes in livestock production in the Republic of Moldova

The possible projections in the livestock production (milk, eggs, wool, beef, pork, mutton and poultry), due to future climate changes in the Republic of Moldova, were considered for two alternative scenarios: (1) assuming no decrease in the future cereal crops yield – optimistic scenario (Figures 5-35A and 5-36A); and (2) considering future possible decrease in the yield of the main cereal crops (winter wheat and grain maize) – pessimistic scenario (Figures 5-35B and 5-36B)[186].

Milk production

In dairy cows, similarly to other species the various factors of the environment, such as the average temperature, humidity and air velocity play an important role in the fertility, reproductive performance and milk yield. The optimal ambient temperature for dairy cows is between 5 to 15°C.

Over 15°C the animals start to sweat, although they are still able to maintain the equilibrium between heat production and heat dissipation. Heat dissipation by sweating gradually increases and although it becomes quite intense above the upper critical temperature (25°C) the cow is no more able to maintain the heat balance at such high temperatures. Kadzere et al., 2002[187] found that on days of heat stress the amount of water lost through evaporation may be up to or even exceed the amount of water excreted in the milk.

The high rate of water loss stresses the importance of water supply for dairy cows at high temperatures. The efficiency of body cooling by evaporative water loss, however, decreases with the increase of humidity. The use of the Temperature-Humidity Index (THI) is suggested as an indicator of the thermal climatic conditions (THI = 0.72(W + D) + 40.6, where W is wet bulb and D is dry bulb temperature in °C). When the THI is in the range of 72-80, 80-90 or 90-98, the corresponding heat stress is mild, medium or severe. Both the increasing ambient temperature (from 25 to 32°C), and the increasing THI (from 73 to 82) have a negative impact

[186] Taranu L. (2013), *Projections of changes in productivity of major agricultural crops in the Republic of Moldova according to an ensemble from 10 GCMs for SRES A2, A1B and B1 emission scenarios in the XXI century*. Mediul Ambiant. In press.

[187] Kadzere, C.T., Murphy, M.R., Silanikove, N., Maltz, E. (2002), *Heat stress in lactating dairy cows: a review.* Livestock Production Science, Vol.77, No. 1 (October 2002), pp. 59-91.

Table 5-36: The Relationship of livestock production variability with predictor variables during the 1981–2010 time period in the Republic of Moldova

Livestock production	Regression equation	*p* – value	R^2,%
Milk, thousand tons	$P_{milk} = 3350.47 - 69.37{*}T_{Jun} - 27.83{*}T_{Jul} - 46.73{*}T_{Aug} + 14.69{*}Y_{Corn} + 5.22{*}Y_{Wheat}$	**0.0001**	67.13
Eggs, million pieces	$P_{eggs} = 2475.81 - 43.97{*}T_{Jun} - 17.85{*}T_{Jul} - 29.11{*}T_{Aug} + 6.46{*}Y_{Corn} + 0.49{*}Y_{Wheat}$	**0.0222**	41.60
Wool, tons	$P_{wool} = 2839.79 - 52.26{*}T_{Aug} + 17.87{*}Y_{Corn} + 7.28281{*}Y_{Wheat}$	**0.0002**	54.33
Beef, thousand tons	$P_{beef} = 287.22 - 6.44{*}T_{Jun} - 3.02{*}T_{Jul} - 4.98{*}T_{Aug} + 1.31{*}Y_{Corn} + 0.99{*}Y_{Wheat}$	**0.0000**	69.20
Pork, thousand tons	$P_{pork} = 351.73 - 6.93{*}T_{Jun} - 4.03{*}T_{Jul} - 5.46{*}T_{Aug} + 2.00{*}Y_{Corn} + 0.82{*}Y_{Wheat}$	**0.0004**	60.78
Mutton, thousand tons	$P_{mutton} = 7.59 - 0.14{*}T_{Jun} - 0.15{*}T_{Aug} + 0.06{*}Y_{Corn} + 0.02{*}Y_{Wheat}$	**0.0003**	57.08
Poultry, thousand tons	$P_{poultry} = 101.31 - 2.49{*}T_{Jun} - 1.72{*}T_{Jul} + 0.46{*}Y_{Corn} + 0.31{*}Y_{Wheat}$	**0.0188**	37.74

Note: Bold is used to mark statistically significant values: $p \leq 0.001$ indicate statistically significant non-zero correlations at the 99.9% confidence level; $p \leq 0.01$ indicate statistically significant non-zero correlations at the 99.0%, and $p \leq 0.05$ indicate statistically significant non-zero correlations at the 95.0% confidence level. *P* – livestock production by categories; Predictor Variables: *T* – June, July, and August average monthly air temperature, ^{0}C; Y – winter wheat and grain corn yield, q/ha.

on the dry matter intake and milk production of cows (West et al., 2003[188]).

The relevant data show, that the shorter the animal is exposed to heat stress, the better they can tolerate it, although even a moderate heat stress will impair their production performance. The heat stress caused feed refusal predisposes the animal to certain metabolic disorders, first of all to ketosis. The occurrence of ketosis at herd level not only leads to a temporary decline in milk production, but in consequence of the mortalities may also cause a drop in the number of dairy cows. The present day selection for production weakens heat tolerance, thus combined selection for heat tolerance and production is recommended when facing the challenge of climate change (Ravagnolo & Misztal, 2000[189]).

Summarizing the relevant data it can be stated that sever heat stress results in an average production loss of 1.5-2 liters/cow/day (5-10% of the daily milk yield). Moreover, the altered rumen fermentation influences not only milk yield but also milk composition by reducing its protein and fat content (Babinszky et al., 2011[190]).

The analysis of the obtained results revealed that due to the impact of the main climate and crop predictors variables in the RM, the milk production by 2020s could decrease from 7% (SRES A2) to 12% (SRES A1B), without changes in cereal crop yield (optimistic scenario), respectively from 12% (SRES A2) to 22% (SRES A1B), by considering projections of changes in the yield of winter wheat and grain maize (pessimistic scenario). In comparison with the 1981-2010 time periods, by 2050s the milk production may decrease in dependence of the assessed emission scenario, from 23% (SRES B1) to 34% (SRES A1B) under the optimistic scenario, respectively from 44% (SRES B1) to 66% (SRES A1B) under the pessimistic scenario. The maximum values of milk production decrease may be reached by 2080s. Due to changes in values of main climate predictors (Jun, Jul and Aug T_{avg} and cereal crop yield) the milk production will decrease from 32% (SRES B1) to 63% (SRES A2) under optimistic scenario (Figure 5-35A), respectively from 61% (SRES B1) to 93% (SRES A1B) according to the pessimistic scenario (Figure 5-35B).

Eggs production

The optimal laying temperature is between 11°C and 26°C (Kekeocha, 1985). Relative humidity level above 75 per cent will cause a reduction in egg laying. When the temperature is rise above 28° C the production and quality of eggs decrease (Table 5-37). Seasonal temperature increases can reduce eggs production by about 10 per cent.

In addition, several studies reported that high ambient temperatures decrease the digestibility of nutrients in poultry likely due to a reduced activity of trypsin, chymotrypsin, and amylase (Hai et al., 2000[191]).

Table 5-37: Temperature and its effects on eggs production

Temperature (°C)	Effects/Impacts
11 - 26	Good production
26 - 28	Some reduction in feed intake
28 - 32	Feed consumption reduced and water intake increased; eggs of reduced size and thin shell
32 - 35	Slight panting.
35 - 40	Heat prostration sets in, measures to cool the house must be taken
40 and above	Mortality due to heat stress

Source: Kekeocha (1985), *Poultry production handbook*. London, Macmillan Publishers Ltd., cited from <http://www.fao.org/docrep/005/y4628e/y4628e03.htm>.

[188] West, J.W., Mullinix, B.G., Bernard, J.K. (2003), *Effects of Hot, Humid Weather on Milk Temperature, Dry Matter Intake, and Milk Yield of Lactating Dairy Cows*, Journal of Dairy Science, Vol. 86, pp. 232–242.
[189] Ravagnolo, O. & Misztal I. (2000), *Genetic Component of Heat Stress in Dairy Cattle, Parameter Estimation.* Journal of Dairy Science, Vol.83, No.9, pp. 2126-2130.
[190] Babinszky L., Halas V. and Verstegen M. (2011), *Impacts of Climate Change on Animal Production and Quality of Animal Food Products.* In: Climate Change – Socioeconomic Effects. Ed: J. Blanco and H. Kheradmand. In Tech. 454 p.
[191] Hai, L., Rong, D. & Zhang, Z. Y. (2000), *The effect of thermal environment on the digestion of broilers.* Journal of Animal Physiology and Animal Nutrition (Berl.) Vol. 83 pp. 57–64.

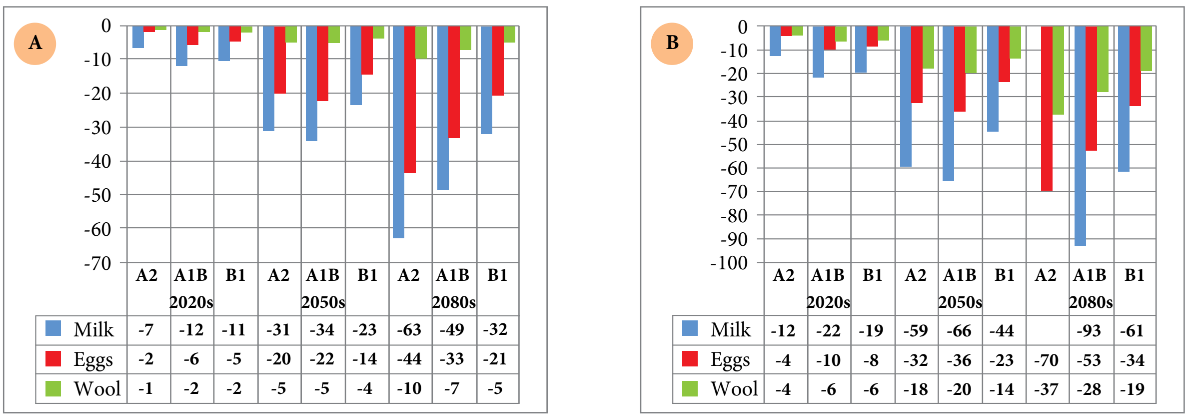


Figure 5-35: Projections of future changes in livestock production (milk, eggs and wool) in the Republic of Moldova (%/30 years) relative to 1981-2010 current period, according to an ensemble from 10 GCMs for SRES A2, A1B and B1 emission scenarios in the XXI century: (A) optimistic scenario – without changes in the yield of main cereal crops (winter wheat and grain maize); (B) pessimistic scenario – considering projections of changes in the yield of main cereal crops

Consequently, the lower and by most probability insufficient nutrient supply limits eggs production and eggs mass in layers, and the growth rate in broilers. During heat stress poultry lose a large amount of carbon dioxide by panting; CO_2 however, is essential for Ca-carbonate in eggshell formation. Therefore, in addition to an insufficient nutrient supply, the compromised eggs shell formation limits the eggs production further (eggs/day or eggs production/ number of birds), which can be very substantial as the eggs production percentage might decline from 80-90% to 50-60%, with a 10 g lower egg weight on average (Mashaly et al., 2004[192]). Furthermore, the lack of carbon dioxide results in decreasing eggshell thickness and an increasing number of broken eggs that further aggravates the profit losses in hens kept in a hot environment (Babinszky et al., 2011[193]).

The analysis of the obtained results revealed that due to the impact of main climate and crop predictors variables in the RM, the eggs production by 2020s could decrease from 2% (SRES A2) to 6% (SRES A1B), under the optimistic scenario, respectively from 4% (SRES A2) to 10% (SRES A1B), according to the pessimistic scenario. In comparison with the 1981-2010 time periods, by 2050s the eggs production may decrease from 14% (SRES B1) to 20-22% (SRES A2 and A1B) under the optimistic scenario, respectively from 23% (SRES B1) to 32-36% (SRES A2 and A1B) according to pessimistic scenario. The maximum values of eggs production decrease could be reached by 2080s, from 21% (SRES B1) to 44% (SRES A2) under the optimistic scenario (Figure 5-35A), respectively from 34% (SRES B1) to 70% (SRES A2) according to the pessimistic scenario (Figure 5-35B).

Wool production

A greater frequency of drought, pasture deterioration, higher summer temperatures and an increased incidence of pests and diseases under warmer climates are likely to put further physiological stress on sheep. This stress may be alleviated to some degree by higher winter temperatures and lengthening of warm seasons, both of which have the potential to improve wool quality.

For wool production in the RM, there is projected a slight decrease by 1-2% in the 2020s under the optimistic scenario, respectively a decrease by 4-6% under the pessimistic scenario. In comparison with the 1981-2010 time periods, by 2050s the wool production may decrease by 4-5% under the optimistic scenario, respectively from 14% (SRES B1) to 18-20% (SRES A2 and A1B) according to the pessimistic scenario. The maximum values of wool production reduction could be reached by the 2080s, from 5% (SRES B1) to 10% (SRES A2) under the optimistic scenario (Figure 5-35A), respectively from 19% (SRES B1) to 37% (SRES A2) according to the pessimistic scenario (Figure 5-35B).

Beef production

With reference to other cattle categories, the unfavorable meteorological conditions directly affect the animals and their physiology, as discussed in the above section on dairy cows. The extreme weather conditions diminish the growth performance (weight gain, feed intake and feed conversion potential) of beef calves, particularly of those kept outdoors. Slower growth and smaller slaughter weight however are reflected in the quality of meat as well, since animals of the same age but smaller body weight have less muscle fat and also the taste panel traits of juiciness and tenderness are poorer (Keane & Allen, 1998[194]).

Increasing mean temperatures and declining precipitation reduce the dietary crude protein and digestible organic matter content of grass; it is unlikely, however, that any future increases in precipitation would compensate for the declines in forage quality following from the projected temperature increases (Craine et al., 2010[195]). Aridity, water deficiency may lead to a drop in groundwater levels, alteration and thinning of pasture flora, and in consequence to a decline in feed supply, besides aggravating the problems of water supply (Babinszky et al., 2011). As a result, cattle are likely to experience greater nutritional stress in the future with the two options of either accepting the loss of performance or being prepared to provide supplemental nutrition to the extensive beef sector as well. Feeding concentrate to beef cattle increases the costs of beef production, and it may also affect the nutritive and health value of meat. In respect of fatty acid composition, numerous publications suggest that the meat of grass fed cattle contains more n-3 fatty acids and conjugated linoleic acid than meat from their concentrate fed peers (Nuernberg et al., 2005[196]; Scollan et al., 2006[197]). These fatty acids play an important role in maintaining health and preventing diseases (i.e. cardio vascular diseases, cancer) and consumers are increasingly aware of these functional components of foods. In addition to the above-mentioned problems, extreme weather may result in respiratory disease, immune suppression and thus higher mortality of the animals, which further reduces the profitability of beef production (Babinszky et al., 2011[198]).

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[193] Babinszky L., Halas V., Verstegen M. (2011), *Impacts of Climate Change on Animal Production and Quality of Animal Food Products, Climate Change - Socioeconomic Effects*, Dr Houshan Kheradmand (Ed.), InTech, DOI: 10.5772/23840. Available on: <http://www.intechopen.com/books/climate-change-socioeconomic-effects/impacts-of-climate-change-on-animal-production-and-quality-of-animal-food-products>.

[194] Keane, M.G., Allen, P. (1998), *Effects of production system intensity on performance, carcass composition and meat quality of beef cattle*. Livestock Production Science, Vol. 56, pp. 203–214.

[195] Craine, J.M., Elmore, A.J., Olson, K.C., Tolleson, D. (2009), *Climate change and cattle nutritional stress*. Global Change Biology, Vol.16, No.10 (October 2010), pp. 2901-2911. Doi: 10.1111/j.1365-2486.2009.02060.x

[196] Nuernberg, K., Dannenberger, D., Nuernberg, G., Ender, K., Voigt, J., Scollan, N.D, Wood, J.D., Nute, GR., Richardson, R.I. (2005), *Effect of a grass-based and a concentrate feeding system on meat quality characteristics and fatty acid composition of longissimus muscle in different cattle breeds*. Livestock Production Science, Vol. 94, No.1-2. pp. 137– 147.

[197] Scollan, N. Hocquette, J.F., Nuernberg, K., Dannenberger, D., Richardson, I., Moloney, A. (2006), *Innovations in beef production systems that enhance the nutritional and health value of beef lipids and their relationship with meat quality*, Meat Science,Vol.74, pp. 17–33.

[198] Babinszky, L., Dunkel, Z., Tythi, R., Kazinczi, G., Nagy, J. (2011), *The impacts of climate change on agricultural production*, Hungarian Agricultural Research, in press, ISSN:1216-4526

For beef production in the RM by 2020s, when assessing the combined effect of T_{Jun}, T_{Jul}, T_{Aug} and cereal crop yield, it is expected a decrease in productivity by 12% (SRES A2) to 21% (SRES A1B) under the optimistic scenario, respectively by 24% (SRES A2) to 41% (SRES A1B) under the pessimistic scenario. By 2050s, there will persisting the decreasing trend in beef production due to climate changes increase in summer average temperature and decrease in cereal crop productivity. Severe decrease in beef production, by 42% (SRES B1) to 61% (SRES A1B), is expected under the optimistic scenario, while according to the pessimistic scenario, i.e. by considering the projected changes in the yield of the main cereal crops, under the SRES B1 low emission scenario the animal breeding will be economically not cost-effective, while under the SRES A2 (high) and A1B (medium) emission scenarios, even impossible in the conditions of the Republic of Moldova. The maximum values of beef production decrease may be reached by 2080s, from 57% (SRES B1) to 87% (SRES A1B) under the optimistic scenario (Figure 5-36A), while according to the pessimistic scenario under all three SRES emission scenarios the cattle breeding will be impossible in the Republic of Moldova (Figure 5-36B). In case the predicted climate change occurs, the current beef production potential can be maintained only if supplemental feed is offered; this factor would reduce significantly the economic efficiency of cattle production and may have an impact also on beef quality as well.

Pork production

The climate change with rising mean temperatures may cause a permanent stress load for pigs, especially in continental summer or warmer climate areas. The upper critical temperature for pigs from nursery to adult ages is 25-26°C; however, some research data suggest that the optimal temperature decreases with the increase in body weight. The heavier an animal, the less ability it has to lose heat due to the relative small surface area compared to its body weight. In consequence feed refusal increases with body weight at high ambient temperatures (Close, 1989[199]; Quiniou et al., 2000[200]). High temperatures cause loss of appetite in pigs; however, both the upper critical temperature and the rate of feed refusal are influenced by the relative humidity of the air (Collin et al., 2001[201]; Huynh et al., 2005[202]).

With the increase of humidity a 60–70 kg pig may lower its feed intake by up to 80-150 g/day (Huynh et al., 2005). The lower feed intake compromises the daily gain, however, after exposure to hot periods of 30-33°C pigs display compensatory growth, they overcome their heat stress and grow further, but they can't compensate for temperatures as high as 36°C (Babinszky et al., 2011).

There is a curvilinear relationship between the increase of temperature and the average daily gain and feed conversion rate of pigs fed ad libitum (reviewed by Noblet et al., 2001[203]). The average daily gain reaches its maximum between temperatures of 15 to 25°C in young pigs (up to 30-34 kg) and between 10-20°C in growing and finishing pigs. Recent publications highlight the fact that high temperatures not only impair growth but also change body composition and thus can impair the nutritive value and quality of pork. Prolonged heat stress (30-33°C) reduces the rate of protein deposition in growing and finishing pigs (Kerr et al., 2003[204]; Le Bellego et al., 2002[205]).

Due to warming and decrease in cereal crop productivity, pork production in RM by 2020s may decrease from 8% (SRES A2) to 14% (SRES A1B) under the optimistic scenario, respectively by 16% (SRES A2) to 28% (SRES A1B) under the pessimistic scenario. In comparison with the 1981-2010 time periods, by 2050s the pork production may decrease, in dependence of the assessed emission scenario, from 28% (SRES B1) to 37-41% (SRES A2 and A1B) under the optimistic scenario, respectively from 59% (SRES B1) to 59-78% (SRES A2 and A1B) under the pessimistic scenario. The maximum values of pork production decrease may be reached by 2080s, from 38% (SRES B1) to 76% (SRES A2) under the optimistic scenario (Figure 5-36A), while according to the pessimistic scenario, i.e. by considering the projected changes in the yield of the main cereal crops, under the SRES B1 low emission scenario the swine breeding will be economically not cost-effective, while under the SRES A2 (high) and A1B (medium) emission scenarios, even impossible in the conditions of the Republic of Moldova (Figure 5-36B).

Mutton production

Temperatures ranging between 15°C and 29°C do not seem to have any effect on growth performance of lambs. The effects of high ambient temperature on growth performance are induced by the decrease of the anabolic activity and the increase in tissue catabolism (Marai et al., 2007[206]). This decrease

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[200] Quiniou, N., Dubois, S. & Noblet, J. (2000): *Voluntary feed intake and feeding behaviour of group-housed growing pigs are affected by ambient temperature and body weight.* Livestock Production Science, Vol. 63, No. 3. pp. 245–253.

[201] Collin, A., van Milgen, J., Dubois, S. & Noblet, J. (2001), *Effect of high temperature on feeding behaviour and heat production in group-housed young pigs.* British Journal of Nutrition, Vol.86, pp. 63-70.

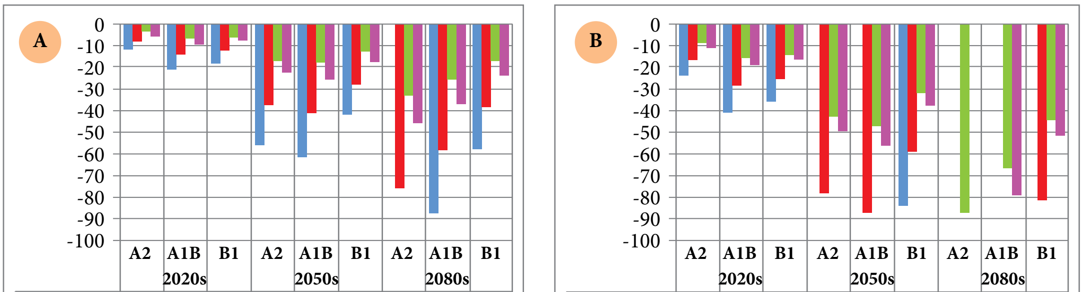
[202] Huynh, T.T.T., Aarnink, A.J.A., Verstegen, M.W.A., Gerrits, W.J.J., Heetkamp, M.J.W., Kemp, B. & Canh, T.T. (2005), *Effects of increasing temperatures on physiological changes in pigs at different relative humidity.* Journal of Animal Science, Vol.83, pp. 1385-1396.

[203] Noblet, J., Le Dividich, J., van Milgen, J. (2001), *Thermal environment and swine nutrition*, In: Swine Nutrition, A.J. Lewis & L.L. Southern (Eds), pp. 519-544, CRC Press, ISBN:0-8493-0696-5, Boca Ration, Florida, US.

[204] Kerr, B.J., Yen, J.T., Nienaber, J.A., Easter, R.A. (2003), *Influences of dietary protein level, amino acid supplementation and environmental temperature on performance, body composition, organ weights and total heat production of growing pigs*, Journal of Animal Science, Vol.81, pp. 1998-2007.

[205] Le Bellego, L., van Milgen, J., Noblet, J. (2002), *Effect of high ambient temperature on protein and lipid deposition and energy utilization in growing pigs*. Animal Science, Vol.75, pp. 85-96.

[206] Marai, I.F.M., El-Darawany, A.A., Fadiel, A., Abdel-Hafez, M.A.M. (2007), *Physiological traits as affected by heat stress in sheep — a review.* Small Rumin. Res. 71, 1–12.



A

	A2 2020s	A1B 2020s	B1 2020s	A2 2050s	A1B 2050s	B1 2050s	A2 2080s	A1B 2080s	B1 2080s
Beef	-12	-21	-18	-56	-61	-42		-87	-57
Pork	-8	-14	-12	-37	-41	-28	-76	-58	-38
Mutton	-3	-6	-6	-17	-18	-12	-33	-25	-17
Poultry	-5	-9	-7	-22	-26	-17	-46	-36	-23

B

	A2 2020s	A1B 2020s	B1 2020s	A2 2050s	A1B 2050s	B1 2050s	A2 2080s	A1B 2080s	B1 2080s
Beef	-24	-41	-36			-84			
Pork	-16	-28	-25	-78	-87	-59			-81
Mutton	-9	-15	-14	-43	-47	-32	-87	-66	-44
Poultry	-11	-19	-16	-49	-56	-37		-79	-52

Figure 5-36: Projections of future changes in livestock production (beef, pork, mutton and poultry) in the RM (%/30 years) relative to 1981-2010 current period, according to an ensemble from 10 GCMs for SRES A2, A1B and B1 emission scenarios in the XXI century: (A) optimistic scenario – without changes in the yield of main cereal crops (winter wheat and grain maize); (B) pessimistic scenario – considering projections of changes in the yield of main cereal crops

in anabolism is essentially caused by a decrease in voluntary feed intake of main nutrients. The increase in tissue catabolism occurs mainly in fat depots and/or lean body mass. Lamb production is deleteriously affected by exposure to heat stress and this causes an economic loss (Salem et al., 2011[207]).

For mutton production by 2020s, when assessing the combined effect of T_{Jun}, T_{Aug} and cereal crop yield, it is expected a slight decrease in the productivity, from 3% (SRES A2) to 6% (SRES B1 and A1B) under the optimistic scenario, respectively from 9% (SRES A2) to 14-15% (SRES B1 and A1B) under the pessimistic scenario. In comparison with the 1981-2010 time periods, by 2050s the mutton production may decrease, in dependence of the assessed emission scenario, from 12% (SRES B1) to 17-18% (SRES A2 and A1B) under the optimistic scenario, respectively from 32% (SRES B1) to 47% (SRES A1B) under the pessimistic scenario. The maximum values of mutton production decrease may be reached by 2080s. Due to changes in values of main climate predictors (T_{Jun}, T_{Aug} and reduced yield of the main cereal crops), the mutton production could decrease from 17% (SRES B1) to 33% (SRES A2) under the optimistic scenario (Figure 5-36A), respectively from 44% (SRES B1) to 87% (SRES A2) according to the pessimistic scenario (Figure 5-36B).

Poultry Production

There are a large number of reports on the effects of high ambient temperature and humidity on poultry production, since the poultry industry is concentrated in hot climate areas of the world, mainly in Asia and South America (Daghir, 2009[208]). However, their higher production performance and feed conversion efficiency make today's chickens more susceptible to heat stress than ever before (Lin et al., 2006[209]).

The thermoregulation characteristics of poultry differ to some extent from those of mammals due to their high rate of metabolism associated with more intensive heat production and low heat dissipation capacity caused by their feathers and lack of sweat glands. Evaporative cooling is achieved exclusively by panting. In the first days of their life poults need hot climate (32-38˚C), but the optimal temperature decreases rapidly with age by 2.5-3.0˚C per week (FASS, 2010[210]).

After feathering birds prefer mean ambient temperatures between 18-22˚C for their growth performance and egg production although the optimal temperature for feed efficiency is higher. The crucial temperature for poultry is 30˚C, because up to this point birds, through a better feed conversion rate and lower basal metabolic rate, are able to compensate for the energy loss caused by the lower feed intake (Daghir, 2009). Above 30˚C the feed and energy intake declines to such an extent that birds are no more able to compensate for it, production declines rapidly and the rate of mortality increases.

The analysis of the obtained results revealed that due to the impact of the main climate (T_{Jun}, T_{Jul}) and crop yield predictors variables in the RM, the poultry production by 2020s could decrease from 5% (SRES A2) to 9% (SRES A1B) under the optimistic scenario, respectively from 11% (SRES A2) to 19% (SRES A1B) under the pessimistic scenario. In comparison with the 1981-2010 time periods, by 2050s the poultry production may decrease in dependence of the assessed emission scenario from 17% (SRES B1) to 22-26% (SRES A2 and A1B) under the optimistic scenario, respectively from 37% (SRES B1) to 49-56% (SRES A2 and A1B)

[207] Hichem Ben Salem, Mourad Rekik, Narjess Lassoued, Mohamed-Aziz Darghouth (2011), *Global Warming and Livestock in Dry Areas: Expected Impacts, Adaptation and Mitigation, Climate Change - Socioeconomic Effects*, Dr Houshan Kheradmand (Ed.), InTech, DOI: 10.5772/24734. Available from: <http://www.intechopen.com/books/climate-change-socioeconomic-effects/global-warming-and-livestock-in-dry-areas-expected-impacts-adaptation-and-mitigation>.

[208] Daghir, N.J. (2009), *Nutritional Strategies to Reduce Heat Stress in Broilers and Broiler Breeders*, Lohmann Information, Vol. 44, No.1 (April 2009) pp. 6-15.

[209] Lin, H., Jiao, H.C., Buyse, J., Decuypere, E. (2006), *Strategies for preventing heat stress in poultry*. World's Poultry Science Journal, Vol.62, pp. 71-86.

[210] FASS (Federation of Animal Science Societies). (2010), *Guide for the Care and Use of Agricultural Animals in Research and Teaching*, (January 2010), Champaign, Illinois, USA. <www.fass.org/docs/agguide3rd/Ag_Guide_3rd_ed.pdf>.

under the pessimistic scenario. The maximum values of poultry production decrease could be reached by 2080s. Due to changes in values of main climate predictors (T_{Jun}, T_{Jul}, T_{Aug}) and reduced yield of the main cereal crops, the poultry production will decrease from 23% (SRES B1) to 46% (SRES A2) under the optimistic scenario (Figure 5-36A), respectively from 52% (SRES B1) to 79% (SRES A1B) under the pessimistic scenario (Figure 5-36B).

The impact assessment performed allow conclude that the negative effect of increased T_{Jun}, T_{Jul} and T_{Aug} average temperatures and the sharp decline in the crop productivity of main cereal crops, according to an ensemble from 10 GCMs for SRES A2 (high), A1B (medium) and B1(low) emission scenarios, without undertaken any adaptation measures, by 2080s will lead to a significant drop in the livestock production, from 57% (SRES B1) to 87% (SRES A1B) for beef, from 38% (SRES B1) to 76% (SRES A2) for pork, and from 32% (SRES B1) to 63% (SRES A2) for milk; to a medium drop in the livestock production, from 23% (SRES B1) to 46% (SRES A2) for poultry, from 21% (SRES B1) to 44% (SRES A2) for eggs, and from 17% (SRES B1) to 33% for mutton; respectively to a slight decrease in the livestock production, from 5% (SRES B1) to 10% (SRES A2) for wool, as per the optimistic scenario considered; respectively to a significant drop in the livestock production, from 61% (SRES B1) to 93% (SRES A1B) for milk, from 52% (SRES B1) to 79% (SRES A1B) for poultry; from 34% (SRES B1) to 70% (SRES A2) for eggs; from 44% (SRES B1) to 87% for mutton (SRES A2); to a medium drop in the livestock production, from 19% (SRES B1) to 37% (SRES A2) for wool, as per the pessimistic scenario considered (i.e., by considering the projections of future changes in the yield of main cereal crops: winter wheat and grain maize, with respect to the average Republic of Moldova's livestock production by categories in the most recent period of 1981-2010). Furthermore, according to the pessimistic scenario the production of milk, beef, pork and poultry in RM will be impossible under the SRES A2 high emission scenario, if no adaptation measures will be undertaken in the RM in the second half of 21st century.

5.5.3. Potential Impact of Climate Changes on Forest Ecosystems

The impact of climate changes on forest ecosystems has been assessed using two methods: the first one is based on the Holdridge scheme of vegetation-climate ranking and the second one – on JABOWA III, a dynamic method that describes the evolution of species composition and productivity (biomass and base area) depending on the local conditions, species characteristics and climate parameters.

For this purpose, the model areas were chosen for which the annual increases are determined for each sample separately, adding the newly appeared samples and eliminating the ones that will die. JABOWA III uses 3 sub-models: (1) GROW, which provides data about the annual increases for each sample; (2) BIRTH, which shows the possibility of appearance of new samples, and (3) KILL, forecasts which sample will die.

As a dynamic model, JABOWA needs an intermediated climate scenario that would characterize the evolution in time of the climate variables. For this purpose, an ensemble of 10 global coupled atmosphere ocean general circulation models imposed by SRES A1B[211] emission scenario was used.

Using JABOWA III and the climate data generated for the 21st century, which derives from the use of a set of 10 interlinked general models of atmospheric and oceanic circulation, made available by the World Climate Research Program (WCRP), compared with the climate data characteristic for reference period (1961-1990), simulations have been done for three geographic areas of the Republic of Moldova:

- North – with a prevailing composition of pedunculate oak (*Quercus robur*), cherry (*Cerasus avium*), white locust (*Robinia pseudacacia*), ash (*Fraxinus excelsior*), maple (*Acer platanoides*), red oak (*Quercus rubra*); in this area, the pendunculate oak and cherry ecosystems at present cover an area of about 11.6 thousand ha;
- Center – with prevailing composition of pedunculate oak (*Quercus robur*), sessile oak (*Quercus petraea*), white locust (*Robinia pseudacacia*), ash (*Fraxinus excelsior*), common beech (*Fagus sylvatica*), small-leaved lime (*Tilia cordata*), silver lime (*Tilia tomentosa*); in this area, sessile oak, pedunculate oak and common beech ecosystems at present cover an area of about 160 thousand ha;
- South – with prevailing composition of white locust (*Robinia pseudacacia*), pubescent oak (*Quercus pubescens*), pedunculate oak (*Quercus robur*), red oak (*Quercus rubra*), ash (*Fraxinus excelsior*), walnut (*Juglans regia*); in this region, the pubescent oak (*Quercus pubescens*) at present covers an area of about 7 thousand ha;
- The non-zonal forest ecosystems in the riverbeds of Dniester, Prut and their tributaries, with prevailing composition of white willow (Salix alba), weeping willow (*Salix babylonica*), crack willow (*Salix fragilis*), poplar (*Populus L.*) and pedunculate oak (*Quercus robur*) in their turn cover an area of about 15 thousand ha.

The study was conducted to find out the vulnerability of the forest ecosystems in these areas to the new climate conditions characteristic of the 21st century.

The inputs and outputs are presented below as well as the results obtained for various species, which can also be correlated by area.

[211] Taranu L., Bercu I., Deveatii D. (2012), *Regional Climate Change Scenarios for the Republic of Moldova: Future Temperature and Precipitation Projections from Ensembles of 10 Global Climate Models. Mediul Ambiant.* Nr.3 (63), P. 33-42.

Inputs: maximum age (age of use); average diameter; the average height and the relation between the height and diameter (slenderness); total foliar weight (foliar coverage ratio or consistency) and the average diameter of the tree; photosynthesis rate and amount of available light; relative increases and climate data (temperature, precipitations, solar radiation); level of clearance of forest vegetation and level of non-coverage with forest vegetation; optimal conditions of soil humidity for plant growth; and conditions of solarization.

The sources of reference for the inputs have been a range of publications of the Forestry Agency "Moldsilva", Institute of Research and Forestry Management, State Hydrometeorologic Service, Institute of Pedology, Agrochemistry and Soil Protection "N. Dimo", as well as a number of specialized teaching materials.

Model outputs are as follow: evolution of total biomass increase for various forest species; the characteristic and evolution of the sector in time; composition of bushes and their productivity.

Prospect of Future Changes and Productivity of Various Forest Species

Based on the prospects of the changes in annual and seasonal average air temperatures (ΔT, °C), precipitations (ΔP, mm), and heat and humidity level in the RM during the 21st century, for a set of ten global climate models imposed by the intermediary emissions scenario SRES A1B, as compared to the 1961-1990 reference period, the conclusion reached was that essential changes are likely to occur in the forest ecosystems as well as in the environmental group range.

An increase in the percentage of xerophytes and mezoherophytes on the account of a decrease in mezohigrophytes and higrophytes, is possible. The spreading area of southern and south-eastern elements is likely to expand on the account of decreased northern and western elements. There are no premises and arguments that the forest ruderalisation (degradation and weediness) will stop.

The results of an analysis of the influences of climate changes on various species revealed that:

- The common beech, towards the lower limit of its areal, as compared to the reference period, through its production cycle negatively reacts to the new climate conditions by decreasing its total production, by up to 50% by 2050s; short-term, the common beech will still participate in producing stable forest structures from an ecosystem and forest-productive point of view;
- The sessile oak is apparently unaffected by the new climate conditions, producing by about ±20% more as compared to what was produced in normal conditions (referring to the 1961-1990 reference period); in the last quarter of its production cycle the new climate conditions are favorable to this species, which would have a higher total production, of 20 up to 40%. Nonetheless, long-term, on the eve of 2090s, the total production will tend to decrease as a result of a decline in this species (Figure 5-37); thus, the sessile oak proves to be a structurally and forestry-productively stable species, at least short- and medium-term.
- The common hornbeam (*Carpinus betulus*), as an important mixture species, both in hill and valley areas, shows lower total production, starting with the second half of the production cycle (2060s) until toward the end of the century, given the decline and drying off displayed at species level (Figure 5-38); the common hornbeam is a structural element that gives stability, at least short-term, to the forest ecosystems of which it is part.
- The ash, another important mixture species and a generator of complex forest structure (the ash is the first one that appears in the forest structure (followed by the common hornbeam and pedunculate oak) does not seem to be strongly affected by the new environmental conditions in the first two-thirds of its production cycle (until towards 2070s), so that after that to do lower bioaccumulation (less by 20-40%) (Figure 5-39); the ash will represent an important structurally ecosystem element.

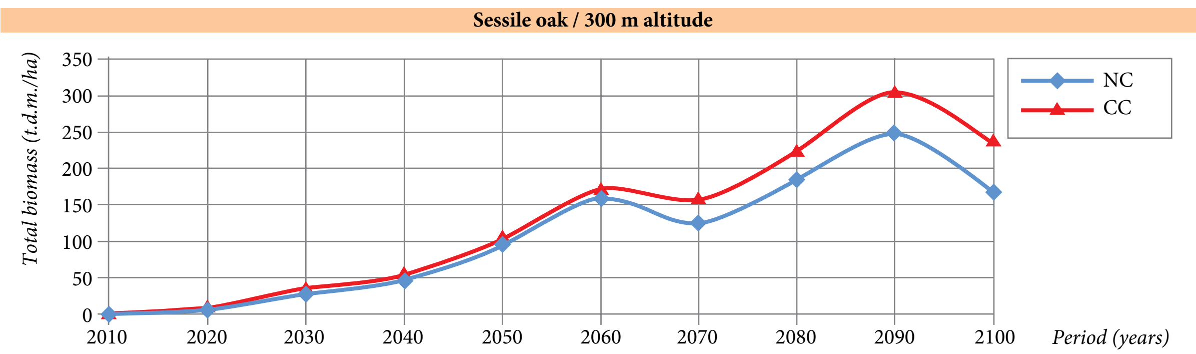


Figure 5-37: Prospects of relative biomass accumulations for the sessile oak (t.d.m./ha) in RM, in the 21st century (the Climate Change Scenario) as compared to the climate conditions typical for the 1961-1990 period (Normal Climate Scenario) according to an ensemble of 10 global climate models imposed by the emission scenario SRES A1B.

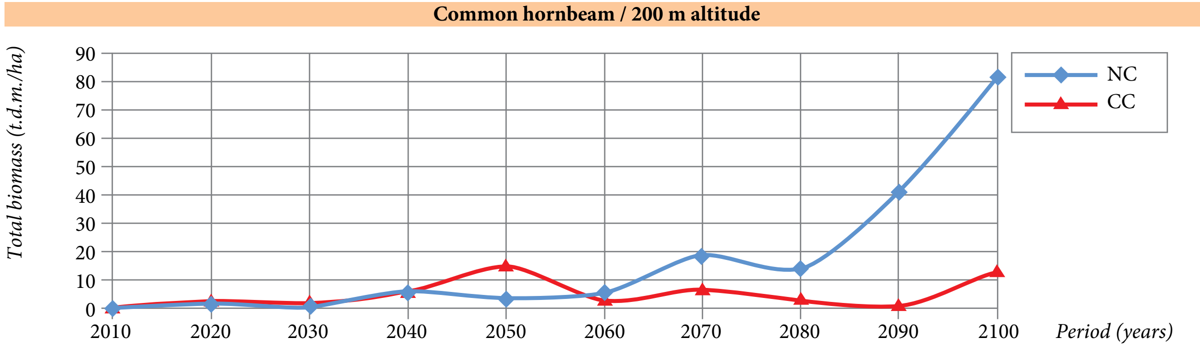


Figure 5-38: Prospects of relative biomass accumulations for the common hornbeam (t.d.m./ha) in RM in the 21st century (the Climate Change Scenario) as compared to the climate conditions typical for the 1961-1990 period (the Normal Climate Scenario), according to an ensemble of 10 global climate models imposed by the emission scenario SRES A1B.

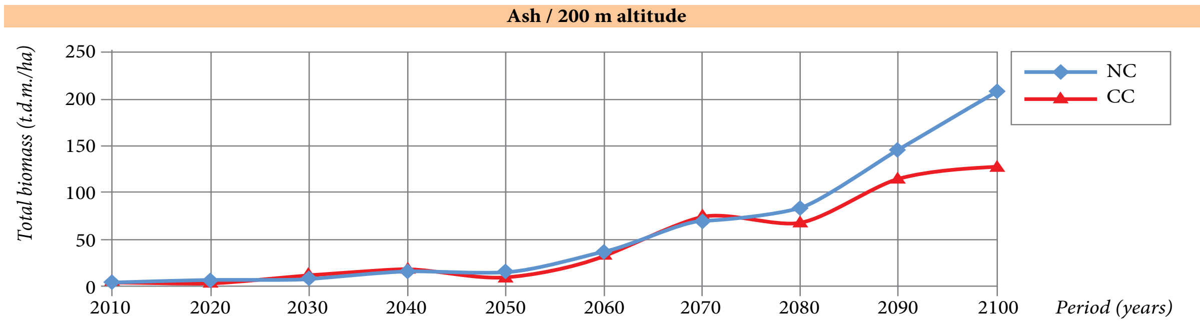


Figure 5-39: Prospects of relative biomass accumulations for the ash (t.d.m./ha) in RM in the 21st century (the Climate Change Scenario) as compared to the climate conditions typical for the 1961-1990 period (the Normal Climate Scenario), according to an ensemble of 10 global climate models imposed by the emission scenario SRES A1B.

- The small-leaved lime significantly positively capitalizes the new environmental conditions, being a species that grows rapidly in its youth. After the period of maximum growth (in 2030s it reaches a growth level of about 124.4 t.d.m./ha), enters decline around the 2050s and practically does not have a significant weight in the ecosystem structure (Figure 5-40); in climate change conditions, the small-leaved lime will represent a forestry-productive element and of structural stability only short-term.
- The maple is a species having a belated maximum of growth given its biological characteristics of a species of maximum growth at average ages; medium- and long-term will be significantly negatively affected by the new climate conditions (Figure 5-40); short-term, this species still represents a bush element with contribution to the ecologic and forestry-productive stability of the forest ecosystems.

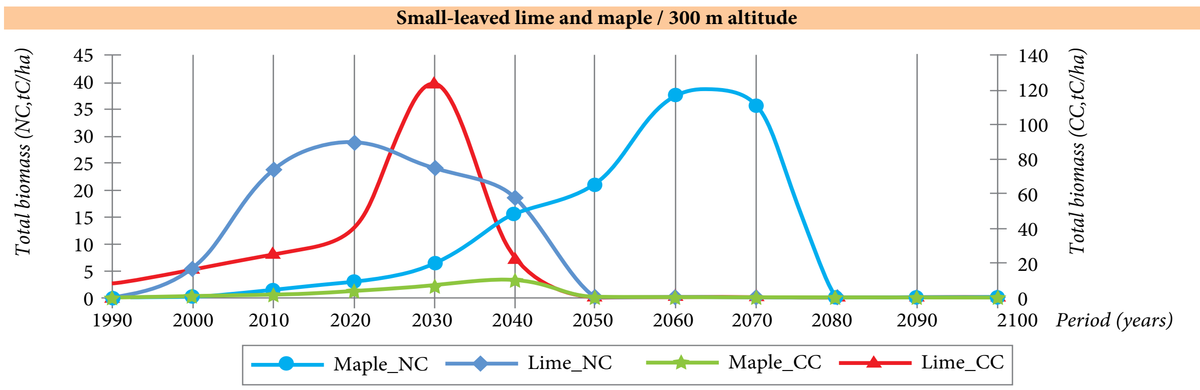


Figure 5-40: Prospects of relative biomass accumulations for the small-leaved lime (tC/ha) in RM in the 21st century (the Climate Change Scenario) as compared to the climate conditions typical for the 1961-1990 period (the Normal Climate Scenario), according to an ensemble of 10 global climate models imposed by the emission scenario SRES A1B.

- The pedunculate oak represents a bush element that gives stability to the complex ecosystem structures, such as mixt forests. However, in pure structures or those made up only of oak species, it will suffer in the new environmental conditions caused by the climate changes and will tend to show a decline and drying off at younger ages (Figure 5-41). Nonetheless, from a bio-accumulative point of view, the new environmental conditions are favorable to this species. To note that the pednuculate oak comes to have weight in biocenosis rather late, in about 30 years from the planting of seedlings. The effect of care works for the bushes is seen through total biomass reduction at about 30 year time intervals.
- The pubescent oak has similar reactions to climate change as other species of indigenous oaks, in general, benefiting from the new environmental conditions. To note that in normal conditions the pubescent oak (*Quercus pubescens*) and the Hungarian oak (*Quercus frainetto*) produce the highest amounts of biomass, followed by the Turkey oak (*Quercus cerris*), while the brown oak (*Quercus pedunculiflora*) and the pedunculate oak (*Quercus robur*) would produce smaller biomass accumulations; at the beginning of the production period the pubescent oak would show drying off and decline but later on, from a bio-accumulative point of view, the new environmental conditions are favorable to this species.
- The white locust is one of the species of high economic and protective significance in certain regions of the country, which reacts similarly to the climate change scenario in the next century, without showing any major changes in the total production as compared to what it has produced in typical climate conditions (with reference to the 1961-1990 period).

The analysis of the obtained results, in the perspective of the regional climate main components evolution towards a pronounced dryness by the end of the 21st century, shows the following possible changes in the space distribution of forest ecosystems on the territory of the RM:

1. The common beech (*Fagus sylvatica*) that at present covers about 400 ha of the summits of planes in Central Moldova, could disappear;
2. The freed areas could be taken over by plant formations of sessile oaks (*Quercus petraea*), linden (*Tilia cordata* and *Tilia tomentosa*), and ash (*Fraxinus excelsior*) that in their turn will withdraw to the summits, conceding immense spaces to the archeological oak (*Quercus sp.*) with common hornbeam (*Carpinus betulus*);
3. Semiarid forests of pubescent oaks (*Quercus pubescens*) with smoke trees (*Cotinus coggygria*) will move towards the north, covering the lowest lands of the relief, as well as will move to the spaces freed of forests on the plane of Northern Moldova;
4. As a whole, the areal of thermophilic species may be available to extend while the areal of mezophilic species (Northern, Central-European, Euro-Asian) may disappear from the territory of the Republic of Moldova.

5.5.4. Potential Impact of Climate Changes on the Wildlife

The presence of three bio-geographical areas in the territory of the Republic of Moldova has created conditions for a rich biological diversity but at the same time a high level of vulnerability for many species, especially for those living outside the area borders.

The current situation of wildlife in the Republic of Moldova is difficult as a result of the low functionality of natural ecosystems. The degradation of natural ecosystems and animal communities to a large extent is determined by the anthropic pressing, which overlaps with the humidity deficit in the biggest part of the territory of RM, especially in the southern and central areas.

In water bodies, one can notice an intensification of water eutrophication while in steppe and plain ecosystems, rather haggled in fact, xerophytisation and substitution of plant species characteristic of these ecosystems with weeds plants. The tree clearing on river and brook banks has led to an

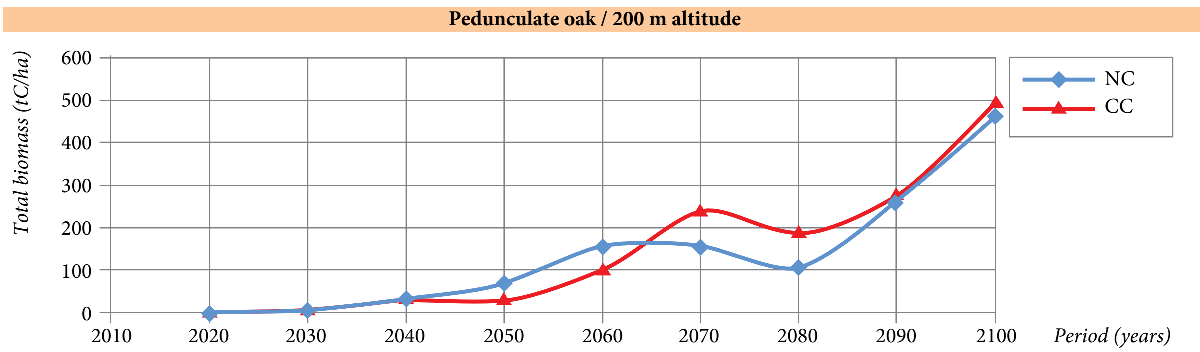


Figure 5-41: Prospects of relative biomass accumulations for pedunculate oak (tC/ha) in RM in the 21st century (the Climate Change Scenario) as compared to the climate conditions typical for the 1961-1990 period (the Normal Climate Scenario), according to an ensemble of 10 global climate models imposed by the emission scenario SRES A1B.

intensification of water evaporation and a reduction of the ecologic capacity of water bodies of maintaining the biodiversity of the hydrologic ecosystems.

In addition, the climate becoming more arid has hurried up the degradation of biodiversity, including of the wildlife.

In the above context, the animal species may have three possible reactions to the new environmental conditions imposed by the climate change:

A. Changing the geographical distribution as a result of changing the living environment;
B. Remaining in the same areal and alike the new conditions they will change their behavior, phenology, tolerance etc.;
C. Disappear.

A) Changing the geographical distribution of animal species as a result of changing the living environment

For the animals with increased mobility (birds, cheiroptera, lepidoptera, etc.) the pulsing of the areal is characteristic, mainly in the pessimistic zones, where living conditions are harder than in the optimal area in the center of the areal. This phenomenon may create confusing impressions about the periodical appearance and disappearance of certain animal species.

For instance, such bird species of northern origin as the fieldfare (*Turdus pilaris*), black woodpecker (*Dryocopus martius*), and green woodpecker (*Picus viridis*) came to nestle for the first time in RM around the 1960s. At the same time, the European serin (*Serinus serinus*), the Syrian woodpecker (*Dendrocopus syriacus*), and the Euroasian collared-dove (*Streptopelia decaocto*), species of the southern area were registered in the central area (in Codri).

In the 1970s-80s, the whiskered tern (*Chlidonias hybridus*), representative of the Mediterranean fauna, appeared and became dominant among the bog birds. At the same time, the pigmy cormorant (*Phalocrocorax pygmaeus*), another representative of the same fauna, was registered nestling. At present, an optimal development has been reached by another southern element, the European bee-eater (*Merops apiaster*). At the end of the 20th century, two species of curlews were noticed nestling – the pied avocet (*Recurvirostra avosseta*) and the black-winged stilt (*Himantopus himantopus*) in the southern area of the country (Jurminschii, 2006).

The process of colonization of new habitats with new animal species took place gradually, decades in a row. At the beginning, unproductive individuals or rambling couples of birds appear. At the second stage, nestling hatching couples arrive and further on, constantly reproductive populations are formed. In some cases, the populating of new habitats is interrupted. For instance, the European serin, after the first hatching couples encountered in the country's territory, subsequently disappeared. It possibly encountered obstacles related to the condition of the habitat, competition, rapacious animals, etc.

Also, the landscape changes have changed the migration directions for some bird species. For example, such water birds as the greater white-fronted goose (*Anser albifrons*), the lesser white-fronted goose (*Anser erythropus*), and the red-breasted goose (*Branta ruficollis*) in the past were migrating from the north of Eastern Europe to the Caspian Sea area while in the past decades they have headed west, in the autumn also stopping in the territory of our country. In the past decades, many bird species such as the chaffinch (*Fringilla coelebs*), the common starling (*Sturnus vulgaris*), the common blackbird (*Turdus merula*), and the European robin (*Erithacus rubecula*) rather often spend winters also in RM's territory.

After a period of several tens of years of periodic appearance and disappearance, in the past years the black stork (*Ciconia nigra*) has been noticed increasingly frequently in the country's territory in the reproduction period.

The draining of bogs and construction of dams has created favorable conditions for the Caspian whipsnake and the blotched snake, more limited in their areas in the past. The appearance of irrigation canals in the arid area has permitted the penetration of wetlands species, of the grass snake and the tessellated watersnake into new territories.

The fall webworm (*Hyphantria cunea*), a species of quarantine insects, flagged in the country's territory in the second part of the 20th century, in the context of climate warming moves from the southern to the central area of the country.

B) Changing the behavior, phenology, tolerance of animal species as a result of the changes in the living conditions, remaining in the same areal

As a result of the change in living conditions, the black redstart (*Phoenicurus ochruros*), a cliff-based species, due to its big adaptive potential, has changed its biosocial behavioral relations, switching from colonial living conditions to solitary ones in urban areas, becoming a synanthropic bird.

The saker falcon, a species of daytime rapacious bird had nearly left the forestry ecosystems, nestling on tall trees and has settled in the southern area, taking over the nests built by ravens on high voltage polls at the height of 25-30 meters. The rook (*Corvus frugilegus*), a typical colonial species, in some circumstances appears in solitary nestling.

A significant moment in the process of dispersal and colonization in new environmental conditions is the attitude of bird species to the nestling method. A big part of semi-water birds have the possibility to nestle in trees, in cane plantations or even on the ground. In bogs with relative big areas of cane plantations they prefer to nestle in this type of biotopes; however, in its absence they nestle in the trees nearby the food source, with less deep waters. As a result of drying off of bogs, the cane plantations have disappeared;

however, due to their adaptive reproduction plasticity, these species have moved to nestling in trees. Thus, on limited areas the birds nestle compactly in a sizeable space in mixed colonies. This type of nestling is determined by the low interspecific aggressiveness and by the high level of protection against the ground and avian varmints.

C) Gradual disappearance of certain animal species a result of the changes in the living conditions

The vulnerability of animal and plant communities has increased with the degradation and decrease in the areas covered by steppe, plain, wetland and forest ecosystems. At this stage, in RM there have disappeared some species of birds and animals (the great bustard, little bustard, demoiselle crane (*Anthropoides virgo*), steppe eagle, Egyptian vulture, southern birch mouse, etc.).

As a result of the reduction of bog areas the number of semiaquatic birds has also reduced, many of the species having reached the lowest limit of their members. The further degradation of water habitats will lead to the disappearance of some of these species (heron, cormorant, egret, shoveller, and the glossy ibis) from RM's territory, despite their highly adaptive nestling capacity (see above).

As a result of the disappearance of ephemeral plants and ephemeral plants with bulbs, as a result of their crushing by the sharp hooves of sheep and goats while pasturing in wet time periods, the amount of ground squirrels, which is the main food source for a number of rapacious birds and carnivore mammals (eagles, hawks, steppe polecats etc.) has significantly decreased. Also, the unstable winters, with periodical warming up of the weather, makes the ground squirrels wake up from their hibernation; however, once they come up to the ground surface they die. As a result of a number of factors (food deficit for reproduction, development, accumulation of fat reserves in the context of the climate changes), both species of ground squirrels in RM are vulnerable, and the common ground squirrel is included in the Red Book of the RM.

As results from the above-mentioned, the capitalization of the natural ecosystems has led to their fragmentation, to the significant reduction of animals and even to the disappearance of some of the species. In the absence of competitors and in the presence of free environmental niches, premises are created for the appearance of local species and a numeric eruption of some local species that by their exaggerated development may become invasive.

The species of local invasive animals include the striped field mouse, the brown rat, several tens of species of insects – the main varmints of agricultural and forest crops. The local invasive species include the Colorado potato beetle, fall webworm, Mediterranean fruit fly, San Jose louse, horse-chestnut leaf miner etc.

At present, RM's territory is populated by circa 150 species of invasive animals, among which about 130 of species harm the agricultural crops and 15 species – the forests. It has been established that the annual losses in agriculture account for 5 to 10% of the grain crops, about 15% of cultivating plants, and 25% of the multiannual crops.

The species of local invasive animals may appear in different ways. For instance, the Colorado potato beetle, the fall webworm, the Mediterranean fruit fly, and grape phylloxera have been introduced unconsciously by the man; the others, such as the Columbian black-tailed deer *(Lepoptena fortesetosa)*, appeared with the acclimatization of the sika deer, then it switched to parasiting domestic cattle.

Insects and ticks are sensitive to changes of the ambient temperature. The geographic distribution of disease transmitters (ticks) in Europe started changing at about the beginning of 1980s. In RM, the *Ixodes ricinus* species has increased both its areal and the number of individuals.

The voraciousness of the insects increases with the temperature. Many species of harmful insects in draughty years when the actual temperatures are increased affect much more strongly the agricultural crops and the forests as compared to the regular years. This phenomenon to a large extent is determined also by the number of generations of those species. The number of insect generations is directly proportional to the sum of actual temperatures. The regression analysis of the number of generations of the diamondback moth (*Plutela maculipennis*) as compared to the sum of real temperatures shows with a high level of credibility that when the actual temperatures increase, so does the number of generations, from 4-6, as regularly develop in the county at present, to 8-9 generations towards the 21st century (Voloșciuc, 2000).

According to the data from the literature, ones and the same species of insects in various climate areas produce a different number of generations. For example, the beet webworm (*Pyrausta sticticalis*) in the north of Europe has one generation and in the steppe area in the south of Europe – 3 generations; the oscinella frit (*Oscinella pusilla*) in the forest area has 2-3 generations while in the steppe area – 4-5 generations; the turnip moth (*Agrotis segetum*) in the north of Europe has one generation and in the steppe area of south of Europe - 3 generations. These examples prove that once the climate warms up so will the influence of pests on agricultural crops, forests and other ecosystems. To note that a part of the insect species as well as the fall webworm (*Hyphantria cunea*), alfalfa plant bug (*Adelphocoris lineolatus*), in addition to high temperatures also need high humidity (of over 60-70%).

In the context of the above-said, is to be concluded that the climate change has both a direct and an indirect impact on the wildlife. The direct influence is less pronounced, since the animals, unlike the plants, may adapt to certain changes through behavioral and eco-physiological mechanisms. Indirectly, the wildlife will be influenced by the degradation of the associations of plants, food and water deficit, and places of reproduction.

In this connection, in a more difficult situation at present are the endangered, vulnerable and rare species, being at the limit of the minimal reproductive number. Taking into account that in the animal species and populations there are individuals having an increased ecologic capacity of adaptation, it can be admitted that the common species will have enough time to adapt to the new living conditions. As an eloquent example can serve the bird species of the families of *Corvidae* (the rook, hooded crow, raven, magpie, jackdaw and the jay) and *Columbidae* (wood pigeon, Eurasian collared-dove, the common wood pigeon, turtle dove). For example, some species of birds and animals, such as the Eurasian collared-dove, common chaffinch, black redstart, collared-dove, stone marten, hedgehog, hazel dormouse etc. adapt to the urban environment, thus becoming less affected by the changes in nature.

A main criterion that determines the capacity of adaptation of bird and animal species to the new ambient changes is the phenomenon of sinanthropy. In order to become a sinanthrope species, to be able to populate in the mankind's vicinity (in the rural and urban environments), a longer period of time is necessary. For instance, in Western and Central Europe, during several decades, the common blackbird has been a sinanthrope species, while in RM's territory it only recently has started to nestle in a small number in Chișinău's surroundings. At the same time, one can notice the appearance for nestling of the fieldfare (*Turdus pilaris*), widening of the nestling area of the black woodpecker (*Dryocopus martius*), green woodpecker (*Picus viridus*), etc. The rough-legged buzzard (*Buteo lagopus*) appears more frequently in the cold period of the year. This proves that many species have a rather high adaptation capacity, which will permit adapting to the new living conditions, imposed by the climate change phenomenon.

Projections of Future Changes in the Density of the Population of Rodent Species Microtus arvalis

The scope of the zone of comfort of homoeothermal animals (birds, mamals) is broader and their mobile behavior helps them avoid somehow the direct impact of the climate changes. As a result of the global warming, most of the homoeothrmal animals may change the limits of their metabolism towards broadening the higher limit. For example, the preferences of rodents to the temperature vary significantly from one season to another and among different geographic areas. For the common vole (*Microtus arvalis*), the preferred temperature in wintertime is about 17-18°C, spring 24-28°C, and in summer 30-32°C, respectively.

The research conducted in agrocoenoses during nearly four decades have allowed to conclude that this species does not show a strict cycle of the population dynamics, and the top phases, with the highest density, largely coincide with those in other areas of the areal. The common vole considerably grows in number and harms the agricultural crops (autumn crops, perennial plants) in the vegetation period that follows a mild winter. Being an animal that feeds on succulent vegetation, it prefers climate conditions with optimal temperatures and humidity.

Based on the information collected about the trends in the density of *Microtus arvalis*in population in natural ecosystems and agrocoenoses, attempts were made to establish how the climate factors influenced the trends of this species in the previous period. Prospects for the future have also been made by using three global coupled atmosphere ocean general circulation models (CSIROMK3, ECHAM5 and HadCM3) imposed by SRES A2, A1B and B1 emission scenarios.

In order to assess the correlation between the density per hectare of *Microtus arvalis* colonies and temperature and humidity parameters, the Seleaninov Hydro-Thermal Coefficient (CHT) was used. The CHT is a relative empirical indicator that shows the level of humidity and is represented by the relation between the amount of precipitations (R) expressed in millimeters for a period of time with daily average temperatures of the air higher than 10°C related to the amount of daily average temperatures higher than 10°C (Σ T) for the same period, divided by 10 (CHT = R/0.1 $\Sigma_{T>10°C}$).

The temperature and humidity data were supplied by the State Hydrometeorological Service of the Republic of Moldova, and the future temperature and precipitation prospects are available in Țăranu et al, 2012[212]. The climate data and data related to the density of *Microtus arvalis* colonies were statistically processed. Also, a regression analysis (R^2 = 0.41, $p \leq 0.01$) was made, which showed the correlation between CHT and the change in the density of *Microtus arvalis* colonies in the period from 1973 to 2010. Figure 5-42 shows an increase in the density of the number of *Microtus arvalis* colonies per hectare with the increase in the CHT values.

Figure 5-43 shows that, as compared to the reference period 1973-1990, in the period from 1991 to 2010 an unessential increase in the density of the *Microtus arvalis* rodent species was revealed. At the same time, according to the three global climate models (CSIROMK3, ECHAM5 and HadCM3) imposed by SRES A2, A1B and B1 emission scenarios, a decline in the density of this rodent species population is anticipated in the 21st century, as a result of the drop in the HTC values on the territory of the Republic of Moldova.

In all the assessed emission scenarios (SRES A2, A1B and B1), the GCMs CSIRO MK3, ECHAM5 and HadCM3 fo-

[212]Taranu L., Bercu I., Deveatii D. (2012), Regional Climate Change Scenarios for the Republic of Moldova: Future Temperature and Precipitation Projections from Ensembles of 10 Global Climate Models. Mediul Ambiant. Nr.3 (63), P. 33-42.

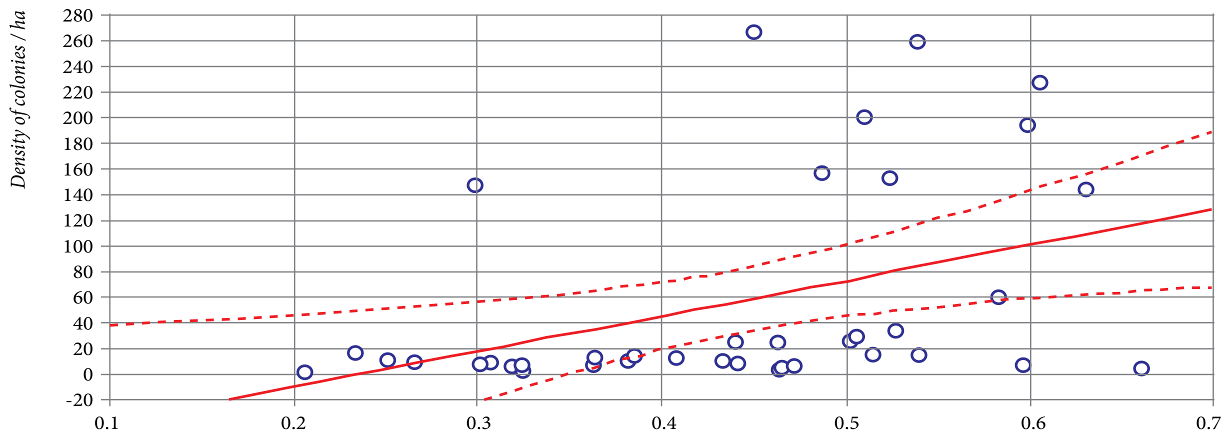


Figure 5-42: Dependence between the density of *Microtus arvalis* colonies and the Seleaninov's Hydrothermal Coefficient.

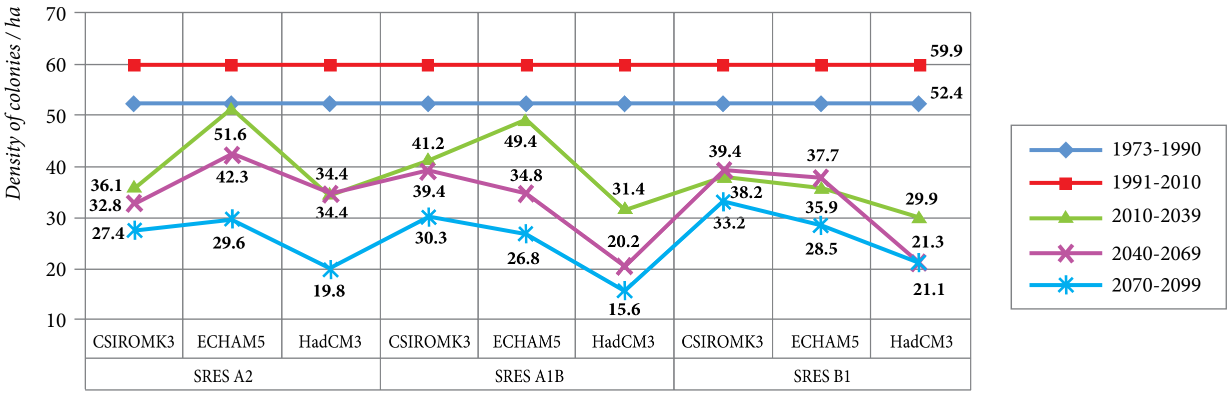


Figure 5-43: Prospects of the changes in density of the rodent colonies of *Microtus arvalis* for 2010-2039, 2040-2069 and 2070-2099 time periods of 30 years each, according to CSIROMK3, ECHAM5 and HadCM3 GCMs, imposed by the emission scenarios SRES A2, A1B and B1, as compared to the 1973-1990 reference period and the 1991-2010 current climate

recast a varied reduction in the density of *Microtus arvalis* rodent colonies in the time periods 2010-2039, 2040-2069 and 2070-2099. The highest indicators of the *Microtus arvalis* colonies density are predicted by the ECHAM5 and CSIROMK3 models, and the lowest indicators – by the climatic model HadCM3.

5.5.5. Potential Impact of Climate Changes on Soil Resources

Soil Resources Available in the Republic of Moldova

The chernozems formed under the forest-steppe and steppe vegetation are the main soils in RM and cover an area of about 2,363.2 thousand or 70.0% of the land fund area. The climate conditions, the relief and the vegetation determine the areas for the sub-types of this soil, from the north to south, and include: luvic and podzolit chernozems (117.7 thousand ha or 3.5% of the land fund area); cambic and leached cernozems (395.5 thousand ha or 11.7%); typical chernozems (281.6 thousand ha or 8.3%); common chernozems (634.1 thousand ha or 18.8%); carbonate chernozems (671.9 thousand ha or 19.9%); southern chernozems (1.7 thousand ha or 0.05%). The chernozems differ through the cumulative character of the nutritive elements of the humus (up to the depth of 80-100 cm, the content of humus exceeds 1%). The content of humus in the capitalized soils is very varied (6.0-1.5%) depending in the subtype and the granulometric composition. The soil reaction is neutral or mildly alkaline. The chernozem profile, both horizon A and B have a molic character, the latter horizon being in transition, relatively humified and structured. Chernozems as type of soil are characterized by relatively favorable agronomic properties and have a high natural fertility.

At the altitude of 200-400 meters the following types of soils can be found: grey (329.8 thousand ha or.8% of the land fund area); brown (27.2 thousand ha or 0.8%); and xero-forest chernozems (18.2 thousand ha or 0.5%). The grey soils cover the prevailing heights (220-350 meters) of the Northern Plateau, Dniester and Central Codri hills, they are partly also found on other heights (Tigheci, Puhoi, Rădoaia, etc.). They formed in conditions of deciduous forests and of mixed forests. They are characterized by a differentiated profile with the percolative periodical hydric regime. Being capitalized, the grey soils become mildly humified (1.5-2.5%), practically unstructured, with a mild acid reaction.

The grey soil type is represented by 4 subtypes: albic; typical; molic and vertic. The brown soils have a cambic character (different from the color of the mother rock). The content of humus in the upper layer is 5-7%, in the arable layer is 1.2-2.0%, and the acidity is low. The brown soils are represented by two subtypes: luvic and typical.

The grey and brown soils, the cambic (leached) chernozems in the center of RM were formed as a result of the vertical zonality and are different from the analogical soils in the north of the country through a more favorable temperature regime (Σt>10C°=2900-3100°). The areas of such soils represent extremely important ecologic niches for the location of vineyard plantations with valuable vineyard varieties for the production of high quality fine wines.

The climate changes have multiple effects on the soils, many of them potentiating each other, and in the end lead to amplifying the initial phenomena. The interrelations among such phenomena are presented in Figure 5-44.

In the above context, the impact of the climate changes on the soils is either direct (resulted from the increase in temperatures, amount and intensity of precipitations and concentration of carbon dioxide), or indirect, resulted from the changes caused to the vegetal carpet or soil biota by the climate changes.

The climate changes produce:

- An increase in the hydric erosion of the soil and washing off/leaching of nutrients due to the change in the amount and intensity of precipitations;
- A change in the structure and texture of the soil due to the increased disaggregation/alteration tendency under the influence of the excessive climate factors;
- An amplification of the Aeolian erosion due to the increase in temperatures and reduction of precipitations in summertime;
- A reduction of the amount and quality of organic matter in the soil due to the reduction of the photosynthesis in C3 plants (with first enzyme involved in fixing the CO_2, rubisco, inhibited at temperatures higher than 35°C);
- A reduction of the biodiversity of the soil biota due to temperature increase and reduction of water in the soil;
- An increased amount of salt in the soils due to intensified irrigation.

Some climate scenarios suggest that the photosynthesis will amplify and the plants will take over the excess of carbon through photosynthetic fixation. The plants in any case will require much higher amounts of carbon dioxide than the current ones so that the photosynthesis works efficiently.

In the context of the future climate changes, the water in the soil will undergo an obvious reduction, especially in summertime, due to the temperature increases. In such conditions, for an efficient agriculture, efficient irrigation systems will be required. To note, however, that the irrigation will also imply the construction of dams and additional energy consumption.

The interrelations between the soil and GHG emissions are multiple. The organic matter accumulated in the soil represents one of the reservoirs for storing the excess of carbon. The fixation of carbon dioxide in the biomass takes place within the photosynthesis process. In the light phase of photosynthesis the radiant energy of the sun is taken over and transferred into the energy of the reduced equivalents (NADPH +H+) and of the macroergic phosphate connections in ATP. In the second phase, the metabolic energy accumulated is used for fixing the carbon dioxide (the Calvin cycle). The final products of the Calvin cycle are then used by the plants for their own metabolism (catabolism and anabolism) and deposited in the organic matter of the soil. The dead vegetal organic matter is then converted also into

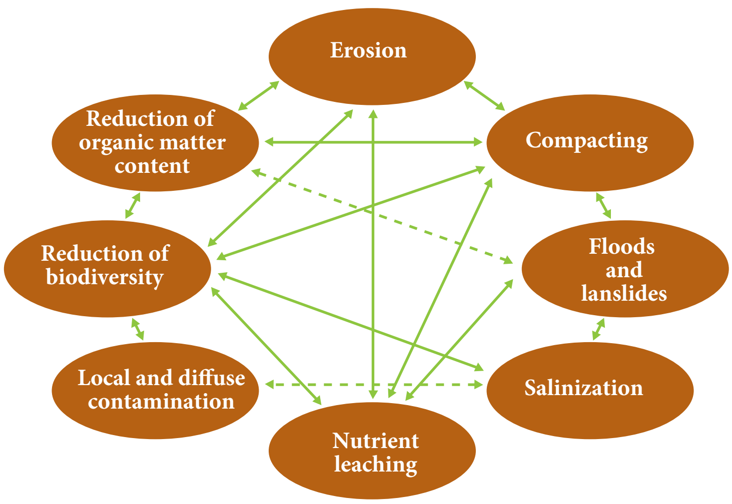


Figure 5-44: The effects produced by the climate changes on the soils and the interrelations among such effects.

the organic matter of the soil, a large amount thereof becoming part of the composition of the humus.

The climate changes and the variation of the concentration of carbon dioxide in the atmosphere can cause changes in the structure and function of the soil/ground ecosystems. In their turn, the changes in the structure and function of the soil of the ground ecosystems influence the climate system through the biogeochemical processes that involve GHG changes between the soil and the atmosphere as well as through biogeophysical processes that involve changes of water and energy. The combined consequences of these effects and the reverse reactions are to be taken into account in assessing the condition of the soil in its interaction with the atmosphere.

Soil Erosion

Soil erosion is a phenomenon by which the soil formed loses its fertile horizon or loses all its horizons. This phenomenon is due to the action of the water and wind, of those agents that in past contributed to forming the soil through the desegregation and alteration of rocks and minerals. Soil erosion can be produced by: surface erosion (when soil removal takes place homogenously, from large surfaces and on the same thickness of the horizon) as well as through depth erosion (when soil removal takes place in a concentrated manner, on certain tracks). The surface erosion is not easy to notice, since the soil layer washed off during a year and especially through ploughing is replaced with soil brought from the depth. However, the loss of the higher horizon of the soil is obvious through the yield reductions, which become smaller with each year. As the erosion takes scope, the content of humus also decreases, the soil color changes, the soil becomes thinner. The water flows on the slope tend to concentrate in small catchments that join and become increasingly bigger. When the tracks formed cannot be leveled through ploughing, we reach the depth erosion and the tracks become too deep, furrow are formed and when their banks breakdown, ravines are formed.

The main consequences of erosion are reduction of the soil fertility and of yields on the slopes subjected to surface erosion. On RM's soils that can still be cultivated and on which no fertilizers are applied, small yields and of lower quality are obtained. If we compare the yields with the thickness of the horizon "A" left, we find a positive correlation: the more the horizon "A" decreases, the more the agricultural production decreases. When all the horizons of the soil have been removed and the mother rock can be seen, most of the times the soil cannot be cultivated anymore; it is taken out of use, thus reducing the area of agricultural land plots in the respective region. The areas on which the depth erosion has created furrow and ravines are definitely taken out of use. When the ravines and furrows are frequent and ramified, they leave uneroded areas among them; however, these areas are inaccessible for the agricultural equipment and the entire land plot becomes unusable for the agriculture. At the first phase of the surface and depth erosions, the eroded soil is deposited at the base of slopes or in the form of alluvial sediment, in the valleys. The deposited soil thickens the "A" horizon of the alluvial sediment and the fertility grows.

At the end of the erosion stage the soil is taken down from the hills to valleys, uncovering the mother rock: sand, gravel, etc. The soil in valleys is covered by an increasingly thicker layer of rock that covers the layer of washed soil, also destroyed, making it thus inadequate for growing agricultural crops. The water fallen with the atmospheric precipitation very fast flows on the surface or through tracks, furrows and ravines. It does not infiltrate in depth anymore, the feeding of the phreatic water layer stops, the level of water in wells also decreases, the springs dry off, and the region being deprived of vegetation and water becomes arid. The river debits become extremely anomalous. In the rainy season or when the snow melts, the debit may significantly increase and rivers cause floods.

In drought periods, the debits significantly decrease, often dry off or lose the water in the gravel or sand deposits of riverbed. The erosion produces severe consequences also for the infrastructure of the transport sector. Roads and railways are often broken by the floods flowing through tracks and furrows. Other times, the communication lines become mudded with eroded material and the circulation is disrupted. The erosion represents a big danger also for the hydroelectric stations if the river catchment area that feeds them is subjected to erosion. Once mudded, the catchment area does not contain the necessary amount of water to supply the anticipated amount of electric power. Many catchment areas have been abandoned as a result of being mudded with eroded material. Also, the depth erosions destroy human settlements.

Prospects of Future Changes in Soil Erosion Trends in the Republic of Moldova

The WEPP (Water Erosion Prediction Project) model represents a system of soil erosion forecast based on fundamental technologies that take into account the storing of sediments during flows, the theory of infiltrations, hydrology issues, the science of plants, hydraulics and mechanical erosion. The model broadly applies the information about slope structures and soil profiles. The most notable advantages of this model include capacities for space estimation and distribution of soil losses (the net loss of the soil for the entire slope or for each point of a profile slope that can be estimated for one day, one month or one year). The modeling process is based on a broad range of conditions that play a practical role in the test area.

In forecasting soil losses through hydric erosion on slope-based land plots, already towards the end of 1970s there had been developed coherent mathematical models for simulating erosions, which includes the "Universal Soil Loss Equation". The structure of the initial equation was observed

(Wischmeier, Smith, 1978) but changing the significance and methods of establishing some component parameters:

$$E = K \cdot S \cdot Lm \cdot in \cdot C \cdot Cs$$

Where:

E (t/ha x year) – annual soil loss through surface erosion;

K (t/ha x year) – zonal erosion, soil loss in areas of rainwater aggressiveness;

Lm (m) – length of slope in the sense of water flowing;

in (%) – average slope of the land alongside the flowing;

S – soil erodability (depending on the type of the soil);

C – factor to influence soil usages, crops and works;

Cs – factor to influence conservations measures of the existing soil.

It may be admitted for relatively smaller land areas to leave factors *K, S, L* unchanged in time, with relative changes (sometimes even annually) only for factors *C* and *Cs,* in the context of "agricultural management."

The area selected for the case study has about 31 ha (width - 553 m and length - 560 m), having a rather complicated relief. The altitude varies between 135 m in the Eastern part and 137 m - in the Western part, with the altitude in the Center on the average reaching about 114 m. To model soil losses, the area was divided into three fields: (1) the area with an inclination from West to East, 282.25 m x 560 m and an area of 15.81 ha, with a difference of about 23 m between the upper and the lower parts; (2) the central area, with inclination from south to north, with a length of 560 m, width - 30 m, area - 1.68 ha, with a difference of about 10 m between the upper and the lower parts, representing the field through which the water flows and the soil is washed off; (3) the eastern area, with inclination from east to west has an area of 13.62 ha, with the size of 240.85 m x 560 m, and a difference of 22 m between the upper and lower parts.

The data about the amount of precipitations and the daily average temperature for the station 338150 Chișinău (47.0° and 28.9°) have been downloaded from the website <ftp://ftp.ncdc.noaa.gov/pub/data/gsod> for the periods 1983-1993 and 2003-2012, this station being located at 22 km away from the area selected for modeling. The coordinates of the evaluated area are $47^{0}03'25.47''$ and $28^{0}42'17.52''$, with the altitude of 112 m.

The daily average amounts of precipitations were used for the calculations. The trends of the precipitations for these periods are shown in Figure 5-46.

Figure 5-45: Area subjected to evaluation using the WEPP model

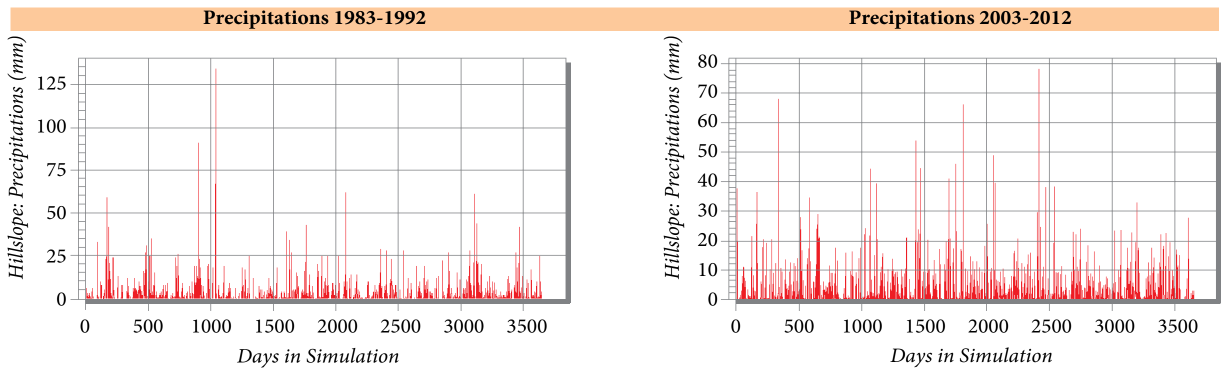


Figure 5-46: The trends of daily precipitations for two distinct time periods (1983-1992 and 2003-2012) for the Chișinău station

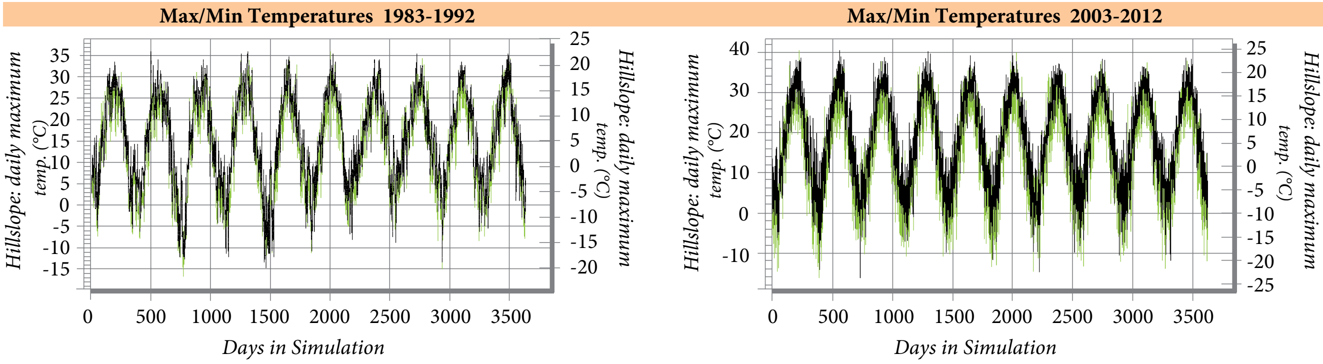


Figure 5-47: The trends of daily highest and lowest temperatures for two distinct time periods (1983-1992 and 2003-2012) for the Chișinău station.

Table 5-38: Level of initial saturation (SAT) – 0.7 (soil capacity – about 33 kPa)

Horizon	Typical chernozem					Carbonated chenozem				
	DG	bd	POR	RFG	Thetdr	DG	bd	POR	RFG	Thetdr
A arl	0.29	1.18	0.555	0	0.121	0.25	1.20	0.547	1	0.123
A1	0.16	1.20	0.547	0	0.122	0.25	1.27	0.528	1	0.128
B1	0.18	1.25	0.528	0	0.119	0.23	1.33	0.498	1	0.119
B2	0.35	1.28	0.517	0	0.116	0.28	1.37	0.483	1	0.119

Note: POR – porosity layer cm^3/cm^3 = 1-bd/2.65; RFG – correction for the context of porosity in the rock; DG – thickness of the soil layer, m; thetdr –volumetric content of water in the soil at the pressure of 1500 kPa, m3/m3.

Table 5-39: Erosion between brooks and small rivers

Horizon	Typical chernozem					Carbonated chenozem				
	SAND %	VFS %	SILT %	CLAY %	ORGMAT %	SAND %	VFS %	SILT %	CLAY %	ORGMAT %
A arl	8	11	42	39	3.70	12	13	42	33	3.47
A1	13	13	37	37	2.95	9	4	47	40	2.99
B1	8	10	44	38	2.02	7	6	42	45	2.35
B2	5	9	41	45	1.53	7	8	41	44	1.70

Note: SAND – sand (%); VFS – fine sand (%); SILT – silt (%); CLAY – clay (%); ORGMAT – organic matter (%).

The trends of highest and lowest temperatures for the periods 1983-1992 and 2003-2012 are shown in Figure 5-47.

The area selected for the study is located in the 2nd pedoclimate zone that has chernozem and alluvial soil in its lower part. Subtypes of soil: molic alluvial soil, leached chernozem, typical chernozemoid soil; typical cernozem. The soil is slightly eroded. Texture: clay-argil based, clay-based, clay-sand-based. The data used for the calculations are shown in Tables 5-38 and 5-39.

The granulometric composition of the soil has a big influence on the level and speed of erosion. From a granulometric point of view, eroded soils do not present any specific features.

In both cases there is a prevalence of clay-argil-based soils – 9.5% of the total country's area. This group of soils is assessed as being resistant to erosion. The strong erosion of such soils is determined by the common influence of the relief, climate conditions, structure of the arable areas and the protection agro-technical measures.

The clay-based soils have a share of about 17.7% of the country's total area. They can be found on the slopes of Codrii and on river terraces. Such soils have a lower anti-erosion resistance due to their high disaggregation.

The soils having lighter texture are subjected to erosion more easily, such as the clay-sand-based, sand-clay-based and sand-based, all of them together taking about 5.4% of the country's total area.

The results obtained after modeling are shown in Table 5-40. It was found that the level of soil erosion in 1983-1992 represented about 1742 t/ha and in 2003-2012 – about 1672 t/ha.

As results from the information presented in the table, the period 2003-2012 was characterized by a high level of precipitations, by over 80 mm more and, accordingly by a bigger flow of water on slopes, by over 13 mm more than in 1983-1992. Nonetheless, this fact did not lead to high soil losses, as would result from an analysis of the amounts of precipitations. The difference representing about 25.5 kg/m^2 does not reflect the amount of precipitations and the flow of water on the slopes. In this case, a big significance most likely would have the amount of precipitation falls during wintertime. In the above context, in order to have a clearer

Table 5-40: The results of the modeling of soil erosion using the WEPP model for a field having a total area of 31 ha, being located in the central area of RM, for two periods of time of ten years each (1983-1992 and 2003-2012)

Indicators	1983-1992	2003-2012
Annual average precipitations (mm)	472.00	552.55
South-North slope		
Annual flows (mm)	41.11	43.17
Annual average soil loss (kg/m²)	25.91	23.64
Annual soil sedimentation (t/ha)	73.611	236.07
East-West slope		
Annual flows (mm)	53.52	56.60
Annual average soil loss (kg/m²)	82.34	70.07
Annual soil sedimentation (t/ha)	823.41	700.70
West-East slope		
Annual flow (mm)	52.24	59.41
Annual average soil loss (kg/m²)	84.56	73.62
Annual soil sedimentation (t/ha)	845.64	736.19
Total area		
Annual flow (mm)	146.60	159.18
Annual average soil loss (kg/m²)	192.82	167.33
Annual soil sedimentation (t/ha)	1742.66	1672.96

view of the soil erosion trends, it is necessary to also take into account the additional parameters, such as the snow layer, duration of water flow from the slopes and the amount of humidity in the highest layer of the soil.

Further one, the modeling of soil erosion was produced for the reference period (1961-1990) as well as for the 21st century.

The information about the climate in the 21st century was generated by using the regional climate model PRECIS (Providing Regional Climates for Impacts Studies), developed by the Hadley Center of the Meteorological Office of the United Kingdom of the Great Britain and Northern Ireland. PRECIS is largely used to generate high resolution maps and statistics about the future changes in the climate conditions of the 21st century. During the study, the climate of the reference period (1961-1990) and the future climate of the 21st century were simulated based on the limit conditions imposed by the emission scenario A1B for the global climate model ECHAM5.

In order to model the soil erosion trends for the reference period (1961-1990) and for the 21st century, separately for three time periods of 30 years each, focused on the years 2020s (2010-2039), 2050s (2040-2069) and 2080s (2070-2099), the general data provided by the PRECIS/ECHAM5 model were used, including daily average, minimum and maximum temperatures (Figure 5-48) as well as the daily precipitations (Figure 5-49).

The data obtained by using the WEPP model are presented in Table 5-41 and confirm the increasing trends of soil erosion under the influence of the climate changes.

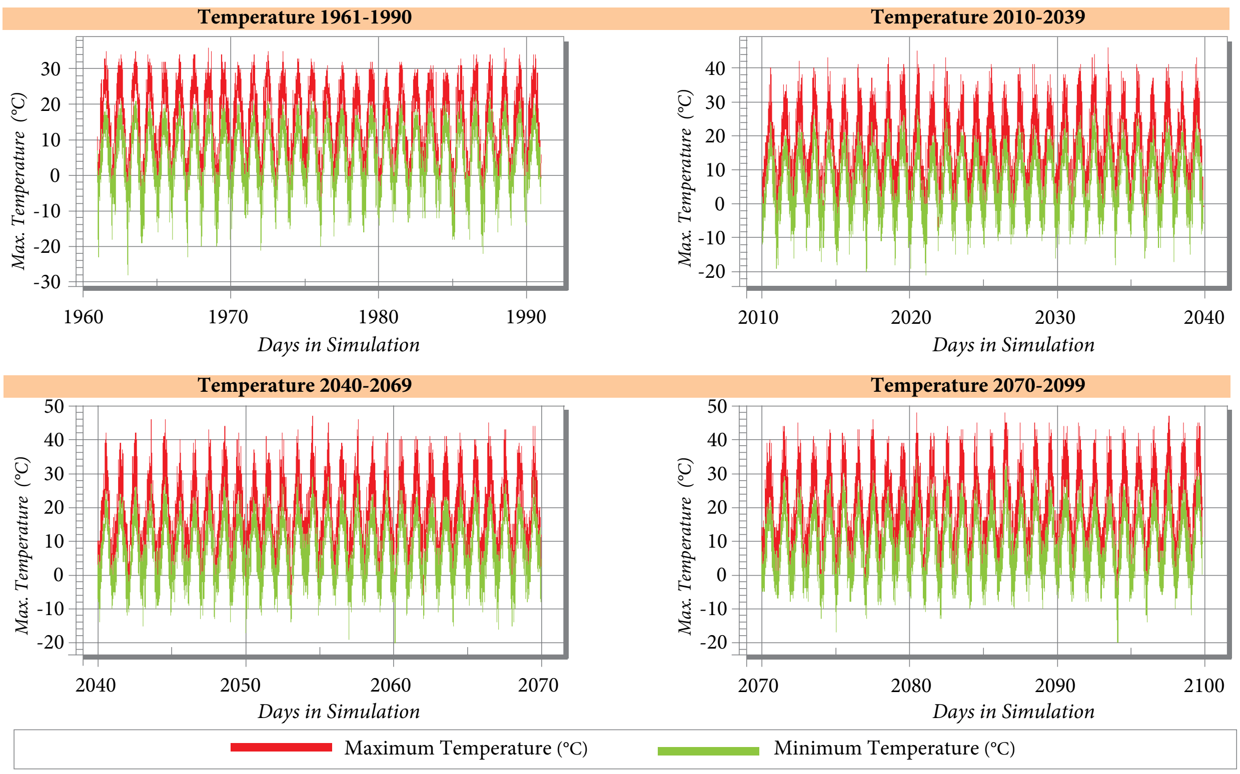


Figure 5-48: The trends of maximum and minimum daily temperatures in RM for the reference period (1961-1990), respectively for the 21st century: three time periods of 30 years each, focused on the years 2020s, 2050s and 2080s, generated by the PRECIS/ECHAM5 model, imposed by the emissions scenario SRES A1B.

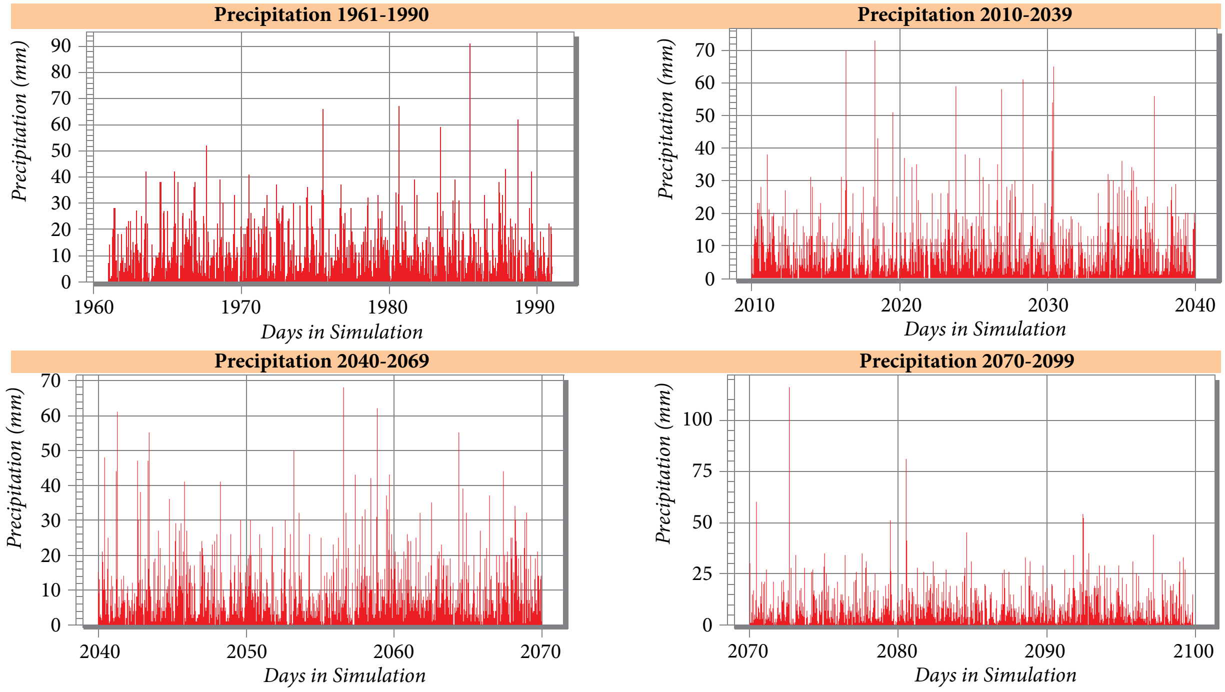


Figure 5-49: The trends of daily precipitations in the Republic of Moldova for the reference period (1961-1990), respectively for the 21st century: three time periods of 30 years each, focused on the years 2020s, 2050s and 2080s, generated by the PRECIS/ECHAM5 model, imposed by the emission scenario SRES A1B.

Table 5-41: The results of modeling soil erosion using the WEPP model for a field with a total area of 31 ha, located in the central region of RM, for the reference period (1961-1990), respectively for three time periods of 30 years each of the 21st century

	1961-1990			
	East-West Slope	South-North Slope	East-West Slope	Total area
Annual average precipitations (mm)	509.75	509.75	509.75	509.75
Annual flows (mm)	56.00	41.20	47.59	144.79
Average annual soil loss (kg/m²)	44.18	14.63	37.71	96.52
Annual soil sedimentation (t/ha)	441.8	21.42	377.12	840.34
	2010-2039			
	East-West Slope	South-North Slope	East-West Slope	Total area
Annual average precipitations (mm)	438.51	438.51	438.51	438.51
Annual flows (mm)	36.15	25.85	35.29	97.29
Average annual soil loss (kg/m²)	41.59	12.22	43.01	96.82
Annual soil sedimentation (t/ha)	415.89	14.70	430.15	860.74
	2040-2069			
	East-West Slope	South-North Slope	East-West Slope	Total area
Annual average precipitations (mm)	467.14	467.14	467.14	467.14
Annual flows (mm)	35.59	25.52	36.32	97.43
Average annual soil loss (kg/m²)	44.62	12.16	43.40	100.17
Annual soil sedimentation (t/ha)	446.17	13.09	434.01	893.27
	2070-2099			
	East-West Slope	South-North Slope	East-West Slope	Total area
Annual average precipitations (mm)	392.71	392.71	392.71	392.71
Annual flows (mm)	28.08	20.31	29.39	77.78
Average annual soil loss (kg/m²)	42.32	11.77	42.40	96.50
Annual soil sedimentation (t/ha)	423.23	16.75	423.99	863.97

Thus, the obtained results allowed to conclude that in comparison with the reference period (1961-1990), for the location selected (a sector of about 31 ha located at 22 km away from Chişinău), a reduction in the amount of precipitations by about 14.0% in 2020s, by 8.4% in 2050s, and by 23.0% in 2080s, is anticipated. At the same time, the climate changes

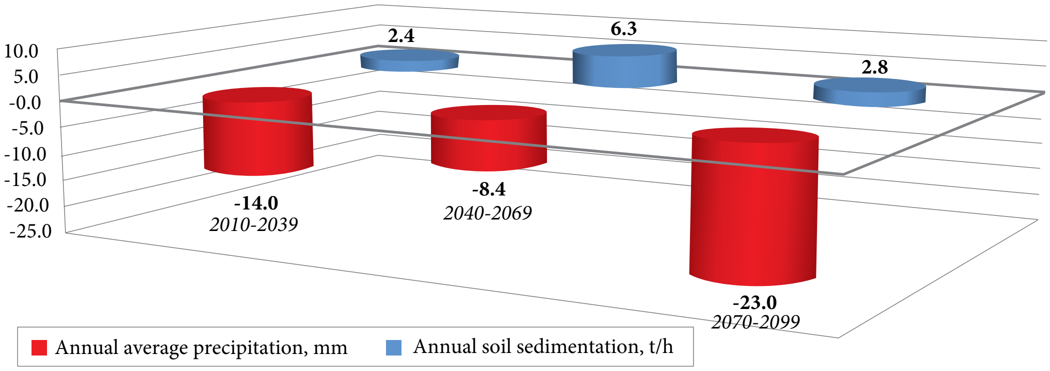


Figure 5-50: The results of modeling the soil erosion trends using the WEPP model for a field with a total area of 31 ha, located in RM's central area, for three time periods of 30 years each of the 21st century, in % as compared to the reference period (1961-1990)

will influence an increase in soil erosion, of about 20.4 t soil/ha or by 2.4% more in the period 2010–2039; about 52.9 t soil/ha or by 6.3% more in the period 2040–2069, about 23.6 t soil/ha or by 2.8% more in the period 2070–2099as compared to the level of erosion characteristic of the reference period (1961-1990) (Figure 5-50).

Using the current modeling capacities and technical possibilities the consequences of the climate changes on RM's soil resources can be forecasted at a larger scale. In accordance with the results obtained, soil processing technologies may be used that would permit decreasing soil losses as a result of the climate changes anticipated in the 21st century.

5.5.6. Potential Impact of Climate Changes on Water Resources

For the Republic Moldova, the lack of water is and will be the most perceived impact of the climate changes, and adjusting water availability to the country's needs will lead to big economic and social benefits and will be the key of success for the adaptation measures implemented.

If the adaptation policies are inefficiently implemented, even in the case of the scenario with the lowest level of concentration of the GHG emissions in the atmosphere (SRES B1), RM risks being included in the category of "regions with an advanced hydric stress". In such conditions, it is imperative to develop a correct and efficient water management policy that would fully take into account the anticipated impact of the climate changes for the water resource sector.

In this connection, the most typical displays of the climate changes on this sector are: extreme climate events (draughts, floods); water insufficiency; water quality; water supply and quality; critical condition of freshwater ecosystems; changes in river water debits; water flows; and abundant precipitations.

Projections of Future Changes in Annual Average Flows of Surface Waters

The specifics of the geographical position of the Republic of Moldova, located almost entirely between two main rivers – Dniester and Prut – determines the specifics of the structure of surface water resources. About 91% of the their total amount accounts to Dniester's and Prut's transit resources, which are formed on the territory of Ukraine and partly in Romania (Prut), and only 9% - to local water resources that are determined by small river flows and intermittent courses.

The layer of river average multiannual climate flow was used as a criterion for assessing the impact of climate changes on surface waters.

The water balance method was used to make a forecast of annual average flows. The calculation method proposed by Mezențev (1976) is broadly used to calculate the modern annual flow standard[213]:

$$\overline{Y} = \overline{X} - \overline{E}$$

Where: $\overline{X}$ and $\overline{E}$ are the average multiannual values of atmospheric precipitations and summary evaporation, mm.

The formula is adequate for the rivers having a well-pronounced regional character or conditioned by climate factors in the conditions of complete drainage of underground waters.

In order to determine $\overline{X}$ the data of observations in the network of meteorological and hydrological monitoring are used. The source of information for the average multiannual amount of precipitations and monthly and annual average temperatures is the World Meteorology Organization[214], the data have been processed in the form of numeric models with a resolution of 30 arc-seconds.

The amount of evaporation $\overline{E}$ is determined by calculations – with the help of formula and nomograms that are based on the correlations among various hydrometeorological characteristics.

The model proposed by V. Mezențev (1976) was used to determine the evaporation[215]:

$$\overline{E}_{zon} = \overline{E}_m \left[1 + \left(\frac{\overline{E}_m}{\overline{X}} \right)^n \right]^{-\frac{1}{3}}$$

[213] Mezentsev V.S. (1976), *Calculation of Water Balance.* – Omsk: Selhozinstitut, 1976. – 76 c.
[214] <http://www.worldclim.org/methods>.
[215] Mezentsev V.S. (1976), *Calculation of Water Balance.* – Omsk: Selhozinstitut, 1976. – 76 c.

Where: $\overline{E}_{zon}$ – is the multiannual average amount of zonal evaporation from the surface of the catchment area, mm; $\overline{X}$ – annual average value of the amount of precipitations, mm; $\overline{E}_m$ – maximum possible evaporation, mm, n – numeric parameter equal to 3.

In this model there are a number of solutions for determining maximum possible evaporation. Better results are obtained when using the approach proposed by Gopcenko and Loboda (2001)[216]:

$$\overline{E}_m = 13.3\sum_{V}^{IX} \overline{t} - 307$$

This formula was developed for Ukraine's territory where the climate conditions are similar to Moldova's and the heating regime is largely dictated by the flow of solar radiation to the ground surface.

The calculations have been made based on the numeric models of the catchment areas of Dniester and Prut Rivers and of the Dniester-Prut inter-river clipped out of the numeric model. The results obtained are presented in Figure 5-51.

The water balance method (Mezentsev, 1976) was largely used to calculate the modern standard of annual flows. The calculation formula, as edited by Professor Lalykin (2005)[217], looks as follows:

$$\overline{Y}_{pr} = (\overline{X} \mp \Delta\overline{X}) - \overline{E}_m(1+\varepsilon_2\Delta\overline{t})\left\{1+\left[\frac{\overline{E}_m(1+\varepsilon_2\Delta\overline{t})}{(\overline{X} \mp \Delta\overline{X})}\right]^n\right\}^{-\frac{1}{n}}$$

Where, $\overline{Y}_{pr}$ – value of forecast of annual average flow, mm; $\overline{X}$ and $\overline{E}_m$ – modern values of annual precipitations and of maximum possible evaporation, mm; $\Delta\overline{X}$ and $\Delta\overline{t}$ – average changes forecasted of the annual amount of precipitations and air temperature; $\overline{\varepsilon}_2$ –coefficient that relatively represents the changes of the maximum possible evaporation to 10C of increase in the average annual air temperature, equal to 0.04 (Budiko, 1980)218; n – parameter, equal to 3.

The numeric model of the territory was used to analyze the distribution of the annual average amount of precipitations (Figure 5-52A). The modern flow (Figure 5-52B) was calculated using the model proposed by Professor Lalykin (2005):

$$\overline{Y}_{pr} = \overline{X} - \overline{E}_m\left\{1+\left[\frac{\overline{E}_m}{(\overline{X})}\right]^n\right\}^{-\frac{1}{n}}$$

The $\Delta\overline{X}$ and $\Delta\overline{t}$ variables have been used for 3 sets of climate

[216] Gopchenko E.D, Loboda N.S. (2001), *Assessment of natural water resources of Ukarine using the water-heat balance method.* // Naukovi praci Ukrainskogo nauk. – doslidn. Gidrometeorologichnogo institutu – 2001. Issue 249. – page 106-120.

[217] Ladykin N.V., Kazak V.Ya (2005), *Hydrological characteristics of small rivers of Moldova and their antropogenous changes.* Chisinau, Mediul Ambiant, 2005, 208 c.

[218] Budko M.I. (1980), *Climate in the past and the future.* -L.: Gidrometeoizdat, 1980. - 351c.

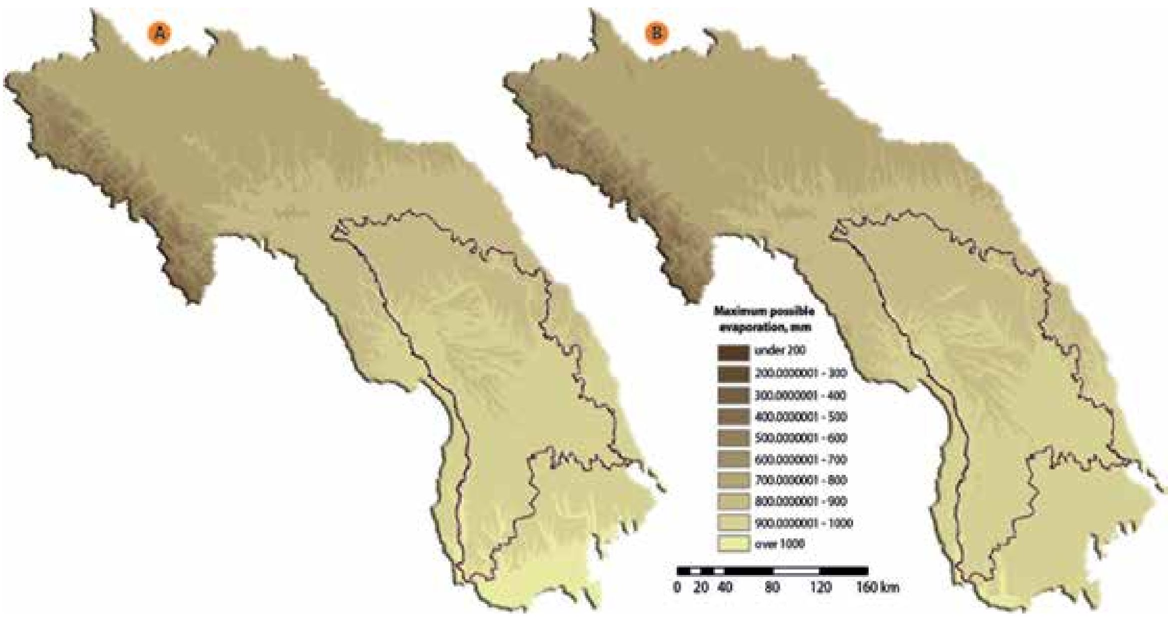


Figure 5-51: Maximum possible evaporation calculated by using two alternative methods: (A) after Loboda[1] and (B) after Gopcenko[2]

[1] Loboda N.S. (2003), *Annual discharge of Ukraine's rivers in conditions of antropogenous influence.* Dissertation for acquiring the level of Doctor of Geographical Sciences. Odessa State Environmental University. – Odessa, 2003, page 37.

[2] Gopchenko E.D, Loboda N.S. (2001), *Assessment of natural resources of Ukraine using the water-heat balance method.* // Naukovi praci Ukrainskih nauk. –doslind. Gidrometeorologichnogo institutu – 2001. Issue 249. – page 106-120.

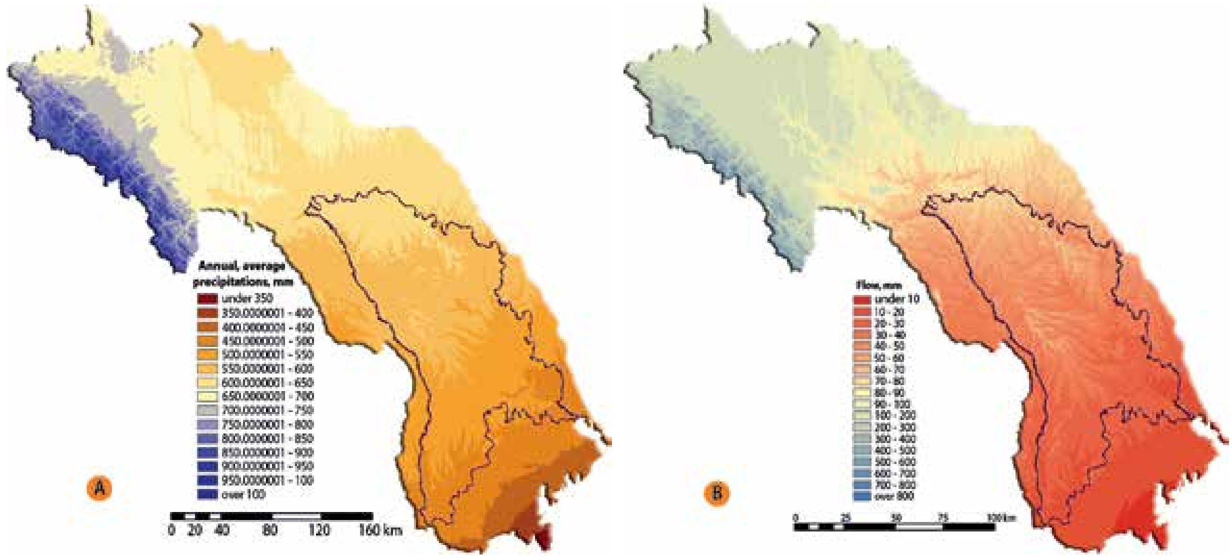


Figure 5-52: Annual average amount of precipitations, mm (A) and modern climate average flow, mm (B)

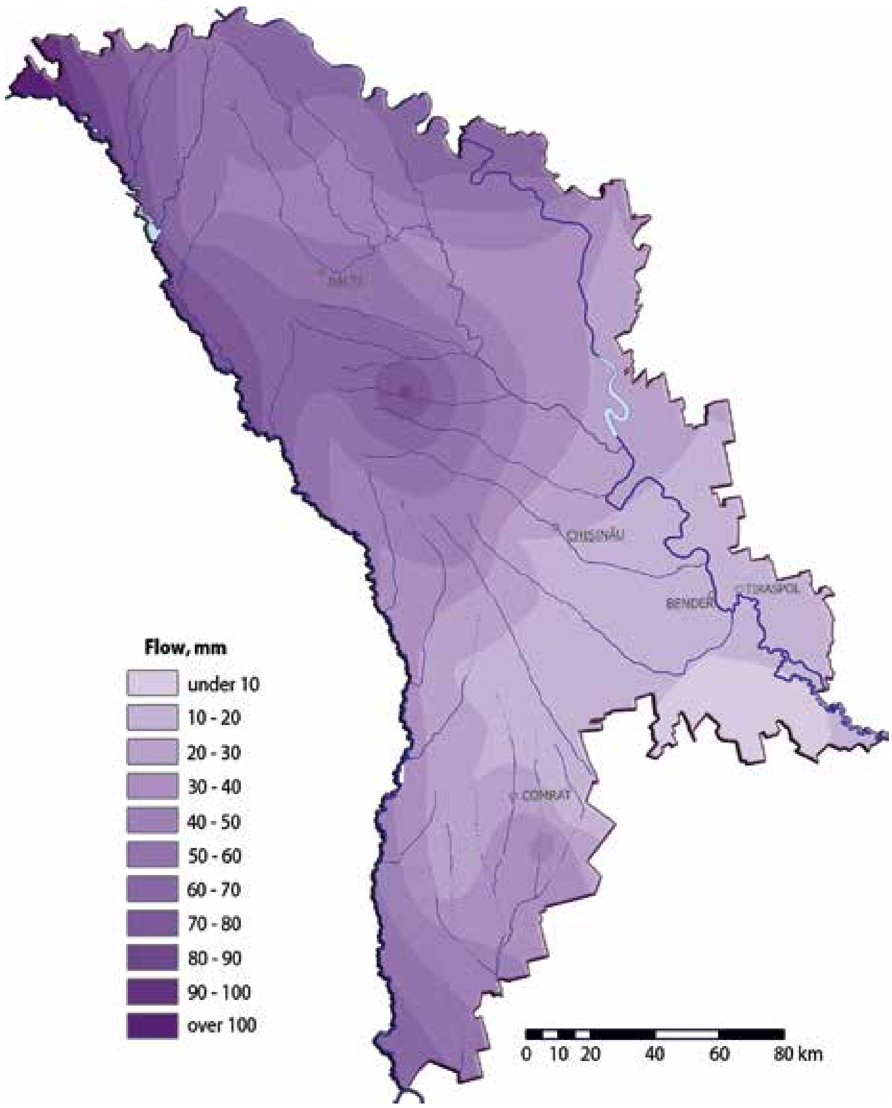


Figure 5-53: Layer of multiannual average flow, mm

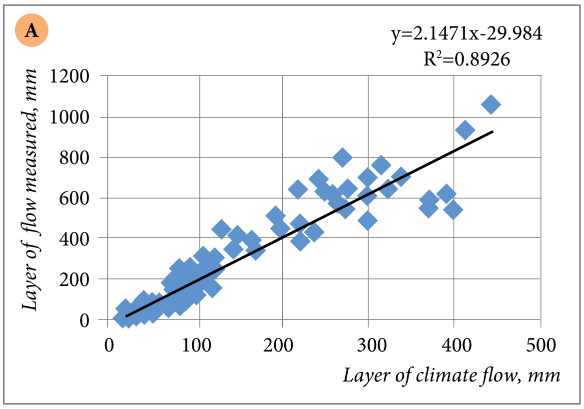
models imposed by the emission scenarios SRES A2, A1B and B1[219].

Three sets of maps have been drawn based on the collected information processed, representing the results of the calculations and mapping of the annual climate average water flows induced by the climate for three time periods (2020s, 2050s and 2080s) based on the set of models for three emission scenarios SRES A2, A1B and B1 as compared to the reference period 1961-1990, for three regions of RM (Figure 5-31, Table 5-18).

[219] Taranu L., Bercu I., Deveatii D. (2012), *Regional Climate Change Scenarios for the Republic of Moldova: Future Temperature and Precipitation Projections from Ensembles of 10 Global Climate Models. Mediul Ambiant.* Nr.3 (63), P. 33-42.

Subsequently, the center of each catchment area as determined, and based on the information provided by RM's State Hydrometeorlogical Service, the layer of multiannual average flow was identified for each catchment area, later mapped using the interpolation method. To note that the mapping was done for the catchment area's center – the place where the flow forms but not for the closing section, where the hydrometric posts are located (Figure 5-53).

Analyzing and comparing the modern flow with the climate flow, it was established that the flow layer measured, in some cases, was higher than the climate flow layer (Figure 5-52B and Figure 5-53). This is explained through the nonzonal character of rivers in Moldova's territory. At the same time, comparing the layer of the climate flow to the measured one presents a high level of correlation (Figure 5-54).



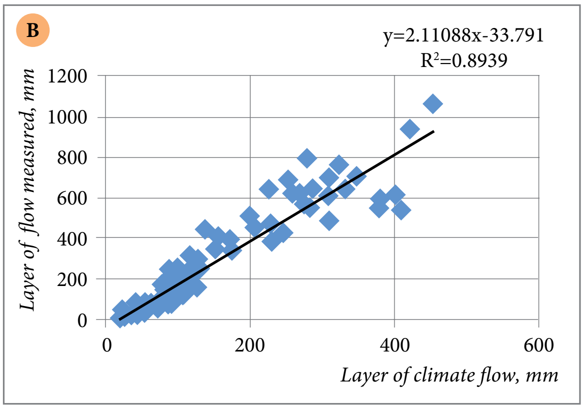
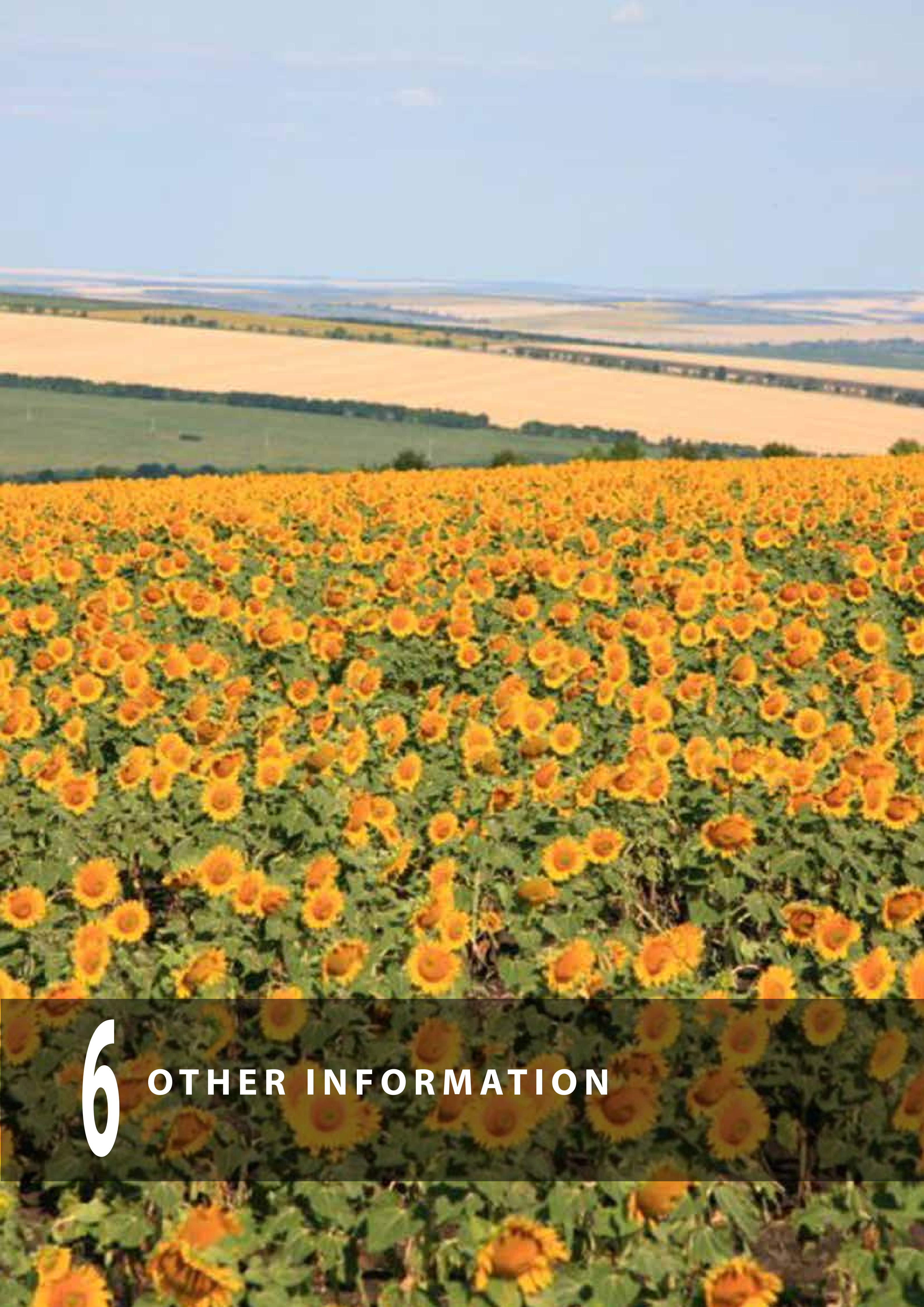


Figure 5-54: Correlation of the flow layer measured with the climate flow layer, calculated by using two alternative models, after Loboda (A) and Gopcenko (B), mm

This permits determining the average annual flow only based on the climate flow.

The index "flow layer, mm" was selected as a unit of expression in order to analyze the modern water resources and the possible future changes. Unlike other indicators (debits, amounts, etc.), this index can be mapped, which facilitates the space analysis of the information.

In the context of the study conducted, the following conclusions have been made: (1) the difference between decreasing the average climate flow and the measured one requires an additional study to clarify the non-zonal character of the flow in the researched area; (2) the high level of correlation between the average climate flow and the measured flow grants a high level of optimism in forecasting the water resources for the future, with reference to determining the climate flow based on the global and regional climate models available, imposed by various emission scenarios; (3) a comparative analysis of the average climate flow values shows that both at present and in the future this will tend to decrease from north-west to south-east within the limits of the territory under research.



6 OTHER INFORMATION

CHAPTER 6. OTHER INFORMATION

6.1. Activities Related to Technology Transfer

In general, it is recognized that technology transfer has a crucial role in achieving the objective of mitigating climate change, given that most of the technologies used are emissions sources, so, replacing old technologies with more efficient ones imminently entail GHG emissions reduction.

Among many definitions of technology transfer concept, that proposed by Global Environment Facility (GEF) deserves attention, according to which technology transfer is:

"…a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, NGOs and research/education institutions…

… The broad and inclusive term "transfer" encompasses diffusion of technologies and technology co-operation across and within countries. It covers technology transfer processes between developed countries, developing countries and countries with economies in transition. It comprises the process of learning to understand, utilise and replicate the technology, including the capacity to choose and adapt to local conditions and integrate it with indigenous technologies. "[220]

IPCC identifies three core dimensions needed to ensure efficient transfer of technologies: capacity building, enabling environment and technology transfer mechanisms.

6.1.1. Capacity Building

So far the RM has undertaken a number of actions to strengthen the capacity for innovation and technology transfer; however the efforts specifically targeted towards GHG emissions reduction have been felt only in the last decade.

Thus, in 2004 the Agency for Innovation and Technology Transfer (AITT) was set up. The AITT is subordinated to the Academy of Science of Moldova (ASM) and is an expert organization ensuring technological extension, aimed at coordination and implementation of mechanisms to stimulate innovation and technology transfer. Currently, the AITT uses only two tools to support innovation: innovation and technology transfer projects and support provided to science and technology parks and innovation incubators. The number of technology transfer projects ranged from 5 to 47 in the period 2005-2011, and the maximum level of funding was MDL 9.8 million, achieved in 2010[221]. It should be noted that technology transfer projects are approved for funding by STDSC (Science and Technological Development Supreme Council), while disbursements and project implementation are monitored by the AITT. Although one of the conditions for application to such competitions is the requirement that 50% of the funding should be matched by the private sector, eligible applicants are only institutions accredited by the National Accreditation and Attestation Council. Projects promoted by the AITT enjoy tax incentives. Unfortunately, data on the follow up of these projects, economic benefits from their implementation are not reflected in any report of the organizations managing the corresponding budget allocations.

Compliance with its direct functions and duties, the AITT jointly with the ASM, in accordance with the *Law on Scientific and Technological Parks and Innovation Incubators* have created scientific-technological parks and an innovation incubator, which is the best solution for domestic companies, because these facilities provide a number of strategic and logistical development services.

Currently there are 3 science and technology parks and 3 innovation incubators in the RM:

- Scientific-Technological Park "Academica", universally specialized;
- Scientific-Technological Park „INAGRO" specialized in intensive and organic agriculture;
- Scientific-Technological Park „MICRONANOTEH" specialized in microelectronics and nanotechnologies;
- Innovation incubator „INOVATORUL", universally specialized;
- Innovation incubator "POLITEHNICA", competitive selection of residents was announced;
- Education and innovation incubator "UNIVERSIENCE", competitive selection of residents was announced.

Organization for Development of Small and Medium Enterprises (ODIMM) is active in the RM. The ODIMM is an implementing agency under the Ministry of Economy. ODIMM's functions include development and implementation of programs and projects aimed at small and medium enterprises (SME) development, provision of advisory and training services to SME managers and employees, creating and developing a network of business incubators, support development of innovation clusters and networks. ODIMM implements support programs approved by the Ministry of Economy, however these programs are general and are not specifically targeted towards innovative companies

Development of industrial parks is scaling up in the country. An industrial park is a limited territory hosting the production equipment and infrastructure, where economic activi-

[220] <http://www.ipcc.ch/ipccreports/sres/tectran/index.php?idp=517>.
[221] Innovation Strategy of the Republic of Moldova for 2013-2020 „Innovation for Competition". Draft, 2013.

ties, mainly industrial production, provision of services, research and technological development activities, take place, all on specific preferential terms. An industrial park can be created for a period of 30 years, either on public or private land, or through green investments or public-private partnerships. The new Law on Industrial Parks was adopted in 2010. In 2010-2011 three companies were granted the status of industrial parks, on the basis of Government Decisions:

- „Bioenergagro", created in Tarigrad, Drochia district, with the purpose to implement the first private investment aimed at biogas production by the "Bioenergagro" SRL enterprise;
- „Tracom", located in Chisinau municipality, specialized in production of metal works;
- "Cimislia" specialized in production of diary and meat products.

Based on feasibility studies, other locations for setting up industrial parks were identified – in Chisinau municipality, as well as in Edinet, Falesti, Hancesti, Cantemir, Cainari, Straseni districts.

Since September 22, 2011, the RM became a partner to the *Enterprise Europe Network (EEN)*, by creating a consortium between the Chamber of Commerce and Industry, the Agency for Innovation and Technology Transfer and the Organization for Small and Medium Enterprises Development.

These partners pursued to establish a centre offering a range of services for businesses aiming to access the European market and implement innovative technologies in their operations.

The main objective of the new EEN centre in the RM is to provide:

a) integrated services to support innovation and promote economic-commercial relations within the business community in the country.

b) Innovation and technology transfer services, including:
   - provision of information with reference to EU innovation policies, legislation and innovation activities (including eco-innovation);
   - promotion of technological cooperation international opportunities;
   - participation in EU level events such as: European days dedicated to innovation, information stands, presentations at conferences and exhibitions;
   - development and distribution of technological profiles of companies;
   - organization of study tours, seminars, workshops to promote innovation and technologic transfer among SMMs[222].

[222] <http://infoeuropa.md/een/>

Recognizing the inputs of the structures mentioned above to building the country's capacity to transfer technologies, it should be mentioned that their contribution to the promotion of technologies entailing mitigation of greenhouse gases emissions is actually too modest[223].

A much more significant impact on the transfer of such technologies is felt following the establishment of the Agency on Energy Efficiency (AEE) in 2010[224] and the Energy Efficiency Fund (EEF) in 2012[225], the value of the latter continuously growing every year, with 80 million MDL[226] budget provided by donors and the state budget, in 2013. The AEE's mission is to monitor the developments in energy efficiency and renewable energy sources sector, ensure drafting and submission of programs summaries, evaluation of relevant investment projects, draft legislation and develop a data base within the scope of its activity. While accomplishing its mission, the AEE is responsible for providing and supporting the objectives of the National Energy Efficiency Programme for 2011-2020, providing the necessary assistance in developing local energy efficiency plans and programs, development of renewable energy sources, monitoring their implementation.

Aiming at implementing state policies on energy efficiency and renewable energy sources, in 2011 the AEE initiated a technical assistance program *"Strengthening the capacity of the Ministry of Economy in energy efficiency and renewable energy sources in the Republic of Moldova"* funded by the Swedish International Development Agency (SIDA), aimed at building the AEE's capacity and strengthen the capacities of the General Directorate for Energy Security and Efficiency of the Ministry of Economy of the Republic Moldova.

Also, the GEF/UNIDO Project *"Reduction of greenhouse gas emissions by improving energy efficiency in the industrial sector of the Republic of Moldova"* was initiated to build the monitoring and energy efficiency verification capacities, the AEE being the main beneficiary of the first component of the project.

In view of fulfilling the obligations related to the supervision and monitoring of energy efficiency, local public authorities are to assign energy managers, in conformity with the Law No. 142 of 02.07.2010 on Energy Efficiency and the Government Decision No. 833 of 10.11.2011 on the National Energy Efficiency Programme for 2011-2020.

Energy managers shall be appointed from among individuals with university degree in energy area, to be responsible for planning and monitoring the implementation of the

[223] <http://www.mrda.md/step/?cont=catalog2&m=2>
[224] Decision of the Government of the Republic of Moldova No. 1173 of 21.12.2010 on set-in-up the Agency on Energy Efficiency.
[225] Government Decision no. 401 of 12.06.2012. Official Monitor No.126-129/448 of 22.06.2012.
[226] <http://www.interlic.md/2012-12-24/fondul-pentru-eficientza-energetica-a-alocat-80-milioane-lei-pentru-finan-area-proiectelor-eligibile-27858.html>.

energy efficiency improvement measures and use of renewable energy sources on the sights.

Of the 33 vacancies, 10 are already filled in by mid of 2013. The energy managers, supported by the AEE, shall be charged with developing local programs to improve energy efficiency at three years intervals, and annual energy efficiency action plans.

Having the support of USAID-funded projects, work is being done on setting up an information system for the purpose of developing a local database to fit the needs of energy managers. Within the same project, Guidelines on energy efficiency, intended for use by the public sector[227], have already been developed. Under the EUREM Program[228], launched in 2011 in the RM, after signing the Memorandum of Understanding on promoting training of energy efficiency managers, signed by the Chamber of Commerce and Industry of the RM, Ministry of Economy of the RM, the German Agency for International Cooperation (GIZ) and Economic Committee of East Germany, a numerous energy managers were trained, which is already a success in the context of energy efficiency capacity building in the country. In the same context, to strengthen the energy managers' capacities, supported by USAID funded SYNENERGY Program; approximately 35 professionals have been trained in 2012. The trained managers have practical knowledge necessary to develop, design, implement and monitor projects aimed at increasing efficiency of energy processes within a public or private facility.

Capacities are also strengthened through the significant contribution of:

- MoREFF and MoSEFF credit lines (residential sector) [229], launched by the EBRD in 2010 to promote energy efficiency projects and development of renewable energy sources[230]. The already implemented projects are widely publicized in the country, and businesses and residential sector representatives come with new energy efficiency initiatives;
- The bilateral program EU – Moldova, which in 2011 included a financing package of approximately 78.6 million Euros, targeted towards the energy sector, mainly for the implementation of renewable energy sources and energy efficiency promotion. The amount of 42.6 million Euros has been allocated for the period 2011-2016. The package included the cost for comprehensive strengthening of the institutional capacities of the Chamber of Commerce and Industry. The "Energy and Biomass" Project benefited of 14 million Euro; 1.5 million Euros were allocated for the "Use of Renewable Energy" Project (2010-2013); 1.25 million Euro were allocated for "FEEF-MO, funding for energy efficiency", and 0.9 million Euros - for "Waste Management" area (2009-2013). [231]
- Energy Package launched by the World Bank[232], etc.

A special role in capacity building belongs to NGOs, including the Technology Transfer Network of Moldova (RTTM). The RTTM's goal is to promote innovation and technology transfer in the country by creating and promoting an effective platform for interaction between key stakeholders and organizations involved in the process[233].

6.1.2. Enabling Business Environment

In general, the current business environment of RM, including the aspect of technology transfer for climate change mitigation, is described in the draft National Development Strategy "Moldova 2020", being identified as a country's priority for the next eight years. According to the strategy, business environment features unjustified financial costs that significantly exceed the costs level in developed countries, which is discouraging to fair competition focused on productivity and innovation.

In the international ranking on "Doing Business Facility" developed by the World Bank in 2011, the RM ranked 90 of 183, significantly outrun by most countries in the region and CIS.

In the global competitiveness ranking RM ranked 94 of 139 countries[234], outrun by most countries in the region and CIS. In terms of competitiveness, the aggregate indicator that reflects the regulatory environment "Institutions", RM ranks 102. According to this report, entrepreneurs revealed the following as the main problems in business, in order of priority: (1) political instability; (2) limited access to finance; (3) corruption; (4) inefficient public administration; and (5) Government instability.

Another international benchmark is the Economic Freedom Index, developed by *"The Heritage Foundation"* and *"The Wall Street Journal"*. This indicator assesses the degree of the state's intervention in economic activity on the basis of 10 sub-indicators: business freedom, trade freedom, fiscal freedom, state spending, monetary freedom, investment freedom, financial freedom, property rights, freedom from

[227] <http://www.comunicate.md/index.php?task=articles&action=view&article_id=7054>.

[228] EUREM is a standardized training and a successful network of European Energy Managers, covering 21 countries, including 13 EU countries (Austria, Czech Republic, Finland, France, Germany, Greece, Italy, Portugal, Slovenia, Spain, Hungary, Estonia, Poland). The interest of many non-European countries for the registration of EUREM brand facilitated its international popularization. The EUREM ensures that every European Energy Manager has basic knowledge in all energy relevant subjects, and also learns specific know-hows to implement energy efficiency projects in practice.

[229] <http://moreeff.info/statistica-moreeff/>.

[230] <http://www.moseff.org/>.

[231] <http://infoeuropa.md/asistenta-ue-pentru-moldova/>.

[232] <http://www.mepiu.md/>.

[233] <http://www.rttm.md/>.

[234] "Doing Business Survey 2012", World Bank, <http://doingbusiness.org>.

corruption and labour freedom. For this indicator the RM is ranked 120 among 179 countries.

The problems in business environment are present at all stages of business cycle: launching, development and liquidation of a business. The administrative system of the state in regard to issuing permits and inspecting is far from being perfect.

Removal of regulatory constraints and unjustified costs would create prerequisites for a dynamic and sustainable economic growth, encouraging domestic and foreign investments.

The strategy aims at elimination of current barriers, so that the risks and costs associated with each stage of the business cycle, including technology transfer, become lower than in the countries in the region, by 2020.

6.1.3. Mechanisms for Technology Transfer

According to the IPCC Report "Methodological and Technological Issues in Technology Transfer", technology transfer mechanisms include:

- National Innovation System;
- Official Development Assistance;
- Global Environmental Facility;
- Multilateral Development Banks;
- Kyoto Protocol Mechanisms.

National Innovation System

Research and development and innovation systems in the RM are at different levels of development, which is explained by historical context: the research and development has a rich history behind and is quite mature, while innovation system is still in the incipient stages of development[235].

The research system in the country is centralized, the decision making authority and research management tools are concentrated in the ASM. Since 2008 the financing of R&D has decreased continuously from 0.63% of GDP in 2008 to 0.47% of GDP in 2011, with respective impacts on accomplishment of the ASM's goals. However, association to EU FP7 funding program, completed in 2011, has been achieved.

For every 4 years, at the ASM proposal, the Parliament approves the research priorities, coordinated with ministries (Government), which serves as basis for channelling the research efforts.

The research and development system consists of multiple actors, including the ASM, which is the key actor with and policy making and implementation functions and units, 51 accredited research institutions, including 12 universities, 20 research institutes (7 in agriculture, 10 in medicine; 3 have socio-humanistic profile; 1 – ICT profile) and 19 ASM's institutes. All these institutions are eligible for funding under research and development programs coordinated by the ASM.

The innovation system of the RM encompasses such actors as research institutions, the Agency for Innovation and Technology Transfer (AITT), State Agency for Intellectual Property (AGEPI), 2 PST ("Academica" and "INAGRO"), one Innovation Incubator, universities, Organization for Small and Medium Enterprises Development (ODIMM). However, this system is still in its early stage of development, and lacks the essential elements of a modern innovation system.

The innovation accomplishments of the RM compared with EU countries are much more modest than the average UI indicated in the European inobarometer. The innovative capacity of Moldovan companies is low, and the links between innovative companies, especially SMEs, are practically inexistent. Because of this, the impact of innovation on the national economy is small, and the RM features a very low level of employment in production activities with high technological intensity, and in exports.

In 2004, when the Code on Science and Innovation was adopted, innovation activity was only partially reflected. The responsibility for promoting innovation activity was vested on the ASM only, which though had the tools to generate innovations, did not have direct influence on the real economy, and the funds allocated for research were too small to be used for the development of various types of innovation, and help companies in their innovation activities. However, since 2005 more than 4.5% of public funding allocated to research and development, amounting to the level of about 1 million MDL per year, was earmarked for innovation activities. These funds were used for the development of innovative infrastructure, and financing technology transfer projects and "start-ups". At the same time the ASM website, on the "Technology Transfer Projects" webpage, does not provide any information on this subject.

International experience has proved that in order to reduce barriers to technology transfer, it is necessary to have intermediate bodies dealing with information, management, technology and finance. The specialized government agencies, energy companies, services, non-governmental organizations, academic liaison departments, regional technology centres, research and technology organizations, electric utilities and trans-national networks[236] act as technological intermediaries. Description of a large number of such organizations in the RM is provided above in 6.1.1 "Capacity building".

Official Development Assistance

Official Development Assistance (ODA) is divided into grants and loans to developing countries to strengthen ma-

[235] Draft National Strategy in Innovation for 2012-2020. <http://www.idsi.md/files/file/2011_10_25-Strategia%20Inovarii_RO.doc>.

[236] <http://www.ipcc.ch/ipccreports/sres/tectran/index.php?idp=517>.

croeconomic development (by the IMF), concessional loans to the Government (in particular, by the IDA), grants for direct budget support (by the EU, WB, DFID), technical assistance from a number of multinational organizations and bilateral donors[237].

In 2006, at the meeting of Consultative Group of Donors for the Republic of Moldova, the country's development partners have committed to spend US $ 1.2 billion. Meanwhile, in 2006 RM joined the Paris Declaration on Aid Effectiveness, signed in 2005 by 128 countries and 26 donors.

During 2006-2010, the involvement of donor community in the RM resulted in ODA growth, the dynamics of which was not stable over the years. The relationship of the Government within 2005-2009 periods with the donors was diverse, from plausible relationships to closing projects. The current Government has a more stable and partnership oriented approach.

In recent years donors community has changed; some of them, such as DFID (UK Department for International Development) left, while others become more active, such as Japan, EU and a number of member countries, such as Sweden (SIDA), Germany (GIZ), Romania, Austria, Poland, Czech Republic and Slovakia. Currently there are 34 registered donors. [238]

RM has strengthened its efforts to refocus from survival assistance to assistance for sustainable development. The key documents in this sense are: the Economic Growth and Poverty Reduction Strategy (2004-2006), RM-EU Action Plan (2005-2007), the National Development Strategy (2008-2011), the Economic Stabilization and Recovery Program (2009-2011), the National Development Strategy "Moldova 2020" (2012-2020), the "Rethink Moldova" Program (2010), etc. The latter is not just a strategic planning document, but reflects the government's strategies driven priorities, presented at the Conference of Donors for the RM, which confirmed the allocation of almost 2 billion Euro.

The biggest constraint to the implementation of the National Development Strategy "Moldova 2020" remained unavailability of cost estimates for the proposed measures, making it difficult to assess the resources needed for their implementation. RM has limited experience in developing strategic planning documents or long term resources needed to ensure effective implementation of activities, and the unstable political context and lack of financial resources places the Government in a more vulnerable position and continue to make it more dependent on donor momentous priorities.

Besides national plans and strategies, there are a number of bilateral, country-donor commitments, which are implemented through various agreed action plans. It should be noted that the general trend in development assistance is less general and more sector targeted approach. The growing importance of the sector targeted approach is driven by the goal of EU integration (currently, the Association Agreement is in the process of negotiations with the EU).

Since signing the Paris Declaration, every two years the RM participates in the Paris Declaration survey, which allows, along with other available information, to assess the relevance and efficiency of the assistance.

The ODA provided to the RM went through a period of stagnation in 2008-2009, caused by the global economic crisis, after which featured rapid growth, and then stabilized at the level of about US $ 450 million in 2011 (Figure 6-1), which also represents about 6.4% of the GDP for this year.

The share of bilateral assistance agreements in ODA accounted for 43% in 2009, 26% in 2010 and 29% in 2011. The top

[237] The analysis of the evolution of foreign assistance offered Moldova in the period 2001-2007, ADEPT <http://www.e-de-mocracy.md/fles/prioritati-guvernare-2009.pdf>.

[238] <http://www.google.md/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=2&cad=rja&ved=0CDIQFjAB&url=http%3A%2F%2Fwww.minfin.md%2Fcommon%2Factnorm%2Fbudget%2Fclasificbudget%2F23_04_2013%2FOrdin_6_din_19_01_2009_rom.doc&ei=I-zsUejXHIjhtQbwzIFI&usg=AFQjCNGXX6OoPFdrGYyizAZeWuFHCIbnoA&sig2=T1yOupYU94KwefLVYLhF3Q&bvm =bv.49478099,d.Yms>.

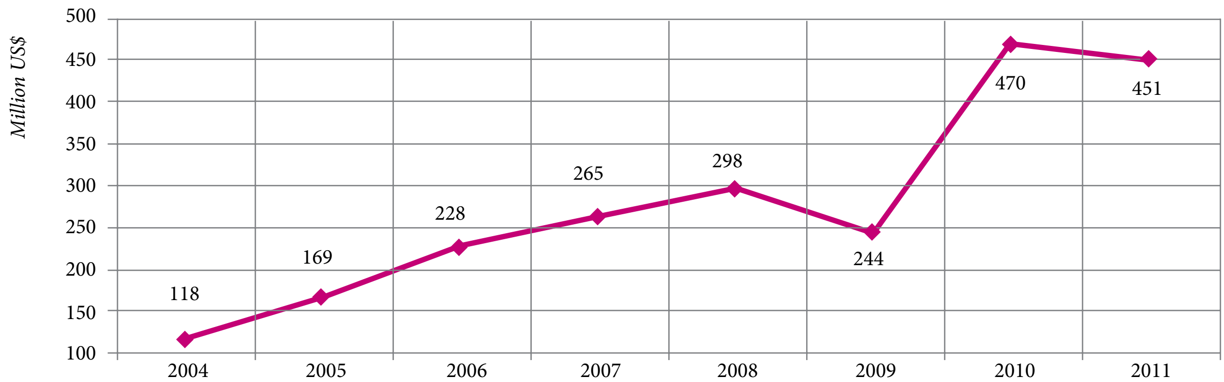


Figure 6-1: Evolution of Official Development Assistance for the RM in 2004-2011

10 donors for the RM registered in the period 2010-2011, are shown in Table 6-1.

Table 6-1: The most important 10 donors for the RM, US $ million, average for 2010-2011

	EU	IMF	IDA	USA	Romania	Sweden	GEF	Germany	Switzerland	UK
ODA	144	108	62	27	19	15	13	11	9	8

In general, cooperation of the Government with donors varied over the years from a relatively good cooperation in 2007-2009, to worsening the relations in late 2009, when the IMF and EU suspended signing a new Memorandum, and the EU postponed provision of budget support. Prime-minister Vlad Filat 1st Government took office in the end of 2009 and signed agreement with MCC (Millennium Challenge Corporation), re-launched multilateral cooperation with the EU, restored the temporarily suspended relationships with the IMF and re-launched budget support from the WB.

As seen in Figure 6-2, most of the assistance is provided to ensure macroeconomic stability, which makes the major part of IMF allocations granted for overcoming the global economic crisis. Also, the largest share of ODA goes to the social sector, justice and home affairs (JHA) and regional development.

As stated in "Foreign assistance and RM's economic development" publication[239], most of the ODA (48% in 2008 and 40% in 2009) is targeted towards the social sector, JHA and good governance, which leads to the conclusion that the real sector gets insufficient ODA (8-10%) and, thus is seriously neglected.

According to the study conducted by IDIS Viitorul[240], the RM is more dependent on the funds for survival, and lacks sufficient support for sustainable development of the real economy. Neglect of certain sectors and excessive attention to the others will surely not help solve the problem of the RM's dependence on external financial support. Treatment is given to effects, not causes of the problems.

One can also observe that certain funds were released for environmental pollution mitigation.[241] These, however, were not provided for reducing GHG emissions, but mostly for reducing and eliminating persistent organic pollutants and accomplishing the National Implementation Plan for the Stockholm Convention.[242]

Despite the significant amounts provided as ODA, the ability of national authorities to guide donors' assistance by exercising leadership in policies and coordinating the efforts of development partners (ownership) still leaves to be desired. In 2006, the degree of ownership in the country was scored at *D* level, within the range of *A* as the highest score and *E* as the lowest score. In 2008 and 2010 – the RM scored level *C*[243].

At present the ratio between promised and actually provided funds is 81%, which is a significant progress compared to 2005 (67%) and show an improvement in terms of predictability and absorption capacity. However, most of funds were allocated to budget support and it is not known how

[239] Valentin Lozovanu, Viorel Girbu, Foreign Assistance and Moldova's Economic Development, IDIS Viitorul, September 2010.

[240] <http://www.viitorul.org/>.

[241] <http://www.academia.edu/1142339/EVALUAREA_CAPACITATII_DE_ABSORBTIE_A_ASISTENTEI_EXTERNE_ACORDATE_REPUBLICII_MOLDOVA>.

[242] <http://www.moldovapops.md/>.

[243] <http://www.oecd.org/dac/effectiveness/Moldova%203.pdf>.

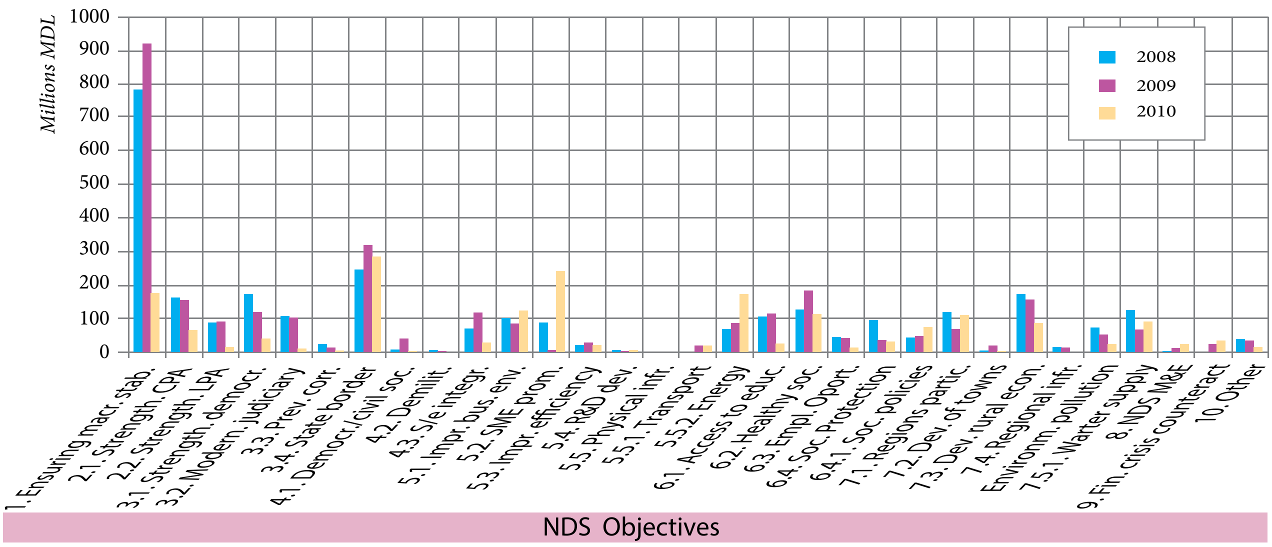


Figure 6-2: Destination of ODA in the RM during 2008-2010

efficiently these means have been absorbed. It is important to note that funds that had been promised but not provided (approximately US $ 77 million) have been included in the budget, thus creating a gap, because the planned activities are not financially covered[244].

Global Environmental Facility

Global Environment Facility (GEF), the entity of the UN financial mechanism, is a key multilateral institution for the transfer of environmental technologies. GEF aims to promote energy efficiency and renewable energy technologies by reducing the long term barriers, technology and implementation costs. An important objective of these programs is to catalyse sustainable markets and create a favourable environment for technology transfer.

GEF projects are focused on testing and demonstrating the variety of financing and institutional models for promoting fusion of technologies, many GEF projects are designed to mobilize private sector funding. Capacity building is a central element of most GEF projects, with direct impact on host countries' capacities to understand, absorb and disseminate technologies.

Since 1991, GEF has provided to developing countries and countries with economies in transition, about US$ 11.5 billion in grants and US$ 57 billion as co-financing for 3215 projects in 165 countries. Through the Small Grants Programme (SGP), GEF has promoted more than 16,030 small grants amounting to US$ 653.2 million directly to civil society and community organizations.[245]

Since joining the GEF and starting to apply to GEF's grants the RM received non-refundable financial support worth US$ 28.8 million and US$ 57.1 million as co-financing for 18 projects, including 6 projects in the "biodiversity protection", 6 projects on "climate change action", 2 projects targeted towards "trans-border rives protection, 1 project in "soil degradation control", 2 POPs projects, and 2 multi-focal area project.

Also, the RM participated in nine regional and global GEF financed projects totalling to US$ 36.0 million, with US$ 387.4 million allocated as co-financing. These include 1 POPs project and 8 trans-boundary rivers protection projects.

In the last operational phase in applying for GEF grants (GEF-5) for the period July 2010 - June 2014, RM has received a proposal for development and implementation of projects worth of US$ 1.5 million for biodiversity protection, US$ 2.0 million for climate change action and about US $ 4.9 million for land degradation control. Projects for GEF-5 have already been submitted for approval by the GEF Council. [246]

GEF has also provided funding through UNDP to implement the Project "Strengthening capacities to undertake environmental fiscal reforms to meet national and global environmental priorities". The support provided to RM is worth US$ 475,000, with co-financing of US $ 610,000 provided by the UNDP and other partners. The project is being implemented since 2011 and was developed as a result of GEF strategic approach to capacity building and priorities in the GEF-5 strategy. To this end, the project aims at achieving the Capacity Development Targets No. 4, which includes the development of sustainable financial mechanisms to achieve common objectives under the three Rio Conventions. The project targets are to implement environmental fiscal reforms aimed at increasing national and global environmental benefits by adopting selected subsidies, fines, taxes and other fiscal instruments, which, according to international experience, prove to be the most effective tools in achieving the goals of reducing GHG emissions. The reason for launching such a project was a very limited environmental sector budget that accounts for 0.1-0.2% of the national budget. Most of these funds cover the human resources costs only and does not allow to the Ministry of Environment to implement its core activities, neither to promote necessary policies. In other sectors, environmental concerns are virtually non-existent. The agricultural sector has received more significant amount of resources equal to 3.1% of the national budget in 2009. However, few environmental issues were included in the sector development plan. In addition, the existing environmental pollution fees established by the Law on payment for environmental pollution, have contributed to the accumulation of only circa US$ 15.6 million for the National Ecological Fund and approximately US$ 0.685 million for Local Ecological Funds. However, these resources are much more limited than the actual needs. Implementation of environmental fiscal reforms would significantly improve the situation, in terms of reducing GHG emissions as well.[137]

One of the recommendations set out in the Country Portfolio Evaluation Report (1994-2009) refers to the fact that the GEF will fully support the implementation of the Small Grants Programme (SGP) in the RM. The RM has expressed interest in joining the SGP promoted by the GEF and the intention was approved by the GEF SGP Steering Committee. A program initiation mission was carried out in autumn 2011. The objective of the initiation mission was to assess the country's preparedness to implement the National Strategy of the UNDP SGP, meaning that governmental and nongovernmental stakeholders, potential partners and donors state the need for such a program and be willing to take over certain roles and responsibilities in conformity with the GEF SGP practical guide.

[244] <http://www.academia.edu/1142339/EVALUAREA_CAPACITATII_DE_ABSORBTIE_A_ASISTENTEI_EXTERNE_ACORDATE_REPUBLICII_MOLDOVA>.

[245] <http://www.undp.md/media/tender_supportdoc/2013/645/Strategia%20Nationala%20a%20Programului%20de%20Granturi%20Mici.pdf>.

[246] <http://www.thegef.org/gef/whatisgef>.

RM already has some experience in implementing small grants in the regional project on trans-boundary waters, as well as in the UNDP component on Small Grants Scheme, which was developed in accordance with GEF SGP. They have been successfully implemented and revealed the potential for this new way of stimulating local initiatives. Also, the SGP would provide much needed support to NGOs community, which is very active, but has limited financial means.

The grant funds are release following the approval of the National Strategy for the Central Management Team of the Program (CMTP), in compliance with the strategic objectives for the GEF 5 operational phase.

To attract co-financing for implementation of the GEF SGP in RM, members of the National Steering Committee and National Coordinator will work intensively with bilateral donors who can provide eligible funds and national funds of government agencies such as:

1. National Ecologic Fund;
2. Energy Efficiency Fund;
3. National Regional Development Fund;
4. Agency for Intervention and Payments in Agriculture, etc.

Co-financing will come from grant beneficiaries and their partners - the private sector, communities, local governments, individuals, etc. One of the requirements of the GEF 5 operational phase is to obtain co-financing at a 1:1 rate at least - in cash and in kind. The SGP of the RM will tend to a 1:1 co-financing rate for the entire GEF 5 operational phase.

Multilateral Development Banks

MDB consider technology transfer as part of their mission to encourage the development, including for a cleaner environment. They have become aware of the role they can play to raise capital to meet the needs of sustainable development and the environment, and the opportunity to use financial innovation to promote environmental projects and initiatives.

Among the MDBs in the RM, the WB and the EBRD have been particularly involved in projects promoting sustainable and environmental development.

World Bank Group (IBRD, IDA, IFC, MIGA, ICSID).

The RM joined the International Bank for Reconstruction and Development (IBRD) on August 12, 1992, the day considered the official date when it became a member of the World Bank.

International Development Association (IDA) provides loans with a low interest rate or no interest rate - called credits - and grants to poorer countries. RM became a member of IDA on June 14, 1994.

International Finance Corporation (IFC) provides loans, equity and technical assistance to encourage private sector investment in developing countries. RM joined the IFC on March 10, 1995.

Multilateral Investment Guarantee Agency (MIGA) provides guarantees against losses caused by non-commercial risks borne by investors in developing countries. RM became a member of MIGA on June 9, 1993.

The International Centre for Settlement of Investment Disputes (ICSID) provides international facilities for reconciliation and arbitration of investment disputes. RM became a member of ICSID on June 4, 2011.

In its activity the WB is guided by World Bank Group's Country Partnership Strategy (CPS) for the RM for the years 2009-2012 and Progress Report on CPS with RM for the years 2009-2013.

A new CPS for the years 2014-2017 is under development and will be consulted with stakeholders and submitted to the Commission in 2013.

The financial support offered by the WB was provided in such areas as health, education, agriculture, energy, water and sanitation, e-Government, social protection, competitiveness and many others. More than US$ 970 million have been committed to present as support to 45 projects. More than 340 trust funds worth over US$ 200 million have been implemented. International Finance Corporation (IFC) and Multilateral Investment Guarantee Agency (MIGA), members of the World Bank Group, have provided funds and guarantees totalling to US$ 295 million.

The World Bank's current portfolio comprises 11 investment projects. The total amount committed raises to US$ 255.6 million and the disbursement rate constantly exceeds 20% annually, reaching a record of 35.1% at the end of fiscal year 2012. The IDA (International Development Association) Portfolio under implementation is vast, covering almost every sector, although the highest concentration of operations is in social protection, agriculture and rural development, as well as financial and private sectors.

The WB manages a substantial portfolio worth of US$ 74 million in trust funds (one of the largest in the Europe and Central Asia), with a quite satisfactory implementation experience, participating in co-financing IDA operations, finance *GEF and carbon operations*, and provide other forms of support, including Economic and Sector Activity and Technical Assistance (AAA). AAA provided in fiscal years 2010-2012, includes a Country Procurement Assessment Report, a Country Economic Memorandum, a regional study on heating system restructuring, an analysis of public expenditure and TA on Financial Sector Monitoring. In the financial sector, in particular, the WB provided assistance in improving the legal and regulatory framework for electronic payments and nonbanking financial sector segments, assisted by the National Bank of Moldova (NBM) conducted stress tests for banks; has prepared a technical note on capital market development, assisted in organizing a roundtable on the supervision of financial services and provided advice and assistance in other areas through continuous dialogue with government partners.

These technical assistance (TA) products will be useful in promoting structural reforms and development of a new tool for economic growth of the RM based not only on remittances, but also on exports and investment. In addition to on-going work in the area of food security, future AAA will include fiscal programmatic activities, further A&A ROSC work, further activities in competition and structural reforms and AT in health. Specific analyses could be performed to supplement the proposed program of lending in energy, education, streamlining ALSAC development in agriculture. AAA in the financial sector could include actions aimed at improving the remittances mediation, monitoring of financial sector to support crisis resistance measures and market development[247]. The WB projects in the RM with impacts to mitigate greenhouse gases emissions over the past few years are shown in Table 6-2.

The World Bank's contribution to mitigating GHG emissions is evaluated in the Synthesis Report of the Country Partnership Programme, drafted in April 2013[248]. According to this report, the biggest environmental problems of the RM are soil degradation, surface water pollution, lack of sustainable waste management (both solid and liquid), and increasing groundwater pollution caused by poor management of manure in rural communities. RM has made significant progress in environmental protection. Also, projects aimed at halting and reversing soil degradation, while providing global benefits such as planned CO_2 emissions reduction of 4.3 million tonnes in the next ten years, are successfully implemented.

The biggest project supported by the WB was the Energy II Project (IDA credit in the amount of US$ 45 million, within 2003-2012), which ended in April 2012, aimed at improving the safety and reliability of the electricity transmission system and of electricity supply and, consequently, facilitation of free trade operations of the energy system and heat supply efficiency in certain public buildings (schools, hospitals, etc.). The WB also finalized the financial and institutional restructuring study of electricity and heat supply in Chisinau, in October 2011, which focused mainly on policy options for corporate and financial restructuring of Termocom and CHPs. The Study conditioned the issue of the Government Decision in November 2011 on the adoption of corporate restructuring plan for Termocom and CHP-1 and the debt restructuring plan with Moldovagaz S.A. WB operation to support the above reform is in preparation for fiscal year 2014.

European Bank for Reconstruction and Development

The EBRD, owned by 64 countries and two intergovernmental institutions, is supporting the development of market economies and democracy. Current projects launched by the EBRD for the RM cover the following sectors: business (agriculture, production and services, ownership, tourism and telecommunications) – 15%; energy (natural resources and electricity) – 0.7%; financial sector (support environment and urban transport) – 46%. Assistance provided to

[247] <http://www.ncu.moldova.md/pageview.php?l=ro&idc=653>.

[248] <http://www.worldbank.org/content/dam/Worldbank/document/Moldova-Snapshot-rom.pdf>.

Table 6-2: WB Projects with impacts on GHG emissions reductions in the RM

No.	Project Name	Amount committed, million $ USA	Approval Date
1	Emergency Agriculture Support Project	10.00	14.05.13
2	Agriculture Competitiveness Project (WB)	18.00	01.05.12
3	Agriculture Competitiveness Project (GEF)	4.44	01.05.12
4	Biogas generation from animal manure project	0.98	24.06.11
5	Moldova: SIDA Trust Fund to finance energy sector reforms and energy efficiency improvements	2.87	17.02.11
6	Moldova Community Forestry Project	2.00	26.05.09
7	Additional Financing for Energy II Project	10.00	29.01.09
8	Environmental Infrastructure Project	4.56	29.05.07
9	Road Sector Program Support Project	16.00	29.03.07
10	Soil Conservation Project	2.48	16.06.06
11	Energy Conservation & Emissions Reduction Project (Community Development Carbon Fund)	0.48	24.02.06
12	Public Heating Biomass Systems in Moldovan Rural Communities (Community Development Carbon Fund Facility)	1.49	24.02.06
13	Renewable Energy From Agricultural Waste (Biomass)	0.97	27.06.05
14	Soil Conservation Project	5.18	23.01.04
15	Energy Project II	35.00	25.11.03
TOTAL		**114.5**	

the RM until March 2013, include: a total of 96 projects with a total value of 1,263 million Euros, of which the gross disbursements amount to 415 million Euros and private sector portfolio of 61%[249].

The EBRD projects in RM, implemented within 2001-2013, with direct impact on GHG emissions reduction, are presented in Table 6-3.

Among the above mentioned projects/loans the most significant impact on reducing GHG emissions is expected to be achieved from MoREFF and MoSEFF[250] credit lines. Typically, energy savings in projects financed through these credit lines exceed 30%, with respective impacts on GHG emissions reduction. To make the investments in energy efficiency projects more attractive, Moldovan Sustainable Energy Financing Facility (MoSEFF) offers a grant component for eligible projects. Depending on energy savings and GHG emission reductions achieved, the grant component may be between 5 and 20% of the loan amount.

Some well-known companies in RM, which have implemented projects under MoSEFF conditions, are as following: Orhei-Vit, Natur-Bravo, JLC, Macon, Ungheni Carpets, etc. Many smaller companies have implemented projects financed from loans ranging from 10 thousand euro to 2 million euro. To facilitate and accelerate investments in energy efficiency, MoSEFF team provides technical assistance and advice to optimize energy consumption. The MoSEFF technical assistance is funded by the EU and is free of charge for eligible projects.

Moldovan Residential Energy Efficiency Financing Facility (MoREEFF) program offers loans to implement energy-efficient technologies in residential sector, helping tenants and owners of living space from the country to reduce consumption and energy bills.

This financing facility provides credit lines to Moldovan banks to credit energy efficiency projects in the residential sector of the country. Borrowers are the owners and tenants of dwellings, apartments owners associations, housing management companies, energy service companies and other eligible companies providing maintenance, operation, construction and renovation works on the basis of contract with owners / tenants and aiming to implement eligible projects. Eligible projects include the following works: installation of energy-efficient windows, insulation of walls, floors and roofs, installing efficient biomass boilers, solar water heating, efficient gas boilers, heat pumps systems, photovoltaic systems, including integrated architectural stations with heat exchangers and engineering systems.

Implementation of this project is expected to have three impacts:

- Demonstration and market extension effect:

The project will generate a transition impact by demonstrating the benefits of energy conservation and promoting greater energy efficiency lending in sectors where commercial financing is absent and in a country featuring inefficient energy saving and largely limited market economy. In addition, the MoREEFF funding opens the financing window to tenants associations / condominiums, and businesses (ESCO, services companies) for residential energy efficiency projects.

- Competence transfer:

It is expected that the project will transfer and develop expertise and competition on several levels: (i) between participating banks, (ii) between sub-borrowers and local experts and technology providers. MoREEFF will help to: increase stakeholders' awareness, improve market capacity. The project will support legislative changes aimed at energy efficiency in buildings and housing related regulations.

- Technology transfer:

Loans and credits are allocated on conditions advanced technologies are promoted and reflected in the lists of respective technologies[251]. Among such conditions are: windows, thermal insulation, heat pumps, biomass boilers and stoves, solar water heaters, gas water heaters, photovoltaic systems, etc.

[249] <http://www.ncu.moldova.md/pageview.php?l=ro&idc=652&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Banca-Europeana-pentru-Reconstructie-si-Dezvoltare&.>.

[250] <http://www.moseff.org/>.

[251] <http://moreeff.info/tehnologii/>.

Table 6-3: EBRD projects/loans with impacts on GHG emissions reduction in the RM

Nr.	Loan(project) name	Amount committed, million $ USA	Approval Date
1	Moldova Roads Rehabilitation IV	150.00	26.03.13
2	Moldovan Railway Fleet Renewal	25.00	16.10.13
3	Moldovan Sustainable Energy FF Extension (MoSEFF and MoSEFF II)	42.00	09.05.12
4	Moldovan Sustainable Energy FF Extension in rural sector (MoREFF)	35.00	09.05.12
5	Moldelectrica Transmission Rehabilitation Loan	21.50	09.05.12
6	Chisinau Urban Road Sector Project	11.40	22.11.11
7	Moldova Road Rehabilitation III	75.00	26.10.10
8	Moldova Road Rehabilitation Project	30.00	27.06.07
TOTAL		**389.90**	

Kyoto Protocol Clean Development Mechanism

Under the Kyoto Protocol, the Republic of Moldova is a country with no commitments to reduce greenhouse gases emissions. However, it can contribute to the international effort to combat climate change, gaining support and benefits for sustainable development.

Aiming to promote projects eligible under the Clean Development Mechanism (CDM) the National Designated Authority (NDA) was established for the purposes of the Kyoto Protocol Clean Development Mechanism. Its activity is regulated by the Government Decision no. 1574 of 26.12.2003[252] .

It should be noted that the Kyoto Protocol has expired in 2012, but in December 2012 in Doha, Qatar, the 18th Conference of the Parties to the UNFCCC has been extended the Kyoto Protocol's term for another eight years. Thus, the Protocol's mechanisms will continue to work, both in technology transfer, and serve as important tools to achieve the objective of reducing GHG emissions globally. Until present, the Republic of Moldova initiated several CDM projects, as reflected in Table 6-4. Implementation of these projects promises annual reduction of GHG emissions, equivalent to 1.5 million tonnes of $CO_{2.}$

Carbon benefits of CDM projects carried out in the RM during 2006-2009, as a result of trading the reduced GHG emissions (348,502 tonnes CO_2) under these projects amounted to US$ 1,969,036[253].

In order to facilitate CDM projects aimed at reducing consumption of electricity produced based on fossil fuels in 2011, with the financial support of the WB, a tool for determining the greed emissions factor (GrEF) was developed, and concrete GrEF values were determined for the crediting periods starting in 2010[254].

Due to additionally criteria applied in CDM projects (for example, projects are eligible if they are not economically feasible without carbon trading, the technology applied is new to the country, etc.) technologies transfer became possible, otherwise the projects would not be implemented in the RM.

6.2. Systematic Observations and Research Activities

6.2.1. Institutions Involved in Systematic Observations

State Hydrometeorological Service (SHS) is a public institution subordinated to the Ministry of Environment, activity of which is regulated by the Government Decision No. 401 of April 3, 2003 "On some aspects of hydrometeorological activity in the Republic of Moldova".

SHS administration is ensured by its director, appointed by the Government. The current organizational formula of the SHS comprised three main fields of activity: meteorology, hydrology and environmental quality monitoring. The SHS Director is backed up by the first deputy director and a deputy director, both appointed and dismissed by the Ministry of Environment. The supreme body governing the SHS is the Technical and Scientific Council, headed by the SHS Director.

The main tasks of the SHS are:

[252] Monitorul Oficial Nr. 6-12 din 01.01.04, <http://lex.justice.md/>.
[253] <http://ro.greenmedia.md/carbon-market-2490.html>.
[254] <http://clima.md/lib.php?l=ro&idc=243&>.

Table 6-4: CDM Projects implemented in the Republic of Moldova

Date of approval by the NDA	Name of the project	Expected emissions reduction, tones CO_2 annually	Project status
07.02.2012	Reducing fugitive gas emissions from the „Tiraspoltransgaz-Pridnestrovie" SRL distribution network, Republic of Moldova	164 043	Initiated
20.12.2011	Reducing fugitive gas emissions from Moldovagaz distribution network, Republic of Moldova	748 903	Initiated
17.03.2009	Afforestation /Re-afforestation Project of the Republic of Moldova	94 354	Initiated, annual average reduction in 2006-2035
31.07.2006	Biogas production from pressed sugar beets pulp at the sugar refinery in Drochia, Südzucker Moldova.	21 142	Initiated
31.07.2006	Building a Combined Heat and Power Production Plant at «Tirotex», Tiraspol, Republic of Moldova.	62 000	Initiated
19.07.2006	Biogas recovery from the solid waste landfill in Tantareni, Anenii Noi, Republic of Moldova	248 560	In the process of being initiated
30.09.2005	Moldova Biomass Heating in Rural Communities Nr. 2	19 026	Initiated
01.10.2005	Moldova Biomass Heating in Rural Communities Nr. 1	7 316	Initiated
02.10.2005	Energy Conservation in the Republic of Moldova	10 934	Initiated
09.09.2004	Soils Conservation in the Republic of Moldova	179 242	Initiated, annual average reduction in 2002-2022
TOTAL		**1 555 520**	

1. To monitor the state and evolution of the hydrometeorological conditions and environment quality with the purpose to protect the population and national economy against dangerous hydrometeorological phenomena and high levels of environmental pollution;
2. Develop meteorological, agro-meteorological, hydrological forecasts, as well as environmental pollution forecasts;
3. To issue warnings on imminence of hydrometeorological hazardous phenomena, as well as on high levels of environmental pollution;
4. To provide hydrometeorological and environmental quality information to the population, central and local public authorities, businesses, national defence;
5. Establishment and operation of the National Hydrometeorological Data Fund to support hydrometeorological justification for design, construction and exploitation of various socio-economic objects and to develop long term national economy development strategies;
6. Participate in the international data exchange within the global observing system and to fulfil the commitments under the conventions and international agreements signed by the RM.

The history of the SHS begins with the first meteorological observations carried out in Chisinau in 1844. Thirty years later the first hydrological post was organized on the Dniester River in Tighina (1878). In the same period meteorological observations were started in five locations of the country: Briceni (1887), Soroca (1890), Comrat (1892), Ploti (1894) and Tiraspol (1898). At the beginning of the XX century stationary meteorological observations were carried out at 11 meteorological posts and 6 hydrological posts. However, at most stations and posts the observations were not carried out regularly, interrupted by the First and Second World Wars. In October 1944, the Hydrometeorological Department of the Republic of Moldova was established which ensure further a planned development of regular hydrometeorological observations in the country. In the same year, the Meteorology Office, comprising hydrological and meteorological forecasting groups was established within the Department. The Meteorological Office carried out a fruitful activity on assessing the methodology used by the Central Forecasting Institute (Moscow) and adapting it to the local conditions, as well as developed methodologies. The Hydrological forecasting group has developed methods of hydrological forecasting for the Prut and Dniester rivers.

In 1950 the first flood forecast was issued and the first flood discharge forecast was issued in 1953. During the post-war period the reconstruction of the old stations started, new stations were established and new types of observation were developed. In 1946 the first radio-sonde was launched in Chisinau. For a long period of time atmospheric sounding was made occasionally, but since the Upper-Air Station was opened in Chisinau in 1957, this process became regular. In 1953 the Hydrological Balance Station was established and in 1957 the Hydrological Station in Dubasari basin was opened. In 1954 observations on the radiation background have started. For agricultural purposes the agro-meteorological observation network was extended, particularly to determine available soil moisture (from 3 posts in 1947 to 24 posts in 1963). In the middle of the 50's of the XX century the hydrometeorological network has reached its optimal allocation density through the entire territory of the Republic of Moldova.

The hydrometeorological network development had required continuous methodical guidance and a series of publications with generalized hydrometeorological data were developed. For this purpose the Hydrometeorological Observatory was established in 1956 (reorganized into Hydrometeorological Centre in 1982) which ensured methodical guidance for the observation network, provision with equipment, developed new types of observation, summarized hydrometeorological data in monthly reports, yearbooks and guidelines, and carried out scientific researches. Environmental pollution monitoring in the RM has started in 1950, by carrying out the studies on hydro-chemical regime of two rivers at 5 posts. At present the work content of these activities has considerably increased. Observations by 45 indicators are taken at 32 posts on 13 rivers and 3 basins. Since 1976 the surface water quality control by 5 hydro-biological indicators has been carried out. Observations on air pollution started in 1969 at 3 stationary posts in Chisinau. Initially the number of observed indices was 4 and gradually this number increased to 7 along with the number of posts. At present such observations are carried out by 7 components in stationary posts in 4 towns of the country. Air pollution forecasts are issued since 1979. Use of chemicals in agriculture preconditioned the need for soil quality monitoring and pesticide control. The monitoring began in 1976 with establishment of the laboratories on soil pollution monitoring that nowadays are widely distributed on the whole territory of the Republic of Moldova where the chemical products are used.

Starting with 2001, a long term plan for the development and strengthening of the SHS potential was developed. To achieve this goal, with the financial support of the Government and National Ecological Fund, important activities aimed at modernization and streamlining the SHS main production subdivisions, including the National Observation Network, were carries out. Automatic weather stations for all the meteorological posts, up-to-date equipment for the hydrological and hydro-chemical posts were procured and installed.

6.2.2. National Systematic Observation System and Monitoring Network

According to the Law No. 1536-XIII of 25.02.1998 on hydrometeorological activity[255], systematic climate observati-

[255] The Law of the Republic of Moldova on the hydrometeorologic activity No. l536-XIII of 25.02.98 Official Gazette of the RM no.60-61 of 02.07.1998.

ons in the RM are carried out by the SHS. The SHS responsibilities include systematic observations of the climate and the environment condition under the influence of natural and anthropogenic factors.

The national meteorological system reproduces, on a country-wide level, the global meteorological system. It is of a complex nature and ensures recording, transmission and processing of meteorological information, according to internal needs, directives and agreements of the World Meteorological Organization (WMO) and other bilateral treaties and conventions to which RM is a part.

Systematic climate observations are the main source of activity data for scientific analysis of climate and climate change.

SHS terrestrial monitoring network includes approximately 90 hydro-meteorological stations and posts and checkpoints to monitor air, water and soil pollution. Observation of meteorological, hydrological and agro-meteorological parameters and ecologic monitoring is carried out in non-stop regime at stations and posts. The permanent observation points forming the network are equipped with the same type of equipment and work following an international classical method. The placement of the hydro-meteorological network of stations and posts on the territory of the RM meets the international requirements contained in the WMO's Global Observing System.

The information obtained from monitoring is used to develop meteorological and agro-meteorological forecasts, assess the air, water and soil pollution, warnings on natural hydrometeorological phenomena, for global and regional of hydro-meteorological data exchange network, also to assess climate change in RM and to complement the National Hydrometeorological Data Base.

National Monitoring System

SHS meteorological observation network includes 18 meteorological stations and 60 observation posts (11 meteorological posts, 20 agro-meteorological posts and 29 hydrological posts) (Figure 6-3). The network functions in accordance with the WMO's rules and requirements, and disseminate the information used in international meteorological and climatologic research.

During 2004-2008 the meteorological stations were equipped with semiautomatic stations "Pogoda". Such stations allow to automatically continuously measure the air temperature and humidity, atmospheric pressure, wind speed and direction, soil temperature up to 20 cm depth, and to transmit the operational data promptly. Other meteorological parameters are measured by using classical equipment. At the 4 stations on the left bank of Dniester river classical equipment is used for climate monitoring purposes.

Every three hours the basic meteorological information, encoded in SYNOP telegrams, is collected by the Telecommunications Centre. These data are submitted to the Regional Meteorological Centre (Moscow, Russia) to be distributed within global and regional exchange among WMO member countries. Monthly meteorological information obtained from four stations and encoded in "Climate" telegrams is transmitted to the Regional Meteorological Centre (Moscow, Russian Federation), DWD (Germany) and World Climate Data Centre (Asheville, North Carolina, USA). These data are then used by the WMO to prepare monthly climatologic reports and climate modelling in scientific research in the field.

The global observations network (GCOS) includes Chisinau weather station, its data being used for global information exchange. At regional level data from all stations of the national network are involved.

Data on adverse meteorological phenomena observed across the country each year are transmitted and placed in the WMO's Bulletin for Region VI.

In November 2010, as part of the regional EUMETSAT project, the National Meteorological Forecasting Centre has been equipped with the DAWBEE station receiving and visualizing satellite data, which allows to monitor the state of the atmosphere, evolution of cloud systems, parameter of moisture fields, meteorological phenomena, etc. in quasi real time.

In 2010 the implementation of "Disaster and Climate Risk Management in Moldova" project, financially supported by the World Bank, started. A series of activities on modernization of the existing hydro-meteorological monitoring system of the SHS are carried out under the project.

In 2013 the Doppler weather radar system with dual polarization has been installed and put into operation. The SHS has a modern laboratory for equipment calibration.

Climate database

SHS continuously builds its climate database. The National Hydrometeorological Data Fund also stores historical data of meteorological observations (since 1886). These data are used to analyse weather patterns across the country and to estimate climate evolution over the period of instrumental observations.

The climate database generated from meteorological observations contains the following parameters:

- atmospheric pressure (at the station and sea level);
- air temperature (average, maximal, minimal);
- air humidity (partial pressure, relative humidity, dew point deficit);
- wind (direction and speed);
- meteorological visibility;
- precipitations;

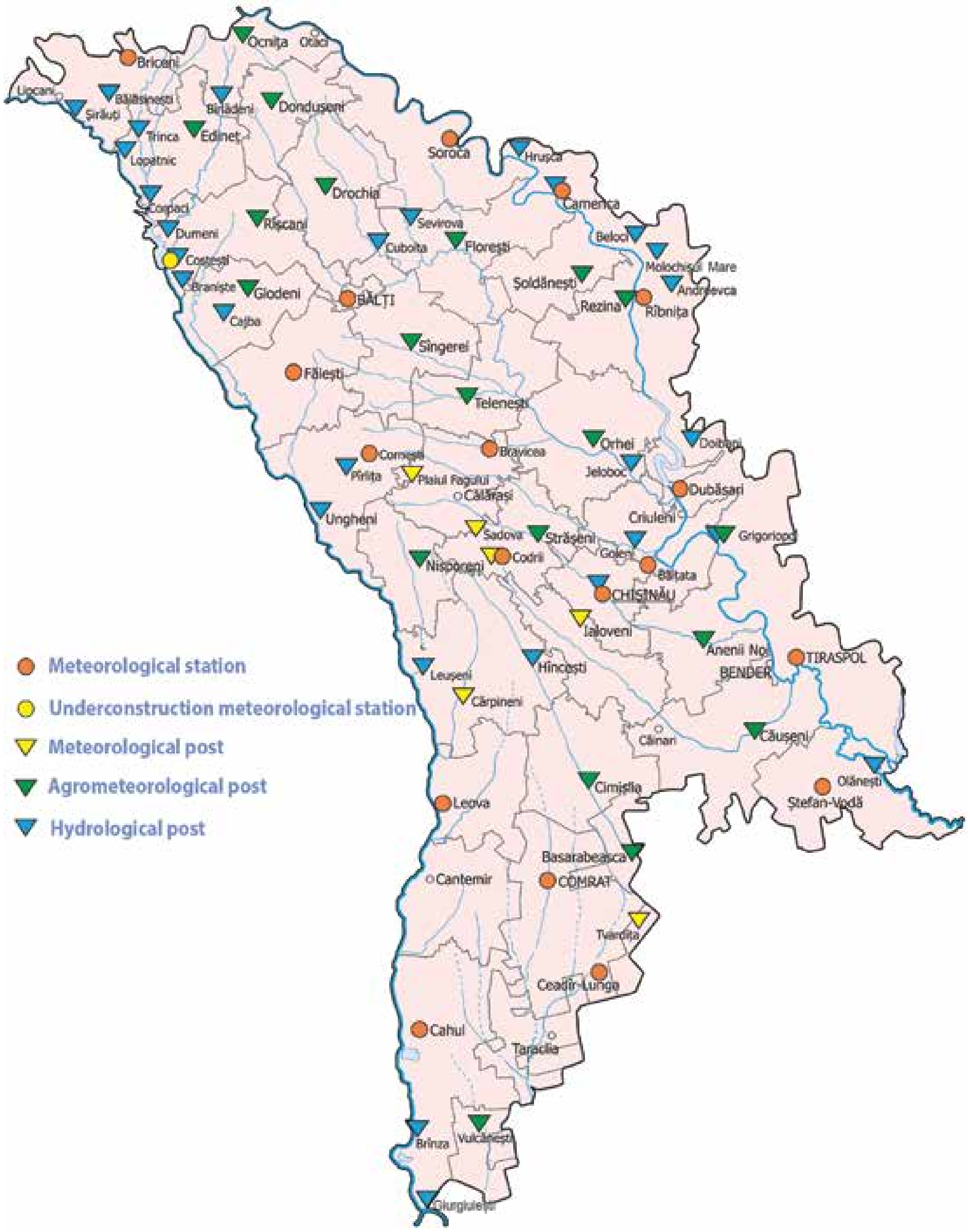


Figure 6-3: SHS Meteorological Observation Network

- nebulosity (clouds type and height);
- soil surface temperature (average, maximal, minimal);
- soil temperature at depth on vegetation free sector (at 5, 10, 15 and 20 cm depth);
- soil temperature at depth on vegetation covered sector (at 20, 40, 80, 120, 160, 240 and 320 cm depth);
- snow layer (height, density, water content);
- atmospheric phenomena.

Meteorological data is processed by „PERSONA MIS" and „PERSONA MIP" software that allow to process information in accordance with the WMO's recommendations and requirements. Climate database is built by using the "CLICOM" climate data processing system.

The National Hydrometeorological Data Fund is systematized and permanently supplemented with hydrometeorological data and scientific research materials in the field.

The basic tasks of the National Hydrometeorological Fund are:

- collect, keep, organize and keeping record of observation and hydrometeorological research materials, including departmental organizations data, both from Moldova and abroad;
- carry out state registration of departmental hydro-meteorological stations and stations;
- develop, based on hydro-meteorological observations data, registers, catalogues, guidelines relevant to the SHS activity.

Data Collection System

The following types of communication are used to collect data from the observation network and receive synoptic information:

- Internet (data from meteorological stations), at 14 out of 18 stations 3G modems ensuring a speed of 4.7 Mb/s are installed;
- Telegraph (data from stations) –"Telex Alpha" telegraph modem and the corresponding software is installed at Telecommunication Centre; this set fully replaces the telegraph and allows to receive the telegram directly to your computer, with subsequent possibility to edit it;
- Telephone (in case of other communication means failure);
- A complex meteorological multi-satellite "MITRA", connected to a satellite communication channel that allows to receive satellite images , maps, data , distributed in the form of meteo-message, and operational information;
- Information from weather radars located in the RM (the radar is located on the territory of Chisinau International Airport) and Romania (complex radar maps within the Doppler radars scheme of the National Meteorological Administration of Romania);
- A direct channel to the Regional Meteorological Centre of the World Meteorological Organization (Moscow), using the designed "UniMas" hardware and software complex intended to perform the message switching function; "UniMas" receives – transmits meteorological data through a direct link channel.

Also, the SHS specialists have designed and developed a website <www.meteo.md>, which contains data about current weather, agro-meteorological, hydro-meteorological and weather forecasts, different maps, satellite images and other meteorological and hydrological information as well as information on environmental quality.

Hydrological Monitoring System

The SHS carries out hydrological monitoring of surface waters. Currently the National Hydrological Monitoring Network (NHMN) of surface water consists of two stations (Ungheni and Dubasari stations) and 54 hydrological posts, 30 in the Dniester River basin, 24 in the Prut River, the Danube and the Black Sea basins. Daily observations on water level, rainfall, water and air temperature, water turbidity, seasonal observations of ice formation phenomena, ice thickness, measurements of water flow, are carried out at hydrological posts. Regional characteristics of the hydrologic regime of water bodies are studied under special programs, zonal factors and economic activity impact is identified, development and spreading of the natural hydrological hazardous phenomena is taken into account for the purpose of insuring national economic organizations. Hydrological data obtained at observation points serve as basis for further data processing and analysis in order to study the occurrence rate of the processes and forecast the environment condition.

In 2006-2008, supported by the Government of the Czech Republic project "Surface Water Monitoring and Flood Prevention in the river Raut" was implemented. Five automatic hydrologic stations were installed under this project. In 2010-2012, with the support of the Government of the Czech Republic 11 automatic hydrologic stations were installed on the river Prut. In 2011, the SHS installed a web server that receives data from automatic hydrologic stations using GPRS and satellite communications. In 2013, the Millennium Challenge Corporation Project "Irrigation Sector Reform" created an automated system of monitoring water resources in Dniester River basin - eight automatic hydrologic stations were installed.

Systematic hydrometeorological observations carried out on the territory of RM over 50-100 years, allowed to summarize hydrologic data and publish it in hydrologic guidebooks and scientific monographs. Hydrological information is shared on a regional level between the Danube river basin (DANUBE-HYCOS) and Black Sea (BLACKSEA-HYCOS) states. Long-term intergovernmental agreements and programs with neighbouring countries, Ukraine and Romania, are of particular importance. Under these agreements and programs hydrologic operational information is shared and the state of water resources of the border Rivers Dniester and Prut is monitored.

Environmental Quality Monitoring System

Environmental Quality Monitoring Department of the SHS carries out systematic ecological monitoring of the environment components quality (surface water, air, soil, sediments, rainfall, ambiental dose rate of γ-radiation etc.) through the monitoring network covering the entire territory of the RM.

The national environmental quality monitoring system was established in the'60 of the XX century and systematic observations started in the '80 of the XX century, now having the following priority objectives: monitoring of the environmental quality and determining the pollution level; detection of extremely high pollution of surface water, air and soil; prevention and mitigation of adverse effects on the environment and population by using emergency warning systems; emergency warning of decision makers about level of environmental pollution; systematic public awareness on the environmental quality.

The results are used in the equivalent information exchange with the neighbouring countries and the member countries of the Danube Convention on Trans-boundary Watercourses Quality, are periodically transmitted to the secretariats of the Stockholm Convention on Persistent Organic Pollutants and the Convention on Long-Range Air Pollution, as a country member of these conventions, for preparation of monthly environmental quality bulletins on cases of high and extremely high pollution of environment components, newsletters and other types of updated information requested by beneficiaries.

Development and management of the database on the state of the environment in RM are needed for the decision-making process and defining the environmental management strategy at all governance levels.

Agro-Climatic Monitoring System

Agro-meteorological monitoring is carried out by SHS. At present, observation of agricultural crops conditions, development and yield formation phases, is carried out at 17 meteorological stations and 20 agro-meteorological posts (Figure 6-4). Observation of complex meteorological elements is carried out at these stations and posts.

In addition, reserves of available soil moisture on land covered by crops are measured during the vegetation period, and temperature at the depth of the twinning node is monitored in winter, and two times in winter - winter crop growth is checked to determine the their viability. To determine the height of the snow layer special measurements are made. The SHS also carries out agro-climatic aridity monitoring. A number of publications that reflect different aspects of combating drought are published with the contribution of the Field Crops Research Institute "Selectia", Institute of Ecology and Geography and Institute of Genetics and Plant Physiology).

Other Types of Monitoring Carried out in the Republic of Moldova

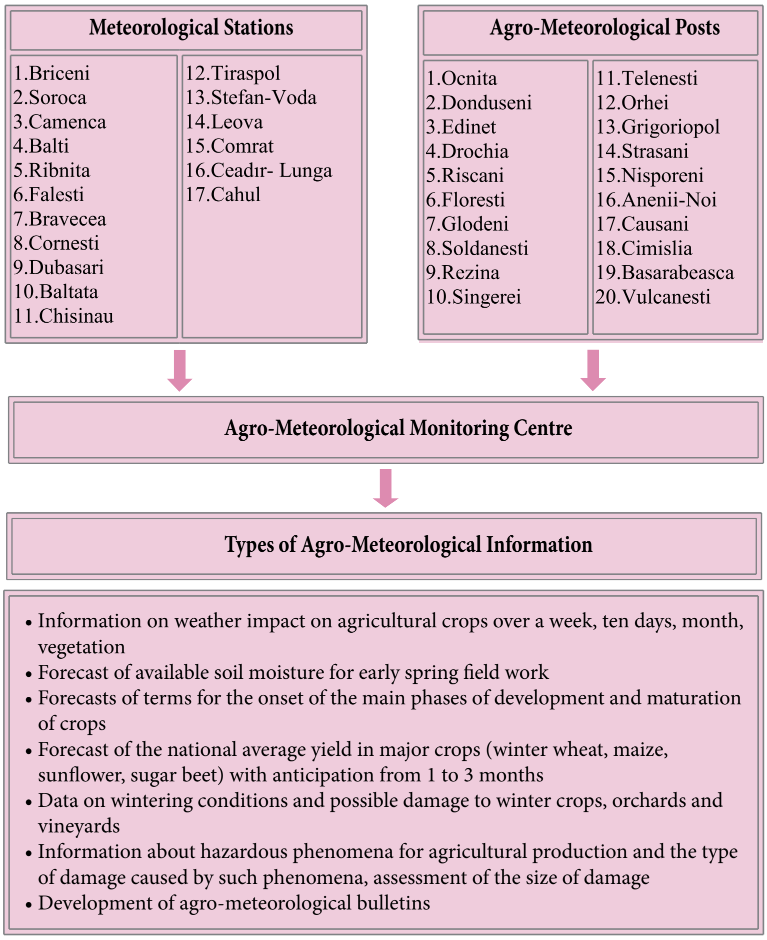


Figure 6-4: Scheme of Agro-Meteorological Monitoring in the RM

Country wide monitoring of ground waters is carried out by the state enterprise "Hydro-Geological Expedition" which subordinates to the Ministry of Environment. Monitoring includes measurement of ground waters level, temperature, and water quality.

Institute of Geology and Seismology of the ASM also implements research projects in geology, and ground water monitoring component is present in some of them. Ground water monitoring results are published in the annual scientific bulletins, in which the analysis of information on changing the ground waters level and quality as a result of human activities and natural processes, is provided. The results of ground water quality monitoring are also transmitted to the State Geological Fund.

A national forest monitoring network of the Republic of Moldova was created within "Moldsilva" Agency.

The Institute of Pedology, Agrochemistry and Soil Protection "N. Dimo" deals with research into soil genesis, geographical distribution of soils, soil classification across the country, development of soil mapping and land value assessment methods, development of soils monitoring and inventory database, as well as research of soil erosion processes, development of erosion control technologies to reduce the degree of soil degradation, and other environmental aspects.

The National Scientific and Practice Centre for Preventive Medicine of the Ministry of Health is in charge of monitoring drinking water quality and air quality in the sanitary areas of settlements in the Republic of Moldova.

"Apele Moldovei" (Moldavian Waters) Agency collects and process statistical data on water use.

The Ministry of Health monitors air quality in urban areas. Measurements of maximum admissible concentrations in the air by six key parameters are made on a monthly basis. Several institutes of the Academy of Sciences (e.g., Institute of Zoology, Botanical Garden (Institute), Institute of Genetics and Plant Physiology), the State University of Moldova and the Moldova State Agrarian University, study the flora and fauna of the country at species level.

6.2.3. Research Activities

Systematic hydrometeorological observations made in the RM over the past 60-110 years, allowed to summarize the climate data, to publish it as climate and agro-climatic guidebooks, monographs, such as "Climate of the Moldavian Soviet Socialist Republic", "Climate of Chisinau Municipality", "Agro-Climatic Resources of the Moldavian Soviet Socialist Republic", "Agro-Climatic Guidelines for the Moldavian Soviet Socialist Republic", "Natural Meteorological Phenomena in Ukraine and Moldova" and other information which is used for planning and controlling harmful effects of dangerous natural phenomena, and environmental protection.

In climate research, special attention is paid to the study of complex adverse weather conditions. This is needed to successfully combat the negative effects of adverse weather conditions, identify solutions to environmental issues, and sustainable management of the environment.

The features of the adverse weather conditions vary depending on the objects which are affected by climate conditions. For example, agriculture is affected by frosts, droughts, hot winds, dust storms, the transport sector – heavy rains, sleet, slush, the constructions sector – by extremes temperatures, strong wind, heavy snowfalls and ice, etc.

The results of hydrologic observations are published in: "Annual data on the regime and surface water resources", "State Water Cadastre of the Republic of Moldova", "Multi-Annual Characteristics Guide", etc.

Scientific research is also conducted in the framework of regional hydrometeorological programs. Based on regional climate monitoring research is carried out focused on the natural and anthropogenic influence on the climate of RM. Such research fosters climate change forecasts for the country; make it possible to calculate changes in the basic features of air temperature and precipitations. Risks and vulnerability for agricultural industries, in the context of climate change, are assessed, and adaptation measures for agriculture are identified.

It should be noted, that Researches Centre and GIS (RCGIS) of SHS conducts research in hydrometeorology and environmental quality monitoring, including to ensure the methodological and scientific support to the SHS subdivisions. The staffs of the Centre process and interpret meteorological, hydrological and environment quality monitoring related information, inclusively by using geographic information systems.

The RCGIS focuses on:

- development of scientific materials and methodologies in the SHS areas of activity;
- development of scientific publications in the SHS areas of activity;
- keeping record of new scientific and practical achievements in GIS;
- mapping materials for forecasts development, analysis of certain hydro-meteorological actions or factors;
- mapping materials for SHS web page;
- digital land use maps, updated on the basis of satellite images;
- spatial maps and different thematic maps;
- thematically dedicated GIS data bases;

- GIS info-planes derived products (surfaces of basins and sub-basins, median altitude of sub-basins, afforestated areas, afforestation coefficient, etc.);
- altimetric digital model of land and derived products (slopes, expositions, altitudinal levels, topographic profiles etc.);
- floods, droughts hazard and risk maps, etc.;
- flood risk model in major large and small riverbeds;
- maps with delimitated areas affected by floods, droughts;
- estimates of water reserves in snow layers, volumetrically expressed as median water layer for basins of interest in terms of hydraulic energy and water supply;
- agro-meteorological and biophysics parameters of vegetal coverage derived from satellite date (soil surface temperature, actual evaporation, foliar index, biomass, spatial structure, vegetation indices, etc.);
- accidental pollution risk modelling in major riverbeds of large rivers;
- methodology guidance for use of GIS technologies in the spatial analysis of hidrometeorological phenomena and processes and their forecasts.

Climate change modelling relevant for the territory of the country is carried out by the Climate Change Office of the Ministry of Environment. Other institutions involved in climate research, including modelling of future climate events, are the SHS and the Institute of Ecology and Geography of the ASM. Researches with reference to the influence of climate change on different sectors of the national economy are made periodically by Climate Change Office of the Ministry of Environment and other organizations, like: Institute of Plant Protection and Ecological Agriculture, Institute of Genetics and Plant Physiology, Field Crops Research Institute "Selectia", Institute of Pedology, Agrochemistry and Soil Protection "Nicolae Dimo", "Moldsilva" Agency, etc. To be noted, that by the end of 2013 year the Institute of Ecology and Geography of the ASM will published the "Atlas of Climatic Resources of the Republic of Moldova" developed based on Geographical Information Systems (GIS) technologies.

6.2.4. International Cooperation

International cooperation is essential for the development of meteorology, hydrology and environmental quality monitoring. It is impossible to carry out activities in these fields without international exchange of hydro-meteorological data and products, as well as information on environmental quality. In order to integrate the principles of sustainable development into government policies and programs, RM has increased efforts to implement the international conventions to which it is a part.

In its turn, the SHS gears its international activities towards the following directions:

- Participation in UN specialized agencies: World Meteorological Organization (WMO), UN Convention to Combat Desertification, the Convention on the Transboundary Effects of Industrial Accidents of the United Nations Economic Commission for Europe;
- Partnership in the Commonwealth of Independent States (CIS);
- Achieving bilateral agreements with other national meteorological hydrological and environment quality monitoring services;
- Participation in scientific programs under international conventions and projects.

Collaboration with state hydrometeorological services takes place in the framework of bilateral agreements. Relationships with hydrometeorological services of the neighbouring countries become more intense. Intergovernmental long-term cooperation programs with Ukraine and Romania are of special importance collaboration strengthening. These agreements and programs foster operational hydrometeorological information exchange, monitoring of the water resources of the state border rivers Dniester and Prut.

During the period 2006-2013, in collaboration with international partners, the SHS implemented the following projects:

- „Surface Water Monitoring and Flood Prevention in the River Raut Basin" Project (2006-2008) (supported by the Government of Czech Republic);
- „Surface Water Monitoring and Flood Prevention in the River Prut Basin" Project (2010-2012) (supported by the Government of Czech Republic);
- EUMETSAT Project „Data Access for Western Balkan and Eastern European Countries (DAWBEE)" (2010);
- World Bank Project „Disaster and Climate Risk Management" (2010-2013).

International cooperation is an important component of hydrometeorological operating in the SHS. International cooperation in hydrometeorology is based on conventions and agreements to which the Republic of Moldova is a part.

According to the Parliament Decision No. 210-XIII of 29 July 1994, RM joined the World Meteorological Organization (WMO) and is represented in this organization by the SHS Director. The SHS specialists participate in the programs and projects of the CIS Interstate Council for Hydrometeorology under the Agreement on cooperation in hydrometeorology, signed by RM on 8 February 1992, as well as in other international programs (such as the UN Framework Convention on Climate Change, United Nations Convention to Combat Desertification, Convention on Cooperation for the Protection and Sustainable Use of the

Danube River, Convention on Long Range Transboundary Air Pollution).

SHS is actively involved in implementation of the World Climate Programme, the World Programme of climate applications and services, hydrology and water resources program, which are organized in the framework of the World Meteorological Organization (MO) and Intergovernmental Panel on Climate Change (IPCC).

6.3. Education, Training and Raising the Public Awareness

6.3.1. Ecologic Education of Population

The objectives of ecologic education are similar in most countries and focused on informing and enhancing the population's knowledge about the environment, the need to improve the quality of the environment, and on identifying ways to prevent environmental problems. People are informed about global warming, environment pollution, about how the planet "works" as an integral system, about the consequences of environmental degradation, and, accordingly they learn about the role of the humanity in generating environmental problems, in solving and preventing them.

At the same time, ecologic education contributes to a better realization by the population of the environmental problems and to establishing a personal value system; as impact, citizens are assisted in clarifying their attitude in environment protection issues and how they can personally contribute to solving them.

The ecologic education has practical aspects, in the sense of teaching simple but efficient things in solving environmental problems, such as how to plant a tree, reduce the consumption of energy, water and other material resources, recycle wastes and others, that in the end would contribute to reducing the negative impact on the environment. Also, the ecologic education stresses the abilities of acting as a citizen - from effective communication with the public institutions responsible for environmental management to influencing the local and central public administrations.

The problems related to the climate changes represent an increasing topical global challenge that requires stringent solutions both globally and locally. The climate change already has a tangible negative impact on the humanity, being asserted through a high frequency of extreme climate phenomena, higher temperatures, increased levels of the oceans and floods, increased dryness and emphasized desertification, etc.

In the context of the increasing number of the planet's population and, respectively, of the consumption of material goods, the humanity contributes to amplifying this phenomenon and its negative impact on the planet. The climate change affects both the developed and developing countries, and the latter find it increasingly harder to cope with such challenges. The said problems place the humanity before the dilemma of finding a compromise between economic development, enhanced welfare of the population, and the effects of extensive development on the "climate change" phenomenon. An efficient tool in improving this situation could be strengthening the national policies on information, raising the awareness, and training the population in such issues as environmental protection, combating climate change, and creating new sustainable environment-friendly development opportunities.

Although RM takes measures to improve its legal and regulatory frameworks on the conservation and reasonable use of natural resources, enhancing energy resources, using innovative environment management methods, projects for mitigating and adapting to new environmental conditions are being implemented, public awareness-raising and training activities remain among the primary ones that can essentially contribute to improving the situation in the future.

Education System

The Moldovan education system is based on the principle of fair education for everyone, which is set out in the Law on Education No.547 of 21 July 1995. The national and sector policies in education are reflected in the Moldovan Government Activity Program "European Integration: Freedom, Democracy, Welfare" (2011-2014) (Chapter "Education and Research); Strengthened Education Development Strategy for 2011-2015, approved by Order of the Minister of Education No. 849 of 29 Nov 2010; Vocational/Technical Education Strategy for 2013-2020 and the Action Plan for implementing the Strategy, approved by the Government Decision No.97 of 1 Feb 2013; and the Inclusive Education Development Program in Moldova for 2011-2020, approved by Government Decision No.523 of 11 July 2011, as well as the draft Sector Development Strategy for 2014-2020 "Education 2020" (as from 13 September 2013 in public consultation process).

The Moldovan education system includes several stages, among which preschool education, primary education, gymnasium education, lyceum education, vocational education, pre-university and university education (Figure 6-5)[256].

Preschool Education

The preschool education is the first level of the education and training system and includes children aged 3-7. It aims at preparing multilaterally the children for life and their subsequent enrolment in school. In this period of life children are acquainted with the concept of "environment". In this process children get acquainted and learn to use ele-

[256] <http://edu.gov.md/ro/structura-sist-invatamint/>.

Education System in the Republic of Moldova

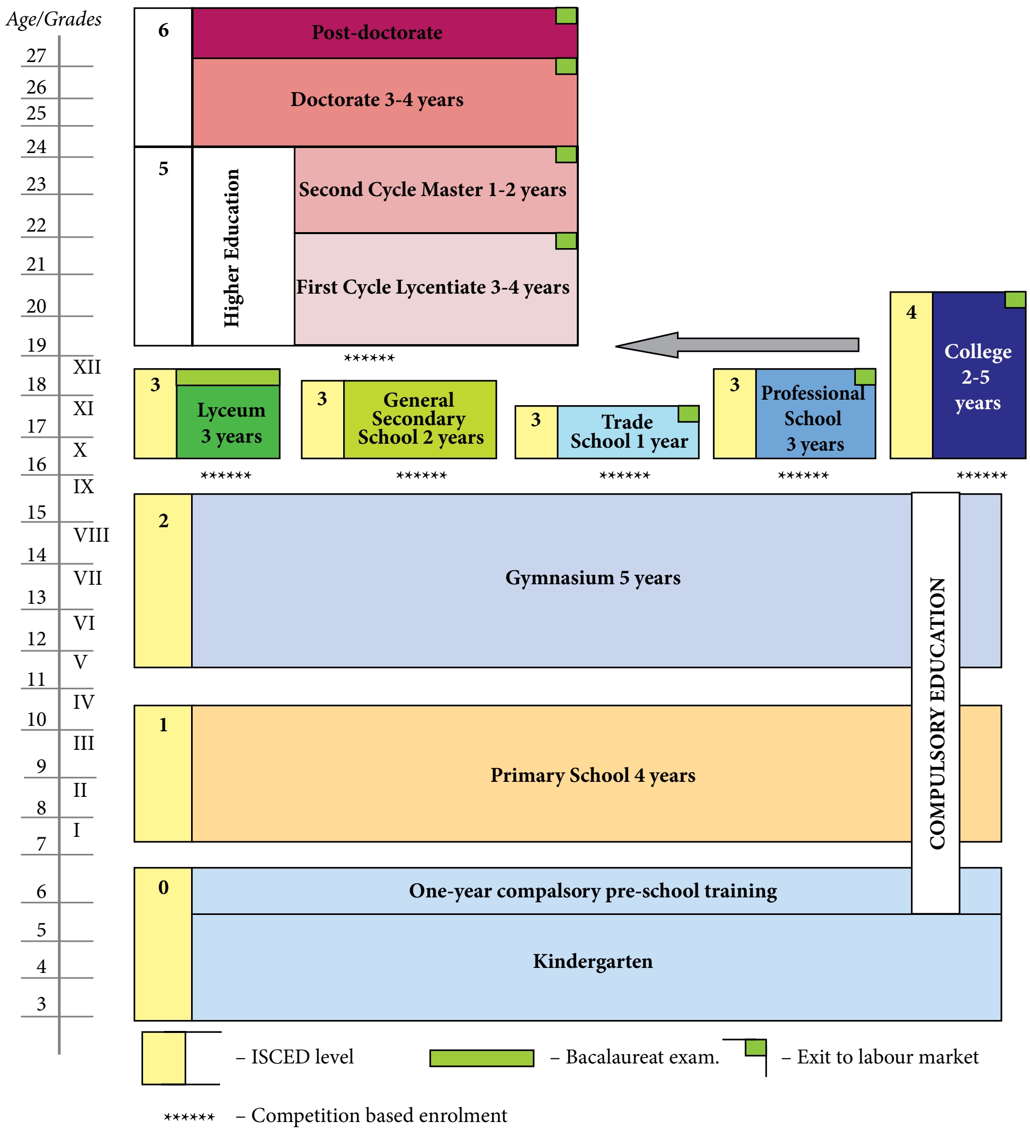


Figure 6-5: Education System in the Republic of Moldova

mentary concepts about their own body, nature and the surroundings.

Primary and Secondary Education

The education process is based on the framework syllabus, a normative document that regulates the organization of the education process, especially in primary, gymnasium and lyceum education.

According to the 2013-2013 syllabus, the framework syllabus for grades 1-9 (primary and gymnasium stages), stipulates the following:

- teaching of *Sciences* to students of grades 2-5 (1 hour per week);
- teaching of *Biology* to students of grade 6 (1 hour per week) and to students of grades 7-9 (2 hours per week).

The biology curriculum for grades 6-9 has one of its main objectives to create beneficial convictions and attitudes in students to their own health and environmental protection. The curriculum contains the topic of environmental protection that teaches (in grade 9) subjects related to human influence on biodiversity and the impact of human action on one's own existence. In this subject, children are taught how to develop recommendations/measures to prevent reduction of the ozone layer, acid rains, and global warming. The syllabus also contains optional courses for grades 1-9, which include the subject of *ecologic education.*

As to the framework syllabus for *lyceum* education (grades 10-12), the subject of *biology*, humanitarian profile, is taught 1 hour per week for grades 10-12; grade 10 - 2 hours per week; grades 11-12 - 3 hours per week.

According to the lyceum *biology* curriculum for grades 10-12 (part of the topical block *math and sciences*), *ecology and environmental protection* is taught only in grade 12 (real sciences profile - 18 hours; humanitarian profile - 6 hours).

In addition to the required courses, the lyceum cycle also includes optional classes in *environment*, with 0-1 hours for grades 10-12, humanitarian profile, and 0-2 hours for grades 10-12, real sciences profile.

The optional subjects focus on forming in students competences that cannot be formed only through one subject. They are meant to contribute to enhancing and deepening the students' knowledge within the scope of the school program but also to their professional orientation. These courses can be offered upon request taking into account the human and financial resources, and the efficiency of the previously taught courses.

As compared to 1990, when school programs and textbooks remained the same for tens of years, at present we find that the education in RM has undergone positive changes and the curriculum is modernized every 5 to 7 years. The textbook content has been revised and completed with information that takes into account the formation of the student's personality but also the mission of chemistry in daily life, in environmental protection and in solving the country's social problems etc.

For example, according to the 2011 syllabus, the chemistry textbook for grade 7 includes such topics as the action of substances on people and the environment, the composition of natural water, conditions and substances polluting the environment, cleaning methods, etc. The purpose of these changes is to make students know and understand not only how chemistry offers solutions to modern problems and how to improve the quality of life but also how they can get involved protecting the waters, soil and air that are or can be polluted as a result of using chemical substances.

Such a change in the school syllabus takes place for the gymnasium and lyceum program. In grade 12, for example, students learn about the contribution of chemistry to producing ecologic materials, food and cosmetic products, or pharmaceutical preparations etc.

Vocational Secondary Education

The vocational secondary education is integral part of the national educational system and is focused on training and developing skills, competences and professional aptitudes that are specific to training qualified workers for the national economic branches in RM. The vocational secondary education ensures learning an occupation (profession) and improving/retraining qualified workers and laid-off workers.

The objectives of vocational secondary education provide for the interaction of the qualified worker with the economic environment. At present in RM there are 67 units of secondary vocational education open, including: 49 vocational schools; 21 occupation schools and 2 vocational lyceums.

In the school year 2012/2013, the vocational secondary education institutions had 19.6 thousand students enrolled. At such institutions the students are trained in the areas of agriculture, forestry, horticulture, etc. As part of such professions, the students also acquire ecology-related knowledge. Ecologic education is taught in general culture subjects as part of biology modules ("Ecology and Environment Protection"), chemistry ("Solving ecologic problems based on chemical knowledge"), geography ("Environmental geography") and physics ("Thermal devices and pollution", "Biological effect of radiations, protection against radiations").

Every year, in April, vocational secondary schools organize conferences on environmental topics (Human excesses as related to the nature; Excessive hunting and poaching; Waste piling and land and water residues). There is organized a by-monthly ecologic event "One tree for our perpetuation", cleaning works, round tables, essay contests, etc.

Specialized Secondary Education

RM conducts professional training of specialists having an average level of qualification in 47 colleges that, in the school year 2012/2013, had 30.7 thousand students enrolled. The *Ecologic College* is the specialized secondary education institution that trains specialists in ecology, according to the following majors: 2701 Ecology and environmental protection; 2806 Forestry and public gardens; and 2506 Water management and protection. For pedagogical colleges, the framework syllabus provides course units/modules in the area of ecology for the future specialists in the following majors: 1203 Primary education pedagogy; 1202 Preschool pedagogy; 1404 Musical training; 1301 Physical education and sports. The course units/optional modules in ecology contain syllabuses for a number of majors, including: 2551 Cadastre and territorial organization; 2512 Anti-fire protection; 2301 Design and technology of fabric manufacturing; 2304 Design and textile technology; 2052 Railway transportation; 2051 Ground transportation; 2902 Tourism, and 2901 Hotel services.

As part of extra-curricular activities, ecologic education takes different forms: monthly ecology-related events; specialized teacher classes; trainings; debates; conferences; essay and poem contests; round tables, etc.

Higher Education

There are 34 higher education institutions in RM, including 19 state institutions (of which two provide only master programs) and 15 – private institutions. At these institutions, students acquire knowledge in chemistry, biology, soil science, environmental protection, hydrology, agriculture, forestry, plant protection, agricultural biotechnology, geography, meteorology, geology, environmental legislation, water management and protection, environment engineering and protection, etc.

In accordance with the Law on Approving the Classifier of Professional Training Areas and Majors for Training in Higher Education Institutions, Cycle I – bachelor higher education, initial training in ecology takes places both in public and private institutions, in several areas, including as part of general educational areas 42 "Natural sciences," 61 "Agricultural sciences," and 85 "Environmental protection."

At present, initial training through bachelor higher education takes place in the following areas of professional training:

- 424 "Ecology" – Moldova State University, Tiraspol State University, "Alecu Russo" State University in Bălţi, Moldova Free International University, Moldova State Agricultural University, University of the Moldavian Academy of Sciences;
- 612 "Plant protection" – Comrat State University, Moldova State Agricultural University;
- 851 "Environmental protection" – Moldova State University.

Starting with the school year 2011/12, education is provided for the major:

- 852.1 "Ecological security"

The course units/modules in the area of ecology contain syllabuses for a number of majors, including:

- 423.1 "Geology" – Moldova State University;
- 425.1 „Geography" – Moldova State University, Tiraspol State University, University of the Moldavian Academy of Sciences;
- 426.1 "Meteorology" – Moldova State University;
- 613.1 "Agriculture" – "Alecu Russo" State University in Bălţi, Comrat State University, Moldova State Agricultural University.

Starting with 2008, in the context of the national reforms for implementing the objectives of the Bologna process, enrolment has been done for cycle II - higher master level education. In view of completing the university training, higher education institutions have developed master programs, focused on deepening the bachelor higher education. At present, the following master programs with an ecologic profile, authorized by the Ministry of Education, are being implemented: *Ecology and Environmental Protection* (Moldova State University); *Biodiversity and Protection of Natural Resources* (Moldova State University); *Environmental Sciences* (Moldova State University); *Meteorological Studies and Analyses* (Moldova State University); *Ecologic Chemistry and Environmental Protection* (Moldova State University); *Ecological Chemistry* (Tiraspol State University); *Agrarian Ecology* (Comrat State University); *Environmental Geography* (Tiraspol State University); *Agro-ecology* (Moldova State Agricultural University); *Ecology, Environmental Protection and Ecological Security* (Moldova Free International University).

Since 2008, ecology and environmental protection specialists have been trained at the University of the Moldavian Academy of Sciences. The educational offer of the University of the Moldavian Academy of Sciences for the Bachelor Level includes two majors – Ecology and Geography. The syllabuses (bachelor level) include both fundamental and specialized subjects (general ecology; environmental pollution and protection; environmental engineering; natural hazards; ecologic audit; environmental monitoring; environmental economy; waste management; estimation of chemical hazards; biological security etc.) that contribute to training students into becoming specialists. Over 30% of the subjects offered to the students are optional and thus they have the possibility to choose and create their individual professional training path. An important role in environmental training and education is played by the three types of internship (initiation; specialized; bachelor) set out in the syllabuses. The experience acquired enables them to establish well-determined objectives focused on modern environment-related issues; develop tasks and ways to execute them, the necessary investigation methods and their socio-economic impact. The specialized master research program implies deepening the theoretical knowledge in Environmental Sciences, the basics of which had been acquired in Cycle I; a detailed study of environmental management and monitoring issues and sustainable development, as well as of modern study techniques – Geographic Information Systems (GIS), Ecosystem Mathematical Modeling etc. For complex research at the master level, the program includes the following basic subjects: Theory of environmental sciences; Methods of Research and Analyses in Environmental Sciences; Environmental Changes; Environmental Management and Sustainable Development - all meant to form instrumental competences in the master graduates. Also, the syllabuses offer to the students' optional courses (Water Quality Management; Soil Quality Management; Food Quality Management etc.) that also contribute to ensuring good professional training of future specialists.

The Moldova State Agricultural University (MSAU) pays special attention to general ecologic education and special training according to major curricula, at bachelor, master and doctoral levels. The MSAU teaches subjects with advanced ecologic character in all majors: 613.1 – Agronomy; 611.1 – Selection and Genetics of Agricultural Crops; 424.1 – Ecology; 612.1 – Plant Protection; 615.1 – Horticulture; 616.1 – Forestry and Public Gardens; 616.1 – Wine-growing and Production; 614.1 – Livestock Production; 618.1 – Agricultural Biotechnologies; 524.2 – Agriculture Electrification; 528.1 – Agriculture Mechanization; 583.1 – Environmental

Engineering; 584.1 – Cadastre and Territorial Organization; 584.3 – Real Estate Appraisal; 381.1 – Law; 812.2 – Tourism; 641.1 – Veterinary Medicine. Students at 424.1 – Ecology, with major in agro-ecology, acquire knowledge in natural sciences, with in-depth studies in rural environmental protection, ecologic agriculture, ecologic mapping; protection of environmental factors in applying phytotechnical, horticultural, livestock production technologies, ecologic and integrated monitoring in agricultural activities in view of securing the quality of environmental factors and agricultural production, practicing ecologic agriculture, ecologic monitoring and inspection of rural spaces, sustainable management of natural resources, and others.

Post-University Education

The post-doctoral program is a form of deepening the theoretical knowledge and scientific research for persons holding the scientific level of doctor and a manner of preparing the habilitated doctoral thesis, and is organized for a timeframe of up to two years. Post-doctoral programs can enroll persons having the scientific level of doctor, who have scientific works (licenses) containing pioneering results for the science and practice – solutions, facts, generalizations, conclusions generating new directions, value implementations - performed after presenting the doctoral thesis (different and at a higher level), and that represent at least two-thirds of the results that can serve as basis for a habilitated doctoral thesis. The decision for admission to the post-doctoral program is made by the senate of the line university, with the subsequent approval of the National Council for Accreditation and Certification.

6.3.2. Ecologic Training

In the context of improving education and ecologic training of the population, the Ministry of Environment undertakes various actions. For example, every year it organizes the "Ecologic Hour", which is teaching material developed for pre-university education institutions. Each year this initiative reveals a certain environmental topic – biodiversity, water protection, climate changes, waste management, access to environmental information etc.

The Ministry of Environment organizes various ecologic contests on various environmental topics, e.g., in April-May 2012 it launched the photo and drawing contest "Environment and Sustainable Development." This contest was started in the context of the UN Conference on Sustainable Development RIO+20 that was held in the period from 15 to 22 June 2012. Students of various pre-university institutions participated in the drawing context, while the photo contest was open to everyone. The contest results have been exhibited in the Ministry's building.

At the same time, the Ministry of Environment has financially supported the publishing of a number of textbook with an ecologic content, a total of 17 book titles, each having been published in about 1500 copies. The books have been distributed to education institutions throughout the country. This activity has been organized jointly with the Moldovan Ministry of Education. The book titles have a scientific and popularization character, and are meant for school and university students, teachers as well as to the public at large interested in environmental protection. These books aim at deepening and integrating the knowledge in sciences, biology, geography and ecology, and also at achieving inter-disciplinary objectives.

Every year, the Ministry of Environment organizes activities related to the celebration of international environmental days, such as:

1. International Biodiversity Day – 22 May;
2. Environment Day – 5 June;
3. World Day of Humid Zones - 2 February;
4. International Water Day - 22 March;
5. World Meteorology Day – 23 March;
6. International Day of Pro-Climate Actions – 15 May;
7. World Day of Combating Desertification and Draughts – 17 June;
8. Danube Day – 29 June;
9. International Day of Ozone Layer Protection – 16 September;
10. World Day for Reducing Natural Disasters – 8 October, etc.

In this context, the Ministry's specialists organize and participate in seminars, round tables, radio and TV programs, public debates etc. that are attended by the public at large.

Also, different projects are being implemented under the aegis of the Ministry of Environment, which aim at improving the situation of environmental components, improving the environmental legislation, and educating the population in environmental issues.

For example, as part of the UNDP-GEF Project "Strengthening the Institutional Capacities and Representation of the Protected Area System in Moldova" (one of the project's major objectives is to create the Orhei National Park) in 2012 there were organized a number of activities to train and inform the population about the importance of conserving biological diversity. There were organized 26 information seminars, with the participation of representatives of the Ministry of the Environment and other relevant public institutions, about the creation of the Orhei National Park, which was attended by representatives of the forestry authorities to be involved in the future National Park; 22 seminars for the students of Orhei district schools; 3 information seminars for the population of the villages of Tabăra, Vatici and Codreanca. Also under the project there were published two informative posters for mayor's offices and schools on the topic "Natural Values of the Orhei National Park"; the brochures "15 Questions about the Orhei National Park"; "Natural Values of the Orhei National Park"; the calendar Orhei National Park; "Development of Ecologic Agriculture in the Orhei National Park"; feature stories in the magazine "Natura", and a set of 500 hats and T-shirts with the logo of the Orhei National Park.

The Ministry of Environment also organizes other actions aimed at informing the population about the importance of environmental protection, such as:

- *European Mobility Week, entitled "Clean Air For Everyone",* action organized every year that aims at bringing in spotlight air pollution, especially from the ground transportation. The main goal of this action is to sensitize local public authorities and the population about certain aspects of air pollution with noxious substances, which has reached critical levels in the past years and has severe economic, social and ecologic consequences. As part of this actions are also tackled the issues of climate change in the context of reducing GHG emissions from the broad use of fossil fuels and combustibles.
- *Global Action "Earth Hour"* – this is a global event during which millions of people on the globe simultaneously disconnect the electricity for 1 hour. The purpose of this action is to stimulate the interest in saving the natural resources and preventing climate change. This action is organized every year and involves business operators, environmental NGOs, and the interested population. In 2013 the event included a number of actions aimed to draw public attention to environmental issues and the importance of solving them. In view of sensitizing and enhancing the level of awareness of the population, there were broadcast films on the following topics: climate change, sustainable development in market economy conditions, protection of the ozone layer, combating desertification and prevention of aqua resources pollution. In parallel to the broadcasting the documentary films there was organized a traditional asphalt drawing contest for children and school students "*Smile - the Planet Loves You*".
- *Action "A Tree for Our Perpetuation"* - is a national action that provides, alongside the proper planting of trees and bushes, recovery of green spaces, arrangement and cleaning of communities, cleaning and recovery of river protection strips.

To note that business operators have had an increasingly broad involvement in such actions. For example, in 2009, the foreign capitals company "RED UNION FENOSA" S.A. launched the project "Energy Efficiency." The goal of the project was to promote energy efficiency culture, stimulate and encourage company's clients to use the electric energy in a responsible and efficient manner. The project aimed to stimulate the clients to reasonably use the energy, reduce the negative impact of energy systems on the environment, identify new directions for the development of energy efficiency programs and of the necessary framework for developing coordination and cooperation actions, increasing the level of energy security and encouraging cooperation in the energy efficiency area. The results of one of the projects are detailed below:

2010:

- Launching the project on company's official website – <www.gasnaturalfenosa.md> with its detailed presentation;
- Implementation the "energy efficiency calculator," where each website visitor has the possibility to simulate the amount of energy he or she can save by using energy efficient bulbs or equipment;
- Internal campaign for promoting the project for the company's staff;
- Drawing contest "Energy Efficiency in my Family" held within the company;
- Promoting the "Energy Efficiency" Project as a result of a cooperation agreement between "RED UNION FENOSA" S.A. and Moldova Technical University.

2011:

- Presentations, seminars, public debates, press conferences organized on the subject of energy efficiency;
- Mini-guide for children "*You can change something in the world. Use energy efficiently and give a chance to the planet*" developed;
- Presentations and seminars for school children on the topic "*Energy Efficiency*" organized in schools and lyceums throughout the country;
- "*Energy and Environment*" contest held in cooperation with the Republican Center for Children and Youth "GUTTA-CLUB" in the area of energy efficiency and environmental protection;
- Participation in the seminar "*Renewable Energy and the Planet's Future*" and public debates on the topic "*Moldova remains behind European and neighboring countries about energy efficiency and energy saving - how can we improve the situation and which is the role of the civil society in this process?*";
- Inside lighting (in several schools) and external lighting (for the LUMTEH Municipal Company) enhancement projects developed in cooperation with the students of Moldova Technical University;
- Technical-economic calculation for streamlining the use of electric energy for the company "Apă-Canal Chişinău" conducted;

- Feasibility study at “Carmez” S.A. on the use of energy efficiency methods in the production process conducted;
- Campaign “*Why Energy Efficiency Investments Are Necessary?*” – Brochures distributed to the clients of “RED UNION FENOSA” S.A. with the largest electric energy consumption.

2012:

In 2012 there were carried out activities for implementing energy efficiency services and techniques focused on stimulating consumers to a more efficient and responsible energy consumption.

- *Energy audit* – detailed analysis of the total use of electric energy for a determined period of time for a building, group of buildings or industrial installations and implementing cost-effective strategies aimed at energy saving and environmental protection.

Since the launching of the project, “Gas Natural Fenosa” has actively cooperated during these years with the Republican Center for Children and Youth “Gutta Club” and with Moldova Technical University in view of developing and promoting the Energy Efficiency Project. There were trained over 3,500 children of 75 schools from the center and south of the country.

At the same time, “Gas Natural Fenosa” takes a number of actions aimed at preventing environmental pollution, informing the population about the importance of reasonable use of natural resources and energy, which can be found on the company’s website (<http://gasnaturalfenosa.md>) such as the environmental protection campaign “*GO Green*”; “*A Tree For Our Perpetuation*”; “*A Tree for the Youth*”; organization of fairytale contest on the topic of resource conservation; Earth Hour, etc.

To note that for the first time in RM there was created a web platform for reporting community problems <www.alerte.md>. The purpose of this project is to identify and solve a number of social problems by having them marked on the map by the citizens. All the problems reported on the site later reach the Chișinău Mayor’s Office and the responsible persons deal with them. The special interest in the above-said platform is represented by the columns: “Green Spaces” and “Household Waste,” that are directly related to the environment and give the possibility to the Chisinau residents to participate actively in identifying and solving environmental problems; as a result, awareness-raising is efficient because it reaches each individual. The web platform works using the Ushahidi technology, which is software created for collecting information, viewing and interactive mapping.

In the context of the above-said it is clear that RM takes considerable measures to educate and inform the population about the climate changes. Nonetheless, taking into account that the most significant impact of the climate changes is to be felt in the future, it is important to further support the education, training and informing of the population. In order to cope with the environmental changes resulted from the climate changes, future generations will have to be prepared and armed with knowledge to understand the situation and take actions to remedy them. In this connection, in the period from 20 May–25 June 2013, the Climate Change Office of the Ministry of Environment organized the national competition *“Act on the CO_2”* in which there participated 16 youth initiatives (Table 6-5), civic associations and local

Table 6-5: List of projects selected for the national competition “Act on CO_2” implemented in Moldova in the period from 20 May to 25 June 2013

No	Name of Project	Organization	Project coordinator
1.	“Act on the CO_2 and Radio Moldova gives you a prize”	National Public Broadcaster «Teleradio - Moldova”, Radio Moldova	Cristina Jandîc, Chişinău
2.	«IJC Motivates, Take the Eco Style!”	Civic Association «Young Journalists Center of Moldova”	Cristina Straton, Chişinău
3.	«Eco-Graffiti”	Individual initiative, Children and Youth Center «Gutta Club”	Elisabeta Guţu, Chişinău
4.	«Flowers speak more in the interest of our health”	Local Youth Council, village of Ustia, district of Dubăsari	Elena Ipati, Village of Ustia, Dubăsari
5.	«New life for the spring ‘Bujerăuca’ ”	Individual initiative	Cristina Carauș, Town of Soroca, Soroca
6.	«A vacation day - for a cleaner world!”	Child Placement Center «Regina Pacis»	Inga Platon, Chişinău
7.	«Save Yourself” – video production	Initiative group TânărFilms	Adrian Pleşca, Chişinău
8.	«We Think Globally - We Act Locally»	Civic Association «Ştrengărel»	Natalia Lubaş-Verdeş, village of Izbişte, Criuleni
9.	“ActivEco - sustainability in action“	Civic Association «EcoVision“	Liana Cernov, Chişinău
10.	«Biogas - energy independence”	Individual initiative	Prisăcaru Dorin, village of Chișcăreni, Sângerei
11.	«The eye forgets, the lens remembers”	Individual initiative	Irina Iacoban, town of Cimișlia, Cimișlia
12.	“EcoDebate: we debate locally, we act globally on CO_2”	Chişinău General Department for Education, Youth and Sports	Valentina Sandu, Chişinău
13.	«Children’s garden»	Civic Association «Viitorul»	Irina Tertea, village of Ciocilteni, Orhei
14.	«Together for a clean environment”	Civic Association „Caroma Nord”	Rodica Frecauţeanu, village of Pârliţa, Fălești
15.	«Material recycled: carbon amount reduced”	Initiative group „Port Mărţişor”	Zasaviţchi Aneta, Chişinău
16.	“Level of CO_2 depends on us”	Initiative group «Wave Week Moldova»	Vlad Șeremet, Chişinău

public authorities, selected in a rigorous process, to which 33 projects applied[257].

The purpose of the contest was:

- Raise the awareness of the youth and have them protect the environment in the context of the climate change phenomenon;
- Undertake responsibility and develop skills of reducing GHG emissions and mitigating climate changes;
- Identify solutions for solving environmental problems in the climate change context at local and national levels.

The prize award fund of the national competition *"Act on the CO_2"* was as follows:

- First prize and the title *National Champion of the Competition "Act on the CO_2"* – **3000 MDL**, *"Together, for a clean environment"*, coordinator: Rodica Frecauţeanu, CAROMA Nord, Bălţi;
- Second prize – **2000 MDL**, *"A vacation day for a cleaner world"*, coordinator: Inga Platon, Regina PACIS Foundation, Chişinău;
- Third prize – **1000 MDL,** *"The eye forgets, the lens remembers"*, coordinator: Iacoban Irina, town of Cimişlia, Cimişlia;
- Special prizes – **500 MDL** each:

[257] Additional information about the contest can be found on the website www.clima.md, and for media content: photo and video, Facebook page: <https://www.facebook.com/actonco2moldova>.

- "Best rural project" – *"Think globally, act locally"*, coordinator: Natalia Lubaş-Verdeş, village of Izbişte, district of Criuleni; and
- "*Discovery of the competition*" – "*Flowers speak more in the interest of our health*", coordinator: Elena Ipati, village of Ustia, district of Dubăsari.

6.3.3. Raising Public Awareness

Public informing and awareness raising about environmental issues takes place continuously through the media, radio and TV programs, seminars and topical trainings organized in this connection, public debates, flash mobs as well as environmental campaigns, implemented together with the community partners and central and local authorities, own electronic information tools (<www.mediu.gov.md> and <www.clima.md>), as well as of environmental NGOs (Ecologic Movement of Moldova, REC Moldova, Eco-Tiras, Bios, Biotica, Eco-Terra, Ecotox, Gutta Club, Cutezătorul, Environment and Health, Ormax, etc.). This process is coordinated by the Ministry of Environment, institutions subordinated to the Ministry, and environmental NGOs.

In view of informing the population about the activities carried out, the Ministry of Environment periodically publishes a "*Report on the State of Environmental in the Republic of Moldova*"; that can be found in electronic format on the Ministry's website (<www.mediu.gov.md>). Also, the State Ecologic Inspectorate annually prepares and publishes the report "*Environmental Protection in the Republic of Moldo-*

Picture 6-1: Graffiti drawing by the Children and Youth Republican Center "Gutta Club" under the national competition of champions "Act on CO_2" on the wall of the stadium "Dinamo" in Chişinău.

Picture 6-2: Excerpts from the projects implemented within the national competition *"Act on the CO_2"*.

Picture 6-3: Award giving ceremony for the national competition “Act on CO_2” .

va" (<http://inseco.gov.md/monitorizare/>) and the State Hydrometeorology Service publishes the "*State Cadaster of Waters*" as well as the "*Activity Report of the State Hydrometeorology Service*" (<www.meteo.md>).

With the financial support of the National Environmental Fund the following environmental publications are periodically developed: the magazine *"Natura"* (Nature), *"Mediul ambiant"* (Environment), *"Buletinul ecologic"* (Environmental Newsletter) and *"Revista apelor"* (Waters Magazine).

Environment protection issues are broadly and periodically covered in such radio and TV programs as *"Eco-Terra"* and *"Terra-Vita"*, especially by the National Public Broadcaster *"Teleradio Moldova"*.

To note that the level of awareness of the public at large in RM in regard to the climate change has been recently studied through the national survey *"Republic Moldova: What the Population Knows About Climate Changes,"* conducted in the period 29 May–16 June 2012, on the order of the Climate Change Office under the UNEP/GEF Project "Republic of Moldova: Enabling Activities for the Preparation of the TNC to UNFCCC" (the study is available on the website of the Climate Change Office in Romanian and English)[258].

The opinion survey had a pool of 804 respondents, aged between 15 and 65, from 12 administrative-territorial units, living in urban and rural areas. This sample is representative for the adult population of RM (without Transnistria), with a maximum error margin of ±3.5%.

The results of the survey reveal that the perceived level of information about the global warming or its consequences for the time being is very low in RM: 5%-6% consider themselves very informed about the climate system or measures that can be taken to reduce the effects of global warming; and only 3% state to be very happy about the level of information held.

These perceptions are very well highlighted in the respondent answers where many knowledge-related questions show significant gaps for the vast majority of the Moldovan population. The point of view of the scientific community does not reach the population; the representations about the scientific truth are shared, including as effect of the lack of contact with the scientific truth.

We can speak about a level of unreliability of the information held by the respondents - to knowledge-related questions, most of the answers were included in the category "maybe true/false" instead of "Certainly true/false".

Many respondents were surprised by the topic of the survey, expecting a rather social-political one. The operators noted, compared to other surveys, the lack of habit of answering to knowledge-focused questions. Nonetheless, the respondents wondered about the number of correct answers they provided and when they could find out the results of the survey.

For this survey, the relevance of non-answers is very high to some questions; the fact that the respondents chose the answer "I don't know", and the higher share of this answer as compared to any other answer shows once again the low level of information about global warming.

Below there are provided details about the population's perception and knowledge about global warming and climate change.

Civic Spirit and Ecologic Actions

The news about weather condition is a constant concern of 40% of the respondents; environmental news seriously draw the attention of 25%, while global warming raises major interest in 13%. Such subjects as water and air pollution have higher visibility and are easier to understand; this may be the reason why they cause the highest level of concern among the population. The next category of problems that concerns the population also contains global warming but also such problems as the wastes, pollution in agriculture and urban pollution.

When asked about the elements to which "environment" relates, one of five respondents mentioned rather an affectionate thing, such as the heritage left to the children; the second element referred to the proximity of environmental issues, and 15% chose pollution in communities. Climate change ranked third, with 14%, which reflects the presence of this topic in public speeches (the idea is accepted that a part of the answers were probably the effect of the previous questions from the questionnaire, where a lot was discussed about the climate changes). Even though the vast majority of the population understands that environmental problems have a direct impact on their daily lives (52% - totally agree, 38% - partly agree), when it comes to concrete responsibilities and actions, they are rather directed to the local public authorities (61% - fully agree), to the Government (60% - fully agree), to specialized NGOs (54% - totally agree), while taking an active role at personal level was mentioned only by 43% of the respondents.

The lack of information and education in the spirit of environmental protection are the main reasons that respondents think explain the current situation (70% - fully agree). Even though there are serious complaints from the population about the high number of cars (50%) or the lack of authorized dump sites (60%), even though many (63%) request a fine to be imposed when environmental protection provisions are violated, when it comes to making a small effort to protect the environment, effort made at individual level, the percentage rate significantly changes. For instance, only 31% would buy products that observe environmental protection conditions, even if they cost more. Significant shares

258 <http://www.clima.md/libview.php?l=ro&idc=248&id=2882> and <http://www.clima.md/libview.php?l=en&id=2882&idc=248>.

of population (between 20% and 50%) do not think about decreasing their water consumption, the amount of wastes they produce, the amount of electric energy consumed, reduced use of plastic, etc.

Trusts and Concerns Related to Climate Changes

Most of the respondents (85%) think global warming is taking place and 55% of them are very sure or extremely sure. About one of ten participants in the survey (12%) thinks global warming is not taking place but have a high level of uncertainty regarding this statement. The reasons for global warming would be human activities (26% - which is the correct answer); other reasons were identified in the direction of human activities combined with natural phenomena (39%) or rather things related to natural phenomena (26%). The highest share of correct answers was given by those who think global warming does take place, young people (15-29 year old), living in small and medium-sized towns; most of the mistaken answers were given by rural residents, over 45, with a low level of education.

There are two majority opinion flows in regard to what the respondents relate to the opinions of scientists: on the one hand, 43% think that most scientists have established that global warming takes place and other 32% say that there is still room for discussions and there is no consensus among scientists. One in four citizens thinks that they have serious concerns about global warming, while other 48% showed concern to a certain extent. This feeling is more often present among those who think that global warming takes place: women, over 45, especially rural residents. 7% are not concerned at all, and other 19% have low fears about the impact of global warming on their lives.

Perception of the Greenhouse Effect

The greenhouse effect is one of the main mechanisms causing the global warming and it is known more among the young population having higher education, of ethnicity other than Moldovan, living in cities. The sample as a whole is balanced: 47% have heard while 49% have not heard about the relation between the greenhouse effect and global warming. Of those who have heard about the greenhouse effect, 51% have correctly understood that it refers to "atmospheric gases that are characterized by large capacity of absorption of infrared radiation"; other 19% correctly think that the "ozone layer that protects the Earth," the "pollution that causes acid rains" (18%) or "the manner in which plants grow" (7%) relate to the "greenhouse effect." In conclusion, at national level, 24% have heard and correctly identified the elements explaining the greenhouse effect. Most of the survey participants (between 40% and 75%) correctly identified the causes of the increase in the average temperature on Earth: volcano eruptions, greenhouse gases, amount of solid particles in the atmosphere etc. Nonetheless, there is a large share of respondents who incorrectly believe that earthquakes (72% - very much and to certain extent) or the moon phases (46%) can change the average temperature of the air. 60% of the citizens understand that carbon dioxide has a large capacity for absorbing infrared radiation, thus causing the global warming; a relatively smaller share believes that methane (41%) and water vapors (27%) can do the same.

Weather versus Climate

Although 73% know that "Climate means average weather conditions in a region", and 83% know that "Weather changes from one year to another", most of the population does not distinguish between the two terms 'climate' and 'weather', and incorrectly thinks that climate changes often from one year to another and that weather means the average climate conditions in a region.

Climate Changes: Past and Present

The highest share of wrong answers was given to the item "*Earth's climate now is warmer than ever in its past*", 79% indicating that certainly or probably this is true. This is false because there existed significantly higher temperatures in the past. Other confusions that the population has in relation to the planet's warming past refer to "*In the past, the Earth's climate always gradually changed from warm periods to cold periods*" – 63%; "*Earth's climate has been pretty much the same for millions of years*" – 42%; or that "*Earth's climate is colder than ever in the past*" – 30%. The survey found that a significant share of the respondents (56%) correctly understand that "*In the past, the increase in the concentration of carbon dioxide in the atmosphere generated an increase in the atmospheric air at global level*"; approximately the same share (57%) of respondents know that the reverse is also true – the increased temperature has also led to an increase in the carbon dioxide in the atmosphere (*the global temperature and the level of carbon dioxide can positively or negatively influence each other*). To note that there was a high number of no-answers to these questions (28% and 27%). One of two citizens understands that we have had an unusually warm climate in the past 10,000 years as compared to the climate in the past millions of years. To this question, too, the share of no-answers was significant – 35%. Nearly one quarter of the survey participants believe that the climate changes have played an important role in the disappearance of human civilizations in the past.

Estimation of Temperatures

The current average temperature of 14.5 degrees Celsius on the Earth surface was indicated to the respondents. The question requiring an estimation of the average temperature in the glacial era was answered correctly by only 6% (between 7.7 and 10.6 degrees Celsius); 35% indicated a lower temperature, and 11% - a higher temperature. The dominating note however remains the high share of those who did not know how to answer – 47%. The situation was similar when estimating the average temperature 150 years ago. For the year 2050, over one third estimates that the average temperature will be significantly higher than the correct answer (between 15.6 and 16.1 degrees Celsius) and this indicates rather a fear of the population. For this estimation, too, the share of those who answered correctly was low – 9%.

Fossil Fuels

The level of population's knowledge in this area is higher. Two-thirds correctly answered which the fossil fuels are: coal (correctly mentioned by 80%); oil (74%); and natural gases (69%). However, in relation to wood, hydrogen and solar energy there are major confusions about them as between 17% and 33% of the population considers them fossil fuels as well. The segments of the population that believes so are those with low level of education, ethnic Moldovans, and especially rural residents. As to the origin of the fossil fuels, the population's knowledge is rather limited: first of all, over 30% avoided giving an answer to this type of questions. Only 17% were sure of the fact that "*the Sun through plant photosynthesis*" leads to the formation of fossil fuels, while other 27% incline to believing that this is true. 34% erroneously believe that the fossilized dinosaur remnants or the uranium from the earth shell (44%) have contributed to the formation of fossil fuels. Only one quarter of the population knows that carbon dioxide remains in the atmosphere several hundreds or thousands of years once it has been emitted.

Carbon Dioxide

Three fourths of the survey participants answered correctly, identifying the carbon dioxide as a result of the burning of the fossil fuels. Only one in ten respondents know that stopping the burning of fossil fuels would not lead immediately to decreasing the concentration of carbon dioxide in the atmosphere. 8% expect miraculous effects upon stopping burning the fossil fuels and other 38% believe that the beneficial effects will be felt in a relatively short period of time. Also a low share (16%) knows that stopping burning the fossil fuels wouldn't immediately lead to stopping global warming. The socio-demographic variable that determines the quality of the answer is the respondent's education.

Causes of Global Warming

The answers given in this section justify the conclusion that the vast majority of the population rather does not know the causes of this phenomenon. Of a list of 12 possible causes, each of them was mentioned as highly responsible (5-8%) or as responsible to a certain extent (10-20%). Practically, no distinction has been made between the correct and incorrect answers.

Reasoning Climate Changes

Many of the respondents (75%) incorrectly believe that scientists cannot foresee the climate for a far future, and a high level of distrust (52%) also exists in the computer-based models that would be able to foresee the climatic future. More than half of the respondents (54%) incorrectly think that the Earth's climate has naturally changed and that the people are not those who have caused the today's global warming. An even higher number of the respondents (69%) mistakenly relate the global warming to the Sun and nearly one-third expect more benefits than damages if global warming takes place. It is important to take into account that, for all the items of this section, the number of no-answers was considerable and varied between 11% and 38%.

Impact Elements

Even if the share of those who checked "Probably true" is nearly twice as much as the one of those who chose "Certainly true", most of the survey participants (71%) understand that global warming will in some places lead to increased humidity and to desertification in others; also, two-thirds of the interviewees know that another effect of the global warming will generate higher harvests in certain areas while in others the yield will fall. Rural residents and those who stated that they knew global warming was taking place mentioned these phenomena to a larger extent. Nearly half of the interviewees (47%) erroneously think that global warming makes temperature grow similarly for each country in part. Less than one third of the citizens have answered correctly and said that most of the icebergs are melting while 11% others have a more apocalyptical representation, saying that all the icebergs are melting. To stress that 4% have not heard that such a phenomenon takes place at the planet level. 71% correctly understand that the iceberg melting speed has significantly increased in the past one hundred years. This answer is significantly correlated with the share of those who think that global warming is taking place. The increase in the level of sea waters was correctly related (about 80%) to the melting of ice in Antarctica, to the melting of ice in the Northern Ocean, to the melting of icebergs, or to the warming of waters in the oceans. Nearly half (51%) correctly relate the increase in the sea level to water evaporation. When asked to choose one cause responsible for the increase in the see level, the survey participants mostly chose answers related to the iceberg melting. Nonetheless, the correct answer is "*Increase in the temperature of water in oceans*" and was mentioned by only 8%. 40% could not estimate how much the sea level will increase if no correct measures are taken to reduce global warming. 61% have not heard anything or have heard little about the level of acidity in the ocean waters. Also, only 11% correctly identified the reason for the increased level of acidity in the oceans, and namely "*Absorption of carbon dioxide by ocean waters*".

Solutions

Most of the respondents correctly understand that the following actions would significantly contribute to reducing global warming if they were taken at the level of the entire planet: plant trees (89%); reduce tropical forest cutting (85%); less driving by one's own car (77%); switch from using fossil fuels to using renewable energy (75%); switch from fuel-based to electricity-based cars (74%); intensively use common transportation (66%); switch from fossil fuels to nuclear energy (56%); and ensure thermal insulation of buildings (49%). However, we can speak about major confusion, at mass level, in regard to preparing solutions that the population would conceive as reducing global warming as an effect: for example, 84% incorrectly think that less wastes means direct support to reducing global warming; or 77% erroneously think that the holes in ozone layer can be reduced by reducing the launching of spaceships; or 56% who think it is inadequate to increase taxes for the use of fossil fuels.

Information Sources

The most well-known sources for information about global warming are the TV programs (88%) and the less known are the information items presented by various government agencies (17%) or such institutions as museums (13%). Other sources in which this problem is debated upon are the circle of friends and relatives (66%), radio (52%), the Internet (49%), or the print media (48%). The biggest impact regarding the knowledge acquired about global warming was indicated for TV programs (22% say they have learned a lot from such programs) and Internet-based information (19%). The ranking of sources to be sought in the future for information about global warming generally repeats the order of the same ranking: TV (90%), Internet (66%), newspapers (58%), family members, relatives (56%), and the lowest expectations again are from the government agencies or such institutions as museums. The most trustworthy sources of information about global warming are the scientists (74%) and TV documentaries (70%) that can be watched on such channels as Discovery. To note that of the whole list of sources presented, the lowest trust is in teachers; only 12% said they had a lot of trust, and other 38% mentioned some kind of trust. The preferences regarding to sources of information are significantly influenced by the socio-demographic characteristics: for example, women, youth, those with higher education, ethnic Moldovans and city residents prefer to a larger extent the TV documentaries as sources of information; those aged beyond 45 and rural residents rather prefer information mediated by their interpersonal relations with their acquaintances or relatives. The contact with various environments that could convey information about the climate changes is extremely low – about 85% said that in the past 12 months have not been to a natural sciences museum or a science and technology museum; zoos or movie theaters have also been ignored lately by over two-thirds of the population. The main reason for such situation is the low level of such institutions at the national level and their poor promotion. 58% think they need more or much more information about global warming. The categories of the population that insistently request this are ethnic Moldovans, with incomplete school, from small and medium-sized towns but also those living in the rural areas.

6.4. International and Regional Cooperation

6.4.1. Legal and Institutional Frameworks for International Cooperation

The Foreign Policy Concept (1995) remains the main document that identifies the country's priorities in the area of international cooperation. Honoring the commitments made is one of the main principles set forth in the Concept. According to this, foreign policy is focused on bilateral and multilateral cooperation. The country considers the G7 countries as important strategic partners and the cooperation with the United Nations and other international or regional organizations as an essential activity.

The Environment Policy Concept of Moldova (2001) stresses the following:

- Political orientation to EU integration, with emphasis on approximating the national law to the EU Directives;
- Signing bilateral protocols of cooperation with the CIS and EU countries;
- Signing and ratifying regional agreements;
- International cooperation in view of attracting investments for environment protection.

The cross-border cooperation concept has been developed in view of supporting the dialog with the neighboring countries and international and European organizations. By the Parliament Decision "On Developing Cross-Border Cooperation within the Euroregions" (2003), there was established the Committee for Cross-Border Cooperation that is responsible of the following:

- Establish mechanisms of cross-border cooperation within the Euroregions as fundamental elements of the European integration process;
- Approximate the provisions of national legal acts on cross-border cooperation to the European standards; and
- Create a system for implementing the conventions and agreements to which the country is party.

The laws on joining conventions or protocols are an inherent part of the national legislation. The signing of international treaties by RM takes place under two main legal acts: the Law on International Agreements (1999) and the Regulation on the Mechanism for Concluding International Agreements (2001).

The main role in concluding environment agreements or joining environment conventions belongs to the Ministry of Environment.

Until now, RM has joined 18 conventions, 9 protocols and 2 international environment agreements (Box 6.1). A national

Box 6.1: International Conventions and Additional Protocols to which RM is a Party

1. Convention on the Conservation of European Wildlife and Natural Habitats (Berne, 1979), ratified by Parliament Decision No.1546-XII of 23 June 1993;
2. Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 25 February 1991), ratified by Parliament Decision No.1546-XII of 23 June 1993;
3. Convention on the Transboundary Effects of Industrial Accidents (Helsinki, 17 March 1992), ratified by Parliament Decision No.1546-XII of 23 June1993;
   - Protocol on Strategic Environmental Assessment (Kiev, 2003) to the Convention on the Transboundary Effects of Industrial Accidents (Helsinki, 1992), signed by RM on 21 May 2003;
4. Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 17 March 1992), ratified by Parliament Decision No.1546-XII of 23 June 1993;
   - Protocol on Water and Health to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992), ratified by Law No.207-XVI of 29 July 2005;
5. Convention on Biological Diversity (Rio de Janeiro, 1992), ratified by Parliament Decision No. 1546-XII of 23 June 1993;
   - Cartagena Protocol on Biosecurity to the Convention on Biological Diversity (Rio de Janeiro, 1992), ratified by Moldova by Law No. 1381 – XV of 11 October 2002;
6. Convention on Long-Range Transboundary Air Pollution (Geneva, 13 Nov 1979), ratified by Parliament Decision No. 399-XIII of 16 March 1995;
   - Protocol on the Persistent Organic Pollutants to the Convention on Long-Range Transboundary Air Pollution (Geneva, 1979), ratified by Law No. 1018-XV of 25 April 2002;
   - Protocol on Heavy Metals to the Convention on Long-range Transboundary Air Pollution (Geneva, 1979), ratified by Law No. 1018-XV of 25 April 2002;
   - Protocol on Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to the Convention on Long-Range Transboundary Air Pollution (Geneva, 1979), signed by RM on 23 May 2000;
7. UN Framework Convention on Climate Change (New-York, 9 May 1992), ratified by Parliament Decision No. 404-XIII of 16 March 1995;
   - Kyoto Protocol on the UN Framework Convention on Climate Change, joined by RM by Law No. 29 – XV of 13 February 2003;
8. Convention on Ozone Layer Protection (Vienna, 22 March 1985), ratified by Parliament Decision No. 966-XII of 27 June 1996;
   - Protocol on Substances that Deplete the Ozone Layer (Montreal, 16 Sept 1987) to the Convention on Ozone Layer Protection (Vienna, 1985), ratified by Parliament Decision No. 966-XII of 27 July 1996;
9. Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel, 22 March 1989), ratified by Parliament Decision No.1599-XIII of 10 March 1998;
10. UN Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification (Paris, 17 June 1994), ratified by Parliament Decision No.257-XIV of 24 December 1998;
11. Convention on Cooperation for the Protection and Sustainable Use of the Danube River (Sofia, 29 June 1994), ratified by Parliament Decision No.323-XIV of 17 March 1999;
12. Convention on Access to Information, Public Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus, 1998), ratified by Parliament Decision No. 346-XIV of 7 April 1999;
    - Protocol on Pollutant Release and Transfer Registers (PRTRs) to the Convention on Access to Information, Public Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus, 1998), signed by RM on 21 May 2003;
13. Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar, 2 February 1971), ratified by Parliament Decision No. 504-XIV of 14 July 1999;
14. Convention on Conservation of Migratory Species of Wild Animals (Bonn, 23 July 1979), ratified by Law No. 1244-XIV of 28 September 2000;
    - Agreement on the Conservation of Bats in Europe (London, 4 December 1991), as part of the Convention on Conservation of Migratory Species of Wild Animals (Bonn, 1979), ratified by Law No.1244-XIV of 28 September 2000;
    - Agreement on the Conservation of African-Eurasian Migratory Water Birds (Hague, 16 June 1995), as part of the Convention on Conservation of Migratory Species of Wild Animals (Bonn, 1979), ratified by Law No. 1244 -XIV of 28 September 2000;
15. Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington, 1973), ratified by Law No.1246 -XIV of 28 September 2000;
16. European Landscape Convention (Florence, 2000), ratified by Law No.536-XV of 12 October 2001;
17. Convention on the Persistent Organic Pollutants (Stockholm, 2001), ratified by Law No.40-XV of 19 February 2004;
18. Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (Rotterdam, 10 September 1998), ratified by Law No.40-XV of 19 February 2004.

focal point has been appointed for coordinating the implementation of the requirements for each international treaty.

Special units (Offices) have been established under the Ministry of Environment for carrying out the activities under some of the conventions (most of them have been created through the order of the Central Environment Authority). The teams of such Offices, in addition to developing, promoting and implementing projects, have the task to participate in developing, promoting and implementing the national policies and strategies in accordance with RM's obligations to the international conventions and treaties to which our country is signatory.

For example, the Climate Change Office was created under the Ministry of Ecology, Constructions and Territorial Development by Order No. 21 of 11 February 2004. The main objective of the Office is to implement RM's obligations under the UN Framework Convention on Climate Change (Parliament Decision No.404-XIII of 16 March 1995) and the Kyoto Protocol (Law No. 29-XV of 13 February 2003). The main tasks of the Office are: (a) provide logistical assistance to the Government, central and local public administration authority institutions, nongovernmental and academic organizations, in the activities implemented and promoted by RM under UNCCC and the Kyoto Protocol; and (b) implement projects and programs in the climate change area that imply such as activities as: evaluate GHG emissions and prepare National Inventory Reports; develop and implement projects and measures for mitigating GHG emissions; develop and implement projects and programs for adapting to the climate change; assess the impact of the climate changes on the country's biological and socio-economic components; cooperate, promote and implement activities and projects under the Clean Development Mechanism of the Kyoto Protocol; implement and facilitate activities for raising the awareness and informing the civil society, relevant specialists and decision-making factors about the climate change issues, etc. The Secretariat of the National Commission for Implementing the Provisions of the UN Framework Convention on Climate Change and the Mechanisms and Provisions of the Kyoto Protocol (it is located at the premises of the Climate Change Office) was created in accordance with the Government Decision No. 1574 of 26 December 2003 (Official Gazette No. 6 of 1 February 2004) and has as objective the promotion of policies and strategies at the national level for implementing the objectives of the Clean Development Mechanism of the Kyoto Protocol.

The Carbon Funding Office was created in view of developing the institutional capacity for enforcing the Law No. 29-XV of 13 February 2003 on RM's Joining the Kyoto Protocol of the UN Framework-Convention on Climate Change and for Implementing the Clean Development Mechanism. The Office's objectives are to develop, monitor and implement new projects under the Clean Development Mechanism. The main tasks of the Carbon Funding Office are: a) prepare a plan for monitoring the projects supported by the World Bank and the Carbon Community Fund under the Clean Development Mechanism: "Energy Conservation and Reduction of GEF Emission, Associated with the Energy II Project" and "Public Biomass Heating Systems in Rural Communities of RM"; b) strengthen the institutional and human capacities in the area of the Clean Development Mechanism of the Kyoto Protocol; c) provide technical and financial assistance to the beneficiaries of the above-said projects; d) assess and monitor the implementation of the projects of the Clean Development Mechanism, manage the special accounts of the Office, submit reports to the Ministry of Finance, the World Bank, Supervision Committee, and other international organizations; e) develop new projects under the Clean Development Mechanism and submit them to the National Commission for Implementing the UN Framework Convention on Climate Change and the Mechanisms and Provisions of the Kyoto Protocol; f) ensure the implementation of the commitments stipulated in the agreements signed with the donors and the beneficiaries; periodically inspect the objects, monitor and assess the performance; g) coordinate and enhance the training of project beneficiaries by organizing training courses, seminars, conferences, creating a website; h) carry out other necessary activities for the efficient implementation of carbon funding projects, including developing and implementing other environmental projects.

The Ozone Office was created by the Order no.27 of 7 April 1999 of the Ministry of Environment in view of implementing the Government Decision No. 1064 of 11 November 1999 on approving the National Program for Staggered Removal of Substances Depleting the Ozone Layer in RM. The main objective of this Office is to implement activities related to the RM's honoring its obligations under the Convention for the Protection of the Ozone Layer (Vienna, 1985) and of the Protocol on Substances that Deplete the Ozone Layer (Montreal, 1987) (Parliament Decision No. 966-XIII of 24 July 1996, Official Monitor No. 54-55 of 15 August 1996).

The Biodiversity Office was created under the Ministry of Environment and Territorial by the Order No. 334 of 14 July 2000. The tasks of this Office are related to the implementation of the National Strategy and Action Plan on the Conservation of Biological Diversity (Parliament Decision No. 112-XV of 27 April 2001) and implementation of RM's obligations under the Convention for Biological Diversity (Parliament Decision No. 1546 of 23 June 1993, Official Gazette No. 6 of 30 June 1993).

The Sustainable Management of Persistent Organic Pollutants Office was created under the Ministry of Ecology and Natural Resources in accordance with the National Plan for the Implementation of the Stockholm Convention on the Persistent Organic Pollutants (POPs) by the Order No. 22 of

20 March 2006. The main tasks of the Office are to support the Ministry's activities and facilitate the implementation of the National Strategy on Reducing and Eliminating the Persistent Organic Pollutants and of the National Plan for Implementing the Stockholm Convention, approved by the Government Decision No.1155 of 20 October 2004, for implementing RM's obligations under the Basel Convention, Rotterdam Convention, the Strategic Approach to International Chemicals Framework (SAICM), and other line international agreements to which Moldova is a party.

The Environment Pollution Prevention Office was established on 6 May 2010. The Office implements and coordinates projects in environment pollution prevention, including for facilitating the creation of sustainable waste and chemical substances management in accordance with the international treaties and EU Directives, having the following tasks: (a) start, develop and manage/coordinate the implementation of projects funded by international and/or national institutions and organizations focused on implementing and improving the existing policies in pollution prevention, development of the legal framework and institutional potential for preventing environment pollution and establishing a sustainable waste and chemical substances management, including in view of implementing the National Program of Sustainable Chemical Substances Management; (b) cooperate with the international specialized organizations, public and private institutions and the Moldovan civil society in view of promoting and implementing policies on environment pollution prevention, including sustainable waste and chemical substances management; cooperate and have mutual experience exchange with similar projects, started or implemented in the countries in the region; (c) provide local and international consulting in environment pollution prevention, including in waste and hazardous chemical substance management etc.; (d) participate in organizing conferences, seminars, national and international forums in environment pollution issues, including waste and chemical substance management; (e) carry out other necessary activities for the efficient implementation of projects, including developing and implementing other environment projects.

6.4.2. Political Cooperation Framework with the European Union

According to the Activity Program of the Government "European Integration: Freedom, Democracy, Welfare" (2011-2014), the European integration is a fundamental desideratum of RM's internal and external policy.

The plenary realization of this objective will allow the country anchor in a system of security, stability and prosperity, governed by democratic values and respect for fundamental human freedoms. At the same time, assuming and responsibly implementing the commitments resulted from the European path is the most efficient manner of modernizing the country politically, economically, and socially. European integration first of all means internal positive transformations of the country. The government sets to make efforts to promote the reforms requested both by the society and the international community in view of ensuring freedom of the media, independence of the judiciary, and liberalization of the economy, which are vital areas for the European integration of the country. By coherently promoting policies for making all the country's social-political and economic aspects more European and signing the association agreement with the EU, we will manage in a predictable period to transform RM into a country eligible to join the EU. As a result of implementing the Government's Activity Program, RM will become a trustworthy partner and a welcomed country into the international community, which will successfully conduct the negotiations of the Association Agreement (to be sealed on 28-29 November 2013 at the Third Eastern Partnership Summit in Vilnius, Lithuania), including the Deep and Comprehensive Free Trade Agreement with the EU, and will launch the process of negotiation of the EU membership status.

To note that the relations between RM and the European Union were formally launched within the signing of the Cooperation and Partnership Agreement (CPA) on 28 November 1994 that became effective on 1 July 1998 for an initial period of 10 years.

The CPA represents the legal basis of the relations between RM and the EU. This arrangement ensures the basis of cooperation with the EU in the political, commercial, economic, legal and cultural-scientific areas.

In accordance with the CPA provisions, the institutionalized dialog between RM and the EU takes place through the following cooperation structures:

Political level:

- RM – EU Cooperation Council, which is organized annually both at the level of high officials (Prime-Minister/Commissioner for Foreign Affairs and ENP, High Representative of the EU Council/EU Presidency) and aims at outlining the strategic directions for the development of Moldova-EU relations;
- RM – EU Cooperation Committee meets annually at the level of high public officers to review the guiding trends of the RM – EU sector cooperation;
- RM – EU Parliamentary Cooperation Committee meets annually at the level of heads of delegations of the Moldovan Parliament and the European Parliament.

Working level:

The RM – EU subcommittees are sectorial reunions at expert level that are organized once a year:

- Trade and Investments Subcommittee;
- Finance, Economy and Statistics Subcommittee;

- Customs, Cross-border Cooperation, Judiciary and Internal Affairs Subcommittee;
- Energy, Environment, Transportation, Telecommunication, Sciences, Technologies, Training and Education Subcommittee.

At the same time, the political dialog between RM and the EU is ensured through reunions in the format EU-RM Political Dialog (COEST, COPS, Political Directors) that discuss the path of the reforms in RM, the RM – EU relations, and the subjects of common interest on foreign policy and security. During the year there are organized mutual visits, meetings and consultations at all levels.

The Eastern Europe and Central Asia Committee of the EU Council (COEST) is composed of representatives of EU member state governments and is responsible for the EU relations with the Eastern European countries (Armenia, Azerbaijan, Belarus, Republic of Moldova, Georgia, Russia and Ukraine) and Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan). The group is involved in all aspects related to the EU cooperation with these countries, including the new multilateral cooperation formats, such as the Eastern Partnership and the European Neighborhood Policy (ENP).

The Political and Security Committee (COPS) contributes to defining the policies by developing the opinions addressed to the EU Council. Also, COPS ensures, under the EU Council authority, the political control and strategic direction of crisis management operations.

In May 2004, RM was included in the ENP of the EU. The RM–EU Action Plan was signed on 22 February 2005. On 4 May 2006, RM was accepted as full member in the South-East European Cooperation Process, which once again confirms RM's belonging to the South-East European space and opens new perspectives in the RM – EU relations framework.

On 6 October 2005, the Delegation of the European Union to RM was established to facilitate more the RM-European relations, the first EU ambassador became Cesare de Montis, from October 2005 to November 2009; Dirk Schuebel held this office from November 2009 to April 2013; at present this office is held by Pirkka Tapiola.

In June 2008 the RM – EU Mobility Partnership was launched. Staring with 7 May 2009 RM has been participating in the Eastern Partnership Initiatives, actively contributing to developing the bilateral and multilateral dimension. Starting with 1 January 2010, has become full member of the Energy Community Treaty, and from 15 June 2010 the RM–EU Visa Liberalization Dialog was launched. In January 2011, RM received the Visa Liberalization Action Plan that contains two sets of conditions that, once implemented will contribute to instituting a visa-free regime between RM and EU, hopefully since 2014. On 1 May 2011, the Protocol on the General Principles for RM's participation in the EU programs was defined. The first EU program in which RM participates is the Framework Program 7 (FP7) of the European Community for Research, Technological Development and Demos (2007-2013) (Memorandum of Understanding between the EU and RM on RM's joining the FP7, was ratified by the Moldovan Parliament by Law No. 279-XIX of 27 December 2011). Also, on 26 June 2012, RM signed an agreement for joining the EU Common Air Space.

The EU has been developing an increasingly close relation with RM, which goes beyond cooperation, up to gradual economic integration and deepening of political cooperation.

To note that at present RM is in the process of negotiating the draft Association Agreement.

The *"Environment"* section in the Agreement stipulates the specific commitments and activities to be implemented in the area of environmental protection by the Moldovan Government, and namely:

- Develop legislation, norms and regulations aligned to the EU standards, strengthening the institutional capacities and establishing new structures as necessary;
- Develop a new environmental strategy that would include the planned institutional reforms (with pre-established timeframes) for ensuring the enforcement and observance of the environmental law;
- Develop sector strategies on water, air, waste management, biodiversity conservation, etc.
- Strict and clear division of competences among national, regional local environmental bodies;
- Integrate the environment in other sectorial policies, promote green economy development and eco-innovations etc.

The annex to the "Environment" section of the Association Agreement contains 25 EU environment directives according to which RM must transpose and implement a broad set of requirements that also involve significant costs.

There is close cooperation also within the working group "Environment and Climate Change" of the 2nd platform "Economic Integration and Convergence with the EU Policies" of the Eastern Partnership. The cooperation priorities include strengthening the institutional and legislative priorities, including through high-level consulting, trainings and expert exchanges, internships and scholarships for institutional strengthening, implementation of concrete projects in climate changes, European integration, waste management, water resource management, pollution control and air monitoring, raising public awareness, ecologic trainings, etc.

6.4.3. Bilateral Cooperation

In the period from 2010 to 2013 RM initiated a number of bilateral cooperation agreements and memoranda and also has joined programs on environment protection and sustainable use of natural resources, including the following:

- Memorandum of Understanding between the Moldovan Ministry of Environment and the Romanian Ministry of Environment and Forests on the Cooperation in Environment Protection, 27 April 2010, Bucharest;
- Agreement between the Moldovan Government and the Romanian Government on Cooperation for the Protection and Sustainable Use of Prut and Danube, 28 June 2010, Chișinău;
- The Mutual Memorandum of Understanding between the Estonian Ministry of Agriculture and the Moldovan Ministry of Agriculture and Food Industry in the area of research and economic cooperation in agriculture (in force from 16 Aug 2010);
- Agreement between the Moldovan Ministry of Environment and the Estonian Ministry of Environment on cooperation in environment protection, 19 October 2011, Tallinn;
- The Framework Program 7 of the European Community for Research, Technological Development and Demos (2007-2013), ratified by the Moldovan Parliament by Law No. 279-XIX of 27 December 2011;
- Nagoya Protocol on Genetic Resources and Correct Distribution of Benefits resulted from their use in the Biodiversity Convention, 25 January 2012;
- Nagoya-Kuala Lumpur Additional Protocol on the Response and Repair of Damages to the Cartagena Protocol on Biosecurity, 25 January 2012;
- The Agreement between the Moldovan Government and the Israeli Government in Environment Protection, signed in Jerusalem on 14 May 2012;
- Memorandum of Understanding between the Moldovan Government and the Turkish Government in Environment Protection, signed in Ankara on 1 November 2012 (the parties will cooperate in integrated waste management, water management, air quality management, industrial pollution prevention, climate change, assessment of impact on the environment, protection of biodiversity, etc.);
- Agreement between the Moldovan Government and the Ukrainian Cabinet of Ministries for Cooperation in the Protection and Sustainable Development of the Dniester River Basin, 29 November 2012, Rome.

In accordance with the provisions of the Moldovan Government Decision No.790 of 22 October 2012 there has been established a Moldova Office for Science and Technology (MOST) under the EU in view of ensuring the plenary implementation of RM's status as associated country to the Framework Program 7 of the European Community for Research, Technological Development and Demos (2007-2013).

The MOST Office acts as an interface between the Moldovan scientific-innovative community of and the European Research Space actors, having the following major objectives:

- Promote the participation of researchers, scientific and innovative organizations, small and medium-sized enterprises and organizations of the associative sector in EU research-innovation programs;
- Increase the visibility of the scientific and technological potential of RM in the European research space, including in the relations with the European institutions;
- Permanently inform, through the network of National Focal Points, the relevant national actors but also the Moldovan decision-makers regarding the opportunities for participation in the EU research-innovation programs as well as the latest developments in the EU policy on the European research space.

To note also the Program of Cooperation in Science and Technologies between the Academy of Sciences of Moldova and the State Agency for Science, Innovation and Information of Ukraine (2013-2017), signed on 18 July 2013. According to this Program, the priority areas of research are the environment protection, information and communication technologies, new materials, biotechnology, nanotechnology, energy and energy efficiency, medicine and pharmaceutics.

In the period from 2010 to 2013, the extension of international cooperation in environment protection has continued and the relations with the development partners have been renewed: Swiss Office for Cooperation, the Swedish International Development Agency (SIDA), Germany's International Cooperation Agency (GIZ), Austrian Agency for Development (AAD), UN European Commission for Economy (UNECE), European Bank for Reconstruction and Development (EBRD), World Bank (WB), United Nations Development Program (UNDP), United Nations Environment Program (UNEP), United Nations Program for Industrial Development (UNIDO), Global Environment Fund (GEF), Organization for Economic Cooperation and Development (OECD), etc.

6.4.3. Cross-Border Cooperation

On a cross-border level, in the period from 2010 to 2012 RM started and carried out activities on environment protection within common operational programs. On 28 June 2010, an Agreement was signed between the Moldovan Government and the Romanian Government on the Cooperation for the Protection and Sustainable Use of Prut and Danube Waters, that aims at the protection and sustainable use of water resources, exploitation of the Hydro-Technical Joint Costești (Moldova) – Stînca (Romania) on the Prut River, construction and exploitation of other hydro-technical objects.

On 29 November 2012, in Rome, there was signed an Agreement between the Moldovan Government and the Ukrainian Cabinet of Ministers on the Cooperation for the Protection and Sustainable Development of the Dniester River. The goal of the Agreement is to create a legal and organizational basis for cooperation and reasonable use of water resources and of other related resources, and of the ecosystems of the Dniester basin in the interests of the population and sustainable development of the Contracting Parties.

The cross-border cooperation is also ensured through the Romania–Ukraine–Republic of Moldova Joint Operational Program, one of the new funding instruments (ENPI) of the European Union, implemented at the external borders of the extended Europe in the period 2007-2013. The program aims at creating a "connecting bridge" between the three partner countries in view of supporting the communities in the border areas in view of finding common solutions to the similar problems they face. Through this program, the local authorities and other organizations from the border area are encouraged to cooperate in view of developing the local economy, solving certain problems related to the environment and for strengthening the preparation for emergency situations.

6.4.5. External Assistance Received by RM as Part of the Bilateral and Multilateral Cooperation for Development

According to the OECD data, RM ranks among the first ten countries of Europe that benefit from external assistance. According to the situation of 2011, the share of official assistance for development in the Gross National Income for RM accounted for 5.95%, outrunning all the countries in the region, except Kosovo.

When the European Integration Alliance (EIA) came to govern in September 2009, the Government addressed the donor community with the request for support in implementing the priority reforms for the country's economic growth, specified in the "Relaunching Moldova" paper. As a result, during the reunion of the Advisory Group "Partnership for Moldova Forum," held in Brussels on 24 March 2010, the donors community committed to allocate to RM 1.84 billion Euros (0.96 billion in the form of a grant or 52% of the total; respectively, 0.88 billion in the form of credits or 48% of the total) for the period 2011-2013. As a whole, the USA (through the Compact Program of the Millennium Challenge Corporation, signed in 2010 in the amount of US$ 260 million) has become one of RM's main bilateral development partners. The EU commitment and of the EU member states on future allocations have accounted for 40% of the resources promised during the reunion.

Towards the end of 2012, over 70% of the resources provided in the 2010 Brussels reunion had been contracted, through specific projects started in various national economy sectors. In addition, external funds of about 800 million Euros have been attracted. So, a total amount of 2.6 billion Euros was provided to RM by the donor community in the period 2010-2012 (by 40% more than as compared to the financial commitments made during the Brussels reunion). In 2012 the donor funds were estimated at about 474 million Euros. According to the data of the State Chancellery of RM, the budget of the projects contracted in the reporting period account for about 206 million Euros and the disbursements reported by the donors – about 465 million Euros (about 98% of the estimated amount). For comparison, in 2007 the disbursements amounted to 266 million Euros; in 2008 – 298 million Euros; in 2009 – 244 million euros; in 2010 – 470 million Euros; in 2011 – 451 million euros. For 2013 and 2014 there are provided 322 million and 213 million Euros, respectively.

The manner of cooperation between RM and the development partners have taken various forms. Here can be mentioned technical assistance, support for implementing various investment or social projects, the support provided to the budget for implementing sector policies or the support provided for supporting the state's payment balance. The objectives of the cooperation between the Moldovan Government and its partners are agreed upon and stipulated in the medium-term framework cooperation agreements. According to the data available for external development assistance, the highest share is held by the assistance with project implementation (75%), followed by sector budget assistance (about 17%), technical assistance, and assistance with maintaining the state payment balance.

Given the budgetary constraints and of state debt servicing, the manner of attraction of external resources that is preferred by the Moldovan Government are grants and/or concessional credits. The amount of ongoing external assistance in 2012, according to the information from the database of the State Chancellery accounted for about 1.1 billion Euros in the form of grants and 682.8 million Euros in the form of loans. Accordingly, in 2012, the contracted resources were distributed as follows: about 109.4 million Euros in the form of grants and 97.1 million Euros in loans (EBRD, EIB and WB). The share of active grants in the total amount of external assistance has represented about 62%. For 2012, the grant-credit parity represented 53%, accordingly, 47% of the total amount of external assistance contracted during the year.

The community of active development partners in RM brings together about 30 countries and organizations and includes both multilateral (IFI) and bilateral cooperation. Table 6-6 reveals the information, by donors, about the amount of ongoing assistance in 2012 as well as the assistance contracted in 2012. The top ten partners by the amount of financial assistance ongoing in 2012 include EU, followed by USA, WB, EIB, EBRD, Romania, UN, Sweden, Japan and

Swiss. For the resources contracted during 2012, the EU further remains the biggest provider of assistance for development, followed by the WB, financial institutions of the EU, UN, USA, Austria, Sweden and China (on the bilateral).

According to the principles on enhancing the development assistance, aligning the assistance to the national priorities is a key factor in reaching economic development results and improvement of population's living standards. In this sense, the past years communication between the Government and the development partners has been constructive, and as proof of this come also the results of the surveys for two consecutive years, which show that over 90% of the ongoing projects are aligned to the national development priorities. The efforts of both parties have been also focused on reducing project fragmentation and ensure balanced presence of the partners in various sectors. The evaluation of donor presence in the sectors described in the Government's Action Plan shows the following distribution thereof: economic and financial policies (14), environment (11), health and social problems (9 each), education, efficient public services and rule of law (8 each), foreign policy and reintegration (5 each) and youth, culture and minority integration (4 each). At the same time, the donors are also dispersed in a number of sectors (UN - 9, EU - 8, WB, Germany - 6), which creates difficulties in coordinating the activities and reaching concrete results for some more difficult sector reforms.

Table 6-7 reveals the presence of foreign assistance by sectors. The sectors "Transport and storage," "Government and civil society," "Other social infrastructure," "Agriculture" and "Business environment and other services" are in the top five of those accounting for about 78% of the ongoing foreign assistance. For the assistance contracted in 2012 (circa 206 million euros) the respective sectors are "Business environment and other services," "Energy," "Transportation," "Government and civil society" and "Agriculture", with a share of 81% of the total amount. This denotes that the external assistance is directed to implementing investment projects for the economic sectors and for implementing important structural reforms. The projects contracted in 2012 are related to the Competitiveness Growth Program (WB - 23 million Euros); rehabilitation of electric transport networks (EBRD, EIB – 32.6 million Euros); competitive agriculture (WB - 14 million euros); building dwellings for socially vulnerable layers (CEDB – 13.4 million Euros); supporting measures for building trust between the Dniester River banks (EU - 12 million Euros) and road rehabilitation in Chișinău (EBRD, EIB - 20 million Euros).

Table 6-6: Amount of external financial assistance, ongoing and contracted, provided for development to the Republic of Moldova in 2012

Donor	Ongoing (Euro)	Contracted (Euro)
European Union	488,349,915	52,685,902
United States of America	292,546,224	21,726,235
World Bank	321,887,911	40,326,516
European Investment Bank	209,800,000	27,300,000
European Bank for Reconstruction and Development	140,998,160	27,220,074
Romania	102,816,169	478,169
United Nations	85,770,655	1,692,866
Sweden	52,332,996	6,041,493
Japan	37,163,402	268,836
Switzerland	17,986,727	1,191,496
Council of Europe Development Bank	13,400,000	13,400,000
Austria	14,479,129	8,425,094
Germany	12,019,418	
China	11,247,024	4,739,024
Global Fund for Fighting AIDS, TB and Malaria	7,434,590	
the Netherlands	4,956,980	
Liechtenstein	3,653,505	453,111
Norway	1,582,154	
International NGOs	944,474	
Turkey	560,008	556,008
Slovakia	368,640	65,639
Denmark	197,625	
Council of Europe	108,000	
Czech Republic	96,266	96,266
Italy	79,710	
Total	**1,820,779,683**	**206,666,729**

Source: State Chancellery of Moldova (2012), Cooperation for Development, 2012 Annual Report on the External Assistance provided to Moldova. Chişinău, July 2013.

Table 6-7: Amount of ongoing and contracted financial assistance provided for development to Moldova by sectors in 2012

Sector	Ongoing (Euro)	Contracted (Euro)
Transport and storage	361,379,960	26,815,988
Government and civil society	314,807,731	24,876,427
Other social infrastructures and services	257,729,834	17,021,192
Business and other services	223,397,122	43,916,006
Agriculture	197,271,534	21,700,531
Generation and supply of energy	140,301,914	42,683,319
Water and sanitation	109,372,487	2,742,568
Health	105,759,747	8,269,667
Education	32,985,283	10,709,052
Multiple/transversal sector	22,635,716	1,506,826
Banking and financial system	22,075,980	-
Industry	14,300,045	-
Communications	7,109,945	422,322
Tourism	3,789,913	3,380,693
Policy in trade and regulations and their adjustment to the trade	3,228,059	2,040,000
Humanitarian aid	1,786,115	-
Policies in the area of population/ health programs	1,249,823	59,468
Refugees in target countries	1,192,839	117,030
Constructions	405,639	405,639
Total	**1,820,779,683**	**206,666,729**

Source: State Chancellery of Moldova (2012), Cooperation for Development, 2012 Annual Report on the External Assistance provided to Moldova. Chişinău, July 2013.

By the end of 2012, RM was implementing 384 projects in various sectors, including 116 projects in governance and civil society, 58 projects in infrastructure and social services, 49 projects in education, 31 projects in agriculture, 29 multi-sectorial projects, 24 projects for private sector development, 19 projects in the environment and 16 projects related to energy generation and supply. As a total, in 2012, there were launched 98 new projects, with new commitments in the amount of 206.6 million Euros in various sectors. For 2013, the estimated amount of external assistance is 314 million Euros.

As also results from the information presented above, the EU is the biggest of the development partners that have been active in RM[259]. The Country Strategy (CS) for the period 2007-2013 and the National Indicative Program (NIP) for the period 2011-2013 establish in detail the objectives and results to be reached in this period. If in 2006 the EU assistance amounted only to 25 million Euros, then in 2012 it reached 152 million Euros (by September 2012, the total assistance received by RM from EU reached 337 million Euros)[260]. Under the NIP for the period 2011-2013 RM is to benefit from 273.14 million Euros from the European Neighborhood Partnership Tool (ENPT) in three priority areas: (i) good governance, rule of law and fundamental freedoms – circa 194 million Euros or 71% of the total; (ii) social and human development – circa 30 million Euros or 11% of the total; (iii) trade and sustainable development – circa 49 million Euros or 18% of the total. Other EU tools provide support to RM in the following areas: cross-border cooperation; justice and internal affairs; energy and environment; democracy and human rights; education.

The initial EU allocations for 2012 amounted to 94.2 million Euros. As a result of RM's exceptional performance in implementing structural reforms in view of ensuring the application of democratic standards and of creating a functional market economy, the EU, via the Eastern Partnership Integration and Cooperation (EaPIC) Programme, has considerably increased the budget for bilateral assistance – by 30%, based on the principle "more for more," thus reaching the level of 122 million Euros. To note that in 2013 the amount of assistance was planned at about 100.35 million Euros.

The allocations for 2012[261] provided 52.2 million Euros for the Budget Support Program for the Judiciary, 30 million Euros as support for implementing the program of EU-RM agreements (stage II of the CIB Program, Twinning and TA projects), 7 million Euros for the pilot regional development program and 5 million Euros for developing the budget support program for the vocational education. The additional amounts (28 million Euros) allocated by the EU were directed to ongoing healthcare programs, economic stimulations in the rural areas, judicial reforms.

Five budget support programs, with a budget of about 200 million Euros, were implemented in 2012, while the preparation for the next Budget Support Program (BSP) for the

[259] <http://www.ncu.moldova.md/pageview.php?l=ro&idc=549&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Uniunea-Europeana&>.

[260] <http://infoeuropa.md/interviuri/veaceslav-negruta-uniunea-europeana-ramane-principalul-donator-al-republicii-moldova/>.

[261] Due to the administrative procedures of the European Commission, EU fonds are disbursed employed with a delay of one to three years.

National Action Plan (NAP) 2013 were started with an estimative budget of 46 million Euros for reforms in vocational education and in mobility and security. Also, in 2012 eight Twinning projects were being implemented; three of them were completed during the reporting year, four were launched and other five new projects were at the preparation stage. The TAIEX instrument was one of the most preferred ones by the Moldovan public institutions that participated in 87 events with the attendance of 1244 civil servants. As to the central public administration reforms, the modernizing of the public procurement system and of the public internal control, they were supported via three SIGMA projects. In addition to the national program, RM benefits from other EU programs and instruments: Eastern-regional (e.g. TRACECA, INOGATE); inter-regional (Neighborhood Investment Program – FIV, TAIEX, SIGMA, CIUDAD, TEMPUS and Erasmus Mundus), of transboundary cooperation (Republic of Moldova – Romania – Ukraine and the Black See), of cross-border cooperation (South-Eastern Europe), topical (e.g. investments in people, migration and asylum, non-state actors and local authorities), internal EU programs (e.g. FP-7), etc.

The projects to be funded in the next period are determined in the development of the multiannual NAP based on the TS and annual action programs. The Moldovan Government actively participates in developing both documents and also of project documents. The external assistance plays an important role in supporting country development and integrating Moldova's economy in the EU economy.

The most important projects funded by the EU[262] in energy and environment included the Energy and Biomass in Moldova Project, implemented in the period from 2011 to 2014. Its total budget accounts to 14.56 million Euros (14 million Euros provided by EU and 560 thousand Euros by UNDP Moldova). In 2013, the project was launched in other 12 districts, thus covering the entire country. In the first two years, the project covered 20 districts and the ATU Gagauz Yeri. 104 rural communities in these regions have already been selected to connect their public institutions to alternative thermal systems than the existing ones. Modern biomass based stations have been installed in a total of 121 schools, kindergartens, community centers and mayor's offices with the project's financial support. Over 75 thousand persons will benefit from reliable energy and increased heating comfort. The new heating systems have led to creating 226 new jobs as well as launching tens of new businesses for producing pellets and bricks. The total investment of the project in these communities has been of US$ 8.143 million and the communities have contributed with US$ 2.434 million. By 2014, at least 130 schools, kindergartens, and other public institutions will install alternative biomass-based heating systems with the European financial support.

262 <http://eeas.europa.eu/delegations/moldova/projects/list_of_projects/projects_en.htm#>.

On 8 August 2013 a grant contract in the amount of 7 million Euros was signed, funded by the EU, between the Management Authority of the Romania – Republic of Moldova – Ukraine Common Operational Program (2007-2013) and the National Agency of Mineral Resources of Romania for the construction of the gas pipe Iași (Romania) - Ungheni (Moldova). The project will be implemented by the National Agency for Mineral Resources of Romania, as project leader, in partnership with the Moldovan Ministry of Economy and has a period of implementation of 17 months, following a high level of energy security for RM by diversifying the gas supply sources. RM receives 3 million Euros to interconnect the gas networks. The total project budget is of approx. 26.5 million Euros, of which 7 million Euros (26.4%) are the EU financial contribution, through the Common Operational Program ”Romania – Republic of Moldova – Ukraine, 2007-2013”, funded through the ENPT. The works started on 27 August 2013.

The Regional Network of Business Incubators (“Black Sea BI-Net”) is also funded through the ENPT and the Pre-adherence Assistance Tool (PAT) as part of the Black Sea Cross-border Cooperation Program (2007-2013). The Moldovan Organization for Developing Small and Medium-Sized Companies (ODIMM), together with partners from Turkey, Greece, Romania, Armenia and Ukraine has started the Project “Regional Network of Business Incubators” (Black Sea BI-NET). The project aims at creating an international incubators network in the Black Sea basin, transfer of technologies, exchange of good practices and support to the incubated SMEs for internationalization. So far, ODIMM, with the EU support has created 6 business incubators in Soroca, Leova, Ștefan-Vodă, Rezina, Sângerei and Dubăsari (Coșnița). Two new incubators are planned to be created in 2013 in Ceadâr-Lunga and Nisporeni. All the active incubators will be able to be members of the national and international network through which they will benefit from the experience and good practices of the countries of the Black Sea basin while the incubated companies will be able to promote their products for export. At least 20 business incubators of the partner countries will be part of this network. The “Black Sea BI-NET” project is a tool for the efficient development of the business environment and at the same time it is an important tool for promoting regional and international cooperation. The general objective of “Black Sea BI-Net” is to accelerate the development of productive and competitive economy in the Black Sea region by creating a network of incubators in the Black Sea basin; doing exchange of experience and knowledge between the business incubators; supporting the incubated SMEs in coming up to the international level. The project is funded through the ENPT and the PAT, as part of the 2007-2013 periods Black Sea Cross-border Cooperation Program. The project has a budget of 800 thousand Euros and a period of implementation of 24 months.

Other important donors at the bilateral and multilateral levels are USA, Japan, Sweden, Germany, Austria, Czech Republic, Denmark, Switzerland, Romania, Estonia, Hungary, Poland, the International Monetary Fund (IMF), WB, ERBD, EIB and UN.

The Agreement between the Moldovan Government and the US Government on Technical Cooperation was signed on 21 March 1994. The priority cooperation sectors are: economic growth; fair and democratic governance; agriculture; child protection; SME support. The type of financial instruments used is grants and technical assistance. Until 2010, most of the US assistance programs/projects in RM were provided by the United States Agency for International Development (USAID)[263], the project proposals being prepared in full by the USAID, in accordance with the pre-established areas of cooperation. The potential beneficiary was being consulted in the process of preparation of the project documents, and also the Government if the potential beneficiary was a governmental institution. The USAID assistance to RM has had a decreasing trend in the past years due to the former's orientation to Central Asia and the Near East. At the same time, in January 2004, the US Congress created the Millennium Challenge Corporation (MCC)[264], an innovative and independent agency responsible for foreign assistance in combating global poverty. The MCC came with a new approach to the external assistance by focusing on efficient policies, country's affiliation and results. On 22 January 2010, the US and RM signed the Compact Agreement in the amount of US$ 262 million, provided through the MCC. The Compact Program was launched in RM on 1 September 2010 and will be implemented until 1 September 2015. Two projects were developed within the RM-MCC partnership: (i) Transition to Advanced Agriculture – a grant in the total amount of US$ 101.70 million; and (ii) Rehabilitation of National Roads – a grant in the total amount of US$ 132.80 million. The Compact Program implemented in RM comes with a comprehensive approach to the economic growth, including the reforming of the management of water resources and of the maintenance of national roads. The Compact Program is a way to enhance the private sector and is based on the partnership between MCC and USAID in providing assistance to RM in accomplishing its development objectives. In the end, the Compact Program offers an integrated solution for poverty reduction. This aims at increasing agricultural productivity, promotes food safety and gives access to markets via more reliable roads. In 2012 there were 26 projects under implementation with a total budget of about 278 million Euros (including CPM) and 21 projects started in the reporting period with a total budget of about 16 million Euros. The disbursements in 2012 accounted for 35.59 million Euros and those planned for 2013-2014 – 57.42 and, respectively, 40.19 million Euros.

The Agreement on Technical Cooperation between the Japanese Government and the Moldovan Government was signed on 14 May 2008[265]. The assistance is provided through the Japanese International Cooperation Agency (JICA), an independent administrative institution created in 2002 to contribute to the economic and social development of developing countries and to extending Japan's international cooperation. At present, Japan considers the possibility of developing an assistance strategy for RM. The priority cooperation sectors are medical assistance, agriculture, cultural support, private/public sector development, SMEs. The financial tools and manners of assistance used are as follows: grants, credits, technical cooperation, including TA (training of expert, equipment supply). The total amount of the assistance provided by Japan to RM between 1992 and 2010 amounted to US$ 72.7 million as non-reimbursable assistance and US$ 48.2 million in credits. In 2012 Japan made disbursements to RM in the total amount of 1.36 million Euros.

Sweden is the European leader in providing assistance to RM[266]. According to the Cooperation Strategy between RM and Sweden for 2011-2014, the total amount of the assistance for the period represents 52 million Euros, including for promoting internal economic and social reforms, both under bilateral cooperation programs and through international structures[267]. Sweden supports RM in priority areas, including in promoting energy efficiency and rehabilitation of the energy sector. More recently, the Swedish Government has decided to change the manner of cooperation with the Central and Eastern European countries. For this purpose, there was developed the Regional Strategy for Eastern Europe for 2014-2020. Nine projects in the total amount of 20.8 million Euros are planned for the period 2014-2015 as part of the Moldovan-Swedish cooperation. At present there are 16 projects under implementation with a total budget of 36.8 million Euros. The disbursements in 2012 constituted 13 million Euros, and those planned for 2013-2014 represent 12.8 and 8.0 million Euros, respectively.

In October 2012, Moldova announced its intention to join the Fund of the Eastern Europe Partnership for Energy Efficiency and Environment (E5P), an intention reiterated at the Annual Assembly of the E5P Partnership Donors in London on 6 December 2012. The Fund was established at the initiative of the Swedish Government during its EU chairmanship in 2009 and was conceived to promote the investments in energy efficiency in the Eastern-European

263 <http://www.ncu.moldova.md/pageview.php?l=ro&idc=619&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Statele-Unite-ale-Americii-SUA/USAID&>.

264 <http://www.ncu.moldova.md/pageview.php?l=ro&idc=620&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Statele-Unite-ale-Americii-SUA/Corporatia-Provocarile-Mileniului-CPM&>.

265 <http://www.ncu.moldova.md/pageview.php?l=ro&idc=615&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Japonia&>.

266 <http://www.ncu.moldova.md/pageview.php?l=ro&idc=557&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Suedia&>.

267 <http://infoeuropa.md/suedia/>.

countries. The Fund announced its intention of extending its scope of funding in RM through grants and loans for energy efficiency and environmental projects. The estimative amount of the projects funded from this Fund accounts to approximately 100 million Euros while the potential grant amount accounts for about 20 million Euros. The multiplying effect of the funds raised for funding projects in the said areas is 1:5. To be noted that Republic of Moldova, Georgia and Armenia joined in October 2013 to Eastern Europe Energy Efficiency and Environment Partnership. This will allow generate projects in such areas as improvement of the heating and water supply systems, street lighting, energy efficiency of public buildings, urban transportation, waste management and recycling. In RM, the E5P partner agency in project implementation will be the Energy Efficiency Fund (EEF), which is especially created for fund raising and funding energy efficiency and renewable energy projects.

The German Agency for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH) implements projects in RM on behalf of the Federal Ministry for Economic Cooperation and development (BMZ)[268]. GIZ supports complex processes of reforms and changes in developing and transition countries. GIZ focuses its activities on the sustainable improvement of living conditions and of people's perspectives. In addition, environmental protection represents a central problem of the Federal Government. The development cooperation with Germany takes place under the Agreement between the Moldovan Government and the German Government on Technical Cooperation (1994) and the Intergovernmental Agreement on Financial Cooperation (2008)[269]. Since 1994 there have been implemented a number of important development projects that have aimed at facilitating the transition from a planned to a market economy. The strengths of the German commitments in RM are represented by the sustainable economic development and the approximation to the EU, especially by improving the local services in the country's villages and towns, including through investments and innovative technologies; strengthened capacities and modernized management of service providers; strengthening of intercommunity cooperation and local participation; better coordination among local, regional and national institutions, through integrated investment planning and scheduling; and through promoting SMEs. For example, agricultural efficiency is promoted by funding modern greenhouses. RM is also supported through micro-financing: the German capital bank "ProCreditBank" maintains close cooperation with the Credit and Reconstructions Institute (KfW). At present, GIZ is implementing 7 projects in Moldova. Since 1993, the total amount of German technical and financial assistance for Moldova has increased to 39.5 million Euros. In 2012 the German Federal Government allocated 3.6 million Euros for regional development projects and 10 million Euros for replenishing the National Regional Development Fund for implementing investment projects in modernizing the local public services while this year the disbursements have amounted to about 5.37 million Euros. In total, in 2012-2013, the German Government has provided 19.4 million Euros for the health sector (medical equipment), modernizing local public services, regional development fund, and others.

Another important partner is the Austrian Agency for Development (AAD)[270], an operational unit of the Austrian Cooperation for Development (ACD) created in 2004 in view of implementing and managing the funds of the Official Assistance for Development (OAD), responsible for implementing all the bilateral programs and projects in the ACD partner countries. The Office for Technical Cooperation with Austria was opened in Chișinău in 2005[271]. Initially, Austria established the following priorities for the assistance provided to RM: poverty reduction, rural development, and youth training. At present, the ACD activities are focused on supporting the implementation of RM's National Development Plan, Millennium Development Goals (MDG) and the EU-RM ENP Action Plan. At the end of 2012 the amount of the Austrian assistance provided to RM by the Austrian Development Agency was estimated at about 10.6 million Euros. At present, 20 projects in various areas are being implemented in RM under Austria's Cooperation for Development Program. The priority sectors of the RM-Austrian cooperation include water supply and sewerage (8 ongoing projects) and vocational education (5 ongoing projects). Since 2012, Austria has disbursed a total amount of 8.54 million Euros in RM, including 7.5 million Euros for improving the medical services at the Clinical Republican Hospital. The Country Strategy stipulates for RM a budget of 2.4 million Euros for 2013; 2.6 million Euros for 2014; and 2.6 million Euros for 2015 in the form of technical assistance, grants, and contracts for goods and works.

During the past years, the Chinese Government has actively participated in accomplishing the desiderata established by the Moldovan Government, especially in information technologies and healthcare, by offering modern equipment. In 2012, China offered to RM assistance in the amount of 6.61 million Euros, of which 4.70 million Euros were allocated providing computers to student dormitories and for monitoring the road traffic. For 2013, disbursements in the total amount of 6.23 million Euros were planned for 6 ongoing projects.

RM is the priority state of the Official Development Assistance (ODA) of Romania in accordance with the National Strategy on the National Policy for International Cooperati-

268 <http://www.ncu.moldova.md/pageview.php?l=ro&idc=589&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Germania/Deutsche-Gesellschaft-fur-Internationale-Zusammenarbeit-GIZ&>.

269 <http://infoeuropa.md/germania/>.

270 <http://www.ncu.moldova.md/pageview.php?l=ro&idc=555&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Austria&>.

271 <http://infoeuropa.md/austria/>

on for Development and the Action Plan for its implementation[272]. The development of bilateral relations with RM is a priority of Romania's external policy[273], which results from the historical relation, language, traditions and culture of the two countries. Romania's priorities via ODA in RM are as follows: provide support in RM's European perspective and intensify the bilateral cooperation. The sectorial priorities are as follows: good governance, strengthening of democracy and rule of law, agriculture and sustainable economic development, environmental protection, education and health. Romania provides assistance to RM in various cooperation frameworks, as follows: (1) the Agreement between the Romanian Government and the Moldovan Government on a non-reimbursable financial aid of 100 million Euros provided by Romania to RM, signed in Bucharest on 27 April 2010. The funds are provided based on projects agreed upon by the two parties in the Agreement's areas, i.e. infrastructure and transportation, education, energy, emergency humanitarian aid. So far, there have been allocated over 8 million Euros for emergency humanitarian aid (reconstruction of houses in the regions that were under floods in 2010) and other 9 million Euros are provided for building in 2013 the Iași–Ungheni gas pipe on RM's territory. In the education area Romania carries out a number of cooperation projects at all levels. The internships for the Moldovan students alone (about 5500 internships are provided every year) amounted to approx. 8 million Euros in 2010, 12 million Euros in 2011 and 13 million Euros in 2012. RM is also a priority partner country in the period 2012-2015. Starting with 2010, priority interest has been given to supporting RM's European integration, by contributing to strengthening the capacity of central and local public institutions and by supporting the democratic reforms and the civil society. In 2012, Romania made disbursements in RM in the total amount of 14 million Euros. In 2013, there are 14 ongoing projects of approx. 2.7 million Euros in the following areas: agriculture, health, modernizing local public services, support for European integration (legislative harmonization, institutional capacities), internal affairs, research and innovation, support to the civil society. At the same time, Romania is actively involved, beside RM, in cross-border cooperation projects supported by the European Union and aimed to contribute to the development and cohesion of the participating countries.

Czech Republic has been implementing cooperation for development projects in RM since 2001[274]. Starting with 2006, RM was chosen by the Czech Republic as a priority country for external development cooperation[275]. The Czech Development Agency (CzDA) is responsible for identifying, developing, implementing and monitoring cooperation for development projects in accordance with the development program approved in close cooperation with the partner country. As a rule, CzDA concludes a Memorandum of Understanding with its institutional partners for each separate project that stipulates the parties' rights and obligations. The projects are in full compliance with RM's priorities in the social area (improved quality of life, directed social assistance etc.), in water supply and sewerage (water resource exploitation and introduction of waste management), agriculture (improved competitiveness and efficiency), as well as environment (decontamination and reduction of environmental hazards). The cooperation for development program between the Czech Republic and RM for 2011-2017 is based on three priority sectors: environment protection, agriculture and the social sector. The program is a continuation of the previous program of cooperation with RM that put emphasis on the environment protection (cooperation in water protection, elimination of ecologic pollution, and many others), as well as on the social and medical sectors. Under the previous program (2006 - 2010) in RM there were implemented 25 important development projects whose common budget amounted to approx. 9.1 million Euros. The budget planned for 2011-2014 amounts to about 10.25 million Euros. By the end of 2012, 16 projects were under implementation. In 2013, the Czech Republic has made disbursements in RM in the total amount of 2.87 million Euros. So far, the Czech Republic has implemented in the RM projects of approximately 14 million Euros.

The assistance provided by the Danish Government to RM mainly relates to projects in environment, improvement of Parliament efficiency, strengthening of the civil society and of a free and independent press, promotion of rural economic growth and poverty reduction[276]. One billion DKK (133 million Euros) have been provided in the Neighborhood Program for 2013-2017 for the Eastern and South-Eastern Europe that will be disbursed in installments of about 200 million DKK per year[277]. The priority sectors are: (1) human rights and democracy, including good governance, regulation of conflicts and peace keeping, gender equality, rights of minorities, rights of indigenous peoples as well as strengthening civil society and independent media; (2) sustainable and inclusive economic development, including developing of the private sector in view of promoting sustainable economic growth, skill development, creation of jobs, ensuring energy efficiency and biotechnologies. The development assistance provided by Denmark is provided for and managed under the Act on International Cooperation for Development of 18 June 2012.

The Swiss Agency for Development and Cooperation (SDC)[278], a component part of the Swiss Federal Department for External Affairs is also very active in implementing techni-

272 <http://www.ncu.moldova.md/pageview.php?l=ro&idc=556&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Romania&>.
273 <http://infoeuropa.md/romania/>.
274 <http://www.ncu.moldova.md/pageview.php?l=ro&idc=590&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Republica-Ceha&>.
275 <http://infoeuropa.md/republica-ceha/>.
276 <http://www.ncu.moldova.md/pageview.php?l=ro&idc=631&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Danemarca&>.
277 <http://infoeuropa.md/danemarca/>.
278 <http://www.ncu.moldova.md/pageview.php?l=ro&idc=558&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Elvetia&>.

cal assistance projects in RM. Alongside other federal offices, SDC is responsible for the entire coordination of cooperation and development activities in Eastern European countries. The Swiss Government decided to open a permanent office in RM in 2000. Until September 2001, there were developed and approved bilateral agreements on humanitarian assistance and technical cooperation (including economic cooperation) and the SDC office received a diplomatic status. The cooperation activities aim to improve the living conditions for the most disadvantageous social layers. In the first years of cooperation, SDC provided to RM only humanitarian assistance that was offered to social institutions and winter programs for the vulnerable layers. Starting with 2005, the Swiss assistance was divided into two directions: (i) technical assistance, with the objective to contribute to strengthening and developing the entrepreneurial sector and to creating long-term jobs; and (ii) humanitarian aid, with the objective of contributing to reforms, rehabilitation in the selected areas of public health and social assistance. The priority cooperation areas are private sector development; generation of income; micro-financing; local economic development; social development; public health (mother and child health); social assistance (winter program for the vulnerable layers); water and sewerage system; rehabilitation of social institution. During the entire period of its work, SDC has funded 50 projects and humanitarian and technical assistance. At present, 11 projects funded by SDC are being implemented, with a total budget of US$ 4.3 million. The budget of the Swiss Strategy for Cooperation for 2010-2012 was of approximately 7 million Swiss francs per year. In 2012, Switzerland made disbursements in RM in the total amount of 5.8 million Euros. The Country Strategy stipulates a budget for RM of 7.4 million Euros for 2013 and of 8.7 million Euros for 2014 in the form of technical assistance, grants, contracts of goods and works.

Starting with 2006, RM is also one of the priority partner countries for Estonia[279]. The Protocol of Cooperation between the Estonian Ministry of Foreign Affairs and the Moldovan Ministry of Foreign Affairs has been in force since 3 April 1996. The assistance is provided in accordance with the Decision of the Estonian Government on the “Conditions and procedures of providing development and humanitarian assistance,” in force since 15 February 2010. Estonia’s strategy for providing cooperation for development and humanitarian assistance covers the period 2011–2015. The general objective of the cooperation for development provided by Estonia to RM is to contribute to eradication of poverty and accomplishment of the Millennium Development Goals. The financial allocations for RM have been as follows: in 2012 – 487 thousand Euros; in 2013 – 500 thousand euros; in 2014 – 700 thousand; and in 2015 – 900 thousand euros. The priority areas are: healthcare, education/science, good governance/economic development and others. The projects are identified by Estonia. Starting with 2000, Estonia’s contribution in various areas has increased ten times. In addition to the cooperation with the Estonian Ministry of Foreign Affairs, successful cooperation with RM has also taken place via other ministries and institutions (Ministry of Social Affairs, Ministry of Interior, Ministry of Agriculture, Ministry of Environment, Ministry of Education and Research, National Audit Office, Academy of Intelligence Sciences, and the Border Guard Service). The nongovernmental sector also shows increased interest in its activities with RM. The representatives of ministries and civic associations participate in the committee for the evaluation of cooperation for development projects that approves bilateral cooperation for development projects and supervises their implementation. To note also that the Training Center of the Eastern Partnership (EP) of the EU started its operation in Tallinn at the beginning of 2011. Under the experience of the Estonian School of Diplomacy, the training center carries out training programs and seminars in different aspects of public administration for the EP countries, including for RM. The center is funded from the cooperation for development budget of the Estonian Ministry of Foreign Affairs.

The first bilateral cooperation agreement between RM and Hungary was signed in 2007[280]. In 2007 Hungary committed to start 28 projects in RM with a total budget of HUF 73 million, of which HUF 4.5 million were allocated for the legislative harmonization program. The Hungarian Ministry of Foreign Affairs is responsible for planning and coordinating cooperation activities in international development (CID). The Governmental committee for CID, chaired by the Ministry of Foreign Affairs, coordinates Hungary’s development policy and determines its geographical and sectorial priorities. The committee is assisted by a Civil Advisory Council that is made up of representatives of the Ministry of Foreign Affairs, political parties, trade unions, academia, NGOs, and individual experts. The non-for-profit organization HUN-IDA is the agency that implements Hungary’s CID programs in RM. Its strategic objective is to support RM’s alignment to the EU standards and to provide economic and social assistance. The priority sectors are: good governance, European integration/legislative harmonization, justice, rule of law, agriculture, private data protection, democracy and infrastructure. By 2010, the Hungarian assistance for RM had reached to US$ 1.285 million. Hungary intends to plan project in a number of priority areas for RM’s development that partly focuses on continuing the previously established fruitful cooperation. In 2012, Hungary made disbursements to RM in the total amount of 0.62 million Euros, with 8 projects under implementation.

Since 2004, RM has been on the list of priority beneficiaries of the Polish assistance for development.[281] Poland’s coope-

[279] <http://www.ncu.moldova.md/pageview.php?l=ro&idc=628&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Estonia&>.

[280] <http://www.ncu.moldova.md/pageview.php?l=ro&idc=616&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Ungaria&>.

[281] <http://www.ncu.moldova.md/pageview.php?l=ro&idc=691&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Polonia&>.

ration for development is implemented in the form of bilateral assistance provided through NGOs, public institutions, Poland's Academy of Sciences and its organizational units, universities, as well as in the form of multilateral assistance provided through international organizations. The multilateral assistance represents approximately 75% of the cooperation for development provided by Poland. Its biggest part is the contribution to the EU general budget for cooperation for development. The other funds represent bilateral cooperation. The multiannual program for development for 2012-2015, in RM's case provides for 2013 a budget of PLN 3 million. The objective of the cooperation for development provided by Poland is to create conditions for sustainable development, especially by promoting and strengthening democracy, providing assistance in creating modern and efficient state institutions, actions contributing to poverty reduction and improvement of health conditions, as well as increasing the level of education and professional qualification of citizens. The sectors of priority cooperation with RM in the 2012-2015 are as follows: public security and border management; regional development, strengthening of public administration and local public authorities; agriculture and rural development. The financial instruments and assistance methods used are: technical assistance/training; small grants aimed at reaching the MDGs; the tasks of the cooperation for development can be delegated to the Polish Foundation for Cooperation for International Development "Know-How"; accordingly, the funds can be transferred directly to the budget of the beneficiary country; the Polish assistance also relates to projects implemented by other government agencies, including internships, assistance for the refugees, credits, debt reduction and restructuring. In 2012, Poland has made disbursements to RM in the total amount of 1.02 million Euros, with 21 projects under implementation.

RM joined the International Monetary Fund on 12 August 1992[282]. RM accepted the obligations established in Article VIII of the IMF Status on 30 June 1995. The strategic framework of cooperation is ensured by the Letter of Intention; Additional Memorandum on Economic and Financial Policies; and the Technical Memorandum of Understanding, signed on 31 August 2012, as well as the Progress Report on the RM's Poverty Reduction Strategy for 2011. The priority cooperation sectors are poverty reduction, MDGs, macroeconomic stability, developing the capacities of the public administration. The financial instruments and manners of assistance used include credits (extended crediting facility, extended funding facility) and technical assistance. RM's share in IMF represents 123.2 million SDI (around US$ 191 million) or 0.05% of the total share. RM's voting power in the IMF is 1973 votes or 0.08% of the total. The IMF three-year program for RM approved on 29 January 2010 is supported by a loan of 369.6 million SDI, 320 million of which (around US$ 490 million) have already been disbursed. Half of the amount of the loan is paid as part of the Extended Crediting Facility that has a zero interest rate until 2013, a grace period of 5 years and a half, and a maturity period of 10 years. The other part of the loan is provided as part of the Extended Funding Facility, with a yearly interest rate equal to the SDI base rate (now 1.15%) and is to be reimbursed in 10 years, having a grace period of 4 years and a half. In 2012, the IMF made disbursement in RM in total amount of 114.92 million Euros.

The multilateral approach, in the form of multi-donor fiduciary funds for the country, allows taking into account the Government's priorities together with the development partners priorities. These multi-donor interventions, including the project-based ones, directly contribute to implementing the existing national programs and strategies. Two multi-donor fiduciary funds provide assistance to the Moldovan authorities in reaching strategic objectives:

(i) Multi-donor fiduciary fund managed by the WB for implementing the Central Public Administration Reform; and

(ii) Neighborhood Investment Facility (NIF),[283] which combines grants from the EU budget with credits provided by multilateral European development banks, such as ERBD, EIB and CEB, as well as with the contributions of the partner countries. This supports infrastructure projects in transportation, energy, environment and social sector, as well as private initiatives (especially SMEs) in the EU Neighborhood.

Two decades of RM–WB cooperation[284] and the common efforts to ensure prosperity, reduce poverty and improve the quality of life of Moldovan citizens have been transposed in different types of support provided to the country in such areas as healthcare, education, agriculture, energy, water supply and sewerage, el-governance, social protection, competitiveness and many others. Over US$ 970 million have so far been committed to support 45 projects. Over 340 fiduciary funds have been implemented in an amount of over US$ 200 million. The International Financial Corporation and the Multilateral Investment Guarantee Agency – members of the World Bank Group – provided financial resources and guarantees in the amount of US$ 295 million. The current portfolio of the WB includes 11 investment projects. The total amount committed reaches US$ 255.6 million and the rate of disbursements constantly exceeds 20% yearly, reaching the record of 35.1% at the end of the fiscal year 2012. The IDA portfolio under implementation is vast and covers nearly every sector, although the highest concentration of

[282] <http://www.ncu.moldova.md/pageview.php?l=ro&idc=550&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Fondul-Monetar-International&>.

[283] <http://ec.europa.eu/europeaid/where/neighbourhood/regional-cooperation/irc/nif_moldova_en.htm>.

[284] <http://www.ncu.moldova.md/pageview.php?l=ro&idc=653&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Banca-Mondiala&>.

operations is in social protection, agriculture and rural development, as well as the financial and private sector. The WB manages a substantial portfolio of US$ 74 million as part of the Fiduciary Funds (one of the biggest in Europe and Central Asia), with rather satisfactory implementation experience, which participates in co-funding the IDA operations, fund the GEF and carbon operations, and provide other forms of support, including for the AAA. The AAA provided in the fiscal years 2010-2012 include an evaluation report on the country's procurements, a country economic memorandum, a regional study on the restructuring of the heating system, an analysis of public expenditures and TA on the monitoring of the financial sector. The financial sector, especially the WB has provided assistance with improving the legal and regulatory frameworks on e-payments and segments of the financial non-banking sector, assisted by the National Bank of Moldova in running stress tests for banks; has developed a new technique on the capital market development; provided assistance with organizing a round table on supervising financial services and has provided counseling and assistance in other areas through continuous dialog with the governmental partners. These TA products will be useful in promoting structural reforms and developing a new tool of economic growth for RM based not only on remittances but also on exports and investments. In addition to the continuous activity food security, the future AAA will include programmatic fiscal activities, subsequent activities A&A ROSC, continuation of activities in competition and structural reforms and TA in the health sector. There could be conducted specific analyses that would complete the crediting program proposed in the energy sector, education, rationalization, ALSAC development in agriculture. AAA in the financial sector could include actions to improve the intermediation of remittances, monitoring of the financial sector to support the measures of resistance to crisis and market development. In 2012, the WB made disbursements in RM in the total amount of 70.64 million Euros. For the 2013-2014 there are planned disbursements in the total amount of 33.04 and 20.07 million Euros, respectively. At the end of 2012, there were 23 WB projects under implementation in RM. Four of the projects approved during 2012 are meant for the implementation of reforms and for investments in agriculture, education and competitiveness development. In 2012 the WB started developing a new Country Partnership Strategy (CPS) for 2014-2017 that will support RM in increasing prosperity and reducing poverty, through full benefiting from openness and European integration, as well as from a higher level of global economy. Three pillars have been suggested that will contribute to diversifying and extending the country's institutional, human and natural capital: (i) increase competitiveness; (ii) strengthen human capital and minimize social risks, and (iii) promote an ecological, clean and optimistic Moldova.

European Bank for Reconstruction and Development (ERBD)[285] is one of the biggest investors in RM. From the beginning of activity in 1992, EBRD has signed over 100 investment projects in the country in the area of energy, transportation, agricultural entrepreneurship, industry and banking[286]. The total amount of investments attracted by EBRD in the country (including from the donors money) has exceeded 1.571 billion Euros[287]. The portfolio of EBRD's own investments in in Moldova has exceeded 795 million Euros. In 2012, the EBRD provided 94 million Euros for implementing 13 projects in RM (for comparison, in 2011 there were provided 69 million Euros for implementing eight projects). One of the priority directions has been the support provided to the Moldovan Government in energy and crediting of energy efficiency projects. The EBRD has offered 16 million Euros to the State Company "Moldelectrica" for modernizing the electrical networks and subsequent participation in the European network Entso-E. The second phase for MoSEFF[288] program on enhancing energy efficiency (22 million Euros) has been started and a broad framework project for funding energy efficiency in the residential sector MoREEFF[289] (35 million Euros) has been launched. In 2012, EBRD provided to the municipality of Bălţi a credit of 3 million Euros for buying new trolleybuses (1.4 million Euros more were offered by donors). In 2012, the Business Advisory Service (BAS) of EBRD, implemented with the financial support of Sweden and EU, funded 71 projects, giving small grants of 430 thousand Euros. Nearly half of the projects have been implemented as part of the initiative for reducing energy consumption (consulting services that have contributed to enhancing the energy efficiency of companies), as well as the initiative "Women in Business." In 2013, EBRD plans to participate in funding modernizing the water supply system in Chişinău. The biggest infrastructure project implemented with the financial support of EBRD is the reconstruction of national roads (Project I - 75 million Euros; Project II – 92.5 million Euros; Project III – 181.2 million Euros, Project IV – 315.5 million Euros). An advantage of EBRD is not only to provide credits for projects but also the dialogue with its partners in attracting additional funding in the form of grants and technical assistance. At present, it is this formula that is put on the basis of the dialog between EBRD and the Moldovan Government about the funding of the State Company "Calea Ferată a Moldovei" (Moldova's Railways) (CFM). The EBRD is preparing a feasibility study for the situation at CFM to establish all the technical and economic aspects of an eventual cooperation. It is expected in December 2013 there will be approved the funding of the project "Rehabilitation of the railway trans-

[285] <http://infoeuropa.md/berd/>.
[286] <http://www.ncu.moldova.md/pageview.php?l=ro&idc=652&t=/PROFILURILE-PARTENERILOR-DE-DEZVOLTARE/Banca-Europeana-pentru-Reconstructie-si-Dezvoltare&>.
[287] <http://www.ebrd.com/pages/country/moldova.shtml>.
[288] <http://infoeuropa.md/moseff/>.
[289] <http://infoeuropa.md/moreeff/>.

port system in Moldova" with a total cost of 30 million euros[290]. In 2012, the EBRD has made disbursements in RM in the total amount of 8.13 million Euros. For 2013-2014 there are planned disbursements in the total amount of 18.25 and 40.40 million Euros, respectively.

European Investment Bank (EIB)[291] is an important investor in RM. The Framework Agreement between the Moldovan Government and EIB on the EIB activities in RM was signed in November 2006. The extension of the EIB activity has been done in the context of the decision of the EU Council on providing a mandate of loan in the amount of 500 million Euros for the Eastern Neighborhood countries, including RM. On 28 June 2007 there was signed an Agreement between RM and EIB on funding the project for the rehabilitation connecting the capital city Chişinău with the EU border. This is the first EIB operation in RM. In six years, since RM has been cooperating with EIB, there have been started 9 investment projects in the total amount of 282 million Euros, in such areas as road infrastructure, wine production, renovation of public transportation in Chişinău, water supply and sewerage in a number of cities in the country and SME crediting. In 2012 EIB made disbursements to RM in the total amount of 27.84 million Euros. For 2013-2014 there are planned total disbursements of 27.56 and 52.29 million Euros, respectively.

Council of Europe Bank (CEB) is present in RM with the implementation of projects of mainly social infrastructure and is partner in the rehabilitation of the Republican Clinical Hospital. The project for the construction of dwellings for socially vulnerable layers (phase I) has already been completed and in 2012 there was signed the Agreement for funding phase II of the Dwelling Project, with a budget of about 20.3 million Euros, where the CEB loan represents 13.4 million Euros. Preparations have been started for conducting feasibility studies for launching a new project related to human right protection by improving detention conditions for arrested persons.

In the period from 2008 to 2012 in RM there were implemented 12 projects through the Neighborhood Investment Facility (NIF), which combines the grants from the EU budget with the grants provided by multilateral European development banks, such as ERBD, EIB and CEB, as well as with the contributions of the partner countries (Table 6-8).

RM's cooperation with the United Nations (UN) aims at tackling the main national development challenges and at reaching the country's development objectives at the international level and the human rights commitments. The program is developed and implemented jointly by the Moldovan Government and the respective UN agencies, and other stakeholders.

The activities of the UN agencies are in compliance with the national development priorities established in the National Development Strategy "Moldova 2020", the national sector strategies and other national strategy papers and action plans that support RM's transition to a modern and prosperous European country, with emphasis on equity and inclusion; achievement of the Millennium Development Goals and of sustainable development objectives for the period beyond 2015; and execution of RM's international normative commitments including in the area of economic, social, cultural, civil and political rights.

The three topical pillars of cooperation are: (1) democratic governance, equality and human rights; (2) human development and social inclusion; (3) environment, climate changes and disaster risk management.

In this connection, the UN cooperation with the Moldovan Government will support strengthening the regulatory and institutional capacity and of the conditions for good governance; promote the UN values and democracy; ensu-

[290] <http://www.ebrd.com/saf/search.html;jsessionid=1FF12199D0E9FFF9969F3CDFAEE764EB?type=project&country=Moldova>.
[291] <http://infoeuropa.md/banca-europeana-de-investitii/>

Table 6-8: Projects implemented and under implementation in RM via NIF in 2008-2012

Projects	Total costs, Euros	NIF Grant, Euros	Financial institution responsible
Modernizing of the Republican Clinical Hospital	20.5 million	3.0 million	CEB
Modernizing of Chişinău Airport	46.25 million	1.75 million	EBRD, EIB
Road Rehabilitation (Project II)	92.5 million	12.0 million	EBRD, EIB
Road Rehabilitation (Project III)	181.2 million	16.2 million	EBRD, EIB
Feasibility Study to Improve Water Supply and Sewerage System in Chişinău	59.0 million	3.0 million	EBRD, EIB, KfW
Water Supply System Development Program	31.5 million	10.0 million	EBRD, EIB
Public Transportation Project for Chişinău	15.45 million	3.0 million	EBRD, EIB
Rehabilitation of Wine Production Industry	391.3 million	2.0 million	EIB
Moldova Residential Energy Efficiency Funding Facility (MoREEFF)	41.8 million	5.0 million	EBRD
Moldova Energy Efficiency Funding Facility (MoSEFF II)	23.3 million	4.5 million	EBRD
Moldelectrica Transmission Network Rehabilitation Project	236.6 million	8.0 million	EBRD, EIB
Bălţi Trolleybus Company (Rehabilitation of Public Transportation in Bălţi)	5.0 million	1.6 million	EBRD
Total:	**1144.4 million**	**70.05 million**	

re equity by developing the national capacity of providing social services and inclusive development opportunities and will ensure sustainable environment development with adaptation to the climate changes and disaster risk management.

The resource needs established in the Action Plan of the partnership framework are partially covered from the regular/main resources or the estimated resources of the UN organizations but especially from extra-budgetary, bilateral and multilateral sources, private sources, by sharing costs with the government, and from the community contributions.

There are three types of assistance: (1) technical assistance; (2) financial assistance; and (3) equipment supply.

UN projects and programs are developed under the 2013-2017 UN-RM Partnership Framework and its Action Plan. The Action Plan is operationalized through annual working plans and/or project papers that establish actions for the Government and its partners in supporting the results agreed upon to get the UN financial and/or technical support. The project papers and annual activity plans are developed in consultation with the corresponding stakeholders within the Government.

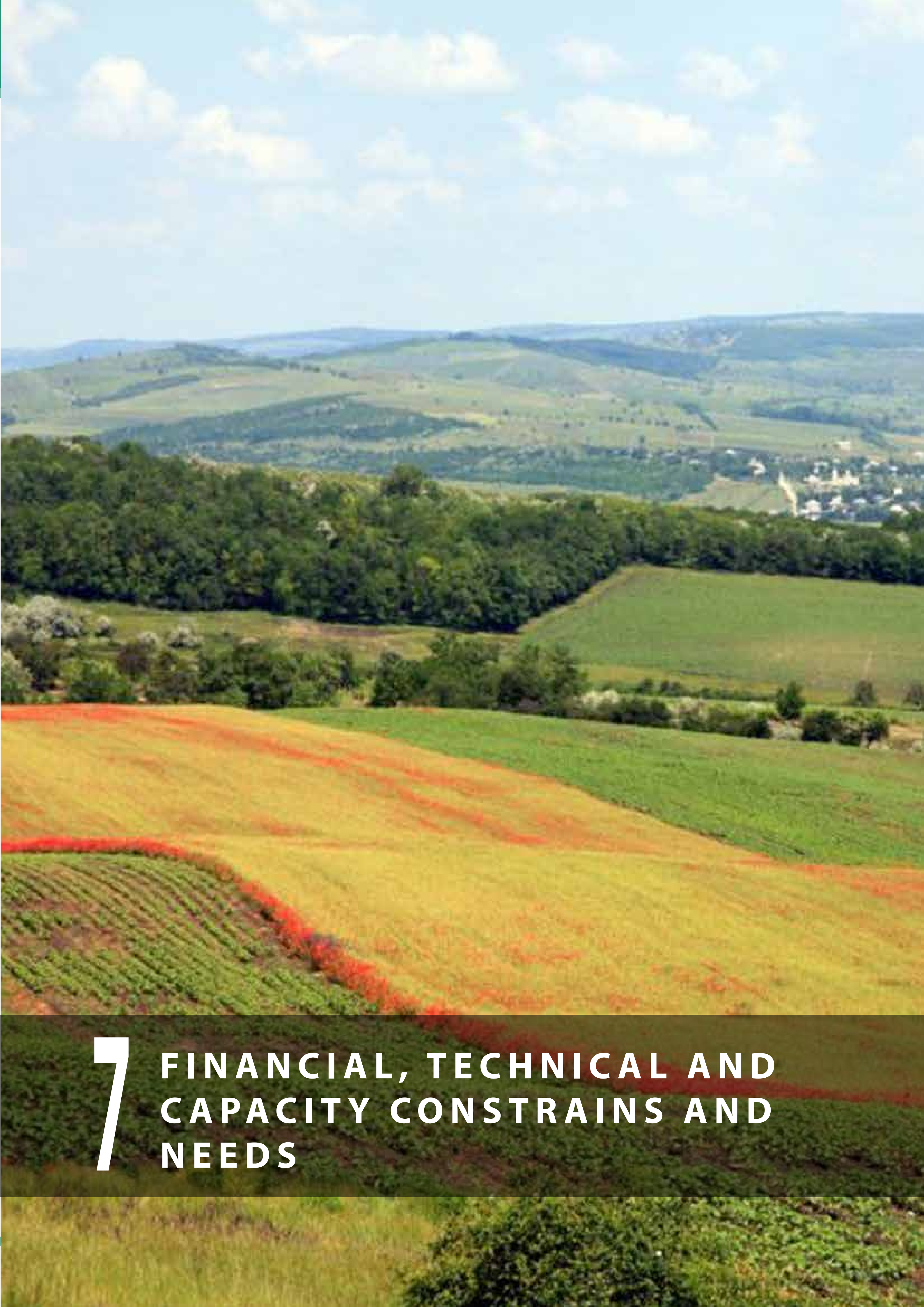
The partnership framework for 2013-2017 in RM includes over 20 UN agencies, funds and programs that through their activity contribute to reaching RM's development priorities: Food and Agriculture Organization (FAO), International Fund for Agricultural Development (IFAD), International Labor Organization (ILO), International Organization for Migration (IOM), Office of the High Commissioner for Human Rights (OHCHR), United Nations Common Program for HIV/AIDS (UNAIDS), United Nations Development Program (UNDP), United Nations Population Fund (UNPF), United Nations High Commissioner for Refugees (UNHCR), United Nations Children's Fund (UNICEF), UN Agency for Gender Equality and Women's Empowerment (UN Women), World Health Organization (WHO), World Bank (WB) and the International Atomic Energy Agency (IAEA), United Nations Commission for International Trade Law (UNCITRAL), UN Economic Commission for Europe (UNECE), United Nations Organization for Education, Science and Culture (UNESCO), UN Office for Drugs and Crime (UNODC), International Trade Center (ITC), UN Conference for Trade and Development (UNCTAD), United Nations Environment Program (UNEP) and the United Nations Industrial Development Organization (UNIDO). At the request of the Moldovan Government, the UN adopts the approach "Delivering as One" for better coherence and coordination.

Through the 2013-2017 Partnership Frameworks the UN structures active in RM commit to move to unity in their actions, enhancing coherence and cooperation among the UN agencies and their national partners and providing a broad picture of the UN support in the said period and a strategic emphasis thereon. The Action Plan transposes the Partnership Framework in practice, establishing how the UN agencies will work the national stakeholders as well as among themselves in view of harmonizing, simplifying and strengthening the coherence of the UN actions.

In 2012, the ongoing UN-supported projects followed the same priority areas, established in the United Nations Development Assistance Framework (UNDAF) 2007-2012, and namely: (i) good governance, rule of law, equal access to justice and human rights promotion; (ii) equal and guaranteed access to basic services and (iii) regional and local development.

Given the flexibility capacities and broad presence of UN agencies in our country, UN implements projects as implementation agency for other international multilateral structures. For example, during 2012, UN implemented the Common Local Integrated Development Program with the support of Swedish Government; the Project "Improving Irrigation System to Support Small Farmers," with the support of the Hungarian Government; the Institutional Capacity Enhancement Project, supported by the Romanian Government; the Energy and Biomass in Moldova Project, from the EU funds, and others. The summary of projects under implementation in cooperation with the UN agencies, for 2012, reveals 98 active projects, with a total budget of about US$ 50.5 million[292].

[292] Moldova State Chancellery (2012), Cooperation for Development 2012 Annual Report on External Assistance Provided to Moldova. Chişinău, July 2013.



7 FINANCIAL, TECHNICAL AND CAPACITY CONSTRAINS AND NEEDS

CHAPTER 7. FINANCIAL, TECHNICAL AND CAPACITY CONSTRAINTS AND NEEDS

7.1. Constraints on the Way to Low Carbon Development by Sectors

Financial, technological, institutional and economic constraints on the way to low carbon development in key sectors of the economy are described in the draft *Low Emissions Development Strategy of the Republic of Moldova until 2020*, developed in 2010-2013, which is to be approved by the Government in the first quarter of 2014. The most important constraints in each sector will be mentioned below.

7.1.1. Energy Sector

RM lacks an adequate regulatory framework and the low paying capacity of consumers and the relatively high cost of capital investment in RM make the investments either difficult to be achieved, or unbearably expensive.

So, lack of adequate funding and technology transfer are among the barriers that limit the power and thermal plants efficiency increase.

However, most of the measures aimed at reducing GHG emissions require investment that entails increased energy prices, which does not ensure sustainable economy.

The interest rates charged by local banks for loans are very high in general, all foreign loans are exposed to significant risks because RM is still defined as a country with a high risk (*long-term country risk rating is rated B3, Global Risk Premium is 14.8%*). For comparison, the country with the highest risk in the world is Belize (*long-term risk - Caa3, Global Risk Premium 20.8%*), Greece's risk was 16.3% (Caa1).

RM's investment risks are mainly determined by the Transnistrian separatism, and political and economic instability, what does not favour access to foreign loans.

Lack of interest for the rehabilitation or construction of new power plants in a free electricity generation market is another important barrier. The availability of electricity generation sources (Ukraine, MTPP) providing electricity at lower prices than a new plant is limiting investors' interest for construction of new power plants in the country.

It would seem that the more favourable legal framework for developing renewable is created. However, investors are reluctant to trust it because tariffs for electricity produced from such sources are not known *apriori*, i.e. "feed-in" tariffs was not approved yet. Consequently, accomplishment of objectives outlined in Government's strategic documents becomes problematic, in terms of renewable energy promotion.

High investment costs of renewable energy technologies and lack of certainty about balancing energy insurance when these sources are called to cover the energy demand are also a major obstacle to the expansion of renewable energy sources in the RM. An exception might be the use of biomass for heating in rural areas of the country where several projects of this kind have been launched with the support of foreign partners.

Weak institutional capacity leads to lack of viable projects in the energy sector. An eloquent example in this regard is lack of an integrated plan for district heating system restructuring, including in Chisinau municipality.

Accomplishment of the objective of joining the EU, the RM will have to necessarily comply with the EU Emissions Trading System (EU ETS). As a result, CO_2 reduction activities are an important factor towards boosting energy efficiency in RM.

RM considers the appropriateness of concluding a bilateral agreement with the EU aimed at identifying the potential for the Kyoto Protocol's CDM credits related to projects approved after 2012, credits to be used in the EU ETS. However, the uncertainty of the future demand for such credits affects the prices and investors' interest in a negative way.

Currently there is no definite solution at the international level on policy framework regulating CO_2 emissions. However, it can be stated for sure that mitigation policies will be based on market instruments and price capping.

This approach is already confirmed by the EU decision to set limits on CO_2 emissions and prices. This means that the RM has to start preparing institutional changes and to change the activity paradigm of all entities releasing GHG emissions, including power plants, since once implemented, such a system will quickly cover not only international air emissions traffic, but also the emissions from other emission categories and sources.

7.1.2. Transport Sector

Reduction of GHG emissions from the transport sector will require significant changes in transport planning and infrastructure, as well as transition to low-carbon fuels. One of the barriers associated with demand for energy efficiency improvements in commercial vehicles is the perceived commercial risk of investing in the development of efficient technologies, which partly results from lack of clear regulatory signals in the form of standards on vehicle efficiency.

In terms of demand, pre-operating costs for electric and hybrid vehicles are high. Lack of infrastructure for charging electric vehicles is also a barrier.

Such fuels as compressed natural gas, liquefied petroleum gas and bio-fuels (bio-ethanol, biodiesel) have to be promoted as less carbon-intensive alternatives, compared to conventional petroleum-based fuels.

Domestic fossil fuel resources are very limited and the RM faces fuel security related problems, the same for gas and oil supplies.

Use of bio-fuels, given the demand for arable land and water resources for irrigation, compete with more pressing domestic policy objectives related to food security.

A major challenge faced by public transport infrastructure projects is associated with very high pre-operational capital costs.

Other issues include poor urban planning and inadequate institutional mechanisms for managing transport demand in urban areas.

7.1.3. Buildings Sector

Many energy efficiency projects in buildings are too small to attract the attention of investors and financial institutions. The small size of the projects along with disproportionately high transaction costs prevents some energy efficiency investments.

In addition, the low share of energy costs in disposable income of affluent population groups and the opportunity costs associated with time, often limited to these groups, to identify and implement efficient solutions, severely limits the motivation to increase energy efficiency in the buildings sector.

Thermal insulation of multi-storey blocks of flats encounters more difficulties like:

- An owner of a flat connected to the district heating system is not interested to insulate the exterior walls, as economic gain is minor, given that the heat used to heat the flat is not metered for the flat only, but for the whole block of flats;
- Insulation of exterior walls of the residential buildings leads to a decrease of the thermal load at the cogeneration power plants in Chisinau and Balti and the heat plants in other towns, what in consequence reduces the overall efficiency of these sources, of electric capacity fed into the network, and as a result, freezes the investment made in construction of these facilities and increases the price of heating;
- Usually, residents resort to thermal insulation of external walls of residential blocks only if they have individual heating systems installed. They resort to such actions because the quality of district heating services is low. To discourage switching to individual heating systems, the Government issued a decree requiring owners of individual heating systems to pay 20% of the cost of heat provided through the district heating systems, which sparked discontent among them.

7.1.4. Industrial Sector

Though there is a wide range of cost–efficient technologies to reduce GHG emissions, full implementation of such technologies is hindered by a multitude of economic barriers.

The existing machinery and equipment at the industrial enterprises of the RM is highly outdated and obsolete, while the state has limited possibilities to financially support the restructuring and re-tooling the industrial enterprises.

In industry there is a growing shortage of qualified engineering and technical personnel and a deep mismatch between the training of technical staff and the needs of the industry.

The slow rate of the capital stock rotation in many areas is a barrier to mitigate GHG emissions. The capacity excess that exists in some industries may slow further rotation of the capital stock. Policies that encourage capital stock rotation will increase greenhouse gas mitigation. New, relatively expensive technologies often have longer payback periods and represent a greater risk.

Lack of an enabling business environment is also a barrier to technology transfer. The ability of SMEs to access and absorb information about the best performing technologies is often limited. Even large companies have limited technical resources to interpret and translate the information available on this subject.

Another important constraint is lack of energy service companies (ESCO) which would assume the role to help the SMEs to find and fund efficiency improvements. Establishment of energy service companies is constrained by the non-availability of starting capital from the financial institutions that are not used to the business model of such organizations.

7.1.5. Agriculture Sector

Agricultural activity in the RM is volatile and highly vulnerable to risks, being particularly susceptible to climatic factors (such as droughts, frosts, floods, hail, and soil erosion). Reducing dependence on such phenomena is a major challenge for the sector. Other barriers to low carbon development are associated with:

- reduced budget allocations, especially for the renovation of inventory basis, and lack of capital investment for assets renovation;
- insufficient financial support from the *Fund providing subsidies to agricultural producers* (agricultural subsidies in recent years did not exceed 3% of budget expenditures);
- insufficient level of agricultural insurance market development;
- excessive fragmentation of agricultural land, which contributes to decreasing of agricultural production efficiency by not following the respective tillage technologies;

- insufficient development of conservative agriculture;
- insufficient and disproportionate fertilization of crops with chemical fertilizers (20-25 kg/ha of active ingredient, of which 80-90% nitrogen fertilizers), gradually depletion of phosphorus and potassium content in the soil with a negative effect on quality of agricultural production;
- incomplete use of organic fertilizers on arable lands, what leads to lowering the efficiency of chemical fertilizers, creating a strongly negative balance of humus and soil carbon, increasing GHG emissions, destroying and strong compaction of the arable layer and increase the risk of drought events with serious consequences for the soil quality status and production capacity of agricultural soils;
- lack of investment to revive the livestock sector and for the implementation of sustainable systems of manure management;

Unfortunately, along with positive changes (privatization, multitude of legal forms of production process organization, competition, initiative, entrepreneurship climate enhancement, etc.), such structural changes have caused the emergence of evident inter-sectoral disparities that resulted from job losses, reduced investment, high share of subsistence agriculture, use of mostly obsolete agricultural production technologies, low labour productivity and high production costs, excessive simplification of crop rotation, reduced product range and poor quality of agricultural production, underuse of mineral and organic fertilizers, respectively a strongly negative balance of humus and soil fertility, etc.

Forage crops were excluded from cropping, as well as some industrial crops, including tobacco, partially sugar beet, as well as vegetables, potatoes, aromatic oil crops, medicinal plants and other products with high added value. The production of the basic livestock products significantly decreased due to the fact that the livestock sector became dominated by small-scale production in individual farms with predominately extensive production technologies. As a result, not only sector productivity decreased, but environmental pollution has intensified, due to the fact that animal waste are not used in the fields as organic fertilizer, but remain stored within the areas of rural settlements.

In recent years, the share of foreign direct investments in agriculture was only about 1.5% of total investment, which indirectly confirms the low competitiveness of this sector of the national economy.

7.1.6. Forestry Sector

Cases of illegal timber harvesting are still frequent. According to statistics, in 2012 the amount of illegally cut timber accounted for 0.9% of the total amount harvested.

The current production processes monitoring and control system in the forest sector is only applied to forest areas managed by the “Moldsilva” Agency. So, a broad range of monitoring and forest management efforts are needed to address the deforestation issues faced by the country at present.

7.1.7. Waste Sector

The legal framework on waste management in the RM is still underdeveloped, requiring of both legal and institutional restructuring, as well as creation of an integrated recycling and waste recovery system.

Worsening of waste management related problems, including management of municipal solid wastes occurs due to lack of waste processing capacity. Another important problem encountered in the course of waste management projects implementation is conditioned by the lack of available land for siting solid waste landfills, which will require the purchase of land.

To reduce the biodegradable fraction of municipal waste, significant investment and specialized treatment facilities that have significant operating costs and are based on advanced technologies, will be required.

It is also worth mentioning that the current statistical system of waste management follows a different the European Union approach.

7.2. Capacity Building Needs

The capacity in climate change mitigation should be understood as the ability of individuals, relevant groups, organizations and institutions to solve problems associated with climate change, this activity being considered as part of a series of efforts towards sustainable development[293].

The needs for climate change emissions mitigation capacities are relevant and have to be available in four dimensions:

- research and evaluation in climate change;
- formulation of climate change strategies and policies;
- implementation of climate change strategies and policies;
- negotiation of climate change issues internationally, mainly to attract funds. [294]

7.2.1. Capacity to Conduct Climate Change Research and Assessment

As noted above in Chapter 6, there is a wide network of research institutions in different areas, but no structures clearly oriented towards research in climate change mitigation. This is justified by the fact that the country does not feature sectors with significant GHG emissions and the legal

[293] Donor assistance to capacity development in environment, OECD, Paris, 1995.

[294] Sagar, A. Capacity development for the environment: A view from the south, a view from the north, in: Annual Review of Energy and Environment 25, 2000, pages 377–439.

framework did not reflect climate change mitigation as the country's priority, so far. However, the respective institutions continue to maintain climate change related research structures and quite skilled personnel, what make it possible to conduct studies on climate change phenomena, including for the development of NCs and NIRs to the UNFCCC.

It is true, however, that not all the same can be said about calculation models available and applied, as well as information capacity available for this purpose. For example, since 2000, the Institute of Power Engineering of ASM (IPE ASM) has obtained the license to use the ENPEP (Energy and Power Evaluation Program) package models (WASP and IMPACT models being mostly used). Due to insufficient budgetary funding, the specialists who successfully used these instruments left the institute, and the IPE ASM lost the professional capacity to conduct studies on the development of energy sources in the country. Virtually the same happened with the calculation model MARCAL. Use of other tools such as MAED (Model for Analysis of Energy Demand), LEAP and others, runs into an obstacle of a different nature. Input data are not available from credible sources and independent collection of data needed by experts requires significant time and financial resources. In other words, the national statistical system is far from meeting the requirements for conducting studies aimed at assessment of energy efficiency potential and development of energy demand based on "bottom up" approach.

Most currently, the RM enjoys the support provided by the USAID and UNDP to identify the needs for restructuring to be undertaken in the statistical system of the country so that it is in line with the EU statistical system. So, one can expect to have a system of official statistics meeting the requirements for studies and research towards climate change mitigation not earlier than 5-7 years.

7.2.2. Capacity to Formulate Climate Change Strategies and Policies

At this point any policy on climate change actions has not yet been approved by the Government in the RM. The draft Low Emissions Development Strategy of the Republic of Moldova until 2020 started being developed in late 2010, but until now it has not yet been approved, being at the final stage of endorsement by stakeholders and is planned to come into force in the first quarter of 2014 year.

The first LEDS draft was developed by international consultants with the support of the Regional Bureau for Europe and Community of Independent States (RBEC Bratislava) of the United Nations Development Programme (UNDP) and UNDP Moldova. Subsequently, this process has involved numerous national consultants who have contributed with important amendments.

LEDS was developed in accordance with the Government Activity Programme of the Republic of Moldova "European Integration: Freedom, Democracy, Welfare" (2011-2014), Chapter "Environmental Protection", as well as provisions of Chapter "Climate Change" of the EU Association Agreement.

There is a wide range of other national and sector strategies already approved which deal with climate change mitigation. Some of these have been developed being largely supported by external donors. In this sense, energy strategies of the RM are of relevance. The first Energy Strategy of the Republic of Moldova until 2010[295] was approved in the end of 2000. This strategy has not achieved its goals due to lack of proper attention to the energy sector. With the intention to make the strategy realistic, a new Energy Strategy of the Republic of Moldova until 2020[296] was drafted and approved by the Government in 2007. But this strategy has not been fully implemented as well, the main cause being the multitude of targets which dispersed the attention of policy makers towards the country's most important objectives. To overcome the situation, a new Energy Strategy of the Republic of Moldova until 2030[297] was approved in 2013, largely developed by external consultants, with the financial support of the EU. It has limited objectives, however hopes for effective implementation of these objectives is still quite reserved. Thus, about US$ 2 billion have to be put into value over about six years, an incredible amount of investment for the RM, the Gross Domestic Product of which in 2012 was only about US$ 7.252 billion[298].

Strategies developed for other sectors had similar fates. The fundamental reason for such a state of things, when the development documents for the most important sectors remain with no impact on the country, is lack of studies substantiating the objectives set out in the policy documents. So, the targets set out are more like wishes, since there is no financial and organizational justification of social, technical, economic, etc. impacts behind them. Most of the national consultants (and national institutions) have the capability to carry out such studies. The problem is, however, the ability to formulate and compile them into a credible strategic document. Donor assistance in this area is much welcomed. Such assistance would yield a draft policy document that would specify in a pragmatic way the need for such studies and funding options.

7.2.3. Capacity to Implement Climate Strategies and Policies

The Low Emissions Development Strategy of the Republic of Moldova until 2020 is to be approved by the first quarter

[295] Government Decision No. 360 of April 11, 2000 „On Approval of the Energy Strategy of the Republic of Moldova until 2010". Official Gazette, 2000, No.42-44.
[296] Government Decision No. 958 of 21.08.2007 on Energy Strategy of the Republic of Moldova until 2020. Official Gazette No. 141-145/1012 of 07.09.2007.
[297] Energy Strategy of the Republic of Moldova until 2030. Government Decision No. 102 of 05.02.2013. Official Gazette No. 27-30/146 of 08.02.2013.
[298] World Economic Outlook Database, April 2013. International Monetary Fund. Retrieved April 16, 2013.

of 2014 and contains sector policies and actions to mitigate direct GHG emissions, which are largely reflected in other policy documents. Many of these are aimed at achieving priority goals within key sectors of the economy, the aspect of climate change mitigation being of secondary importance in most of them. Compiling sector policies with an impact on climate change mitigation in a single document (LEDS) raises the likelihood of implementation, given the global importance of the problem of climate change action, and, as a result, availability of international support to deal with it.

The main elements necessary for LEDS implementation in the RM are[299]:

- Adequate institutional capacity;
- Relevant regulatory framework;
- Action Plan to implement the activities planned.

The objective of the institutional arrangements for the implementation of Low-Emission Development Strategy of the Republic of Moldova 2020 shall cover three main areas:

1) national planning and integrating low emissions economic development priorities in national regulatory and strategic development priorities;
2) effective management of public and donors funding, transfer of environmentally friendly technologies to the benefit of LEDS and nationally appropriate mitigation actions (NAMA) implementation;
3) governance framework to ensure adequate monitoring and control of implementation of planned economic development actions by reducing emissions and the appropriateness of the measures contained in LEDS.

Highlighting low carbon development priorities in the country's political agenda can be achieved by means of high level advisory body, fully able to address cross-cutting issues in response to the combined challenges of climate change and green economic development.

Such a body is the "National Commission for the Implementation of the UNFCCC and the Kyoto Protocol mechanisms and provisions" (hereinafter National Commission), established by the Government Decision No. 1574 of 26.12.2003.

The nominal composition of the National Commission has to be reviewed to ensure a higher level of key ministries representation (at the Deputy Minister and/or Head of General Directorate level). Members of the Commission have to act as focal points for interaction of the Ministries they represent with the National Commission. The office of the Deputy Chairman of the National Commission shall be assigned to the Ministry of Economy (at the Deputy Minister level), the institution with direct responsibility for national development planning.

[299] Draft of the Low Emissions Development Strategy of the RM until 2020, <http://www.clima.md/lib.php?l=ro&idc=236&>.

Technical tasks related to the implementation of potential actions supported by donors and credited in energy, industry, buildings and transport sectors are to be assigned to the Agency on Energy Efficiency (AEE) under the Ministry of Economy; mitigation aspects in agricultural sector – to the Ministry of Agriculture and Food Industry (MAFI); mitigation aspects in the forestry sector - to "Moldsilva" Agency, while those related to waste and industry sectors (*refrigeration and air conditioning sub-sector*), to the Ministry of Environment (Environmental Pollution Prevention Office and Ozone Office, respectively).

The initial decisions on the general framework of the LEDS and nationally appropriate mitigation actions adopted at the Conference of Parties in Cancun (2010), indicate that the Monitoring, Reporting and Verification (MRV) will follow two fundamentally different approaches:

- Monitoring, reporting and verification of unilateral mitigation actions and analysis and overall assessment of LEDS implementation;
- Monitoring, reporting and verification of donors supported and credited mitigation actions.

These approaches will require fundamentally different sets of skills and capacities from the responsible institutions.

While Monitoring, Reporting And Verification of unilateral mitigation actions and LEDS progress allow to apply the UNFCCC reporting procedures and principles (through National Communications, National Inventory Reports and Biennial Update Reports), Monitoring, Reporting and Verification (MRV) of mitigation actions supported by donors or creditors will have to follow MRV principles and procedures similar to those currently used in CDM Projects.

Since the national institutions designated by government authorities for MRV procedures at the national level and project-based already exist, the responsibility for the MRV under LEDS and its components as well as nationally appropriate mitigation actions (NAMAs) could be shared as follows:

- *Climate Change Office* under the Ministry of Environment, which is the institution responsible for the analysis and evaluation of mitigation policies and compilation of and reporting at the international level of national communications, national inventory reports and biennial reports reviewed by the UNFCCC, shall be assigned the responsibility for monitoring, reporting and verification of LEDS and unilateral NAMAs implementation; and
- *Carbon Finance Office* under the Ministry of Environment, which is the institution responsible for overseeing the implementation of CDM Projects of the Kyoto Protocol, shall be assigned responsibility for monitoring, reporting and verification of the implementation of the supported and credited mitigation actions.

To gain international recognition and support for its actions, it is important for the RM to demonstrate its national commitment by institutional strengthening and making the necessary preliminary steps to promote low emissions economic development agenda.

So, the first steps in implementing the LEDS should be primarily focused on meeting the commitments and domestic measures, as well as creating a favourable institutional and regulatory framework.

The basic means for accomplishing LEDS objectives are the nationally appropriate mitigation actions (NAMAs) identified in the strategy as technologies and measures to reduce GHG emissions. The first step towards their implementation is developing Action Plans for each selected NAMA. For some of them, the Action Plan has been developed within the project "Technology Needs Assessment" funded by UNEP in 2011-2013. Development of Action Plans for other NAMAs requires capacity building and financial availability. Effectively, the major share of the needed resource are not available, consequently there is a need for enhanced external donors assistance.

7.2.4. Capacity to Negotiate Climate Change Aspects at International Level

Once the RM has made a national and international commitment to reduce GHG emissions and the institutional basis to meet these commitments is in place, the country becomes eligible for funding from the Green Climate Fund to implement supported NAMAs following their registration in the NAMAs Registry managed by the UNFCCC Secretariat.

Despite the fact, that specific procedures and instructions for applying for Green Climate Fund grants are not completed yet, formulation of prioritized NAMA projects for funding and support from the international community has to be initiated as soon as possible.

In this regard, the country shall request bilateral funding available through the rapid funding mechanism (Fast Track Funding), inclusively to prepare feasibility studies, technical assessments and full project documentation for priority nationally appropriate mitigation actions.

An additional measure to obtain financing for LEDS implementation could be the opportunity, considered by the Government, of concluding a bilateral agreement with the EU that would allow access to the European carbon market by providing credits generated from mitigation projects.

It should be noted that the ability to negotiate funding for GHG emission reductions in the RM is limited, and in the early stage of consolidation. Consequently, significant efforts are required to overcome this constraint.

It is expected that such skills can be well developed in the Global Project "Low Emissions Development Program" implemented by the UNDP in 25 countries around the world with the support of the EU and the Governments of Germany and Australia, which is expected to be implemented in the RM within 2014-2016 periods. The project objectives are aimed at strengthening national capacities so that it makes possible to: enhance the GHG inventory system; formulate nationally appropriate mitigation measures and low emission development strategies; and establish MRV systems aimed at supporting NAMA and LEDS implementation.

7.3. Financial Needs in the Context of Low Emissions Development

In order to achieve GHG emission reduction targets in the context of low emissions development, two categories of funding are required to be available. The first one is about the need to achieve the appropriate level of capacity in mitigating GHG emissions. The second relates to the volume of investments needed to implement measures and technologies that contribute to GHG reductions.

Estimates have shown that building the country's capacity to solve problems associated with low emissions development would require approximately US$ 1.2 million in the next four years (around US$ 0.3 million annually), other resources as one time input as technical assistance, mainly coming from international donors. Some of the resources, in the amount of US$ 642,000 have been allocated and are expected to be used in 2014-2016 under the Global Project "Low Emissions Development Program". More detailed information on the structure of financial needs mentioned above is shown in Table 7-1.

Table 7-1: Funding needs for capacity building in climate change mitigation area in the Republic of Moldova in 2014-2016, US$ million

Nr.	Capacity building areas	Financial needs	Comments
1.	Conducting studies, research, evaluations on climate change	0.30	To conduct studies, research and evaluations on climate change on annual basis
2.	Climate change strategies and policies formulation	0.15	To formulate justifications for the key elements of the sector strategies and action plans
3.	Climate change strategies and policies implementation	0.65	To develop NAMAs in conformity with the LEDS priorities
4.	Negotiating climate change aspects at international level	0.10	To have the possibility to widely participate in negotiation of future climate agreements at the international level
	TOTAL	**1.20**	

Regarding the investments needed for implementation measures and technologies that lead to GHG emissions reduction, identified by the RM and which will also ensure the sustainability of the national economy, they have been calculated on the basis of the investments planned to be made to implement prioritised NAMAs identified in the LEDS. The investment value and specific investments for GHG reductions are reflected in Table 7-2.

Table 7-2: The investments needed until 2020 to achieve the GHG emission reduction targets through the nationally appropriate mitigation actions

Nr.	Sector	Investment value		Specific investments for GHG reductions, Gg CO_2 annual/US$ million
		US$ billion	% of total	
1.	Energy	1.9664	30.1	0.34
2.	Transports	2.5330	38.7	0.28
3.	Buildings	0.9426	14.4	1.15
4.	Industry	0.0075	0.1	11.58
5.	Agriculture	0.5502	8.4	-1.20
6.	LULUCF	0.1647	2.5	22.89
7.	Waste	0.3757	5.7	0.95
	TOTAL	**6.5402**	**100**	**0.92**

The total investment required for the purposes referred to above amounts to US$ 6.540 billion. For comparison, in 2012 the Republic of Moldova's GDP was equivalent to US $ 7.252 billion. [300]

The investments would have the following destinations:

- 38.7% of the requested funding would be directed towards the transport and road management sector, including for: *production and use of biodiesel and bioethanol; implementation of "Bus Rapid Transit" systems; implementation of direct injection in internal combustion engines technology; use of compressed natural gas, liquefied petroleum gas in transport; implementation of electronic road pricing; implementation of non-motorized transport, hybrid electric vehicles, hybrid electric vehicles with electric grid connection; rehabilitation of much damaged roads, etc.;*
- 30.1% of the requested funding would be targeted to electricity and heat production sector, including for: *implementation of condensed natural gas boilers, cogeneration technology based on the use of internal combustion engines up to 500 kW electric capacity, cogeneration technology based on the use of gas turbines with capacity up to 500 kW, cogeneration power plants based on the use of internal combustion engines and gas turbines with capacity greater than 1 MW, combined cycle high capacity power plants on natural gas, integrated gasification combined cycle groups on coal (IGCC), grid-connected wind plants, wind pumping systems, grid connected photovoltaic plants, photovoltaic energy for small irrigation, small hydraulic power plants, no dams small hydropower plants, straw and pellets based power plants to provide heating for social and cultural facilities, etc.;*
- 14.4% of the requested funding would be directed to the buildings sector, including for: *walls insulation, room temperature programmed controllers; automatic temperature regulators, including with a day/night mode; replacing incandescent bulbs with energy efficient bulbs; installing heat meters in each apartment; implementation of pellets based heat plants, medium and large capacity heat pumps, etc.;*
- 8.4% of the requested funding would be directed to the agricultural sector, including for: *replacing harrow plough* with *heavy discs* plough *to process the soil up to 20 cm in depth without introducing organic fertilizers, implementation of crop rotations involving only often sown crops (straw grains, legumes grasses, perennial grasses) on slopes with inclination greater than 5°; use on a 5 fields crop rotation of one field as a field occupied by a legume sidereal crop (two harvested crops of autumn and spring vetch incorporated into the soil as green manure on each field once in 5 years); the conservative "mini -till" soil tillage system with introduction of mostly mineral fertilizers; conservative "mini-till" soil tillage system with use of mineral fertilizers and all agricultural waste products (straw, corn cobs, crop residues, etc.); conservative "no-till" tillage system with prior restoration of positive features of the post- arable layer and use of vetch, as intermediate crop, one year later as green fertilizer; conservative "mini-till" tillage system with prior restoration of positive features of the post- arable layer and use of vetch, as intermediate crop, one year later as green fertilizer; storing manure on platforms, composting manure, implementation of cattle feeding technology* implying use of different types of feed separately, *implementation of cattle feeding technology using one type mixtures (mono-ration); use of feed additives which reduce the formation of methane during the digestive process in cattle; manure processing for biogas and using it for energy production;*
- 5.7% of the requested funding would be directed to the waste sector, including for: *development of primary collection and storage of waste in urban and rural areas; development of regional infrastructure for municipal waste disposal by building regional municipal solid waste deposits and transfer stations; development of regional infrastructure for municipal waste disposal by building mechanical-biological treatment facilities; treatment of sewage sludge at the wastewater treatment plants in Chisinau, Balti and Cahul; biogas recovery at municipal solid waste landfill in Tintareni, etc.;*
- 2.5% of the requested funding would be directed towards the LULUCF sector, including for: *afforestation*

[300] World Economic Outlook Database, April 2013. International Monetary Fund. Retrieved April 16, 2013.

of areas and rivers protection belts and aquatic basins; extension of afforested areas; extension of areas covered with forest vegetation; restoration / rehabilitation of forest belts protecting the agricultural fields; program to support communities in sustainable and integrated management of forests and carbon sequestration through afforestation; planting of forest energy crops; reducing emissions from deforestation and forest degradation; implementation of "Moldova Soil Conservation" and "Development of Communities Forests Sector in Moldova" Projects, etc.;

- 0.1% of the requested funding would be the industrial sector, including for: *implementation of energy management systems according to ISO 50001; use of 2nd generation bio-fuel for thermal power generation; harmonization of the national regulatory framework with the EU (EC Regulation 842/2006 on certain fluorinated greenhouse gases) on phased suppression of F-gases that provokes GHG emissions; developing/improving the system of reporting data on imports and consumption of HFCs, products and equipment containing HFC, PFC and SF_6; training and provision of available tools/instruments to regulate HFCs, PFCs and SF_6; capacity building for Customs Service; phased decrease of HFC consumption, etc.*

Judging by the criterion of the highest level of direct GHG emissions reduction for the investments envisaged, in other words by the parameter "*Specific investment to reduce GHG*" in Table 7-2, it should be stated that the first by importance in reducing the GHG emissions per US$ 1 million investment, are: the LULUCF - 22.89 Gg CO_2/US$ million; industry - 11.58 Gg CO_2/US$ million, and buildings sector - 1.15 Gg CO_2/US$ million.

Such an approach, however, would not be right given that sectors with lower values of this parameter, as for example, the energy sector, should not consider all investment in the sector in determining "*specific investment to reduce GHG*", because such investments are geared mainly towards development of renewable energy sources to meet increasing energy demand and ensure energy security, which is currently quite low in the country. Investments in other sectors have the same effect.

Thus, in the absence of generally accepted guidelines on how to determine the aforementioned indicator, a more complex analysis should be made to determine the investment available application for emissions reduction.

The mitigation potential of the NAMAs to be implemented within 2014-2020, presented in accordance with the objectives of reducing GHG emissions from the Low-Emission Development Strategy of the RM until 2020 is presented in **Annex 2**, and the *Action Plan for the implementation of priority nationally appropriate mitigation actions* to achieve the overall objective of *Low Emissions Development Strategy of the RM 2020*, respectively in **Annex 3** of the TNC of the RM to the UNFCCC.

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ANNEXES

Annex 1: Republic of Moldova's National Greenhouse Gas Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of All Greenhouse Gases Not Controlled by the Montreal Protocol and Greenhouse Gas Precursors, 1990-2010

Annex 1-1: Inventory Year - 1990

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**35356.1083**	**-7180.2643**	**218.6027**	**10.6978**	**137.2194**	**428.0672**	**512.2303**	**294.9063**
1. Energy	**33365.5535**		**45.8690**	**0.6180**	**134.6595**	**423.1362**	**71.9509**	**293.0068**
A. Fuel Combustion	33364.9158		13.3788	0.6180	134.6595	423.1362	71.3692	293.0068
1. Energy Industries	19332.7655		0.4423	0.1653	54.2987	4.9157	1.3281	203.2514
2 Manufacturing Industries and Construction	2188.7285		0.0953	0.0167	5.8887	1.4012	0.1954	24.1072
3. Transport	3926.6606		1.1921	0.3352	38.6268	289.6096	54.5258	4.3700
4. Other Sectors	7762.4898		11.6427	0.0993	35.4060	127.0250	15.3004	60.5137
5. Other (other works and needs in energy sector	154.2715		0.0064	0.0016	0.4393	0.1847	0.0195	0.7646
B. Fugitive Emissions from Fuels	0.6377		32.4902	0.0000	NO, NE	NO, NE	0.5817	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	0.6377		32.4902	0.0000	NO, NE	NO, NE	0.5817	NO, NE
2. Industrial Processes	**1899.7988**		**0.0071**	**0.0035**	**2.4622**	**1.3407**	**409.0571**	**1.8994**
A. Mineral Products	1888.0806		NO, NE	NO, NE	2.2958	1.2584	392.0868	1.7797
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.3657	NO, NE
C. Metal Production	11.7182		0.0071	0.0035	0.1663	0.0822	7.0883	0.1198
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	9.5163	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**90.7560**			**0.0001**	**0.0001**	**0.0019**	**31.2223**	
4. Agriculture			**99.4897**	**9.7772**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			87.3513					
B. Manure Management			12.1384	4.4577			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				5.3195			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-7180.2643**	**0.1090**	**0.0032**	**0.0977**	**3.5884**	**NO, NE**	**NO, NE**
A. Forest Land		-2197.5790	0.0112	0.0006	0.0071	0.2544		
B. Cropland		-4196.1852	0.0978	0.0025	0.0906	3.3340		
C. Grassland		-786.5000	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**73.1279**	**0.2958**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			62.8611		NO, NE		NO, NE	
B. Wastewater Handling			10.2667	0.2958	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**217.3668**		**0.0430**	**0.0070**	**0.7949**	**0.8733**	**0.5202**	**0.0689**
Aviation	217.3668		0.0430	0.0070	0.7949	0.8733	0.5202	0.0689
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**210.8274**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-2: Inventory Year - 1991

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**31076.8754**	**-5080.1241**	**212.5720**	**10.7299**	**118.9043**	**376.9457**	**424.0149**	**256.1539**
1. Energy	**29193.0936**		**40.9613**	**0.5390**	**116.4861**	**366.4809**	**63.4604**	**254.5103**
A. Fuel Combustion	29192.4796		10.4689	0.5390	116.4861	366.4809	62.9165	254.5103
1. Energy Industries	17361.2078		0.3826	0.1457	48.8473	4.4530	1.2021	172.1415
2 Manufacturing Industries and Construction	1684.7939		0.0827	0.0140	4.6748	1.3740	0.1698	19.1446
3. Transport	3548.3245		1.0880	0.2951	34.4576	264.4692	49.7832	3.9274
4. Other Sectors	6294.8303		8.9152	0.0818	27.7087	96.1384	11.7409	56.4259
5. Other (other works and needs in energy sector	303.3231		0.0005	0.0024	0.7977	0.0462	0.0205	2.8710
B. Fugitive Emissions from Fuels	0.6140		30.4924	0.0000	NO, NE	NO, NE	0.5438	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	0.6140		30.4924	0.0000	NO, NE	NO, NE	0.5438	NO, NE
2. Industrial Processes	**1805.5679**		**0.0062**	**0.0031**	**2.3294**	**7.1967**	**333.7468**	**1.6436**
A. Mineral Products	1795.3959		NO, NE	NO, NE	2.1839	1.0436	326.3613	1.5383
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.2883	NO, NE
C. Metal Production	10.1720		0.0062	0.0031	0.1455	6.1531	0.0722	0.1052
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	7.0250	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**78.2139**			**0.0001**	**0.0001**	**0.0020**	**26.8078**	
4. Agriculture			**92.0923**	**9.8995**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			81.2128					
B. Manure Management			10.8795	4.0464			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				5.8531			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-5080.1241**	**0.0965**	**0.0026**	**0.0888**	**3.2662**	**NO, NE**	**NO, NE**
A. Forest Land		-1924.1010	0.0019	0.0001	0.0012	0.0426		
B. Cropland		-2498.4431	0.0946	0.0025	0.0876	3.2236		
C. Grassland		-657.5800	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**79.4158**	**0.2857**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			70.1560		NO, NE		NO, NE	
B. Wastewater Handling			9.2598	0.2857	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**232.8115**		**0.0487**	**0.0074**	**0.8447**	**0.9641**	**0.5792**	**0.0738**
Aviation	232.8115		0.0487	0.0074	0.8447	0.9641	0.5792	0.0738
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**427.7268**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-3: Inventory Year - 1992

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**21823.1088**	**-5111.5226**	**207.7844**	**7.9480**	**79.9920**	**195.6386**	**334.4593**	**170.1669**
1. Energy	**20587.3862**		**32.7354**	**0.3529**	**78.3833**	**186.1429**	**32.6833**	**169.0262**
A. Fuel Combustion	20586.8688		5.1318	0.3529	78.3833	186.1429	32.1902	169.0262
1. Energy Industries	13009.2232		0.2828	0.1102	36.6784	3.3396	0.8992	128.3280
2 Manufacturing Industries and Construction	962.3355		0.0403	0.0070	2.6619	0.4088	0.0879	10.8429
3. Transport	1986.1727		0.5432	0.1830	19.7994	128.4896	24.2288	2.4049
4. Other Sectors	4388.8608		4.2655	0.0508	18.6192	53.8737	6.9587	26.7322
5. Other (other works and needs in energy sector	240.2766		NO, NE	0.0019	0.6244	0.0312	0.0156	0.7182
B. Fugitive Emissions from Fuels	0.5175		27.6036	0.0000	NO, NE	NO, NE	0.4931	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	0.5175		27.6036	0.0000	NO, NE	NO, NE	0.4931	NO, NE
2. Industrial Processes	**1173.2440**		**0.0060**	**0.0030**	**1.5274**	**6.5042**	**280.4182**	**1.1408**
A. Mineral Products	1163.3615		NO, NE	NO, NE	1.3860	0.5263	274.2274	1.0384
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.1579	NO, NE
C. Metal Production	9.8825		0.0060	0.0030	0.1415	5.9779	0.0702	0.1023
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	5.9627	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**62.4785**			**0.0001**	**0.0001**	**0.0018**	**21.3579**	
4. Agriculture			**89.8359**	**7.3148**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			79.7688					
B. Manure Management			10.0671	3.5097			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				3.8051			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-5111.5226**	**0.0884**	**0.0024**	**0.0813**	**2.9896**	**NO, NE**	**NO, NE**
A. Forest Land		-1766.5038	0.0020	0.0001	0.0013	0.0466		
B. Cropland		-2761.3147	0.0864	0.0022	0.0800	2.9430		
C. Grassland		-583.7040	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**85.1187**	**0.2748**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			77.7145		NO, NE		NO, NE	
B. Wastewater Handling			7.4042	0.2748	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**96.2635**		**0.0189**	**0.0031**	**0.3512**	**0.3847**	**0.2288**	**0.0305**
Aviation	96.2635		0.0189	0.0031	0.3512	0.3847	0.2288	0.0305
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**531.1505**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-4: Inventory Year - 1993

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**16595.8911**	**-2416.7596**	**197.0836**	**7.8543**	**63.1479**	**160.3229**	**266.7580**	**146.0971**
1. Energy	**15776.0767**		**28.9628**	**0.2933**	**61.6055**	**149.7682**	**25.0331**	**144.5701**
A. Fuel Combustion	15775.6384		4.1598	0.2933	61.6055	149.7682	24.5895	144.5701
1. Energy Industries	11336.5625		0.2533	0.1010	32.0283	2.8827	0.7709	121.2726
2 Manufacturing Industries and Construction	539.8762		0.0267	0.0043	1.4796	0.6719	0.0576	5.0323
3. Transport	1463.2667		0.3525	0.1382	15.0985	85.9911	16.2216	1.8949
4. Other Sectors	2249.3719		3.5220	0.0478	12.4659	60.0628	7.5191	15.0889
5. Other (other works and needs in energy sector	186.5611		0.0054	0.0020	0.5331	0.1598	0.0203	1.2813
B. Fugitive Emissions from Fuels	0.4382		24.8030	0.0000	NO, NE	NO, NE	0.4437	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	0.4382		24.8030	0.0000	NO, NE	NO, NE	0.4437	NO, NE
2. Industrial Processes	**769.0314**		**0.0061**	**0.0030**	**1.4332**	**6.5401**	**224.4332**	**1.5270**
A. Mineral Products	758.9541		NO, NE	NO, NE	1.2918	0.4444	218.2458	1.4258
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.1077	NO, NE
C. Metal Production	10.0773		0.0061	0.0030	0.1414	6.0957	0.0695	0.1012
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	6.0103	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**50.7831**			**0.0001**	**0.0001**	**0.0019**	**17.2917**	
4. Agriculture			**83.0069**	**7.2909**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			74.9883					
B. Manure Management			8.0186	2.9555			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				4.3354			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-2416.7596**	**0.1179**	**0.0032**	**0.1092**	**4.0127**	**NO, NE**	**NO, NE**
A. Forest Land		-1491.3852	0.0001	0.0001	0.0001	0.0001		
B. Cropland		-437.5904	0.1178	0.0031	0.1090	4.0126		
C. Grassland		-487.7840	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**84.9898**	**0.2637**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			77.8178		NO, NE		NO, NE	
B. Wastewater Handling			7.1720	0.2637	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**62.0927**		**0.0099**	**0.0020**	**0.2331**	**0.2215**	**0.1293**	**0.0197**
Aviation	62.0927		0.0099	0.0020	0.2331	0.2215	0.1293	0.0197
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**763.4134**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-5: Inventory Year - 1994

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**14999.4874**	**-2379.2647**	**192.2448**	**6.0290**	**56.7902**	**146.6000**	**175.1392**	**102.6067**
1. Energy	**14335.8965**		**28.1368**	**0.2611**	**55.6893**	**137.6924**	**23.0075**	**101.8663**
A. Fuel Combustion	14335.4880		4.2653	0.2611	55.6893	137.6924	22.5806	101.8663
1. Energy Industries	9998.7215		0.1898	0.0875	28.6601	2.8304	0.7050	82.8434
2 Manufacturing Industries and Construction	807.8587		0.0224	0.0030	2.1880	0.5786	0.0778	1.5249
3. Transport	1271.1186		0.3262	0.1270	12.4665	79.3899	14.9588	1.4527
4. Other Sectors	2112.0567		3.7236	0.0423	11.9701	54.7840	6.8245	14.8890
5. Other (other works and needs in energy sector	145.7325		0.0033	0.0014	0.4045	0.1096	0.0145	1.1562
B. Fugitive Emissions from Fuels	0.4085		23.8714	0.0000	NO, NE	NO, NE	0.4269	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	0.4085		23.8714	0.0000	NO, NE	NO, NE	0.4269	NO, NE
2. Industrial Processes	**621.8877**		**0.0063**	**0.0032**	**1.0396**	**6.6573**	**137.9887**	**0.7405**
A. Mineral Products	611.4205		NO, NE	NO, NE	0.8955	0.3258	131.9842	0.6385
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0323	NO, NE
C. Metal Production	10.4672		0.0063	0.0032	0.1441	6.3314	0.0701	0.1020
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	5.9020	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**41.7033**			**0.0001**	**0.0000**	**0.0017**	**14.1431**	
4. Agriculture			**81.1566**	**5.5020**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			73.2244					
B. Manure Management			7.9323	2.8481			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				2.6539			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-2379.2647**	**0.0670**	**0.0018**	**0.0612**	**2.2486**	**NO, NE**	**NO, NE**
A. Forest Land		-1743.7096	0.0031	0.0002	0.0020	0.0710		
B. Cropland		-31.8751	0.0639	0.0017	0.0592	2.1776		
C. Grassland		-603.6800	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**82.8780**	**0.2608**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			76.5442		NO, NE		NO, NE	
B. Wastewater Handling			6.3338	0.2608	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**37.8235**		**0.0058**	**0.0012**	**0.1433**	**0.1323**	**0.0766**	**0.0120**
Aviation	37.8235		0.0058	0.0012	0.1433	0.1323	0.0766	0.0120
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**599.5042**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-6: Inventory Year - 1995

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**11556.9918**	**-1160.8385**	**181.7577**	**6.4771**	**47.8938**	**145.3208**	**162.6902**	**61.0006**
1. Energy	**11030.3907**		**29.4496**	**0.1996**	**46.9101**	**135.3017**	**23.2127**	**60.4022**
A. Fuel Combustion	11029.9714		2.9941	0.1996	46.9101	135.3017	22.7366	60.4022
1. Energy Industries	6913.6176		0.1314	0.0496	19.4831	2.0275	0.5135	46.0290
2 Manufacturing Industries and Construction	452.0136		0.0153	0.0022	1.2336	0.3226	0.0455	1.3217
3. Transport	1297.6775		0.3431	0.1073	12.3891	83.5294	15.7355	1.4669
4. Other Sectors	2193.9896		2.5000	0.0387	13.3229	49.2149	6.4240	9.8365
5. Other (other works and needs in energy sector	172.6731		0.0043	0.0018	0.4813	0.2073	0.0181	1.7481
B. Fugitive Emissions from Fuels	0.4194		26.4555	0.0000	NO, NE	NO, NE	0.4761	NO, NE
1. Solid Fuels			NO, NE		NO, NE	NO, NE	NO, NE	NO, NE
2. Oil and Natural Gas	0.4194		26.4555	0.0000	NO, NE	NO, NE	0.4761	NO, NE
2. Industrial Processes	**488.4036**		**0.0066**	**0.0033**	**0.8959**	**6.7854**	**126.5848**	**0.5984**
A. Mineral Products	477.5446		NO, NE	NO, NE	0.7502	0.2171	119.1409	0.4970
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0267	NO, NE
C. Metal Production	10.8590		0.0066	0.0033	0.1456	6.5683	0.0698	0.1014
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	7.3473	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**38.1975**			**0.0000**	**0.0000**	**0.0015**	**12.8927**	
4. Agriculture			**71.0669**	**6.0215**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			64.8018					
B. Manure Management			6.2651	2.7252			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				3.2963			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-1160.8385**	**0.0949**	**0.0025**	**0.0878**	**3.2322**	**NO, NE**	**NO, NE**
A. Forest Land		-1620.7949	0.0002	NO, NE	0.0001	0.0041		
B. Cropland		1079.4983	0.0947	0.0025	0.0877	3.2281		
C. Grassland		-619.5420	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**81.1398**	**0.2502**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			75.0597		NO, NE		NO, NE	
B. Wastewater Handling			6.0800	0.2502	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**41.9185**		**0.0060**	**0.0013**	**0.1573**	**0.1413**	**0.0820**	**0.0133**
Aviation	41.9185		0.0060	0.0013	0.1573	0.1413	0.0820	0.0133
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**645.5674**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-6: Inventory Year - 1995 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-32	HFC-125	HFC-134a	HFC-143a	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0000**	**0.0000**	**0.0014**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0000**	**0.0000**	**0.0014**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.000005	0.000008	0.001439	0.0000002	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-7: Inventory Year - 1996

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**11664.1123**	**-1008.5757**	**180.7137**	**5.9267**	**45.1745**	**142.8140**	**148.9657**	**58.9692**
1. Energy	**11198.7301**		**32.5523**	**0.1915**	**44.3305**	**133.5421**	**22.5061**	**58.4038**
A. Fuel Combustion	11198.2574		3.7968	0.1915	44.3305	133.5421	21.9901	58.4038
1. Energy Industries	7135.1010		0.1349	0.0469	19.9904	2.1475	0.5422	42.2225
2 Manufacturing Industries and Construction	360.0648		0.0131	0.0019	0.9864	0.2736	0.0371	1.2002
3. Transport	1267.6092		0.3266	0.1007	11.7158	79.5586	14.9784	1.3726
4. Other Sectors	2290.6492		3.3179	0.0405	11.2283	51.3353	6.4162	12.4324
5. Other (other works and needs in energy sector	144.8332		0.0043	0.0016	0.4095	0.2271	0.0162	1.1762
B. Fugitive Emissions from Fuels	0.4726		28.7555	0.0000	NO, NE	NO, NE	0.5160	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	0.4726		28.7555	0.0000	NO, NE	NO, NE	0.5160	NO, NE
2. Industrial Processes	**431.5010**		**0.0067**	**0.0033**	**0.7816**	**6.9732**	**115.0469**	**0.5653**
A. Mineral Products	420.4386		NO, NE	NO, NE	0.6210	0.2816	107.9721	0.4482
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0154	NO, NE
C. Metal Production	11.0623		0.0067	0.0033	0.1606	6.6917	0.0803	0.1171
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	6.9791	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**33.8813**			**0.0000**	**0.0001**	**0.0021**	**11.4128**	
4. Agriculture			**65.4124**	**5.4779**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			59.6262					
B. Manure Management			5.7862	2.6551			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				2.8228			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-1008.5757**	**0.0677**	**0.0018**	**0.0624**	**2.2966**	**NO, NE**	**NO, NE**
A. Forest Land		-1705.1295	0.0010	0.0001	0.0007	0.0237		
B. Cropland		1274.6697	0.0667	0.0017	0.0618	2.2728		
C. Grassland		-578.1160	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**82.6746**	**0.2522**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			77.0144		NO, NE		NO, NE	
B. Wastewater Handling			5.6601	0.2522	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**65.8650**		**0.0048**	**0.0021**	**0.2556**	**0.1687**	**0.0901**	**0.0209**
Aviation	65.8650		0.0048	0.0021	0.2556	0.1687	0.0901	0.0209
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**615.3433**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-7: Inventory Year - 1996 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-32	HFC-125	HFC-134a	HFC-143a	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0000**	**0.0000**	**0.0031**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0000**	**0.0000**	**0.0031**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.000007	0.000012	0.003098	0.000002	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-8: Inventory Year - 1997

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**10863.9811**		**161.7750**	**6.2412**	**41.9948**	**138.7959**	**75.1749**	**33.9676**
1. Energy	**10179.4508**		**26.0885**	**0.1574**	**40.9470**	**126.4156**	**22.3271**	**33.3351**
A. Fuel Combustion	10178.3402		2.4211	0.1574	40.9470	126.4156	21.9087	33.3351
1. Energy Industries	5641.7033		0.1107	0.0245	15.3909	1.8340	0.4618	21.4411
2 Manufacturing Industries and Construction	586.4696		0.0165	0.0022	1.5900	0.3945	0.0569	0.9572
3. Transport	1292.0143		0.3711	0.1021	12.4630	90.3625	17.0009	1.4286
4. Other Sectors	2522.6439		1.9187	0.0271	11.1212	33.6107	4.3736	8.5533
5. Other (other works and needs in energy sector	135.5091		0.0042	0.0015	0.3818	0.2139	0.0154	0.9549
B. Fugitive Emissions from Fuels	1.1105		23.6674	0.0000	NO, NE	NO, NE	0.4183	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	1.1105		23.6674	0.0000	NO, NE	NO, NE	0.4183	NO, NE
2. Industrial Processes	**481.8103**		**0.0081**	**0.0041**	**0.9386**	**8.3583**	**42.7141**	**0.6325**
A. Mineral Products	468.4076		NO, NE	NO, NE	0.7440	0.2510	37.0856	0.4906
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0049	NO, NE
C. Metal Production	13.4027		0.0081	0.0041	0.1946	8.1074	0.0973	0.1419
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	5.5263	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**29.8558**			**0.0000**	**0.0001**	**0.0020**	**10.1338**	
4. Agriculture			**56.1968**	**5.8297**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			51.2098					
B. Manure Management			4.9870	2.2291			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				3.6005			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF	**172.8643**		**0.1181**	**0.0031**	**0.1092**	**4.0199**	**NO, NE**	**NO, NE**
A. Forest Land		-2132.2121	0.0003	NO, NE	0.0002	0.0072		
B. Cropland		3034.0024	0.1178	0.0031	0.1090	4.0127		
C. Grassland		-728.9260	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**79.3635**	**0.2470**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			73.8295		NO, NE		NO, NE	
B. Wastewater Handling			5.5341	0.2470	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**75.6443**		**0.0055**	**0.0024**	**0.2921**	**0.1965**	**0.1020**	**0.0240**
Aviation	75.6443		0.0055	0.0024	0.2921	0.1965	0.1020	0.0240
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**322.4374**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-8: Inventory Year - 1997 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-32	HFC-125	HFC-134a	HFC-143a	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0000**	**0.0000**	**0.0050**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0000**	**0.0000**	**0.0050**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.000011	0.000018	0.005031	0.000002	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-9: Inventory Year - 1998

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**9065.4720**	**-190.1995**	**155.5755**	**5.4989**	**35.2592**	**122.6704**	**62.6311**	**26.9756**
1. Energy	**8709.0855**		**24.1905**	**0.1401**	**34.3358**	**111.6272**	**19.5024**	**26.4235**
A. Fuel Combustion	8708.0126		2.0403	0.1401	34.3358	111.6272	19.1101	26.4235
1. Energy Industries	4846.8481		0.0964	0.0191	13.1501	1.5935	0.4015	17.0883
2 Manufacturing Industries and Construction	537.4686		0.0141	0.0018	1.4532	0.3393	0.0518	0.8653
3. Transport	1126.3239		0.3162	0.0915	10.8830	77.0271	14.4903	1.2511
4. Other Sectors	2104.8957		1.6113	0.0267	8.5884	32.5657	4.1567	6.7725
5. Other (other works and needs in energy sector	92.4763		0.0023	0.0010	0.2611	0.1016	0.0098	0.4463
B. Fugitive Emissions from Fuels	1.0729		22.1502	0.0000	NO, NE	NO, NE	0.3923	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	1.0729		22.1502	0.0000	NO, NE	NO, NE	0.3923	NO, NE
2. Industrial Processes	**332.5442**		**0.0072**	**0.0036**	**0.8239**	**7.3825**	**34.8933**	**0.5521**
A. Mineral Products	320.6681		NO, NE	NO, NE	0.6567	0.1987	30.2177	0.4322
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0038	NO, NE
C. Metal Production	11.8761		0.0072	0.0036	0.1672	7.1838	0.0823	0.1199
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	4.5895	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**23.8423**			**0.0000**	**0.0001**	**0.0026**	**8.2354**	
4. Agriculture			**54.6562**	**5.1097**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			49.8919					
B. Manure Management			4.7643	2.0630			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				3.0467			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-190.1995**	**0.1084**	**0.0029**	**0.0995**	**3.6580**	**NO, NE**	**NO, NE**
A. Forest Land		-2027.8925	0.0031	0.0002	0.0020	0.0714		
B. Cropland		2541.0990	0.1053	0.0027	0.0975	3.5866		
C. Grassland		-703.4060	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**76.6133**	**0.2426**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			71.9409		NO, NE		NO, NE	
B. Wastewater Handling			4.6724	0.2426	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**72.4974**		**0.0046**	**0.0023**	**0.2802**	**0.1828**	**0.0919**	**0.0230**
Aviation	72.4974		0.0046	0.0023	0.2802	0.1828	0.0919	0.0230
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**409.1761**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-9: Inventory Year - 1998 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-32	HFC-125	HFC-134a	HFC-143a	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0000**	**0.0000**	**0.0072**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0000**	**0.0000**	**0.0072**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.00002	0.00003	0.00719	0.000004	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-10: Inventory Year - 1999

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions	**7168.4086**	**-560.7042**	**154.3389**	**4.9458**	**25.8379**	**86.9378**	**39.5516**	**14.0259**
1. Energy	**6841.7537**		**23.9243**	**0.0924**	**25.0195**	**75.3152**	**12.8458**	**13.5377**
A. Fuel Combustion	6840.7159		1.8265	0.0924	25.0195	75.3152	12.4508	13.5377
1. Energy Industries	3670.0376		0.0727	0.0088	9.7970	1.2779	0.3199	6.1854
2 Manufacturing Industries and Construction	495.3902		0.0118	0.0015	1.3352	0.2861	0.0461	0.4769
3. Transport	770.1737		0.1867	0.0578	7.2771	45.5918	8.5793	0.8862
4. Other Sectors	1848.8722		1.5520	0.0235	6.4442	27.8804	3.4965	5.6814
5. Other (other works and needs in energy sector	56.2421		0.0033	0.0008	0.1660	0.2791	0.0090	0.3077
B. Fugitive Emissions from Fuels	1.0378		22.0978	0.0000	NO, NE	NO, NE	0.3950	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	1.0378		22.0978	0.0000	NO, NE	NO, NE	0.3950	NO, NE
2. Industrial Processes	**295.7244**		**0.0080**	**0.0040**	**0.7223**	**8.0882**	**16.1765**	**0.4882**
A. Mineral Products	282.5579		NO, NE	NO, NE	0.5394	0.1239	13.3931	0.3580
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0033	NO, NE
C. Metal Production	13.1665		0.0080	0.0040	0.1830	7.9643	0.0894	0.1302
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	2.6907	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**30.9306**			**0.0000**	**0.0001**	**0.0030**	**10.5293**	
4. Agriculture			**50.4361**	**4.6106**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			46.1429					
B. Manure Management			4.2933	1.8491			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				2.7615			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-560.7042**	**0.1044**	**0.0028**	**0.0960**	**3.5314**	**NO, NE**	**NO, NE**
A. Forest Land		-2111.2238	0.0023	0.0001	0.0015	0.0534		
B. Cropland		2346.8976	0.1021	0.0026	0.0945	3.4780		
C. Grassland		-796.3780	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**79.8661**	**0.2360**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			76.0378		NO, NE		NO, NE	
B. Wastewater Handling			3.8283	0.2360	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**72.4938**		**0.0044**	**0.0022**	**0.2641**	**0.1693**	**0.0862**	**0.0213**
Aviation	72.4938		0.0044	0.0022	0.2641	0.1693	0.0862	0.0213
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**373.6048**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-10: Inventory Year - 1999 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-32	HFC-125	HFC-134a	HFC-143a	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0000**	**0.0000**	**0.0087**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0000**	**0.0000**	**0.0087**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.000022	0.000038	0.008708	0.000004	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-11: Inventory Year - 2000

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**6390.2553**	**-783.2114**	**148.0800**	**4.5116**	**24.5483**	**84.2057**	**37.4619**	**9.9288**
1. Energy	**6092.4074**		**25.6880**	**0.0983**	**23.5733**	**73.7128**	**12.7201**	**9.3243**
A. Fuel Combustion	6091.3834		1.7645	0.0983	23.5733	73.7128	12.2880	9.3243
1. Energy Industries	3149.1129		0.0600	0.0066	8.4121	1.1286	0.2786	2.5730
2 Manufacturing Industries and Construction	531.0553		0.0122	0.0015	1.4303	0.3089	0.0494	0.4589
3. Transport	838.3532		0.1902	0.0678	8.3751	46.5294	8.7674	1.0574
4. Other Sectors	1512.1110		1.4995	0.0217	5.1812	25.6301	3.1846	5.0113
5. Other (other works and needs in energy sector	60.7510		0.0025	0.0007	0.1746	0.1158	0.0080	0.2237
B. Fugitive Emissions from Fuels	1.0240		23.9235	0.0000	NO, NE	NO, NE	0.4321	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	1.0240		23.9235	0.0000	NO, NE	NO, NE	0.4321	NO, NE
2. Industrial Processes	**266.2359**		**0.0091**	**0.0045**	**0.9388**	**9.1593**	**13.9756**	**0.6046**
A. Mineral Products	251.2206		NO, NE	NO, NE	0.7317	0.0767	11.3973	0.4579
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0063	NO, NE
C. Metal Production	15.0154		0.0091	0.0045	0.2070	9.0826	0.1008	0.1466
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	2.4712	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**31.6119**			**0.0000**	**0.0001**	**0.0025**	**10.7662**	
4. Agriculture			**46.8215**	**4.1735**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			43.3896					
B. Manure Management			3.4319	1.6077			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				2.5658			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-783.2114**	**0.0391**	**0.0010**	**0.0362**	**1.3310**	**NO, NE**	**NO, NE**
A. Forest Land		-2140.3185	0.0001	0.0000	0.0001	0.0019		
B. Cropland		2182.6351	0.0390	0.0010	0.0361	1.3291		
C. Grassland		-825.5280	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**75.5223**	**0.2342**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			71.8615		NO, NE		NO, NE	
B. Wastewater Handling			3.6608	0.2342	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**66.1989**		**0.0041**	**0.0021**	**0.2528**	**0.1657**	**0.0818**	**0.0210**
Aviation	66.1989		0.0041	0.0021	0.2528	0.1657	0.0818	0.0210
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**367.8560**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-11: Inventory Year - 2000 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-32	HFC-125	HFC-134a	HFC-143a	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0000**	**0.0000**	**0.0101**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0000**	**0.0000**	**0.0101**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.00003	0.00005	0.01015	0.000006	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-12: Inventory Year - 2001

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**7000.1804**	**-280.8032**	**143.3422**	**5.0448**	**26.7705**	**87.3850**	**45.6717**	**9.4514**
1. Energy	**6700.4292**		**25.3406**	**0.1054**	**25.8089**	**75.8569**	**13.2617**	**8.8672**
A. Fuel Combustion	6699.3738		1.5735	0.1054	25.8089	75.8569	12.8348	8.8672
1. Energy Industries	3674.9208		0.0705	0.0076	9.8228	1.3623	0.3280	2.3780
2 Manufacturing Industries and Construction	616.9501		0.0153	0.0020	1.6795	0.3457	0.0573	0.6479
3. Transport	892.9559		0.2055	0.0747	9.1449	50.2701	9.4752	1.1545
4. Other Sectors	1451.5894		1.2791	0.0202	4.9727	23.7038	2.9652	4.4252
5. Other (other works and needs in energy sector	62.9575		0.0031	0.0009	0.1890	0.1749	0.0091	0.2616
B. Fugitive Emissions from Fuels	1.0554		23.7671	0.0000	NO, NE	NO, NE	0.4269	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	1.0554		23.7671	0.0000	NO, NE	NO, NE	0.4269	NO, NE
2. Industrial Processes	**254.4700**		**0.0097**	**0.0048**	**0.9118**	**9.6983**	**17.0237**	**0.5842**
A. Mineral Products	238.4819		NO, NE	NO, NE	0.6868	0.0271	13.9627	0.4229
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0099	NO, NE
C. Metal Production	15.9881		0.0097	0.0048	0.2250	9.6711	0.1107	0.1613
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	2.9404	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**45.2813**			**0.0000**	**0.0001**	**0.0024**	**15.3862**	
4. Agriculture			**47.6959**	**4.6855**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			44.1737					
B. Manure Management			3.5221	1.6352			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				3.0503			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-280.8032**	**0.0554**	**0.0016**	**0.0498**	**1.8275**	**NO, NE**	**NO, NE**
A. Forest Land		-2195.4199	0.0053	0.0003	0.0034	0.1208		
B. Cropland		2758.7274	0.0501	0.0013	0.0464	1.7067		
C. Grassland		-844.1107	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**70.2407**	**0.2473**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			66.2014		NO, NE		NO, NE	
B. Wastewater Handling			4.0393	0.2473	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**61.9061**		**0.0041**	**0.0021**	**0.2253**	**0.1718**	**0.0727**	**0.0188**
Aviation	61.9061		0.0041	0.0021	0.2253	0.1718	0.0727	0.0188
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**353.0871**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-12: Inventory Year - 2001 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-143a	HFC-134a	HFC-125	HFC-32	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0000**	**0.0125**	**0.0001**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0000**	**0.0125**	**0.0001**	**0.0000**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.000009	0.01250	0.00007	0.00004	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-13: Inventory Year - 2002

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**6676.9776**	**-71.7804**	**143.1170**	**5.2348**	**27.4538**	**99.7837**	**45.6605**	**10.5082**
1. Energy	**6328.5245**		**27.7260**	**0.1255**	**26.5019**	**94.2123**	**16.4424**	**9.9252**
A. Fuel Combustion	6327.4817		1.9534	0.1255	26.5019	94.2123	15.9752	9.9252
1. Energy Industries	2940.7433		0.0582	0.0065	7.8718	1.1571	0.2656	1.9609
2 Manufacturing Industries and Construction	423.5694		0.0101	0.0012	1.1434	0.2553	0.0401	0.3329
3. Transport	1132.2307		0.2646	0.0931	11.4130	64.6678	12.1906	1.4349
4. Other Sectors	1766.7757		1.6166	0.0238	5.8830	27.9604	3.4688	5.7914
5. Other (other works and needs in energy sector	64.1625		0.0039	0.0009	0.1907	0.1717	0.0101	0.4051
B. Fugitive Emissions from Fuels	1.0428		25.7726	0.0000	NO, NE	NO, NE	0.4672	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	1.0428		25.7726	0.0000	NO, NE	NO, NE	0.4672	NO, NE
2. Industrial Processes	**309.9587**		**0.0051**	**0.0026**	**0.9416**	**5.1943**	**15.9866**	**0.5830**
A. Mineral Products	301.4648		NO, NE	NO, NE	0.8236	0.0565	12.4770	0.4991
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0198	NO, NE
C. Metal Production	8.4939		0.0051	0.0026	0.1180	5.1379	0.0577	0.0839
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	3.4322	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**38.4944**			**0.0000**	**0.0000**	**0.0015**	**13.2315**	
4. Agriculture			**48.5597**	**4.8545**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			45.0836					
B. Manure Management			3.4761	1.6711			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				3.1834			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-71.7804**	**0.0120**	**0.0004**	**0.0103**	**0.3756**	**NO, NE**	**NO, NE**
A. Forest Land		-2134.8652	0.0028	0.0002	0.0018	0.0648		
B. Cropland		2843.5568	0.0091	0.0002	0.0084	0.3107		
C. Grassland		-780.4720	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**66.8142**	**0.2519**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			62.8479		NO, NE		NO, NE	
B. Wastewater Handling			3.9663	0.2519	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**62.0776**		**0.0039**	**0.0021**	**0.2401**	**0.1719**	**0.0677**	**0.0197**
Aviation	62.0776		0.0039	0.0021	0.2401	0.1719	0.0677	0.0197
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**389.5020**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-13: Inventory Year - 2002 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-143a	HFC-125	HFC-134a	HFC-32	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0000**	**0.0001**	**0.0147**	**0.0001**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0000**	**0.0001**	**0.0147**	**0.0001**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production									
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.00001	0.0001	0.0147	0.0001	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-14: Inventory Year - 2003

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**7488.9375**	**-1046.5861**	**139.9327**	**4.4814**	**30.8025**	**118.1225**	**48.3082**	**13.0501**
1. Energy	**7097.9321**		**29.4534**	**0.1475**	**29.8096**	**109.1685**	**19.0950**	**12.4325**
A. Fuel Combustion	7096.8311		2.2027	0.1475	29.8096	109.1685	18.5694	12.4325
1. Energy Industries	3038.6698		0.0594	0.0065	8.1377	1.1963	0.2750	1.3954
2 Manufacturing Industries and Construction	450.9660		0.0106	0.0013	1.2142	0.2802	0.0422	0.4528
3. Transport	1413.6197		0.3165	0.1130	14.3099	77.3685	14.6059	1.8835
4. Other Sectors	2076.2619		1.8136	0.0255	5.8270	30.1763	3.6347	7.6532
5. Other (other works and needs in energy sector	117.3137		0.0026	0.0012	0.3209	0.1472	0.0117	1.0477
B. Fugitive Emissions from Fuels	1.1010		27.2507	0.0000	NO, NE	NO, NE	0.5255	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	1.1010		27.2507	0.0000	NO, NE	NO, NE	0.5255	NO, NE
2. Industrial Processes	**355.3557**		**0.0089**	**0.0044**	**0.9907**	**8.8774**	**16.7982**	**0.6176**
A. Mineral Products	340.7049		NO, NE	NO, NE	0.7856	0.0153	12.7619	0.4711
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0205	NO, NE
C. Metal Production	14.6507		0.0089	0.0044	0.2050	8.8621	0.1006	0.1465
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	3.9152	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**35.6498**			**0.0000**	**0.0000**	**0.0010**	**12.4151**	
4. Agriculture			**44.5097**	**4.0715**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			41.3224					
B. Manure Management			3.1873	1.5941			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				2.4774			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-1046.5861**	**0.0033**	**0.0002**	**0.0021**	**0.0756**	**NO, NE**	**NO, NE**
A. Forest Land		-2135.8765	0.0031	0.0002	0.0020	0.0710		
B. Cropland		1957.3664	0.0001	0.0000	0.0001	0.0046		
C. Grassland		-868.0760	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**65.9575**	**0.2577**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			61.4577		NO, NE		NO, NE	
B. Wastewater Handling			4.4998	0.2577	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**73.5472**		**0.0039**	**0.0025**	**0.2837**	**0.1957**	**0.0736**	**0.0233**
Aviation	73.5472		0.0039	0.0025	0.2837	0.1957	0.0736	0.0233
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**359.7899**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-14: Inventory Year - 2003 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-143a	HFC-134a	HFC-125	HFC-32	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0000**	**0.0193**	**0.0002**	**0.0002**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**0.0000**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0000**	**0.0193**	**0.0002**	**0.0002**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**0.0000**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production									
D. Other Production									
E. Production of HFCs and SF_6									
F. Consumption of HFCs and SF_6	0.000019	0.019300	0.000209	0.000164	NO, NE	NO, NE	NO, NE	NO, NE	0.0000002
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-15: Inventory Year - 2004

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**8281.2966**		**137.4671**	**5.3579**	**32.3275**	**121.9150**	**56.2400**	**11.2448**
1. Energy	**7532.9793**		**31.2551**	**0.1453**	**31.2550**	**111.5122**	**20.4590**	**10.5425**
A. Fuel Combustion	7531.1389		1.9349	0.1453	31.2550	111.5122	19.3617	10.5425
1. Energy Industries	3109.5867		0.0622	0.0069	8.3348	1.2814	0.2843	1.3138
2 Manufacturing Industries and Construction	455.8446		0.0112	0.0014	1.2277	0.3231	0.0430	0.5484
3. Transport	1581.1835		0.3840	0.1139	15.7664	84.7304	16.0064	2.1130
4. Other Sectors	2261.9540		1.4750	0.0219	5.5977	24.9627	3.0158	6.3808
5. Other (other works and needs in energy sector	122.5701		0.0026	0.0012	0.3285	0.2146	0.0121	0.1865
B. Fugitive Emissions from Fuels	1.8405		29.3202	0.0000	NO, NE	NO, NE	1.0973	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	1.8405		29.3202	0.0000	NO, NE	NO, NE	1.0973	NO, NE
2. Industrial Processes	**395.0060**		**0.0101**	**0.0051**	**1.0653**	**10.1451**	**20.5097**	**0.7023**
A. Mineral Products	378.2618		NO, NE	NO, NE	0.8312	0.0166	16.1435	0.5351
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0237	NO, NE
C. Metal Production	16.7442		0.0101	0.0051	0.2341	10.1284	0.1148	0.1672
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	4.2277	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**43.7358**			**0.0001**	**0.0000**	**0.0009**	**15.2714**	
4. Agriculture			**41.2827**	**4.9491**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			38.3224					
B. Manure Management			2.9603	1.5650			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				3.3841			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF	**309.5755**		**0.0103**	**0.0005**	**0.0071**	**0.2569**	**NO, NE**	**NO, NE**
A. Forest Land		-2183.7322	0.0082	0.0005	0.0052	0.1864		
B. Cropland		3320.4637	0.0021	0.0001	0.0019	0.0704		
C. Grassland		-827.1560	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**64.9089**	**0.2578**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			59.9037		NO, NE		NO, NE	
B. Wastewater Handling			5.0052	0.2578	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**70.7060**		**0.0040**	**0.0024**	**0.2773**	**0.2022**	**0.0654**	**0.0224**
Aviation	70.7060		0.0040	0.0024	0.2773	0.2022	0.0654	0.0224
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**296.5059**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-15: Inventory Year - 2004 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-143a	HFC-134a	HFC-125	HFC-32	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0000**	**0.0238**	**0.0003**	**0.0002**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**0.0000**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0000**	**0.0238**	**0.0003**	**0.0002**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**0.0000**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production									
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.000025	0.023782	0.000306	0.000247	NO, NE	NO, NE	NO, NE	NO, NE	0.0000002
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-16: Inventory Year - 2005

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**8367.7991**	**-104.5728**	**136.6975**	**5.3624**	**49.3686**	**124.7128**	**67.3736**	**11.8426**
1. Energy	**7772.5759**		**33.3583**	**0.1477**	**31.7845**	**113.8159**	**20.9926**	**11.0710**
A. Fuel Combustion	7770.6553		2.0070	0.1477	31.7845	113.8159	19.8145	11.0710
1. Energy Industries	3232.6387		0.0627	0.0068	8.6577	1.2731	0.2928	1.1564
2 Manufacturing Industries and Construction	591.0838		0.0137	0.0016	1.5904	0.3990	0.0554	0.4599
3. Transport	1612.7476		0.3573	0.1164	16.0982	87.3479	16.4992	2.1507
4. Other Sectors	2216.1375		1.5670	0.0217	5.1215	24.6433	2.9563	6.1363
5. Other (other works and needs in energy sector	118.0475		0.0062	0.0011	0.3166	0.1527	0.0108	1.1677
B. Fugitive Emissions from Fuels	1.9206		31.3513	NO, NE	NO, NE	NO, NE	1.1781	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	1.9206		31.3513	0.0000	NO, NE	NO, NE	1.1781	NO, NE
2. Industrial Processes	**527.0592**		**0.0105**	**0.0052**	**17.5742**	**10.5312**	**22.8330**	**0.7716**
A. Mineral Products	509.7252		NO, NE	NO, NE	17.3289	0.0459	17.9288	0.5953
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0274	NO, NE
C. Metal Production	17.3341		0.0105	0.0052	0.2453	10.4853	0.1210	0.1763
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	4.7557	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**68.1640**			**0.0001**	**0.0000**	**0.0010**	**23.5480**	
4. Agriculture			**40.1618**	**4.9354**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			37.0653					
B. Manure Management			3.0965	1.7119			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				3.2235			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-104.5728**	**0.0110**	**0.0003**	**0.0099**	**0.3647**	**NO, NE**	**NO, NE**
A. Forest Land		-2246.2332	0.0008	NO, NE	0.0005	0.0178		
B. Cropland		2961.1164	0.0102	0.0003	0.0094	0.3469		
C. Grassland		-819.4560	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**63.1559**	**0.2737**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			57.7585		NO, NE		NO, NE	
B. Wastewater Handling			5.3974	0.2737	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**67.6961**		**0.0038**	**0.0024**	**0.2608**	**0.2005**	**0.0592**	**0.0214**
Aviation	67.6961		0.0038	0.0024	0.2608	0.2005	0.0592	0.0214
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**295.0374**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-16: Inventory Year - 2005 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-143a	HFC-134a	HFC-125	HFC-32	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0000**	**0.0290**	**0.0005**	**0.0004**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**0.0000**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0000**	**0.0290**	**0.0005**	**0.0004**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**0.0000**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.000035	0.029036	0.000461	0.000371	NO, NE	NO, NE	NO, NE	NO, NE	0.000002
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-17: Inventory Year - 2006

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**7699.5936**	**-403.2242**	**132.7645**	**5.1079**	**31.0410**	**116.0094**	**65.8121**	**12.3622**
1. Energy	**7036.1667**		**29.4661**	**0.1568**	**29.8031**	**108.8576**	**19.4557**	**11.5750**
A. Fuel Combustion	7034.7345		2.1424	0.1568	29.8031	108.8576	18.7844	11.5750
1. Energy Industries	2491.4432		0.0492	0.0053	6.6759	1.0122	0.2273	0.8759
2 Manufacturing Industries and Construction	650.9260		0.0140	0.0016	1.7463	0.3660	0.0593	0.5159
3. Transport	1535.8523		0.3316	0.1255	15.9006	80.9715	15.3324	2.1698
4. Other Sectors	2207.0126		1.7398	0.0230	5.0783	26.3517	3.1512	6.4084
5. Other (other works and needs in energy sector	149.5003		0.0079	0.0014	0.4020	0.1562	0.0141	1.6050
B. Fugitive Emissions from Fuels	1.4322		27.3237	NO, NE	NO, NE	NO, NE	0.6713	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	1.4322		27.3237	0.0000	NO, NE	NO, NE	0.6713	NO, NE
2. Industrial Processes	**615.2505**		**0.0068**	**0.0034**	**1.2290**	**6.8269**	**29.3335**	**0.7872**
A. Mineral Products	604.0505		NO, NE	NO, NE	1.0679	0.0520	25.0377	0.6704
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0254	NO, NE
C. Metal Production	11.1999		0.0068	0.0034	0.1610	6.7749	0.0801	0.1168
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	4.1903	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**48.1765**			**0.0001**	**0.0000**	**0.0006**	**17.0229**	
4. Agriculture			**38.9979**	**4.6749**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			35.8562					
B. Manure Management			3.1418	1.7803			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				2.8946			NO, NE	
E. Prescribed Burning of SaSavannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-403.2242**	**0.0123**	**0.0006**	**0.0090**	**0.3243**	**NO, NE**	**NO, NE**
A. Forest Land		-2087.8823	0.0084	0.0005	0.0054	0.1924		
B. Cropland		2491.3937	0.0039	0.0001	0.0036	0.1319		
C. Grassland		-806.7356	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**64.2813**	**0.2722**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			59.0444		NO, NE		NO, NE	
B. Wastewater Handling			5.2370	0.2722	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**75.9977**		**0.0045**	**0.0026**	**0.3029**	**0.2160**	**0.0676**	**0.0241**
Aviation	75.9977		0.0045	0.0026	0.3029	0.2160	0.0676	0.0241
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**323.6620**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-17: Inventory Year - 2006 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-143a	HFC-134a	HFC-125	HFC-32	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0001**	**0.0345**	**0.0006**	**0.0005**	**NO, NE**	**0.0000**	**NO, NE**	**NO, NE**	**0.0000**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0001**	**0.0345**	**0.0006**	**0.0005**	**NO, NE**	**0.0000**	**NO, NE**	**NO, NE**	**0.0000**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.000054	0.034471	0.000618	0.000500	NO, NE	0.000002	NO, NE	NO, NE	0.000011
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-18: Inventory Year - 2007

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**7651.5279**	**-2612.7710**	**128.2957**	**3.1804**	**31.4840**	**118.1991**	**129.9583**	**10.7123**
1. Energy	**6715.9617**		**30.7889**	**0.1484**	**29.8817**	**106.5704**	**19.5972**	**9.7208**
A. Fuel Combustion	6714.2916		1.7388	0.1484	29.8817	106.5704	18.7343	9.7208
1. Energy Industries	2473.4859		0.0481	0.0051	6.6266	0.9940	0.2254	0.5434
2 Manufacturing Industries and Construction	817.0164		0.0159	0.0018	2.1872	0.4318	0.0730	0.3075
3. Transport	1606.1743		0.3415	0.1211	16.4888	83.4406	15.8018	2.2855
4. Other Sectors	1664.5024		1.3257	0.0190	4.1738	21.6075	2.6207	4.6973
5. Other (other works and needs in energy sector	153.1125		0.0076	0.0014	0.4053	0.0964	0.0134	1.8870
B. Fugitive Emissions from Fuels	1.6702		29.0502	NO, NE	NO, NE	NO, NE	0.8628	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	1.6702		29.0502	0.0000	NO, NE	NO, NE	0.8628	NO, NE
2. Industrial Processes	**883.3510**		**0.0097**	**0.0048**	**1.5495**	**9.7369**	**92.1203**	**0.9915**
A. Mineral Products	867.3911		NO, NE	NO, NE	1.3210	0.0827	88.7208	0.8263
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0298	NO, NE
C. Metal Production	15.9599		0.0097	0.0048	0.2284	9.6541	0.1134	0.1652
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	3.2564	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**52.2152**			**0.0000**	**0.0000**	**0.0005**	**18.2408**	
4. Agriculture			**31.3017**	**2.7669**	**NO, IE**	**NO, IE**	**NO, IE**	**NO, NE**
A. Enteric Fermentation			28.9918					
B. Manure Management			2.3099	1.3464			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				1.4205			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-2612.7710**	**0.0799**	**0.0042**	**0.0528**	**1.8913**	**NO, NE**	**NO, NE**
A. Forest Land		-2192.3574	0.0736	0.0041	0.0470	1.6764		
B. Cropland		378.4328	0.0063	0.0002	0.0058	0.2148		
C. Grassland		-798.8464	0.0000	0.0000	0.0000	0.0000		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**66.1155**	**0.2560**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			61.1093		NO, NE		NO, NE	
B. Wastewater Handling			5.0063	0.2560	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**79.9382**		**0.0029**	**0.0027**	**0.3261**	**0.1974**	**0.0664**	**0.0253**
Aviation	79.9382		0.0029	0.0027	0.3261	0.1974	0.0664	0.0253
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**293.1867**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-18: Inventory Year - 2007 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-143a	HFC-134a	HFC-125	HFC-32	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0004**	**0.0419**	**0.0014**	**0.0010**	**NO, NE**	**0.0000**	**NO, NE**	**NO, NE**	**0.0000**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0004**	**0.0419**	**0.0014**	**0.0010**	**NO, NE**	**0.0000**	**NO, NE**	**NO, NE**	**0.0000**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.000357	0.041886	0.001396	0.000995	NO, NE	0.000002	NO, NE	NO, NE	0.000015
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-19: Inventory Year - 2008

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**8860.6528**		**128.2357**	**5.2328**	**34.8908**	**120.5858**	**87.1732**	**14.8404**
1. Energy	**7733.2846**		**30.7089**	**0.1589**	**33.3096**	**110.6004**	**20.5653**	**13.8455**
A. Fuel Combustion	7731.2367		1.8159	0.1589	33.3096	110.6004	19.4251	13.8455
1. Energy Industries	3290.3984		0.0631	0.0110	8.9530	1.2979	0.2902	4.5144
2 Manufacturing Industries and Construction	910.8888		0.0348	0.0047	2.5335	0.6858	0.1051	0.5308
3. Transport	1696.5714		0.3516	0.1219	17.2542	85.9984	16.2811	2.4258
4. Other Sectors	1671.5326		1.3581	0.0198	4.1359	22.4985	2.7338	4.5003
5. Other (other works and needs in energy sector	161.8454		0.0084	0.0015	0.4329	0.1198	0.0149	1.8743
B. Fugitive Emissions from Fuels	2.0480		28.8930	NO, NE	NO, NE	NO, NE	1.1402	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	2.0480		28.8930	0.0000	NO, NE	NO, NE	1.1402	NO, NE
2. Industrial Processes	**943.8549**		**0.0089**	**0.0044**	**1.5523**	**8.9254**	**47.9426**	**0.9949**
A. Mineral Products	929.2221		NO, NE	NO, NE	1.3425	0.0740	44.1023	0.8430
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0241	NO, NE
C. Metal Production	14.6328		0.0089	0.0044	0.2098	8.8514	0.1042	0.1519
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	3.7119	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**53.5824**			**NO**	**0.0000**	**0.0008**	**18.6653**	
4. Agriculture			**29.8982**	**4.8058**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			27.6051					
B. Manure Management			2.2931	1.3457			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				3.4601			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF	**129.9309**		**0.0328**	**0.0010**	**0.0289**	**1.0593**	**NO, NE**	**NO, NE**
A. Forest Land		-2223.0019	0.0051	0.0003	0.0033	0.1165		
B. Cropland		3142.2356	0.0277	0.0007	0.0256	0.9428		
C. Grassland		-789.3028	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**67.5870**	**0.2626**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			62.3186		NO, NE		NO, NE	
B. Wastewater Handling			5.2684	0.2626	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**89.3145**		**0.0018**	**0.0030**	**0.3677**	**0.1904**	**0.0713**	**0.0283**
Aviation	89.3145		0.0018	0.0030	0.3677	0.1904	0.0713	0.0283
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**336.6568**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-19: Inventory Year - 2008 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-143a	HFC-134a	HFC-125	HFC-32	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0006**	**0.0517**	**0.0021**	**0.0015**	**NO, NE**	**0.0000**	**NO, NE**	**NO, NE**	**0.0000**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0006**	**0.0517**	**0.0021**	**0.0015**	**NO, NE**	**0.0000**	**NO, NE**	**NO, NE**	**0.0000**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.000597	0.051741	0.002090	0.001460	NO, NE	0.000003	NO, NE	NO, NE	0.000018
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-20: Inventory Year - 2009

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**8960.7466**	**-872.0809**	**127.7534**	**4.4959**	**34.9055**	**114.0031**	**60.5991**	**18.2960**
1. Energy	**8480.4656**		**25.7669**	**0.1432**	**34.0651**	**109.3094**	**20.3062**	**17.7339**
A. Fuel Combustion	8478.3152		1.8553	0.1432	34.0651	109.3094	19.1817	17.7339
1. Energy Industries	4453.2554		0.0848	0.0177	12.1983	1.7020	0.3838	9.4752
2 Manufacturing Industries and Construction	507.1516		0.0220	0.0030	1.4262	0.4126	0.0622	0.2667
3. Transport	1619.4921		0.3469	0.1018	16.1041	84.8597	16.0487	2.2617
4. Other Sectors	1817.8349		1.3972	0.0199	4.1215	22.2256	2.6797	4.9032
5. Other (other works and needs in energy sector	80.5811		0.0043	0.0008	0.2151	0.1095	0.0073	0.8271
B. Fugitive Emissions from Fuels	2.1505		23.9117	NO, NE	NO, NE	NO, NE	1.1245	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	2.1505		23.9117	0.0000	NO, NE	NO, NE	1.1245	NO, NE
2. Industrial Processes	**431.7594**		**0.0043**	**0.0021**	**0.8290**	**4.2846**	**23.3764**	**0.5621**
A. Mineral Products	424.7167		NO, NE	NO, NE	0.7263	0.0244	20.8339	0.4870
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0204	NO, NE
C. Metal Production	7.0427		0.0043	0.0021	0.1027	4.2602	0.0515	0.0751
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	2.4706	NO, NE
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**48.5216**			**NO**	**0.0000**	**0.0006**	**16.9166**	
4. Agriculture			**31.2712**	**4.0908**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			28.7010					
B. Manure Management			2.5702	1.5374			NO, NE	
C. Rice Cultivation			0.0000				NO	
D. Agricultural Soils				2.5534			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF		**-872.0809**	**0.0161**	**0.0008**	**0.0113**	**0.4086**	**NO, NE**	**NO, NE**
A. Forest Land		-2251.7423	0.0125	0.0007	0.0080	0.2843		
B. Cropland		2161.4666	0.0036	0.0001	0.0034	0.1243		
C. Grassland		-781.8052	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**70.6949**	**0.2590**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			65.7925		NO, NE		NO, NE	
B. Wastewater Handling			4.9024	0.2590	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**82.6447**		**0.0030**	**0.0028**	**0.3397**	**0.1939**	**0.0754**	**0.0262**
Aviation	82.6447		0.0030	0.0028	0.3397	0.1939	0.0754	0.0262
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**321.2484**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-20: Inventory Year - 2009 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-143a	HFC-134a	HFC-125	HFC-32	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0007**	**0.0592**	**0.0023**	**0.0016**	**NO, NE**	**0.0000**	**NO, NE**	**NO, NE**	**0.0000**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0007**	**0.0592**	**0.0023**	**0.0016**	**NO, NE**	**0.0000**	**NO, NE**	**NO, NE**	**0.0000**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.000726	0.059202	0.002281	0.001559	NO, NE	0.000003	NO, NE	NO, NE	0.000019
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 1-21: Inventory Year - 2010

GHG Source and Sink Categories	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)	NMVOC (Gg)	SO_x (Gg)
Total emissions and removals	**8911.3371**		**127.6652**	**5.1845**	**37.0635**	**111.9294**	**95.2324**	**18.7756**
1. Energy	**8369.7595**		**25.1976**	**0.1536**	**36.2690**	**109.3032**	**20.1500**	**18.2448**
A. Fuel Combustion	8367.8987		1.9985	0.1536	36.2690	109.3032	19.2667	18.2448
1. Energy Industries	4188.3127		0.0739	0.0152	11.4309	1.4003	0.3522	8.3173
2 Manufacturing Industries and Construction	539.2384		0.0226	0.0031	1.5105	0.4345	0.0643	0.5832
3. Transport	1861.9016		0.3475	0.1145	18.7731	85.1121	16.1605	2.8017
4. Other Sectors	1653.9545		1.5470	0.0195	4.2172	22.1317	2.6764	5.0450
5. Other (other works and needs in energy sector	124.4914		0.0075	0.0013	0.3372	0.2246	0.0132	1.4976
B. Fugitive Emissions from Fuels	1.8608		23.1990	NO, NE	NO, NE	NO, NE	0.8833	NO, NE
1. Solid Fuels			NO		NO	NO	NO	NO
2. Oil and Natural Gas	1.8608		23.1990	0.0000	NO, NE	NO, NE	0.8833	NO, NE
2. Industrial Processes	**461.5626**		**0.0024**	**0.0012**	**0.7893**	**2.4370**	**56.2679**	**0.5308**
A. Mineral Products	457.5688		NO, NE	NO, NE	0.7316	0.0212	53.3495	0.4887
B. Chemical Industry	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	0.0293	NO, NE
C. Metal Production	3.9938		0.0024	0.0012	0.0578	2.4158	0.0289	0.0421
D. Other Production	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	2.8602	0.0000
E. Production of HFCs and SF_6								
F. Consumption of HFCs and SF_6								
G. Other	NO		NO	NO	NO	NO	NO	NO
3. Solvent and Other Product Use	**53.8690**			**NO**	**0.0000**	**0.0005**	**18.8146**	
4. Agriculture			**31.2269**	**4.7634**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Enteric Fermentation			28.4934					
B. Manure Management			2.7336	1.6095			NO, NE	
C. Rice Cultivation			NO				NO	
D. Agricultural Soils				3.1539			NO, NE	
E. Prescribed Burning of Savannas			NO	NO	NO	NO	NO	
F. Field Burning of Agricultural Residues			IE	IE	IE	IE	IE	
G. Other			NO	NO	NO	NO	NO	
5. LULUCF	**26.1460**		**0.0070**	**0.0003**	**0.0052**	**0.1887**	**NO, NE**	**NO, NE**
A. Forest Land		-2193.2612	0.0044	0.0002	0.0028	0.0994		
B. Cropland		2977.0255	0.0026	0.0001	0.0024	0.0893		
C. Grassland		-757.6184	NE	NE	NE	NE		
D. Wetlands		NE	NE	NE	NE	NE		
E. Settlements		IE, NE	IE, NE	IE, NE	IE, NE	IE, NE		
F. Other Lands		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
E. Other		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE		
6. Waste			**71.2313**	**0.2660**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
A. Solid Waste Disposal on Land			66.0980		NO, NE		NO, NE	
B. Wastewater Handling			5.1333	0.2660	NO, NE	NO, NE	NO, NE	
C. Waste Incineration					NO, NE	NO, NE	NO, NE	NO, NE
D. Other			NO	NO	NO	NO	NO	NO
7. Other	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**	**NO, NE**
Memo Items								
International Bunkers	**82.7287**		**0.0028**	**0.0028**	**0.3427**	**0.1983**	**0.0701**	**0.0262**
Aviation	82.7287		0.0028	0.0028	0.3427	0.1983	0.0701	0.0262
Marine	NO, NE		NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
CO_2 emissions from Biomass	**289.1029**							

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring

Annex 1-21: Inventory Year - 2010 (National GHG Inventory of Anthropogenic Emissions of HFCs, PFCs and SF_6)

GHG Source and Sink Categories	HFCs (Gg)					PFCs (Gg)			SF_6 (Gg)
	HFC-143a	HFC-134a	HFC-125	HFC-32	Other HFCs	CF_4	C_2F_6	Other PFCs	
Total emissions	**0.0009**	**0.0693**	**0.0027**	**0.0019**	**NO, NE**	**0.0000**	**NO, NE**	**NO, NE**	**0.0000**
1. Energy									
A. Fuel Combustion									
1. Energy Industries									
2 Manufacturing Industries and Construction									
3. Transport									
4. Other Sectors									
5. Other (other works and needs in energy sector									
B. Fugitive Emissions from Fuels									
1. Solid Fuels									
2. Oil and Natural Gas									
2. Industrial Processes	**0.0009**	**0.0693**	**0.0027**	**0.0019**	**NO, NE**	**0.0000**	**NO, NE**	**NO, NE**	**0.0000**
A. Mineral Products									
B. Chemical Industry									
C. Metal Production	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
D. Other Production									
E. Production of HFCs and SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Consumption of HFCs and SF_6	0.000905	0.069306	0.002740	0.001856	NO, NE	0.000004	NO, NE	NO, NE	0.000023
G. Other									
3. Solvent and Other Product Use									
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. LULUCF									
A. Forest Land									
B. Cropland									
C. Grassland									
D. Wetlands									
E. Settlements									
F. Other Lands									
E. Other									
6. Waste									
A. Solid Waste Disposal on Land									
B. Wastewater Handling									
C. Waste Incineration									
D. Other									
7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Memo Items									
International Bunkers									
Aviation									
Marine									
CO_2 emissions from Biomass									

Abbreviations: NE – Not Estimated; NO – Not Occurring

Annex 2: Mitigation Potential of the Nationally Appropriate Mitigation Actions during 2013-2020, Presented in Conformity with the GHG Emissions Reduction Objectives of the Low Emission Development Strategy of the RM until 2020

No.	Name of the nationally appropriate mitigation action	Brief description of the mitigation action	Mitigation action implementation capacity	Estimated reductions of GHG emissions
	General Objective of the LEDS: Reduce, by 2020 total national direct greenhouse gases emissions by not less than 20% compared to the Business-As-Usual (BAU) scenario, to support the global effort to limit temperature increase by 2°C			
1.	**Specific objective 1:** Reduce, by 2020 direct greenhouse gases emissions generated by energy sector (stationary combusting of fossil fuels, as well as operations with petrol and natural gas) by 20% compared to BAU scenario.			
1.1.	Condensing gas boilers	The condensing gas boilers use the latent heat of vapour condensation in the flue gas, thus increasing the boiler efficiency by 10-15% compared to conventional natural gas boilers. The capacity of these boilers is up to 100 kW thermal power. Such condensing gas boilers are used to heat homes, offices and other spaces.	By using these boilers it is possible to produce ≈ 5% of the total heat, which is projected to reach 46.6 PJ in 2020	6 500 tons CO_2/year
1.2.	Implementation of cogeneration technology based on the use of internal combustion engines with the capacity up to 500 kW electrical power	The technology allows achieving some environmental, economic, social benefits and reducing dependence on imported fuel due to efficiency of simultaneous production of electricity and heat, as compared to separate production. The duration of heat load use during the year has to exceed 4500 hours. The technology will reduce electricity losses and respectively, thermal energy losses in electricity or heat networks. The technology efficiency can reach up to 80-85%. The fuel used is natural gas.	10 000 kW will account for 1.1% of the maximum load of ≈ 900 MW	10 000 tons CO_2/year, after implementation of projected capacity
1.3.	Implementation of cogeneration technology based on the use of gas turbines with the capacity up to 500 kW electrical power	The technology allows achieving some environmental, economic, social benefits and reducing dependence on imported fuel due to efficiency of simultaneous production of electricity and heat, as compared to separate production. The duration of heat load use during the year has to exceed 4500 hours. The technology will reduce electricity losses and respectively, thermal energy losses in electricity or heat networks. The technology efficiency can reach up to 80-85%. The fuel used is natural gas	5 000 kW will account for 0.55% of the maximum load of ≈ 900 MW.	4 000 tons CO_2/year, after implementation of projected capacity
1.4.	Cogeneration power plants based on the use of internal combustion engines and gas turbines with the capacity greater than 1 MW electric power	Efficiency up to 80-85%. Cogeneration power plants will be built in places where the thermal load is available through the year. The fuel used is natural gas.	150 000 kW will account for 16.6 % of the maximum load of ≈ 900 MW	134 000 tons CO_2/year, after implementation of projected capacity, with substitution of 855 mln kWh at the existent condensing power plants
1.5.	High capacity gas-steam combined cycle power plants	Groups with combined gas-steam cycle consist of one or two gas turbines; one heat recovery where the energy of exhaust gases from the gas turbine is used to produce steam, which is then used in steam turbine to produce electricity. Electricity efficiency of the group reaches 60%. The fuel used is natural gas.	300 000 kW will account for 33.3 % of the maximum load of ≈ 900 MW	330 000 tons CO_2/year, with substitution of 2.1 billion kWh electric power produced by the existent condensation groups
1.6.	High capacity cogeneration combined cycle groups	Electricity efficiency is 50-55%, overall efficiency may reach 80-85%. At the same time it should be mentioned that such efficiency may be reached only if there is a heat load.	150 000 kW will account for 16.6 % of the maximum load of ≈ 900 MW.	140 000 tons CO_2/year , with substitution of 900 mln kWh electric power produced by the existing condensation groups
1.7.	Integrated gasification combined cycle group	Coal gasification technology used to produce electricity is called integrated gasification combined cycle (IGCC) and is an energy unit that uses synthesis gas instead of natural gas. This technology integrates production of purified synthesis gas with production of electricity. Use of such technology is environmentally beneficial because it reduces the emission of pollutants when carbon is captured and stored. IGCC can achieve higher efficiency than 45% because the combustion of synthesis gas is combined and the exhaust gases energy is used for producing live steam and then - electricity. The fuel used is coal, which is cheaper compared to natural gas.	200 000 kW, will account for 22.2 % of the maximum load of ≈ 900 MW	390 000 tons CO_2/year, due to CO_2 capture installations which substitute 1.4 billion kWh electricity produced by the existing condensing groups

No.	Name of the nationally appropriate mitigation action	Brief description of the mitigation action	Mitigation action implementation capacity	Estimated reductions of GHG emissions
1.8.	Grid connected wind farms	In RM there are areas where the average annual wind speed at an altitude of 100 m above the ground is 7.0 - 7.5 m/sec. For such sites wind turbine designed for wind class IIIA are recommended, which also means an efficient operation on the sites where the wind speed is between 5.5 and 8.5 m/sec. The power of a 1.8-3.0 MW group, tower height 80-120 m. Under the RM wind conditions these turbines would operate annually at a rated capacity of 2.2-2.6 thousand hours, or the capacity factor will be 0.25 to 0.30.	250 MW	313 300 tons CO_{2}/year
1.9.	Wind farms for pumping	Eliminates the need for batteries and inverters. Wind generator is directly coupled with an AC motor, which drives the centrifugal pump. Voltage and frequency vary depending on wind velocity, abiding the rule U / f = constant. Provides a perfect correspondence between the characteristics of the wind (power proportional to the cube of speed) and centrifugal pump curve (power required is also proportional to the cube of the speed of rotation).	850 systems with total power 8.5 MW	20 000 tons CO_2/year
1.10.	Grid connected photovoltaic plants	Direct conversion technology excludes intermediate transformations: solar radiation into heat, heat into mechanical energy and mechanical energy into AC electricity. Photovoltaic generator, the so-called photovoltaic cell, unlike electromechanical generator, produces DC electricity. Exclusion of intermediate transformations from the technological chain, lack of movement, noise, vibration, existence of a modular construction, service life of over 25 years, are the arguments asserting that the future of decentralized energy will belong to photovoltaic technology.	10 MW	7 100 tons CO_2
1.11.	Photovoltaic energy for small irrigation	PV pumping systems contain the following main elements: solar panel, inverter, surface or submersible pump. If pumps driven by the DC motors are used, the inverter is unnecessary, as well as the batteries, the function of which is taken over by the water tank. Consequently, photovoltaic pumping systems compete economically with motor pumps or geneneration sets.	1800 systems with installed power 2.7 MW	144 000 tons CO_2
1.12.	Small hydropower plants	Small hydraulic power plants (up to 1 MW) are equipped with water turbine, generator and multiplier. Different types of turbines, the various fields of application have been developed aiming at achieving the highest efficiency. Each type of turbine is reasonable to use for different types of water falls and flows: Pelton turbine - for big drops and small flow rates; Francis turbine - for medium drops and average flow falls, KLPA a turbine - for low drops and high flow rates.	17 MW	43 700 tons CO_2
1.13.	No dam micro-hydropower plants	The technology is based on the overall effect of a hydrodynamic profile of the blade and at an optimal angle to the direction of water velocity. At the blade's movement in the water's direction, the momentum is produced both by the hydrodynamic forces, as well as the pressure forces exerted by the water on the blade surface. The blade's movement against the direction of water, only hydrodynamic forces are used to generate power. The main advantages of these types of small hydropower plants are reduced environmental impact; civil works are minimal.	500 micro-hydropower plants, 2.7 MW	18 000 tons CO_2
1.14.	Solid bio-mass: straw and pellets based heat plants to provide heat to social and cultural facilities	These types of plants could provide, firstly, social and cultural facilities such as preschool institutions, schools, community centres, etc. Straw bales and/or wood products based boilers (pellets, wood briquettes) have to be used in rural areas where it is impossible or too costly to use natural gas. Thermal energy production capacity is 150-750 kW.	560 MW	221 000 tons CO_2
2.	**Specific Objective 2:** Reducing, by 2020, direct GHG emissions from transport sector (mobile combustion of fuels), by 15% compared to the BAU scenario.			
2.1.	Biodiesel fuel	Biodiesel fuel is used to substitute diesel fuel, being mixed with fossil fuel in various proportions. In Europe, the fuel applicable standards allow for up to 5% blend of biodiesel, depending on fuel limitations and vehicle specifications. Blends above 20% may require some modest adjustments of the vehicle. Biodiesel can be produced from various vegetal oils such as rapeseed and soybean, palm oil and animal fats.	20% of the annual consumption of diesel fuel per country or 100 thousand tons of bio diesel fuel per year.	50 000 tons CO_2/year

No.	Name of the nationally appropriate mitigation action	Brief description of the mitigation action	Mitigation action implementation capacity	Estimated reductions of GHG emissions
2.2.	Bio-ethanol	Bio-ethanol can be produced from sugar crops or starch. Bio-ethanol is mixed with gasoline in proportion from 5 to 85%. Smaller proportions of the mixture are applicable to conventional petrol engines. Mixtures containing more than 10% of bio-ethanol can be used only in modified engines. The process for production of bio-ethanol starts from processing of the raw material to obtain sugar, in which yeast is added for fermentation. Sugar fermentation should take place in anaerobic conditions and produce a number of products including lactic acid, hydrogen, carbon dioxide and ethanol. To produce bio-ethanol, most commonly sorghum, sugar beet, as well as other sugar-containing plants is used.	20% of the annual consumption of gasoline per country or 50 thousand tons per year.	35 000 tons CO_2/year
2.3.	„Bus Rapid Tranzit" systems	A „Bus Rapid Transit" system is a high capacity transport system with its own way of travel. This is a key technology for developing countries that can change the modal transfers' trend towards public transport, thus bringing a number of benefits including reduced congestion, less pollution and higher quality services for poor people. A disadvantage of this system to other urban transport systems is the need for urban space.	1.665 mln passengers-km/an or 25% of the urban passenger road transport	128 000 tons CO_2/year
2.4.	Direct injection in engines with internal combustion	Direct injection means injecting fuel, under high pressure, directly into the engine cylinders. The direct injection provides precise control over the timing and quantity of fuel injected. This precise control allows the engine management system to inject the fuel in relatively large quantities only when needed, for example when the vehicle accelerates. Direct injection leads to modification of fuel injection into the engine, but do not require additional changes in vehicle design and transport infrastructure. At the same time, direct injection engines require more robust components.	25% of private vehicles on petrol	47 000 tons CO_2/year
2.5.	Compressed natural gas in transport	Technically speaking, vehicles with compressed natural gas consumption function very similarly to vehicles with gasoline consumption. To use compressed natural gas in existing cars it is necessary to re-equip them with gas reservoir. However, the re-equipped vehicles are not as efficient as the vehicles on compressed natural gas put on sale by manufacturers.	1.118 mln passengers-km/year or 25% of the annual passenger transportation by buses	11 000 tons CO_2/year
2.6.	Electronic road pricing	Road pricing can be implemented in several ways, including: road toll - a fee (usually fixed) to travel on a particular road, congestion charging - a variable fee depending on the congestion level in a specific area; cordon toll - usually applied to covering urban centres mileage fee - applies per vehicle and distance travelled, electronic road pricing methods include: electronic toll, in which users are charged when they go over specific points on the road, optical car recognition, applying an optical system of taxation; GPS by which vehicles are located, and charge is applied based on distance travelled.	3.820 mln passengers-km/year or 25% of the road passenger transport	93 000 tons CO_2/year
2.7.	Liquefied petroleum gas in transport	Liquefied petroleum gas is a widely used as alternative fuel, generally applied to light commercial vehicles and cars	25% of the private gasoline vehicles pool	28 000 tons CO_2/year
2.8.	Non-motorized transport	Non-motorized transport (also known as active transport and transport by human action) include walking and cycling, various units of specific transport (rickshaw, roller skates, skateboards, scooters and strollers) and wheelchairs. These modes of transportation offer leisure as well as transport and travel and are especially important for short distances up to 7 km, which covers most of the trips in urban areas. Deployment path - creating infrastructure and education.	25.0 mln passengers-km or 0.5% of the road passenger transport	4 200 tons CO_2/year
2.9.	Hybrid Electric Vehicle	A hybrid vehicle uses two or more distinct sources of energy, for example, hybrid electric vehicles combine an internal combustion engine and one or more electric motors. The internal combustion engine provides most of the power needed to move the vehicle, and the electric motor provides additional power when it accelerates. This allows use of a smaller, more efficient engine. Electric power for the engine is generated through regenerative braking and the internal combustion engine. Thus, electric motors do not need to be connected to and charged from a power source.	2.352 mln passengers-km or 25% of the annual passenger transportation by buses	25 000 tons CO_2/year

No.	Name of the nationally appropriate mitigation action	Brief description of the mitigation action	Mitigation action implementation capacity	Estimated reductions of GHG emissions
2.10.	Plug-in Electric Hybrid Vehicles	A plug-in hybrid electric vehicle is charged from an external source such as an electric grid. Such vehicle can run driven either by the internal combustion engine or battery. The key advantage of this technology compared to electric vehicles running on battery is flexibility in fuel use. The first have no limit on distance travelled and do not depend on charging infrastructure.	4,000 mln passengers-km or 30% of the total number of private vehicles	97 000 tons CO_2
3.	**Specific Objective 3:** Reducing, by 2020, of direct GHG emissions from buildings sector, by 20% compared to the BAU scenario.			
3.1.	Walls insulation	In 2011, the housing stock of the RM was 79.342 million m^2, of which 30.423 million m^2 in urban and 48 919 million m^2 - in rural areas. In 2020 the housing stock will account for approximately ≈ 82.4 million m^2, of which 32.25 million m^2 in urban areas. In 1997, when the requirements towards walls insulation were changed, the housing stock accounted for 73.2 million m^2. In homes built before 1997 walls insulation corresponded to 70 W/m^2 and 160 W/ m^2 in the urban areas. After 1997 these values were reduced to 50 W/m^2 and 130 W/m^2, respectively. In the last decade containment measures were implemented in about 10% of the older buildings in urban and 1-2% in rural areas: wall insulation, replacing old windows with insulated technology, replacement of doors, etc.	Rehabilitation of 25% of the housing stock	Savings of 150 000 t.c.e./year, emissions reduction by 246 000 tons CO_2/year
3.2.	Programmable thermostats in rooms	Under the district heating system the heat temperature is controlled at source, by regulation of water temperature in the pipes. At the same time, by reducing the room temperature from 18-20°C to 10-12°C during periods of time when the rooms are not used, it is possible to gain 20-30% savings in heat. This technology can be implemented in buildings with centralized heat supply, which account for ≈ 60% of all urban housing stock. Installation of thermostats (which costs US $ 10-12 per unit) on every heating body will allow to change the room temperature to 10-12°C during periods when they are not used, which is ≈ 50% of the time.	Use of thermostats can reduce fuel consumption by 60 thousand t.c.e. by 2020	98 600 tons CO_2
3.3.	Automatic temperature regulators, with day/night mode	Such regulators can be used also in other types of rooms. The rooms in the administrative buildings are used about 10 hours over 5 days a week. During other periods of time, the temperature in the room can be reduced to 10-12°C, to the „night" mode.	Savings of 700 TJ/year, or 29,8 thousand t.c.e./year	≈ 49 000 tons CO_2/year
3.4.	Replacement of incandescent bulbs with energy efficient bulbs	Currently used incandescent bulbs (Class E) have luminous efficiency of 10-12 lm /W, while the energy-efficient bulbs (Class A) indicator is 50 lm/W. If energy intensity during illumination is on average 10 W/m^2, then in fluorescent bulbs this indicator will be 2 W/m^2.	Illumination of 22 mln m^2 premises results in saving 254 mln kWh/year	170 000 tons CO_2/year
3.5.	Installation of heat meters in each apartment	Currently heat meters are installed on residential blocks. If it will be decided to replace the current scheme of vertical distribution of heating in blocks by the horizontal one, it will require installation of heat meters in each apartment. This will result in reducing heat consumption in blocks by at least 5%.	≈ 60% of urban housing stock	≈ 98 000 tons CO_2/year
3.6.	Solid Biomass: implementation of pellets based boilers	Pellets are produced from solid fuel made from vegetal raw material (sawdust, energy crops, and agricultural waste) of cylindrical form, with a diameter up to 25 mm. The heat capacity range from 14 to 19 MJ / kg. Pellet based boilers can be used to ensure heat supply to households. Exploitation of these boilers is simple and does not require high maintenance costs. The thermal energy production capacity is 12-100 kW.	20 000 units of 25 kW, with a total of 490 MW	194 000 tons CO_2
3.7.	Small, medium and big capacity heat pumps	Heat pumps increase the temperature of the low potential heat source to the temperature required by consumer. Low potential heat source can be ambient air, soil, surface water and groundwater, as well as technological sources of heat (air ventilation, waste water, cooling fluids for power plants and machinery, and long-term heat from paved roads, etc.). Heat pumps do not eliminate polluting emissions. Lately, ozone-active refrigerants are replaced by hydrocarbons that are neutral to the ozone layer. Heat pumps use 1 kWh of electricity for 3 to 5 kWh of heat.	Use of heat pumps can ensure ≈ 2 % of heat needed by 2020, or 46.6 PJ	37 142 tons CO_2/ year
4.	**Specific Objective 4:** Reducing, by 2020, of direct GHG emissions from industry sector, by 15% compared to the BAU scenario.			

No.	Name of the nationally appropriate mitigation action	Brief description of the mitigation action	Mitigation action implementation capacity	Estimated reductions of GHG emissions
4.1.	Implementation of Energy Management System	Energy Management System (EMS) introduced by ISO 50001, already approved as a national standard in 2012, is a series of management processes that enable enterprises (organizations) to systematically maintain and improve energy performance. EMS includes the collection, processing and analysis of data on all forms of energy consumption and energy carriers at different points of energy consumption (electricity, heating, cooling, compressed air, natural gas, other fuels, etc.) and informing management on the data collected and proposing actions to eliminate energy waste, implementation of adopted measures, including monitoring of results. Practice of EU enterprises shows that implementation of the EMS may result in reduced energy consumption by about 10-30%.	Implementation in 15% of undertakings and organizations will reduce energy consumption by cca 1%, equivalent to 25 mln kWh/year	By 2020 ≈ 25 mln kWh/ year will be saved, emissions will be reduced by ≈ 12 000 tons CO_{2}/ year
4.2.	Use of II generation bio-fuel for thermal power generation	The process takes place at 450-800 °C, through decomposition of lignocellulose biomass, with ultimately produced bio-fuel gas (syngas), solid bio-fuel (charcoal), liquid bio-fuel (bio-oil). The fast pyrolysis process is controlled and depending on the temperature and the duration of the pyrolysis process, the obtained fuel may have different proportions. For the conditions of the Republic of Moldova it is rational to use installations producing 65% -75% liquid bio-fuels, 20% syngas and 15% -solid bio-fuel.	190 units of 130 kW	57 000 tons CO_2
4.3.	Harmonizing the national regulatory framework to the EU's (EC Regulation Nr. 842/2006 on certain fluorinated greenhouse gases) on phased suppression of F-GHG	Develop and promote by a Government Decision a National Regulation or Program on certain F- greenhouse gases (HFCs, PFCs and SF_6); prohibit the imports of certain types of products and equipment for F- gases (new and used), stimulation innovation, development and deployment of new techniques, developing and promoting the Law on amending and supplementing Law No. 1540-XIII of 25.02.1998 on payment for environmental pollution and approve the annual import quota for F-gases, products and equipment.	National level	n/a
4.4.	Developing/improving the system of reporting data on imports and consumption of HFCs, products and equipment containing HFC, PFC and SF_6	Creating the system, including electronic one on reporting of data on imports and consumption of HFC, products and equipment with HFC, PFC and SF_6	National level	n/a
4.5.	Training and provision of available tools/instruments to regulate HFC, PFC and SF_6	Develop technical criteria adjusted to EU regulations (Regulation no. 305/2008) on training refrigeration technicians for refrigeration equipment, air conditioning and electrical equipment servicing sectors in which F-gases (PFCs and SF_6) are used as dielectric, development / procurement of professional training materials, updating the Code of Practice in refrigeration and air conditioning, mandatory training and certification of refrigeration technicians and AC; equipping refrigeration specialists with tools and equipment for servicing refrigeration and AC equipment.	National level	n/a
4.6.	Building the capacities of the Customs Service of the RM	Development / procurement of professional training materials, updating the Customs Officers Guide, theoretical and practical training of staff / customs brokers, equipping the Customs Service with freon identifiers.	National level	n/a
4.7.	Phased decrease of HFC consumption	Retrofitting and re-equipping the existing refrigeration and air conditioning equipment that works on HFC alternative Freons of new generation, including natural freons (propane, isobutane, isopentane, H_2O, NH_3, air, helium, CO_2)	National level	n/a
5.	**Specific Objective 5:** Reducing, by 2020, direct GHG emissions from agriculture, by 15% compared to the BAU scenario.			
5.1.	Replacing the harrow plough with heavy discs plough to process the soil up to 20 cm in depth without introducing organic fertilizers	The advantage of using the heavy discs plough is fuel savings and almost the same yields as under conventional technology	Annually basic cultivation of soil with discs is implemented on circa 40-50% of agricultural lands. The area recommended to be cultivated should be circa 200 thousand ha/year.	74 000 tons CO_2/year 0.37 tons CO_2/ha/year x 200 thousand ha

No.	Name of the nationally appropriate mitigation action	Brief description of the mitigation action	Mitigation action implementation capacity	Estimated reductions of GHG emissions
5.2.	Implementation of crop rotation involving only often sown crops (straw grains, legumes grasses, perennial grasses) on slopes with inclination greater than 5°	The technology is based on the principle of differential erosion protection provided by different crops: grain crops and perennial legumes after the first year of use ensure protection of 90-95%; good protecting crops - cereal grains, legumes, high density annual forage crops provide a protection up to 70-90%	200 thousand ha arable lands on slopes greater than 5°, 5 years during 2013-2020, on 40 thousand ha each time	300 000 tons CO_2/year 1.5 t/ha/year x 200 thousand ha
5.3.	Implementation of cattle feeding technology implying use of different types of feed separately	Traditional for the RM cattle feeding technology is use of separate feed rations consisting of - hay, green plants, concentrates, etc. Depending on the physiological status and productivity of animals ratios differ by the amount of feed and proportion of components (structure). If the structure is optimal, then productivity, health status, fodder digestibility and rumen gas formation are at an optimum level.	At present the most common technology used in more than 50% of cattle herd in the country. Further the scope of implementation will decrease.	14 175 tons CO_2 equivalent
5.4.	Implementation of cattle feeding technology using one type feed mixtures (mono-ration);	The technology is widely used in countries with well-developed animal husbandry sector. In Moldova this technology is in process of being implemented, currently covering about 5% of the cattle herd. The main difference of this technology is that the ratios are calculated based on physiological requirements of animals and consist of bulky, coarse, juicy, concentrated protein-vitamin-mineral supplements which are mixed evenly with special equipment (mixters) and dispensed to animals as homogeneous mix. It positively affects fodder digestibility, animal health, reproductive indices, and ultimately the productivity grows by up to 20-25% as compared to the traditional technology.	At present it is used at newly created and re-built diary farms at almost 95-100%. By 2020, in at least 25% of the country's cattle herd.	14 700 tons CO_2 equivalent
5.5.	Classical basic soil cultivation method, use in a 5 fields crop rotation of one field as a field occupied by a legume sidereal crop (two harvested crops of autumn and spring vetch incorporated into the soil as green manure on each field once in 5 years)	Classical basic soil cultivation method because of the specifics of crops cultivation (sugar beet and fodder beet, vegetables etc.) cannot be replaced by conservation tillage system. Given this fact, it is proposed to improve the classical tillage system by introducing a five fields crop rotation with «one vetch field used as green fertilizer" on 400 000 ha.	400 thousand ha, during 10 years, on 40 thousand ha each time, so that the technology is gradually implemented on the proposed area	880 000 tons CO_2/year 2.2 tons/ha/year x 400 thousand ha
5.6.	The conservative „mini-till" soil tillage system with introduction of mostly mineral fertilizers	This technology implementation requires: lightweight disc cultivator and a regular sower or combined sower to till the soil and sow at the same time.	200 thousand ha or 20% of the area of arable lands, during 5 years, on 40 thousand ha each time, primarily for cultivation of grain crops	220 thousand tons CO_2/year 1.1 ton CO_2/ha/year x 200 thousand ha
5.7.	Conservative „mini-till" soil tillage system with use of mineral fertilizers and all agricultural waste products (straw, corn cobs, crop residues, etc.)	The soil accumulates 1.0 t/ha of vegetal residues per 1.0 ton of the main crop dry mass at straw evacuation, and 1.43 t/ha at incorporating straw into the soil. So, at incorporating straw into the soil, it additionally accumulates 0.43 t / ha of crop residues containing 40-45% carbon and 0.05-0.08% nitrogen. Given the standard harvest for the Republic of Moldova of 3 t/ha of the main crop, the soil will additionally accumulate 1.3 t/ha of crop residues, which will be used for synthesis of 140 kg of humus and will capture 81 kg of carbon, what will contribute to additional reduction of CO_2 emissions from agricultural soils by circa 0.3 t/ha. Implementation of this technology requires: lightweight disc cultivator and a regular sower or combined sower to till the soil and sow at the same time.	200 thousand ha arable lands, during 5 years, on 40 thousand ha each time, primarily for cultivation of grain crops	60 000 tons CO_2 0.3 tons CO_2/ha x 200 thousand ha

No.	Name of the nationally appropriate mitigation action	Brief description of the mitigation action	Mitigation action implementation capacity	Estimated reductions of GHG emissions
5.8.	Conservative „no-till" tillage system with prior restoration of positive features of the post-arable layer and use of vetch, as intermediate crop, one year later as green fertilizer	„No-Till" is a conservation tillage system whereby sowing is done directly in the stubble. The main working tool is the drill sower. The main element of „No-Till" drill sower is the coulter. Gradually the topsoil layer becomes biogenous, well structured, and loose, forming a favourable aerohidric and nutrients regime for plants; increase the plants resistance to drought. It is proposed to improve the „No-Till" system by using vetch as a successive green fertilizer crop. Before the implementation of the „No-Till" technology it is recommended to preliminarily restore the arable layer. For this purpose one year the field should be sown with winter and spring vetch, and the green mass of this crop should be incorporated into the soil.	200 thousand ha arable lands, during 10 years, on 20 thousand ha each time	1.06 mln tons CO_2 5.3 tons CO_2/ha x 200 thousand ha Soil carbon positive balance ensured for 2 years, annual CO_2 emissions from soil, in comparison with conventional soil cultivation, are totally reduced.
5.9.	Conservative „mini -till" tillage system with prior restoration of positive features of the post-arable layer and use of vetch, as intermediate crop, one year later as green fertilizer	Minimum works system became an embodiment of conservative tillage, based on the following considerations: agro-technical, energy, economic, ecological. This system provides for restitution of crop residues into the soil, partially keeping it as mulch on the soil surface. It is proposed to improve the system by using vetch as a successive crop for green fertilizer. Deployment of this technology is subject to availability of appropriate agricultural machinery. Implementation of this technology requires: combined lightweight disc cultivator and a regular sower or combined sower to till the soil and sow at the same time.	200 thousand ha arable lands, during 10 years, on 20 thousand ha each time, primarily for cultivation of grain crops	1.06 mln tons CO_2 5.3 tons CO_2/ha x 200 thousand ha Soil carbon positive balance ensured for 2 years, annual CO_2 emissions from soil, in comparison with conventional soil cultivation, are totally reduced.
5.10.	Storing manure on platforms	Manure, being stored on waterproof platforms, can be separated. For correct fermentation, it will be covered with plastic wrap to prevent nutrient leaching and reduce CH_4 and NH_3 volatilization. Thus it will become possible to limit penetration of nitrates and nitrites into the soil and water, reduce GHG emissions and obtain valuable organic fertilizer.	40% of the total of 3.0 mln tons of manure	50 000 tons CO_2 equivalent
5.11.	Composting manure	At present, only about 1% of the total amount of manure is composted. Composting results in minimizing the CH_4 and N_2O emissions, formation of a valuable organic fertilizer - humus and consequently, improvement of the soil structure and increased plant productivity. Simultaneously, it ensures environment protection against the adverse consequences of soil, water, air pollution.	50% of the total of 3.0 mln tons of manure	62 500 tons CO_2 equivalent
5.12.	Use of feed additives which reduce the formation of methane during the digestive process in cattle	The homogeneous mixes (mono-rations) for cattle are supplemented with special feed additives containing substances (saponins, ionophore, etc.) that influence the formation and elimination of methane, lowering this indicator to 30%.	By 2020, this technology could be applied in at least 10% of the cattle herd	9 450 tone CO_2 equivalent
5.13.	Manure processing for biogas and using it for energy production	Anaerobic fermentation of biomass that takes place in the fermenting tank, due to the microorganisms activity allows to obtain biogas,1 ton of CH_4 being equivalent to 21 tonnes of CO_2, but the biogas obtained will not be released into the atmosphere, but will be used as a source of power and heat.	10% of total 3.0 mln tons of manure	12 500 tons CO_2 equivalent
6.	**Specific objective 6:** Increase, by 2020, of carbon dioxide sequestration capacity in the land use, land use change and forestry sector, with 25% compared to the BAU scenario.			
6.1.	Afforestation of areas and rivers protection belts and waterbeds	It is planned to plant/rehabilitate protection forest belts of rivers and water basins on the area of 30.4 ha, in conformity with the GD No.593 of 01.08.2011 on the Approval of the National Program on establishing national ecological network for the period 2011-2018.	32.0% of 96 000 ha	590 773 tons CO_2
6.2.	Expansion of afforestated areas	The action implies expansion of afforestated areas by 81 000 ha on account of degraded lands, not used for agriculture	9.4% of the total area of degraded lands 860 000 ha	3 163 050 tons CO_2
6.3.	Expansion of areas covered with forest vegetation	The action implies expansion of areas covered with forest vegetation outside the forest fund by 55 000 ha	55 thousand ha	4 526 500 tons CO_2
6.4.	Restoration / rehabilitation of forest belts protecting the agricultural fields	It is planned to reconstruct / rehabilitate forest belts protecting agricultural fields on an area of about 2000 ha. According to regulations, the surface of forest belts should be 4% of the surface of arable land (about 1.8 million ha).	72 000 ha, implementation capacity circa 2.8%	49 800 tons CO_2

No.	Name of the nationally appropriate mitigation action	Brief description of the mitigation action	Mitigation action implementation capacity	Estimated reductions of GHG emissions
6.5.	Program to support communities in sustainable and integrated management of forests and carbon sequestration through afforestation	Improving productivity of 800 ha of municipal grassland, the total area of grassland is about 370 000 ha; Reconstruction and / or restoration of 1200 ha forests and other types of forest vegetation owned by municipalities, the total area of public forest fund property of administrative-territorial units is 54,500 ha; Development of forest management plans for 3200 ha of forests and other types of forest vegetation owned by municipalities.	For pastures – 0.2% of the total; for forest vegetation – 2.2% of the total	102 000 tons CO_2
6.6.	Planting of forest energy crops	Planting fast growing forest crops, managed in short production cycles (10-15 years).	10 thousand ha	1 287 000 tone CO_2
6.7.	Reducing emissions from deforestation and forest degradation (REDD+)	Reducing emissions from forest deforestation and degradation can be achieved by: a) enhancing guarding activities of forests and other types of forest vegetation; b) improving forest management of existing forests, including by: • reconstruction / replacing damaged / weak-productive trees on 10 000 ha; • conducting timely sanitation and management works on 40 000 ha; • developing forest management projects for the total area of forests and other types of forest vegetation owned by municipalities on about 100 000 ha; • conducting timely forest treatments in the forest regime (progressive cuttings, etc.) on about 10 000 ha	See „Brief description of the mitigation action"	1 378 000 tone CO_2
6.8.	„Moldova Soil Conservation" project	Planting of 20 300 ha forests on degraded lands.	2.3% of the total area of 860 thousand ha degraded lands	3 600 000 tons CO_2
6.9.	„Development of Community Forests Sector in Moldova" project	Planting 8. 468.9 ha forests on degraded lands.	0.98% of the total area of 860 thousand ha degraded lands	3 800 000 tons CO_2
7.	**Specific Objective 7:** Reducing, by 2020, of direct GHG emissions from waste sector, by 10% compared to the BAU scenario.			
7.1.	Development of primary collection and storage of waste in urban and rural areas	It is envisaged to extend the current system of primary collection and storage of waste from urban to rural areas, in the future five years, by the end of 2017, according to the draft National Waste Management Strategy	Provision of containers (35 650 units) and transport units with a capacity of 8 m³ (120 units) for waste collection	420 000 tons CO_2/year or1 680 000 tons CO_2 total
7.2.	Development of regional infrastructure for municipal waste disposal by building regional municipal solid waste deposits and transfer stations	The action envisages developing regional waste disposal infrastructure by building seven regional solid waste storages, of 34 transfer stations and providing 158 vehicles with capacity of 16 m3 for the transfer of waste at landfills.	See „Brief description of the mitigation action"	420 000 tons CO_2/year or 5 040 000 tons CO_2 total
7.3.	Development of regional infrastructure for municipal waste disposal by building mechanical-biological treatment facilities	The action envisages to develop regional waste disposal infrastructure by building two mechanical biological treatment facilities in Chisinau and Balti.	See „Brief description of the mitigation action"	630 000 tons CO_2/year or 7 560 000 CO_2 total
7.4.	Treatment of sewage sludge at the wastewater treatment plants in Chisinau, Balti and Cahul	Providing the technological scheme of wastewater treatment plants for water utilities in Chisinau, Balti and Cahul with anaerobic sludge treatment technologies. The technology includes: methane tank, pumping station, sludge concentrator, methane storage and combustion systems; dehydration tank; distribution and communications network.	Wastewater treatment in Chisinau and Balti municipalities and Cahul town	28 640 tons CO_2/year, Including: 22 900 tons CO_2/year - Chisinau; 4 690 tons CO_2/an - Balti; 1 050 tons CO_2/an – Cahul
7.5.	Biogas recovery at municipal solid waste landfill in Tintareni	Providing equipment and putting into operation of biogas recovery plant from the solid waste landfill Tintareni.	Along with the existing 325 kW electric power generators, additionally, 825 kW will be constructed	47 549 tons CO_2/year

Annex 3: Action Plan for Implementation of Priority Nationally Appropriate Mitigation Actions, Aimed at Achieving the General Objective of the Low Emissions Development Strategy of the RM until 2020

No.	Name of the nationally appropriate mitigation action	Implementation timeline	Institution responsible	Monitoring Indicators	Cost estimates	Funding sources
	General Objective of the LEDS: Reduce, by 2020 total national direct greenhouse gases emissions by not less than 20% compared to the BAU scenario, to support the global effort to limit temperature increase by 2°C					
1.	**Specific objective 1:** Reduce, by 2020 direct greenhouse gases emissions generated by energy sector (stationary combusting of fossil fuels, as well as operations with petrol and natural gas) by 20% compared to BAU scenario.					
1.1.	Condensing gas boilers	2014-2020	Private companies, MEC, AEE	Investments, energy produced, reduced emissions determined by the agreed MRV procedures approved at the national level	The specific investment in such boilers is ≈ 2 times higher than investments in regular boilers	Private investments
1.2.	Implementation of cogeneration technology based on the use of internal combustion engines with the capacity up to 500 kW electrical power	2015-2020	Private companies, LPA, MEC, AEE	Investments, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved at the national level	Total investments – US$ 11.5 mln, operation and maintenance costs, excluding fuel – US$ 1.7 mln/year	Green Climate Fund; Private investments; Projects and grants
1.3.	Implementation of cogeneration technology based on the use of gas turbines with the capacity up to 500 kW electrical power	2015-2020	Private companies, LPA, MEC, AEE	Investments, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 11.5 mln, operation and maintenance costs, excluding fuel – US$ 1.68 mln/year	Green Climate Fund; Private investments; Projects and grants
1.4.	Cogeneration power plants based on the use of internal combustion engines and gas turbines with the capacity greater than 1 MW electric power	2015-2020	Private companies, LPA, MEC, AEE	Investments, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 150 mln, operation and maintenance costs, excluding fuel – US$ 6.0 mln/year	Green Climate Fund; Private investments; Projects and grants
1.5.	High capacity gas-steam combined cycle power plants	2015-2020	Private companies, MEC, AEE	Investments, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 225 mln, operation and maintenance costs, excluding fuel – US$ 10.8 mln	Green Climate Fund; Private investments; Projects and grants
1.6.	High capacity cogeneration combined cycle groups	2015-2020	Private companies, MEC, AEE	Investments, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 195 mln, operation and maintenance costs, excluding fuel – US$ 9.0 mln	Green Climate Fund; Private investments; Projects and grants
1.7.	Integrated gasification combined cycle group	2015-2020	Private companies, MEC, AEE	Investments, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 600 mln, operation and maintenance costs, excluding fuel – US$ 24.0 mln	Green Climate Fund; Private investments; Projects and grants
1.8.	Grid connected wind plants	2015-2020	Private companies, MEC, ANRE, AEE	Investments, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	US$ 525.0 mln	Green Climate Fund; Private investments; Projects and grants
1.9.	Wind plants for pumping	2015-2020	Private companies, MAFI, ANRE, AEE	Investments, number of systems installed, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	US$10.2 mln	Green Climate Fund; Private investments; Projects and grants

No.	Name of the nationally appropriate mitigation action	Implementation timeline	Institution responsible	Monitoring Indicators	Cost estimates	Funding sources
1.10.	Grid connected photovoltaic plants	2015-2020	Private companies, MEC, AEE, ANRE	Investments, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	US$ 16.3 mln	Green Climate Fund; Private investments; Projects and grants
1.11.	Photovoltaic energy for small irrigation	2015-2020	Private companies, MAFI, AEE, ANRE	Investments, number of systems installed, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	US$ 6.5 mln	Green Climate Fund; Private investments; Projects and grants
1.12.	Small hydropower plants	2015-2020	Private companies, MEC, MAFI, AEE, ANRE	Investments, number of plants built, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	US$ 37.4 mln	Green Climate Fund; Private investments; Projects and grants
1.13.	No dam micro-hydropower plants	2015-2020	Private companies, MEC, MAFI, AEE, ANRE	Investments, number of micro-hydropower plants built, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	US$ 1.1 mln	Green Climate Fund; Private investments; Projects and grants
1.14.	Solid biomass: straw and pellets based heat plants to provide heat to social and cultural facilities	2014-2020	Private companies AEE, LPA	Investments, number of heat plants built, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	US$ 176.4 mln	Green Climate Fund; Private investments; Projects and grants
2.	**Specific Objective 2:** Reducing, by 2020, of direct GHG emissions from transport sector (mobile combustion of fuels), by 15% compared to the BAU scenario.					
2.1.	Biodiesel fuel	2014-2020	MTRI	Investments, amount of biodiesel fuel produced and supplied on the fuel market, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 12 mln, operation and maintenance costs – US$ 2 mln/year	Green Climate Fund; Private investments; Projects and grants
2.2.	Bio-ethanol	2014-2020	MTRI	Investments, amount of bio-ethanol produced and supplied on the fuel market, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 11 mln, operation and maintenance costs – US$ 1 mln/year	Green Climate Fund; Private investments; Projects and grants
2.3.	„Bus Rapid Tranzit" systems	2015-2020	MTRI	Investments, share in urban passenger road transport covered by the system, number of transported passenger-km/year, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 100 mln, operation and maintenance costs – US$ 0.5 mil	Green Climate Fund; Roads Fund, National Regional Development Fund; Private investments; Projects and grants
2.4.	Direct injection in engines with internal combustion	2014-2020	MTRI	Investments, number of vehicles consuming gasoline with the changed fuel injection systems, their share in the total number of vehicles, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 130 mln, operation costs –US$ 2 mln/year	Green Climate Fund; Private investments; Projects and grants
2.5.	Compressed natural gas in transport	2014-2020	MTRI	Investments, number of vehicles re-equipped with tanks for compressed natural gas, their share in the total number of vehicles, number of transported passenger-km/year, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 59 mln, operation costs –US$ 1 mln/ year	Green Climate Fund; Private investments; Projects and grants

No.	Name of the nationally appropriate mitigation action	Implementation timeline	Institution responsible	Monitoring Indicators	Cost estimates	Funding sources
2.6.	Electronic road pricing	2014-2020	MTRI	Investments, share in urban passenger road transport covered by the system, number of transported passenger-km/year, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 130 mln, operation costs – US$ 33 mln/year	Green Climate Fund; Private investments; Projects and grants
2.7.	Liquefied petroleum gas in transport	2014-2020	MTRI	Investments, number of vehicles on liquefied petroleum gas, share of such vehicles in the total number of vehicles, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 263 mln, operation costs – US$ 4 mln /year	Green Climate Fund; Private investments; Projects and grants
2.8.	Non-motorized transport	2014-2020	MTRI, LPA	Investments, share in urban passenger road transport, number of transported passenger-km/year substituted by applying this mitigation action, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 1 mln, operation costs – US$ 0.05 mln/year	Green Climate Fund; Private investments; Projects and grants
2.9.	Hybrid Electric Vehicle	2014-2020	MTRI, LPA, private undertakings in urban areas	Investments, share in urban passenger road transport, number of transported passenger-km/year, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 57 mln, operation costs – US$ 1 mln/year	Green Climate Fund; Private investments; Projects and grants
2.10.	Plug-in Electric Hybrid Vehicles	2014-2020	MTRI, LPA, private undertakings in urban areas	Investments, share in the number of privately owned vehicles and number of transported passenger-km/year, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 1.770 billion, operation costs – US$ 25 mln/year	Green Climate Fund; Private investments; Projects and grants
3.	**Specific Objective 3:** Reducing, by 2020, of direct GHG emissions from buildings sector, by 20% compared to the BAU scenario.					
3.1.	Walls insulation	2014-2020	MRDC, AEE, LPA, private and public companies	Total investments, share of rehabilitated buildings in the total housing stock, energy saved, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 700 mln, operation and maintenance costs will not change	Green Climate Fund; Energy Efficiency Fund; Private investments; Projects and grants
3.2.	Programmable thermostats in rooms	2014-2020	AEE, LPA, Custom Service, private and public companies, housing stock managers	Total investments, number of imported and sold annually, amount of energy saved, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 22.5 mln, operation and maintenance costs will increase insignificantly	Energy Efficiency Fund; Private investments; Projects and grants
3.3.	Automatic temperature regulators, with day / night mode	2014-2020	AEE, LPA, Custom Service, private and public enterprises, housing stock managers	Total investments, number of imported and sold annually, amount of energy saved, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 6 mln, operation and maintenance costs will not change	Energy Efficiency Fund; Private investments; Projects and grants
3.4.	Replacement of incandescent bulbs with energy efficient bulbs	2014–2020	AEE, LPA, Custom Service, private and public companies	Total investments, number of energy efficient bulbs imported and sold annually, amount of energy saved, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 14.4 mln	Green Climate Fund, Energy Efficiency Fund

No.	Name of the nationally appropriate mitigation action	Implementation timeline	Institution responsible	Monitoring Indicators	Cost estimates	Funding sources
3.5.	Installation of heat meters in each apartment	2014-2020	AEE, LPA, private and public companies, housing stock managers	Total investments, number of heat meters installed, amount of energy saved, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 45.0 mln	Energy Efficiency Fund; Private investments; Projects and grants
3.6.	Solid Biomass: implementation of pellets based boilers	2014-2020	AEE, LPA, private and public companies, household consumers	Total investments, number of heat plants installed, total installed power, annual amount of energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 61.7 mln	Green Climate Fund, Energy Efficiency Fund; Private investments; Projects and grants
3.7.	Small, medium and big capacity heat pumps	2014-2020	AEE, LPA, TUM, private and public companies	Total investments, number of heat pumps installed, total installed power, amount of energy produced annually, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 93.0 mln, operation and maintenance costs – 13.5 US$/GJ	Green Climate Fund, Energy Efficiency Fund; Private investments; Projects and grants
4.	**Specific Objective 4:** Reducing, by 2020, of direct GHG emissions from industry sector, by 15% compared to the BAU scenario.					
4.1.	Implementation of Energy Management System	2014-2020	Private companies, MEC, AEE, National Institute for Standardization and Metrology	Number of enterprises that have implemented the energy management system and the National Standard SM ISO 50001:2012, amount of energy saved, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 5.74 mln	Green Climate Fund, Energy Efficiency Fund; Private investments; Projects and grants
4.2.	Use of II generation bio-fuel for thermal power generation	2014-2020	Private companies, AEE	Investments, number if installations built, total installed capacity, energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 1.12 mln, given 190 units of 130 kW at a cost of US$ 45 /kW	Green Climate Fund, Energy Efficiency Fund; Private investments; Projects and grants
4.3.	Harmonizing the national regulatory framework to the EU's (EC Regulation Nr. 842/2006 on certain fluorinated greenhouse gases) on phased suppression of F-GHG	2014-2020	MoEN, Ozone Office, Customs Service, TUM	National Regulation on F-GHG approved; annual import shares of F-gases, products and equipment containing such gases, approved	Does not need financial coverage	
4.4.	Developing / improving the system of reporting data on imports and consumption of HFCs, products and equipment containing HFC, PFC and SF_6	2014-2015	MoEN, Ozone Office, Customs Service, TUM	The system of electronic reporting of data on import and consumption of HFC, products and equipment containing HFC, PFC and SF_6 created and functional	US$ 25 thousand	Projects and grants
4.5.	Training and provision of available tools/instruments to regulate HFC, PFC and SF_6	2014-2020	MoEN, Ozone Office, TUM	Technical criteria, adjusted to the EC Regulation No. 305/2008 on training refrigeration technicians from refrigeration, air conditioning and electric equipment containing F-gases servicing sectors developed; Good Practice Code in refrigeration and air conditioning updated; mandatory training and certification of technicians in refrigeration and air conditioning sector; refrigeration technicians provided with tools and equipment for refrigeration and air conditioning equipment servicing	US$ 100 thousand	Projects and grants

No.	Name of the nationally appropriate mitigation action	Implementation timeline	Institution responsible	Monitoring Indicators	Cost estimates	Funding sources
4.6.	Building the capacities of the Customs Service of the Republic of Moldova	2014-2016	MoEN, Ozone Office, Customs Service	Professional training materials developed and and/ or procured; Guidelines for customs officers updated; theoretical and practical training of customs officers / brokers provided; customs officers equipped with freon identifiers	US$ 30 thousand	Projects and grants
4.7.	Phased decrease of HFC consumption	2016-2020	Private companies, MoEN, Ozone Office	Number of existing refrigeration and air conditioning systems operating with HFC retrofitted and re-equipped with alternative freon of new generation (propane, isobutane, isopentane, H_2O, NH_3, air, helium, etc.), total amount of refrigerant replaced, low emissions identified by internationally approved MRV procedures	US$ 300 thousand	Green Climate Fund, Projects and grants
5.	**Specific Objective 5:** Reducing, by 2020, direct GHG emissions from agriculture, by 15% compared to the BAU scenario.					
5.1.	Replacing the harrow plough with heavy discs plough to process the soil up to 20 cm in depth without introducing organic fertilizers	2014-2020	Private companies, MAFI, LPA	Total investments, total area annually subjected to discs cultivation (thousand ha/year), reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 38.8 mln, once in 10 years, for 200 thousand ha in the first year, given US$ 194 /ha; operational costs – US$ 69.6 mln for 200 thousand ha, given US$ 348/ha/year	Businesses own funds
5.2.	Implementation of crop rotations involving only often sown crops (straw grains, legumes grasses, perennial grasses) on slopes with inclination greater than 5°	2014-2020	Private companies, MAFI, LPA	Total investments, total area on which the technology is implemented every year (thousand ha/year), reduced emissions determined by the agreed MRV procedures approved at the national level	Total investments – US$ 42.6 mln, once in 10 years, given US$ 213/ha/yearn, for 200 thousand ha, operational costs – US$ 87.5 mln, given US$ 416/ha/year	Businesses own funds
5.3.	Implementation of cattle feeding technology implying use of different types of feed separately	2014-2020	Private companies, MAFI, LPA	Share of cattle herd in which the technology is used (in % of the cattle herd of the country), reduced emissions determined by the agreed MRV procedures approved at the national level	US$ 300 thousand	Businesses own funds
5.4.	Implementation of cattle feeding technology using one type feed mixtures (mono-ration)	2014-2020	Private companies, MAFI, LPA	Share of cattle herd in which the technology is used (in % of the cattle herd of the country), reduced emissions determined by the agreed MRV procedures approved at the national level	US$ 200 thousand	Businesses own funds
5.5.	Classical basic soil cultivation method, use in a 5 fields crop rotation of one field as a field occupied by a legume sidereal crop (two harvested crops of autumn and spring vetch incorporated into the soil as green manure on each field once in 5 years)	2014-2023	Private companies, MAFI, LPA	Total investments, total area on which the technology is implemented every year (thousand ha/year), reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 88.8 mln, once in ten years, in the first year, given US$ 222/ ha, on 400 thousand ha, by 40 thousand ha each time – operational costs – US$ 145.2 mln, for 400 thousand ha, given US$ 316/ha/year	Green Climate Fund; Private investments; Projects and grants

No.	Name of the nationally appropriate mitigation action	Implementation timeline	Institution responsible	Monitoring Indicators	Cost estimates	Funding sources
5.6.	The conservative „mini-till" soil tillage system with introduction of mostly mineral fertilizers	2014-2023	Private companies, MAFI, LPA	Total investments, total area on which the technology is implemented every year (thousand ha/year), reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 38.4 mln, once in ten years, in the first year, given US$ 192 /ha on 200 thousand ha, during 5 years, by 40 thousand ha each time, operational costs – US$ 64 mln for 200 thousand ha/ year, given US$ 320 /ha/year	Green Climate Fund; Private investments; Projects and grants
5.7.	Conservative „mini-till" soil tillage system with use of mineral fertilizers and all agricultural waste products (straw, corn cobs, crop residues, etc.)	2014-2023	Private companies, MAFI, LPA	Total investments, total area on which the technology is implemented every year (thousand ha/year), reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 44.4 mln, once in ten years, in the first year, given US$ 222/ha, on 200 thousand ha, during 5 years, by 40 thousand ha each time, operational costs – US$ 64 mln for 200 thousand ha/ year, given US$ 320/ha/year	Green Climate Fund; Private investments; Projects and grants
5.8.	Conservative „no-till" tillage system with prior restoration of positive features of the post- arable layer and use of vetch, as intermediate crop, one year later as green fertilizer	2014-2023	Private Companies, MAFI, LPA	Total investments, total area on which the technology is implemented every year (thousand ha/year), reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 170 mln for 200 thousand ha or US$ 17 mln/year, during 10 years, by 20 thousand ha each time , given US$ 850/ha, maintenance and operational costs – US$ 112 mln for 200 thousand ha, given US$ 560/ha/year	Green Climate Fund; Private investments; Projects and grants
5.9.	Conservative „mini-till" tillage system with prior restoration of positive features of the post-arable layer and use of vetch, as intermediate crop, one year later as green fertilizer	2014-2023	Private Companies, MAFI, LPA	Total investments, total area on which the technology is implemented every year (thousand ha/year), reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 46 mln $ SUA for 200 thousand ha or US$ 4.6 mln/year during 10 years, by 20 thousand ha each time, given US$ 230 /ha, maintenance and operational costs – US$ 77.0 mln/year for 200 thousand ha, given US$ 384/ha/year	Green Climate Fund; Private investments; Projects and grants
5.10.	Storing manure on platforms	2014-2020	Private companies, MAFI, MoEN, LPA	Total investments, amount of manure deposited annually on platforms, reduced emissions determined by the agreed MRV procedures approved internationally	US$ 133.0 mln	Green Climate Fund; Private investments; Projects and grants
5.11.	Composting manure	2014-2020	Private companies, MAFI, MoEN, LPA	Total investments, amount of manure composted annually, reduced emissions determined by the agreed MRV procedures approved internationally	US$ 39.0 mln	Green Climate Fund; Private investments; Projects and grants
5.12.	Use of feed additives which reduce the formation of methane during the digestive process in cattle	2014-2020	Private companies, MAFI, LPA, ASM	Total investments, share of cattle herd in which the technology is used (in % of the cattle herd of the country), reduced emissions determined by the agreed MRV procedures approved internationally	US$ 8.45 mln	Green Climate Fund; Private investments; Projects and grants

No.	Name of the nationally appropriate mitigation action	Implementation timeline	Institution responsible	Monitoring Indicators	Cost estimates	Funding sources
5.13.	Manure processing for biogas and using it for energy production	2014-2020	Private companies, MAFI, MoEN, EEA, ANRE, LPA	Total investments, amount of manure stored for fermentation for biogas production, amount of biogas and energy produced, reduced emissions determined by the agreed MRV procedures approved internationally	US$ 3.3 mln	Green Climate Fund; Energy Efficiency Fund; Private investments; Projects and grants
6.	**Specific objective 6:** Increase, by 2020, carbon dioxide sequestration capacity in the land use, land-use change and forestry sector, with 25% compared to the BAU scenario.					
6.1.	Afforestation of areas and rivers protection belts and waterbeds	2014-2018	„Moldsilva" Agency	Total investments, total area afforestated annually, CO_2 emissions sequestrated annually, determined by the MRV procedures approved at the national level	3.6 mln $ SUA	State Budget, Projects and grants
6.2.	Expansion of afforestated areas	2014-2020	„Moldsilva" Agency, LPA	Total investments, total area afforestated annually, CO_2 emissions sequestrated annually, determined by the MRV procedures approved at the national level	US$ 14.6 mln	State Budget, Projects and grants
6.3.	Expansion of areas covered with forest vegetation	2014-2020	„Moldsilva" Agency, LPA	Total investments, total area afforestated annually, CO_2 emissions sequestrated annually, determined by the MRV procedures approved at the national level	US$ 6.7 mln	State Budget, Projects and grants
6.4.	Restoration / rehabilitation of forest belts protecting the agricultural fields	2014-2020	„Moldsilva" Agency; LPA	Total investments, area of agricultural planted annually with protection forests belts, CO_2 emissions sequestrated annually, determined by the MRV procedures approved internationally	US$ 2.3 mln	Green Climate Fund; Projects and grants, State Budget
6.5.	Program to support communities in sustainable and integrated management of forests and carbon sequestration through afforestation	2014	„Moldsilva" Agency; LPA	Total investments, area of community grasslands with improved productivity, area of reconstructed and / or restored forests and lands with other types of forest vegetation owned by municipalities; area of forests and lands with other types of forest vegetation owned by municipalities for which forest management plans were developed, CO_2 emissions sequestrated annually, determined by the MRV procedures approved at the international level	US$ 1.0 mln	World Bank, LPA budgets
6.6.	Planting of forest energy crops	2014-2020	„Moldsilva" Agency; MoEN, LPA; private owners	Total investments, areas planted with energy forest crops, CO_2 emissions sequestrated annually, determined by the MRV procedures approved at the international level	US$ 30.0 mln	Green Climate Fund; Projects and grants, State Budget
6.7.	Reducing emissions from deforestation and forest degradation (REDD+)	2014-2020	„Moldsilva" Agency; LPA, MoEN	Total investments, areas with reconstructed Low-productive standing stock, areas where sanitation works have been done, areas of forests and lands with other types of forest vegetation owned by municipalities for which forest management plans have been developed, forest areas where forest treatments have been made, CO_2 emissions sequestrated annually, determined by the MRV procedures approved internationally	US$ 55.5 mln	Green Climate Fund; Projects and grants, State Budget
6.8.	„Moldova Soil Conservation" project	2002-2022	„Moldsilva" Agency, LPA	Total investments, area of afforestated degraded lands, CO_2 emissions sequestrated annually, determined by the MRV procedures approved at the international level	US$ 19 mln	State Budget, World Bank's Carbon Fund
6.9.	„Development of Community Forests Sector in Moldova" project	2006-2036	„Moldsilva" Agency, LPA	Total investments, area of afforestated degraded lands, CO_2 emissions sequestrated annually, determined by the MRV procedures approved at the international level	US$ 32 mln	State Budget, World Bank's Carbon Fund

No.	Name of the nationally appropriate mitigation action	Implementation timeline	Institution responsible	Monitoring Indicators	Cost estimates	Funding sources
7.	**Specific Objective 7:** Reducing, by 2020, of direct GHG emissions from waste sector, by 10% compared to the BAU scenario.					
7.1.	Development of primary collection and storage of waste in urban and rural areas	2014-2018	LPA, MoEN, MRDC	Total investments, number of procured containers and transport units to collect waste, reduced emissions determined by the agreed MRV procedures approved at the national level	US$ 30.1 mln	State Budget, National Fund for Regional Development, Projects and grants
7.2.	Development of regional infrastructure for municipal waste disposal by building regional municipal solid waste deposits and transfer stations	2015-2027	LPA, MoEN, MRDC	Total investments, number of regional solid waste deposits and transfer stations built, number of transport units procured to transfer waste, reduced emissions determined by the agreed MRV procedures approved internationally	US$ 162 mln	Green Climate Fund, Projects and grants, State Budget, National Fund for Regional Development
7.3.	Development of regional infrastructure for municipal waste disposal by building mechanical-biological treatment facilities	2015-2027	LPA, MoEN, MRDC	Total investments, number of mechanical-biological treatment facilities built in Chisinau and Balti municipalities, reduced emissions determined by the agreed MRV procedures approved internationally	US$ 169 mln	Green Climate Fund, Projects and grants, State Budget, National Fund for Regional Development
7.4.	Treatment of sewage sludge at the wastewater treatment plants in Chisinau, Balti and Cahul	2015-2020	LPA, MoEN, MRDC	Total investments, number of wastewater treatment plants equipped with sludge anaerobic treatment technologies, amount of methane recovered, reduced emissions determined by the agreed MRV procedures approved internationally	Total investments – US$ 10.6 mln, including: US$ 3.14 mln– Chisinau; US$ 2.48 mln– Balti; US$ 2.44 mln– Cahul	Green Climate Fund, Projects and grants, State Budget, National Fund for Regional Development
7.5.	Biogas recovery at municipal solid waste landfill in Tintareni	2014-2020	TEVAS Grup SRL	Total investments, amount of biogas recovered, electric power generators installed, the amount of energy produced, reducing emissions by the agreed MRV procedures approved internationally	US$ 4.0 mln	Private Investments

Annex 4: Action Plan for Implementation of Climate Change Adaptation Strategy of the Republic of Moldova until 2020

Nr.	Objectives and activities	Responsible institution	Implementation timeline	Cost estimates	Funding sources
	General Objective: Create a strong enabling environment and establish clear guidelines for an effective and coherent adaptation to climate change in key sectors of the national economy				
1	**Specific Objective 1:** Improved management and dissemination of information on climate risks and disasters in RM				
1.1	To strengthen the capacity to collect, monitor, report statistical data, analyse and distribute the information needed for climate modelling, climate risks assessment and climate impacts.	Ministry of Environment (CCO and SHS); Academy of Science of Moldova	2014-2020	US$ 400 000	State Budget, Projects and grants from external financial assistance
1.1.1	Strengthen the national collection / monitoring, statistical reporting system, develop electronic databases for hydrometeorological and climate data	Ministry of Environment (SHS and CCO)	2014-2020	US$ 100 000	State Budget, Projects and grants from external financial assistance
1.1.2	Develop regional climate medium and long term scenarios for the Republic of Moldova, based on global coupled atmosphere ocean general circulation models and regional climate models	Ministry of Environment (CCO and SHS); Academy of Science of Moldova	2014-2017	US$ 30 000	Projects and grants from external financial assistance
1.1.3	Develop high-resolution maps for future climate conditions in the Republic of Moldova, taking into account the various emission scenarios (e.g., SRES A2 (high emissions), SRES A1B (medium emissions), SRES B1 (low emissions)	Ministry of Environment (CCO and SHS); Academy of Science of Moldova	2013-2014	US$ 20 000	Projects and grants from external financial assistance
1.1.4	Make spatial and temporal analyses of the trends in frequency and intensity of extreme weather events in the Republic of Moldova, resulting from climate change.	Ministry of Environment (CCO and SHS); Academy of Science of Moldova	2014-2017	US$ 20 000	Projects and grants from external financial assistance
1.1.5	Carry out vulnerability and risk assessment for the agricultural sector at regional level	Ministry of Environment (CCO and SHS); Academy of Science of Moldova; Ministry of Agriculture and Food Industry; Academy of Science of Moldova; Institute of Ecology and Geography of the ASM Institute of Pedology, Agrochemistry and Soil Protection „Nicolae Dimo” State Agrarian University of Moldova Non-governmental Organizations	2014-2017	US$ 30 000	State Budget, Projects and grants from external financial assistance
1.1.6	Carry out studies on the climate change impact on the basic crops base and the main categories of animals reared in the country.	Ministry of Environment (Climate Change Office and State Hydrometeorological Service); Ministry of Agriculture and Food Industry; Academy of Science of Moldova Institute of Ecology and Geography of the ASM Institute of Soil Science, Agro-chemistry and Soil Protection „Nicolae Dimo” Institute for applied research in Biotechnologies, Animal Husbandry and Veterinary Medicine State Agrarian University of Moldova Non-governmental Organizations	2014-2017	US$ 40 000	State Budget, Projects and grants from external financial assistance

Nr.	Objectives and activities	Responsible institution	Implementation timeline	Cost estimates	Funding sources
1.1.7	Carry out spatial assessment of climate change impacts on surface water, groundwater and groundwater and underground waters	Ministry of Environment (CCO, SHS and AGMR); Academy of Science of Moldova	2014-2017	US$ 30 000	State Budget, Projects and grants from external financial assistance
1.1.8	Carry out the assessment of the risk / opportunities for human health and sustainable development sectors, vulnerable to climate change (e.g., agriculture, forestry, water resources, construction industry, etc.) caused by the increased number and intensity of extreme weather events.	Ministry of Environment (CCO and SHS); Ministry of Health Ministry of Agriculture and Food Industry Ministry of Regional Development and Construction Local Public Authorities Academy of Science of Moldova Institute of Ecology and Geography of the ASM Moldovan State University of Medicine and Pharmacy „Nicolae Testemiţeanu" Moldovan State Agrarian University Non-governmental Organizations	2014-2017	US$ 90 000	State Budget, Projects and grants from external financial assistance
1.1.9	Carry out the assessment of the risk and vulnerability of the energy and transport to climate change	Ministry of Economy Ministry of Transport and Roads Infrastructure Ministry of Environment (CCO and SHS); Academy of Science of Moldova Institute of Energy of the ASM Moldovan Technical University	2014-2017	US$ 40 000	State Budget, Projects and grants from external financial assistance
1.2	Create mechanisms to raise awareness of climate change risks and adaptation measures	Ministry of Environment Ministry of Economy Ministry of Education Ministry of Health Ministry of Agriculture and Food Industry Ministry of Transport and Roads Infrastructure Ministry of Regional Development and Construction Academy of Science of Moldova Local Public Authorities Non-governmental Organizations	2014-2017	US$ 350 000	State Budget, Projects and grants from external financial assistance
1.2.1	Revise / supplement primary, secondary and higher secondary education school curriculum, to incorporate the „Climate Change" topic in reference discipline.	Ministry of Education Ministry of Environment Academy of Science of Moldova Non-governmental Organizations	2014-2020	US$ 50 000	State Budget, Projects and grants from external financial assistance
1.2.2	Develop and implement programs and affordable e-learning materials (books, brochures, etc.) on adaptation to climate change, in order to improve the skills of farmers, medical professionals, Civil Protection and Emergencies department staff, energy engineers, transportation and construction professionals, other specialists.	Ministry of Environment Ministry of Economy Ministry of Health Ministry of Agriculture and Food Industry Ministry of Transport and Roads Infrastructure Ministry of Regional Development and Construction Academy of Science of Moldova Local Public Authorities Non-governmental Organizations	2015-2020	US$ 70 000	State Budget, Projects and grants from external financial assistance

Nr.	Objectives and activities	Responsible institution	Implementation timeline	Cost estimates	Funding sources
1.2.3	Develop a strategy / program to raise awareness on climate change and conduct an information and education campaign on climate change using the media, holistic approach and other methods of information proliferation	Ministry of Environment Ministry of Education Academy of Science of Moldova Local Public Authorities Non-governmental Organizations	2015-2020	US$ 90 000	State Budget, Projects and grants from external financial assistance
1.2.4	Create an early warning system on natural hazards of climate origin, providing public access to data and information needed to evaluate climate risks and impacts, and regularly publication of monitoring reports as part of the communication strategy on the climate change impacts	Ministry of Environment (State Hydrometeorological Service) Ministry of Internal Affairs (Civil Protection and Emergencies Service, National Observer for Natural Disasters)	2015-2020	US$ 140 000	State Budget, Projects and grants from external financial assistance
1.2.5	Develop a „climate change" resources platform and experts network (experts, NGOs, scientific institutions, financial institutions), which could provide climate change adaptation services to central and local public authorities	Ministry of Environment Academy of Science of Moldova Non-governmental Organizations	2014-2017	Financial coverage not needed	
1.3	Create a regional body to coordinate with neighbouring countries, to establish the link between the disaster risk management and climate change activities, and regional early warning system on natural disasters of climatic origin (switched to the national early warning system on natural disasters of climatic origin).	Ministry of Environment State Chancellery	2014-2016	Financial coverage not needed	
2	**Specific Objective 2:** Strengthening the institutional framework to ensure efficient implementation of climate change adaptation activities at the national, sector and local level.				
2.1	Change, by the Government Decision, the Regulation and nominal composition of the National Commission for the Implementation of the mechanisms and provisions of the UN Framework Convention on Climate Change and the Kyoto Protocol, so that it becomes responsible for approving adaptation projects and to become the strategy monitoring and implementation body.	Ministry of Environment	2014-2015	Financial coverage not needed	
2.2	Strengthen the capacity of the Government to manage and integrate climate change adaptation into sector development policies and sustainable practices to be implemented at national and local level	Central Public Authorities Local Public Authorities	2014-2020	US$ 600 000	State Budget, Projects and grants from external financial assistance
2.3	A climatic risk scanning of sector development policies	Central Public Authorities	2014-2015	US$ 100 000	State Budget, Projects and grants from external financial assistance
2.4	Develop a mechanism to integrate climate risk in all existing and future sector policies	Central Public Authorities Local Public Authorities	2015-2017	US$ 150 000	State Budget, Projects and grants from external financial assistance
3	**Specific Objective 3:** Enhancing climate resilience by reducing risks and facilitating adaptation to climate change in priority sectors.				
3.1	Conduct an analysis of current adaptation activities to identify the most successful activities that have the potential to be replicated	Central Public Authorities	2014-2015	US$ 100 000	State Budget, Projects and grants from external financial assistance

Nr.	Objectives and activities	Responsible institution	Implementation timeline	Cost estimates	Funding sources
3.2	Develop strategy and / or action plans on climate change adaptation for sectors with high risk to climate impacts	Central Public Authorities	2015-2020	US$ 300 000	State Budget, Projects and grants from external financial assistance
3.3	Conducted a review of relevant legislation and revise them to ensure climate resilience through risk reduction and adaptation to climate change at national and sector level	Central Public Authorities	2014-2015	US$ 300 000	State Budget, Projects and grants from external financial assistance
3.4	Develop a financing plan for climate risk management and climate change adaptation measures	Central Public Authorities State Chancellery	2015-2017	US$ 100 000	State Budget, Projects and grants from external financial assistance
4	**Specific Objective 4:** Monitoring and reporting on implementation of the Climate change Adaptation Strategy of the Republic of Moldova				
4.1	Monitor the Climate Change Adaptation Strategy of the Republic of Moldova and publication of progress reports	National Commission for implementation of UNFCC and Kyoto Protocol mechanisms and provisions	2014-2020	US$ 100 000	State Budget, Projects and grants from external financial assistance