

Kingdom of Morocco

Executive summary

**First National Communication**  
**United Nations Framework**  
**Convention on**



**climate change**

October 2001



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United Nations  
Framework Convention  
on  
Climate Change  
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## Acknowledgements

Morocco's Initial National Communication to the UNFCCC has been prepared by a research team from GERERE (Groupe d'Etudes et de Recherche sur les Energies Renouvelables et l'Environnement) constituted by

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## **Foreword**

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Decades ago, the international scientific community rang the alarm bell on the issue of the effects of human activities on climate change. Today, we are forced to take notice of the global climate disruptions, which were initially predicted by scientists for the end of the 21st century. These have already hit many areas in the world in the form of devastating hurricanes, persistent droughts and rising sea levels and affected sizeable populations all throughout the world. The most disadvantaged countries faces these natural disasters with much difficulty . Vulnerable countries are presently paying the price for these climate upheavals in terms of floods, famine, diseases, population exodus and loss of thousands of human lives.

Morocco is not an exception to such vulnerability.. The recurrent droughts that have caused havoc in Morocco for several years and which have been punctuated from time to time by abrupt and destructive storms, have prompted us to become aware -very early- of the hazards resulting from climate disruptions.

Morocco's ratification of the Climate Convention in 1995, as well as its efforts deployed to abide by the provisions spelt out in the National Initial Communication, demonstrates our willingness to contribute efficiently to the world's struggle to control global warming. The fact that Morocco hosts the Seventh Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC), the first of its kind in Africa, testifies our resolution to draw the world's attention to the specific problems of the African continent. As is well known, African countries are considered to be amongst the most vulnerable to the adverse effects of climate change.

There is unanimous agreement on the fact that countries and their populations must be prepared to face up to the effects of such phenomena. However, concerning developing countries, such efforts need considerable financial and technical support to enable their coping with the aforementioned effects. Here lies the biggest challenge for multilateral co-operation.

Mohamed ELYAZGHI  
Minister of Land Management, Urban Planning,  
Housing and Environment

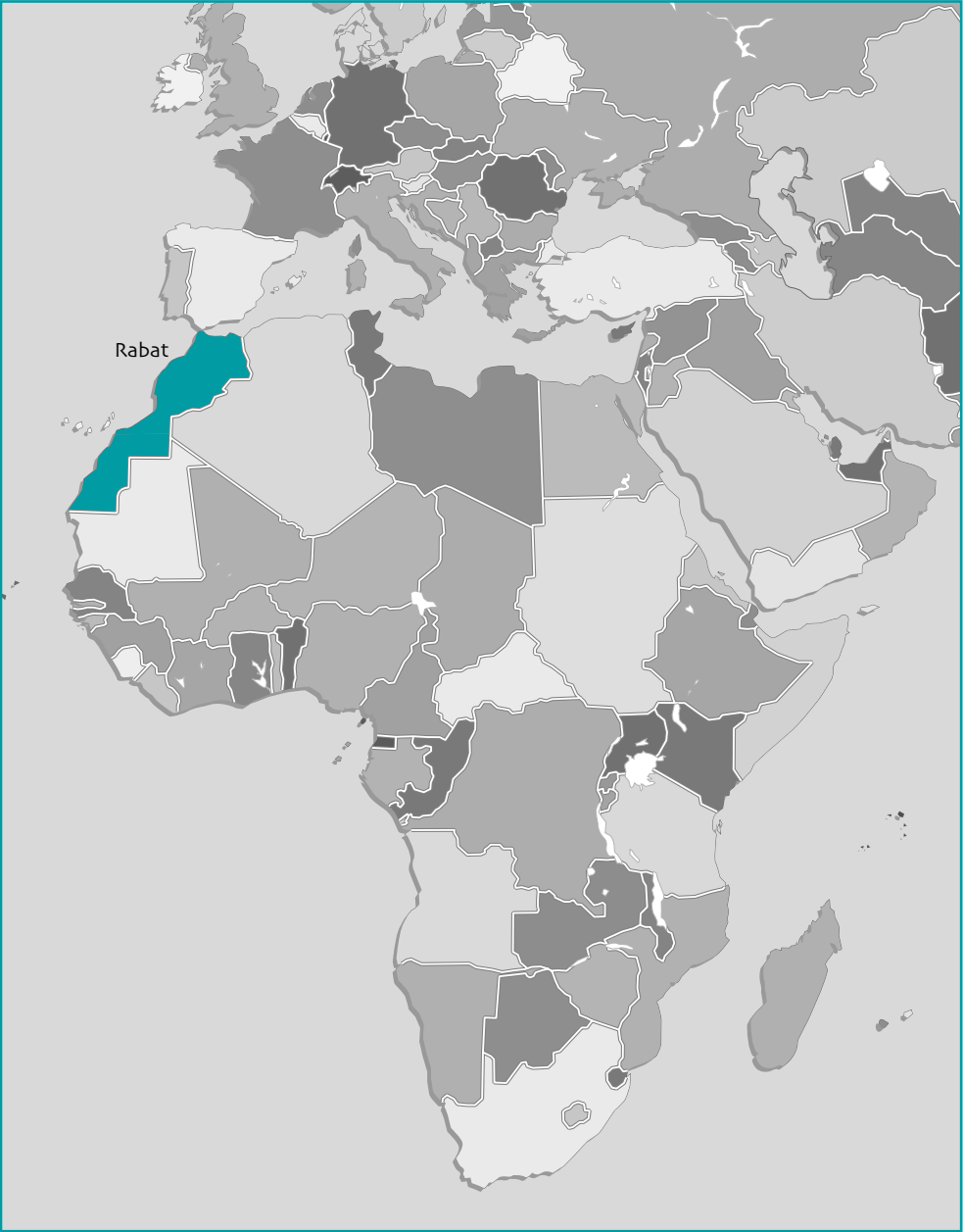




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■ ■ ■ Morocco





# Introduction

Morocco signed the United Nations Framework Convention on Climate Change (UNFCCC) during the Earth Summit held in Rio de Janeiro in June 1992 and ratified it in December 1995. As a Non Annex I Party to the Convention, Morocco has to deliver to the Conference of the Parties a Communication in compliance with Articles 4 and 12 of the Convention. This Initial Communication was prepared simultaneously within the framework of two Global Environment Facility projects: the capacity building regional project (RAB/94/G31) and the enabling activities national project (MOR/99/G32).

Morocco's national Initial Communication summary is a synopsis containing the main

information that is to be conveyed to the Parties of the Conference. This information is given in compliance with the orientations adopted by the Conference for the preparation of national Initial Communications of the Non-annex I Parties to the convention. Detailed information can be found in the national communication document and in the study papers used for its preparation, in particular 'The National Inventory of Greenhouse Gas Emissions, Morocco 1994', 'The Study of Morocco's Vulnerability to CC Effects' and 'The Study of Possibilities of Mitigation of Greenhouse Gas Emissions'.

\* URL : <http://www.minenv.gov.ma>



# Morocco's General Setting

Located between the Atlantic Ocean (to the west) and the Mediterranean Sea (to the northeast), between the Saharan desert (to the south) and Europe (to the north), Morocco is a country of transition and contrasts.

Its principle geographic features can be summed up as follows:

- A large extension in latitude (from 21° to 36° North), which places the country between two climate zones: temperate in the North and tropical in the South.
- An important sea front (more than 3,400km of coastline), which has an effect on the climate, commercial exchanges, fishing activities and tourism, as well as on coastline urbanization.

- Extended high altitude mountainous areas, with peaks culminating at more than 4,000m in the Atlas mountain ranges, constituting a real water reservoir for the country.

Morocco's geographical location – lies between two climate zones, the anticyclone of the Azores (to the West) and the Saharan depression (to the southeast); This location yields a great spatial-temporal climate variation with rainfall ranging from more than 2 meters per year, in the northern heights of the country, to less than 25 mm in the desert plains in the South, and frequent periodic dry spells.

This setting has a considerable impact on





water resources, agricultural production and the whole plant canopy of the country. Indeed, water resources, characterized by spatial and temporal scarcity and irregularity, are under increasing pressure from population explosion, the extension of irrigated agriculture and urban, industrial and tourism development activities.

The water-capital, already neighboring water stress levels (1,010m<sup>3</sup>/inhabitant per year in 2000), is in constant regression. The situation is of particular concern in rural areas where an important drinking water deficit is recorded. Irrigated agriculture is the main user of water in Morocco (83% of harvested water), though the percentage concerns only 13% of cropped land.

In fact, half the land suitable for cultivation is located in low rainfall zones (less than 400mm per year), allowing the existence of only a precarious system of agriculture, based on cereal /fallow alternation.

In spite of the fluctuations in agricultural production, linked to the instability of the climate, the agricultural sector contributes significantly to the total GDP build-up. Hence, the priority given to this sector in the national economic policy, whose most important objective is food self-sufficiency. In this way, an important part of the needs in basic food commodities has been covered.

In spite of their diversity, forest ecosystems are very fragile because of pressures from population explosion and the poor livelihoods of rural inhabitants. The collection of firewood is the first cause of the recession of forested areas, estimated at about 31,000 hectares per year. It is the first, if not the only, source of energy in most rural areas. Although it does not appear in the balance statement of total national energy consumption, it is estimated that firewood holds about 30% of this total consumption.

The other resources of energy in Morocco are renewable energies, consisting of hydroelectricity, which is completely dependent on rainfalls; wind energy and solar electricity. The contribution of renewable energies in the national energy production remains very weak.

The country also depends greatly on imports of crude oil and oil products such as coal and electricity. The result is that the energy bill and the rate of dependence on energy (97% in 2000) are very high.

An important progress in the energy sector was witnessed during the last decade. This progress relates mainly to sources of supply diversification and market liberalization.

The other main characteristics of the country are (a) population increase (as the population increased from 5 million inhabitants in the beginning of the 20th century to more than 28 millions in 1999) and (b) rural migration. Yet, in spite of the large increase in urbanization, the rural population still represented 46% of the total population in 1999. This population lives essentially on the exploitation of natural resources (agriculture, animal husbandry, biomass-energy) and is completely dependent on climate change. The latter factor makes the population very vulnerable.

Generally speaking, the vulnerable sectors of the country are:

- Water resources, already reaching the limits of supply needs.
- Agricultural production and forestry.
- Coastline zones and fishing activities







# Vulnerability to CC Impacts

In Morocco, the examination of the last three decades (1970-2000) show revealing signs of climate change: the frequency and intensity of droughts, unusually devastating floods, the decrease in the snow cover period on the peaks of the Rif and the Atlas mountains, the modification of spatial-temporal rainfall distribution, changes of itinerary and passage dates of migrating birds, the appearance of certain species of birds in the Rabat region that only used to be seen in the south of Marrakech, etc..

Some of these natural manifestations have had a heavy toll on Morocco, at social, economic and environmental levels. The primary concern of the country today is to predict, with scientifically-acceptable uncertainty margins, potential impacts of climate change foreseen by IPCC on vital sectors of the country: water, agriculture-forestry-animal husbandry (agroforestry), coastlines and health. The partial study of vulnerability to CC impacts, carried out within the framework of the preparation of Morocco's Initial Communication to the UNFCCC, provides some projections for the year 2020 for some determining variables: qualitative variables for the environmental sector in the socioeconomic context, and quantitative variables for the water and agriculture sectors.

## **Climate projections**

The development of climate scenarios for Morocco according to IPCC methodology reveals the following results:

- A trend towards an increase in average annual temperature (between 0.6°C and 1.1°C in the horizon of 2020).
- A trend towards a decrease in average annual rainfall volume by about 4% in 2020 compared to 2000 levels.

- An increase in the frequency and intensity of frontal and convective thunderstorms in the north and the west of the Atlas Mountains.
- An increase in the frequency and intensity of droughts in the south and the east of the country.
- A disturbance in seasonal rainfall (winter rains concentrated during a short period of time)
- A reduction in the period of snow cover (a shift of the altitude of 0°C isotherm and the acceleration of snow melting)

## **Impact on Water Resources**

The first quantitative estimate of possible CC impacts on water resources in 2020 points to the fact that there would be an average and general decrease in water resources (in the order of 10 to 15 % -these figures being of the same magnitude as those advanced for two neighboring countries, Algeria Spain). Morocco's water needs in 2020 are estimated at 16.2 billion m<sup>3</sup>, taking into account the expected increase in temperature. However, the harvesting of the 17 billion m<sup>3</sup> that would be theoretically available in 2020 (taking into consideration CC effects), would require great investments (dam construction, drilling of deep wells).

The consequences of this decrease and the disruption of rainfall would be:

- A decrease in dam capacity (concentrated rainfall and accelerated sludge accumulation intensified by erosions)
- A disruption of the Oueds flow rates (streams and rivers)
- A decrease in water levels, producing a decrease in the natural outlets for water



tables and an increase in their salinity in the coastline areas.

- A deterioration of water quality.

## **Impact on Agriculture**

The study of CC impacts on agriculture (dominated by cereal cultivation) in 2020 unfolds the following results:

- A decrease in cereal yields by 50% in dry years and 10% in normal years. In the two cases, the result of the projections made for cereal production in 2020 points to a deficit, in comparison with the 60 million quintals security food program set by the Department of Agriculture. In fact, this production would be in the order of 14 million quintals in dry years and 51 million quintals in normal years. But the need for cereals in 2020 would be in the order of 130 million quintals (85 million of which for human consumption).
- An increase in the needs for the water necessary for irrigated crops (somewhere between 7 and 12%).

Among other expected impacts on agriculture - based on the observations, experiments and analyses made by the National Institute for Agricultural Research (NIAR)- we can put forward the following:

- The reduction in crop cycles.
- The shift and reduction of the growth period.
- The increase in risks of dry periods at the beginning, middle and end of the annual crop cycle.
- Migration towards the north of the arid zone.
- The extinction of some crops (such as the Alpist) and some tree species (such as the Argan)
- The appearance of new diseases (for example, the white fly of tomatoes whose infestation is favored by particular climatic conditions).

The impact on animal husbandry goes hand in hand with that recorded for agriculture, since animal production in Morocco is very much linked to the system of plant production.

## **Other Impacts**

Given that 33% of the total population and 70% of the poor are expected to live in rural areas in 2020, the agricultural performance will be determinant for the living conditions of the poorest social strata.

CC impacts on the forest, on coastlines and fishing, on tourism and precarious human establishments have not yet become the subject of a specific study. However, it is quite clear that all sectors would be directly or indirectly affected by the increase in temperature and sea level or the decrease in rainfall.

## **Adaptation to the Impacts of CC**

CC impacts on the Moroccan society and economy can be eased if adaptation programs are carried out as soon as possible, especially in the most vulnerable sectors. The first diagnosis of Morocco's vulnerability to the CC impacts highlighted a dozen adaptation projects in the sectors of water and agriculture as well as seven accompaniment projects. These projects, whose title and brief specification are given in Appendix A, are classified according to their types. Their design still needs to be worked out and their costs assessed. Likewise, projects for other vulnerable sectors (such as the coastline, forest or precarious human establishments) have to be identified and worked out. But, it is clear that the Moroccan economy, which is still caught up in the problems of development and struggles against poverty, cannot withstand the costs of such projects without sacrificing the major components of its social and economic development programs (education, health, basic infrastructures, rural development, etc.).

Morocco sets its hopes on the provisions that would be made by the international community concerning the issue of adaptation to CC impacts. It is determined to contribute actively to the establishment of an appropriate mechanism to finance these adaptation projects in the Non Annex I Parties.





# National Inventory of Greenhouse Gas Emissions

The drawing up of the inventory of greenhouse gas emissions and absorption in Morocco, for the reference year of 1994, has been carried out according to the 1996 revised version of IPCC Methodology.

The total estimate of GHG, expressed in equivalent-CO<sub>2</sub> (E-CO<sub>2</sub>), was carried out according to the IPCC directives. These directives recommend to accept only the contributions to the radiation effect of the direct greenhouse gases (carbon dioxide CO<sub>2</sub>, methane CH<sub>4</sub> and nitrous dioxide) by using the following global warming potentials (GWP): 21 for CH<sub>4</sub> and 310 for N<sub>2</sub>O (values corresponding to a 100-year period).

The inventory results attest to Morocco's very low contribution to the greenhouse effect amplification, in comparison to industrialized countries. This reflects a low per capita consumption of energy: 0.33 tep / inhabitant (without biomass) and 0.51 tep / inhabitant (with biomass), for the year 1994.

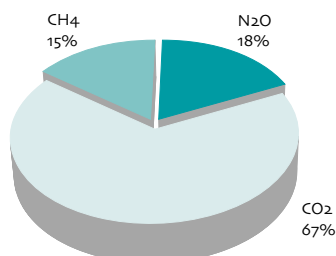
Net GHG emissions of anthropogenic origin have reached, in 1994, the following figures:

**47,917 kilotons equivalent CO<sub>2</sub> (E-CO<sub>2</sub>)**  
 i.e. **1.84 ton E-CO<sub>2</sub> per capita,**  
 of which **1.22 ton of CO<sub>2</sub>**

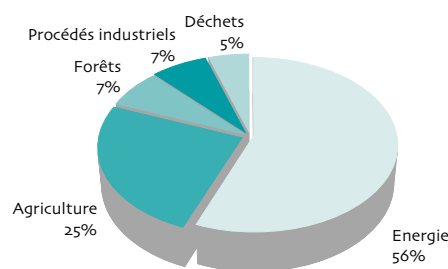
The quantity of emitted carbon dioxide CO<sub>2</sub> (31.908 kt) is larger than that of methane CH<sub>4</sub> (349 kt) and nitrous oxide N<sub>2</sub>O (28 kt).

## Net Emissions of the Three Direct Greenhouse Gases in Morocco, in 1994

by gas type



by emission source



The main source of carbon dioxide (CO<sub>2</sub>) is the combustion of fossilized energies (fuels) (25.206 kt, or 68%), followed by firewood energy (8.592 kt, or 23%), then by cement production (3.158 kt, or 9%).

From the net CO<sub>2</sub> emissions, we exclude the CO<sub>2</sub> absorbed during the growth of forest trees, the growth of orchard trees and afforestation. The absorbed amount reaches 5.090 kilotons. In this way, we get a net emissions of CO<sub>2</sub> of 31,908 kilotons.

Methane emissions (CH<sub>4</sub>) come essentially from Agriculture (55%) through enteric fermentation and manure and Energy (18%). Those of nitrous dioxide (N<sub>2</sub>O) result from agricultural soils and manure.

The analysis of net emissions per source shows the predominance of the Energy module (with 26,839 kt of E-CO<sub>2</sub>, or 56% of the total), followed by that of Agriculture (which is responsible for 25% of the total of GHG net emissions).

If we take into consideration the gross amounts of emissions (53,007 kt E-CO<sub>2</sub>), the weight to be attributed to modules changes. The Forest module shifts from 7% to 16% of the total of E-CO<sub>2</sub> emissions, while that of Energy passes from 56% to 51%. Amongst the other GHGs, carbon monoxide (CO) comes immediately after CO<sub>2</sub>, with 1.1 million tons emitted.

The two tables below show the GHG emissions - absorption of Morocco in 1994, by module (according to IPCC methodology).

\* Direct greenhouse gas: E-CO<sub>2</sub> = CO<sub>2</sub> + 21 CH<sub>4</sub> + 310 N<sub>2</sub>O





### *Inventory of GHG Emissions and Absorption, in Morocco, in 1994 (Figures in Kilotons)*

Sector	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	E-CO <sub>2</sub>	%
<b>Totals in kilotons</b>	<b>31,908</b>	<b>349</b>	<b>28</b>	<b>47,917</b>	<b>100</b>
<b>Energy</b>	<b>25,206</b>	<b>63</b>	<b>1</b>	<b>26,839</b>	<b>56</b>
Energy (combustion)	25,206	54	1	26,650	
Energy industries	8,603	7	0	8,750	
Man. & Bldg ind.	4,694	0	0	4,694	
Transportation	5,815	1	0	5,836	
Tertiary	459	4	0	543	
Residential	2,390	43	1	3,603	
Agriculture & Fishing	3,244	0	0	3,244	
Energy (fugitive emissions)	0	9	0	189	
<b>Industrial Processes</b>	<b>3,158</b>	<b>0</b>	<b>0</b>	<b>3,158</b>	<b>7</b>
Cement	3,133	0	0	3,133	
Lime	11	0	0	11	
Soda	14	0	0	14	
<b>Agriculture</b>	<b>0</b>	<b>192</b>	<b>26</b>	<b>12,092</b>	<b>25</b>
Enteric fermentation	0	184	0	3,864	
Manure Management	0	7	5	1,697	
Rice fields	0	1	0	21	
Agricultural soils	0	0	21	6,510	
<b>Forests</b>	<b>3,544</b>	<b>0</b>	<b>0</b>	<b>3,544</b>	<b>7</b>
Firewood	8,055	0	0	8,055	
Other wood utilization	537	0	0	537	
Forest fires	42	0	0	42	
Absorption - natural forests	-2,675	0	0	-2,675	
- afforestation	-1,835	0	0	-1,835	
- arboriculture	-580	0	0	-580	
<b>Waste</b>	<b>0</b>	<b>94</b>	<b>1</b>	<b>2,284</b>	<b>5</b>
Solid waste	0	93	0	1,953	
Sewage water	0	1	0	21	
Human feces	0	0	1	310	

## Inventory of Gas emissions that are the precursors of Ozone and Aerosols (1994) (in Kilotons)

Sector	NOx	CO	COVNM	SO <sub>2</sub>
<b>Totals en kilotons</b>	<b>152</b>	<b>1,071</b>	<b>190</b>	<b>295</b>
<i>Energy</i>	152	1,069	152	291
Combustion	152	1,068	148	285
Fugitive Emissions	0	1	4	6
<i>Industrial Processes</i>	0	1	38	3
Cement Production	0	0	0	2
Road Asphaltting	0	0	30	0
Sulfuric Acid	0	0	0	1
Paper pulp	0	1	0	1
Drinks & Food	0	0	7	0
Forests	0	2	0	0

# Mitigation Options of GHG Emissions and First Action Plan

## Reference Scenario

The reference scenario for the projection of GHG emissions on the horizon of 2010 and 2020 was based on the 1994 and 1999 inventories and on the evolution of different sectors. This basis took into consideration the programs of sector – related development and the trends recorded during the 2000 – 2020 period. The main hypotheses that have been retained are the following:

- According to the Center for Demographic Studies and Research (CERED) of Morocco,

the country's population will increase at an annual growth rate of approximately 1.6% (in 2000) to 1.2% (in 2020). The Moroccan population will increase from 28.7 millions in 2000 to 37.4 millions in 2020.

- The annual GDP growth rate (very much linked to the agricultural GDP, hence influenced by rainfall and climate) will be about 4% during the 2000-2020 period.
- The medium annual growth rate of energy consumption retained for the same period





will be 4.3%. The consumption of primary energy will increase from 9,655 ktp in 2000 to 22,547 ktp in 2020.

- The industrial production will increase annually by 3% and that of cement by 3.4%. The growth of plant production and nitrogen fertilizers consumption will be in the order of 2.5% per year.
- A significant reduction in the consumption of firewood is expected: it will decrease from 8.6 million tons in 1999 to 6.8 million tons in 2020.
- The rate of solid waste generation will increase by 1% per year.

Based upon these hypotheses, projections for GHG emissions have been computed for 2010 and 2020, following the IPCC methodology. The projections resulted in total net emissions of 75.5 million tons E-CO<sub>2</sub> in 2010 and 111.1 tons E-CO<sub>2</sub> in 2020.

The comparison of these results to the net GHG emissions of 1994 (47.9 million tons of E-CO<sub>2</sub>) yields the following annual average rate of increase in GHGs of 3.3% from 1994 to 2020, with

- 2.9% between 1994 and 2010;
- 3.9% between 2010 and 2020.

#### Projected emissions of direct GHG gases in Morocco: Reference Scenario

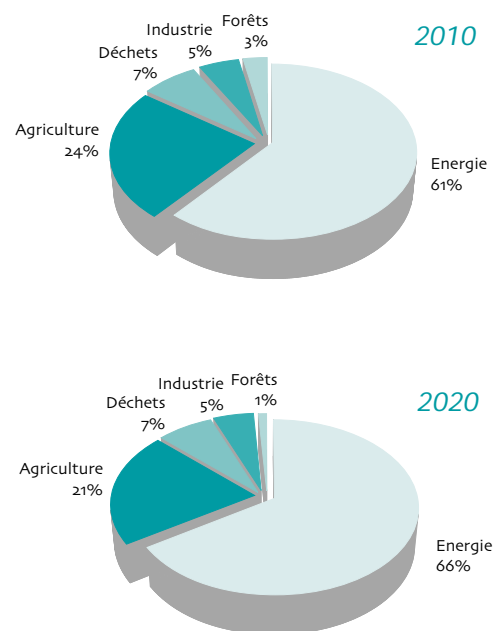
		1994	2010	2020
Net emissions	kt E-CO <sub>2</sub>	47,917	75,455	111,096
Gross emissions	kt E-CO <sub>2</sub>	53,007	81,155	17,396
CO <sub>2</sub> absorption	kt	5,090	5,700	6,300
Net emissions per capita	t E-CO <sub>2</sub>	1.84	2.27	2.97

The results of net per capita GHG emissions show that the Moroccan's contribution to these emissions would remain at a very low level (2.97 t E-CO<sub>2</sub> in 2020), in spite of a 60% increase from 1994 (1.84 t E-CO<sub>2</sub>).

The share of the Energy module in the total net emissions, already high in 1994 (56%), would reach 61% in 2010 and 66% in 2020. That of the module Forests would decrease from 7% in 1994 to 1% in 2020, as a result of

the intensification of afforestation. The shares of the other modules would remain at stationary levels.

#### Projections of sectorial emissions of GHG in 2010 and 2020



### Mitigation Options and Selected Projects

The choices of the sectors with mitigation potential was made on the basis of the reference scenario and the sectorial analysis by category of the emission sources taking into account the technology potential and development objectives.. I

The identification of about twenty mitigation projects of, avoidance of emissions or carbon sequestration is a result of a thorough examination of every sector and branch and the potential of technological options with the main users. The results of this first investigation are summed up below.

The Energy sector, the main source of GHG and the driving force of development, has been particularly targeted. The review of the technological options with the main actors in this sector has resulted in the identification of some fifteen mitigation projects in energy

management, natural gas use in the industry and the development of renewable energy (hydraulic, wind and solar energy, decentralized rural electrification).

The other projects cover the modules of Forests (afforestation and fruit-tree plantations), Waste (bio-gas recovery from solid and liquid wastes) and Industrial Processes (cement production, phosphate treatment).

For every identified mitigation project, the assessment of avoided GHG emissions and additional absorption of carbon has been calculated, taking into consideration the projected time for the realization of the project and its implementation program, as well as the lifetime of the equipment.

The implementation of all 23 projects would enable the avoidance of the emission of 5.9 million tons E-CO<sub>2</sub> in 2010 and 9.4 million tons in 2020. The cumulative amount of avoided emissions would approximately reach 102 million tons E-CO<sub>2</sub> over the whole period of 2001-2020.

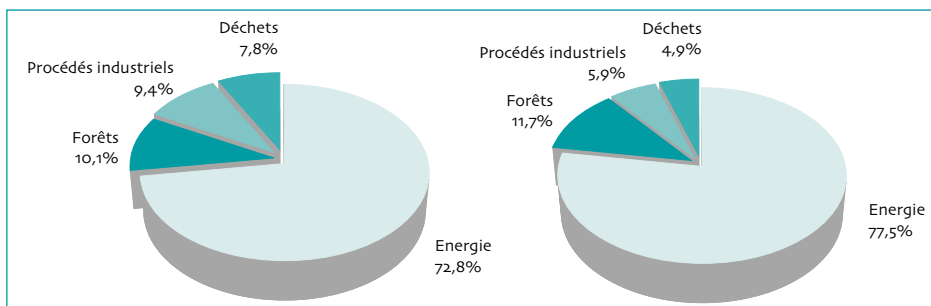
The sectorial distribution of avoided emissions, projected in 2010 and 2020, show that the projects having to do with the module Electrical Power would contribute to an average of 75% in GHG emission reduction. This contribution appears to be more important than the module's share in the generated emissions (approximately 63%). This results from the fact that the action plan has given more weight to this module, under the assumption that it is the sector most responsible for the emissions and one witnessing among the highest growth rates.

The module *Forests* comes in second position, with a contribution of "avoided emissions" (carbon sequestration) of 10% in 2010 and close to 12% in 2020, as a result of the increase in the absorption of CO<sub>2</sub>.

The identification of the projects with the biggest potential for GHG emission reduc-

### Sectorial Distribution of Avoided GHG emissions in the Mitigation Scenario

2010	Total	2020
5,931	kt E-CO <sub>2</sub>	9,390



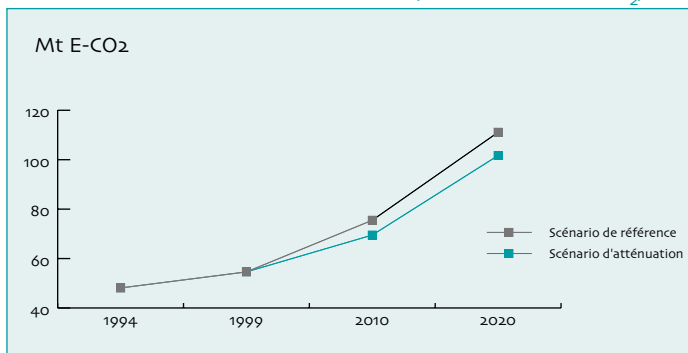
tion by 2020 (more than 50% of all reductions in 2020 and approximately 56% of the cumulative amount of avoided emission for the period 2001 – 2020) is a result of the analysis of avoided emissions. These projects are :

- Development of Renewable Energy
- Development of Natural Gas Use in Industry
- Energy Management in Industry
- Development of Wind Energy for Power Production
- Support to the Afforestation Programme

### Mitigation Scenario

The mitigation scenario is a result of the reference scenario and the avoided emissions. This scenario foresees a 7.9% reduction in the emissions for 2010 and 8.5% in 2020, in comparison to the reference scenario.

### GHG Emissions in 1994 and 1999 and Projections for 2010 and 2020 (Million tons E-CO<sub>2</sub>)



## Net GHG Emissions in Morocco : Synthesis (Inventories for 1994, 1999 and Scenarios for 2010, 2020)

Modules	1994	1999	Reference Scenario		Atténuation Scenario	
			2010	2020	2010	2020
Energy	26,859	31,139	45,836	72,764	41,522	65,492
Industrial Processes	3,158	2,826	4,080	5,698	3,525	5,143
Agriculture	12,092	13,981	18,064	23,894	18,064	23,894
Forests	3,544	3,835	2,318	1,155	1,720	56
Waste	2,419	2,850	5,158	7,586	4,694	7,122
<b>Total</b>	<b>47,917</b>	<b>54,631</b>	<b>75,455</b>	<b>111,096</b>	<b>69,525</b>	<b>101,707</b>

The mitigation action plan has a weak impact on the increase of the emissions per capita.

*Per capita GHG Emissions d*  
(Tons E-CO<sub>2</sub> / inhabitant)

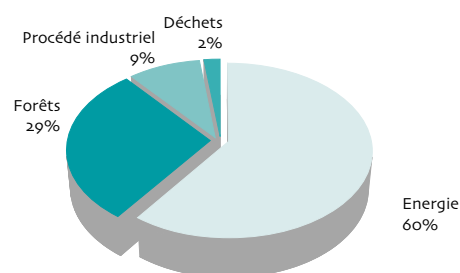
Scenario	1994	1999	2010	2020
Reference Scenario	1.84	1.93	2.27	2.97
Mitigation Scenario		-	-2.09	2.72

### Implementation of the First Action Plan

The implementation of the action plan for the reduction of GHG emissions in Morocco (projects selected for this study) will require the mobilization of financial resources which have been assessed to approximately 14.5 billion Moroccan Dirhams (1.3 billion US dollars). However, it must be underlined that the estimates of the required investments to implement this plan are yet to be confirmed. Before their implementation, the projects will have to be subjected to a detailed feasibility study with the aim to specify their costs. The project briefs, sum up the main characteristics of each project and are outlined in the "The Study of GHG Emissions Mitigation Possibilities". These briefs can serve as a basis for the elaboration of complete projects within the formats required by the investors. The distribution of investments per sector is given below. A cost-benefit analysis is given in the report document on the aforementioned study; however, it needs confirmation.

The Clean Development Mechanism (CDM) of the Kyoto Protocol would be called upon to contribute to the implementation of the action plan by providing the additional financing for the eligible projects. The selected projects for this study meet the eligibility criteria specified by Morocco. They also ought to meet the criteria of financing specified for the CDM, as they will be set at the 7th Conference of the Parties to be held in Marrakech.

### Distribution of Investments by Sector



Total Investment: 14.5 million Dirhams



# Moroccan Initiatives Related to the UNFCCC Provisions

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## **Institutions**

At the institutional level, right after the Rio Summit in 1992, Morocco has created and added to its existing governmental departments, a new department in charge of the Environment. Besides the creation of special units charged with ensuring the follow-up of the implementation of different conventions and protocols, this new Department has endowed itself with a National Environmental Council (NEC) and regional councils. These bodies are entrusted with the task of specifying, implementing and following up the environmental policy approved by the Government and the Parliament.

Concerning climate change, the Department of Environment has set up the administrative bodies listed below. It did so on the basis of the recommendations

of the Conference of Parties to the UNFCCC (ratified by Morocco in December 1995) and its subsidiary bodies, taking advantage of the experience of other countries. These administrative bodies are:

- a CC Unit, in charge of coordination and follow-up of Morocco's commitment vis-à-vis the Convention,
- a National Committee for Climatic Change (CNCC), set up in 1996 and made up of representatives of ministerial Departments and national institutions involved in CC issues,
- an Information Center on Sustainable Energy and Environment (CIEDE) in 2000,
- a National Scientific and Technical Committee (CNST-CC), in 2001, made up of national experts and set up as a national equivalent to IPCC,
- a Unit in charge of CDM, yet to be set up.

The Department of Environment, which is the national focal point of IPCC is also supported by other national committees such as the Council of Water and Climate (CSEC) and the

Committee for Land Use Management (CIAT). Moreover, the National Meteorological Division (DMN), the Royal Center for Space Teledetection (CRTS), the Center for the Development of Renewable Energy (CDER) and the Moroccan Center for Clean Production (CMPP), amongst others, work in close collaboration with the Department of Environment on all the issues related to the environment.

All these institutions need to be consolidated and their capacities strengthened to fully follow up the implementation of the Conventions related to environmental issues.

## **Strategy and National Action Plan for the Environment**

A national strategy of environmental protection and sustainable development was elaborated and adopted in 1995. It specifies the objectives for the years 2005 and 2020 as well as the priorities for environmental action. The National Action Plan for the Environment (PANE), established within the framework of the UNDP's Capacity 21 program, aims at implementing the principles of this National Strategy. Programs have thus been developed in the sectors of water and soil resources, forestry, watersheds, energy, coastal areas, oases, etc. Two programs have been the focus of special attention since 1996 : the Action Program for the Protection of Biological Diversity and the Action Plan for Combating Desertification. These programs have been elaborated within the framework of the related Conventions.

The plan for combating desertification represents, an important component of the 2020 strategy for rural development set up by the Department of Agriculture.





## **Systematic Observations and Data Banks**

Several institutions such as, The National Meteorology Division (DMN), the Royal Center for Spatial Teledetection (RCST), the General Directorate of Hydraulics (GDH) and Research Centers are involved in the process of systematic monitoring. . These institutions carry out the main activities related to monitoring of the climate and the CC.

Terrestrial observations are carried out by meteorological, water resources and water quality observation networks ,flood-warning networks, and drought monitoring networks.

The National Research Institute for Fisheries (INRH) takes up, oceanographic monitoring and the Royal Center for Spatial Teledetection the space based observations.

Data banks are progressively set up within the aforementioned institutions.However, they need to be strengthened and their activities coordinated. The Directorate of Statistics, publishes a yearbook since the 1930's on the main socioeconomic data , and therefore constitutes a basis for the coordination and the treatment of the collected data.

## **Scientific Research**

Research related to the CC issues is carried out by public institutions affiliated to different ministerial departments and universities. The National Center for Scientific and Technical Research (CNRST) has recently included in its "Thematic Support for Scientific Research Program" (two themes linked to CC : "Agriculture under stressed conditions" and "Knowledge, preservation and valuation of natural resources" (amongst which, forest, water and renewable energy). Energy and its connection to CC will appear as a new theme in CNRST future programs. The National Institute of Agronomic Research (INRA), the Center for Forestry Research and the National Meteorology Division in particular, contribute significantly to knowledge related to dry farming and the climate. All these institutions need to be strengthened, in order to t tackle the CC issues.

## **Education and Public Awareness**

As specified in Article 6 of UNCFCCC, Morocco makes every endeavour elaborate and implement educational and public awareness programs on CC and their impacts . Thus, since 1996, all the projects on "energy" and "environment" include a capacity building and public awareness component. ". Furthermore, the GEF Capacity Building Regional project, (RAB/94/G31), which started in 1996, has contributed to awareness raising and capacity building within State institutions and the private sector.

However, actions oriented towards the sensitization of the large public remain insufficient. The Department of Environment has foreseen, to implement an action program on Information-Education-Communication-Partnerships and Training within the State's five-year plan (1999-2003). This action plan should complement the existing programs on environmental protection and sustainable development.

Concerning civil society, more and more NGOs are involved in the environmental field. Some of these NGOs work more specifically on CC and are funded by the GEF Microfinancing Programme.

The Seventh Conference of the Parties convening in Marrakech from October 29 - November 9, 2001 offers Morocco an opportunity for a wide coverage of CC problems. This media coverage is able to reach a broad array of stakeholders such as : the public, decision-makers, economic operators, academia and NGO's.







# Capacity-building

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The process, which has prompted Morocco to prepare this initial communication, funded by the Global Environment Facility, has in itself been a process for capacity reinforcement of climate change issues in Morocco. Substantial progress has been made so far. Subsequent to the 7th Conference of the Parties, Morocco is required to contribute to the implementation of the Convention according to the principle of common but differentiated responsibility. It is particularly required of Morocco to prepare an adaptation mechanism to the potential impacts of the GHG emissions on various sectors of economic and social activities.

In order for Morocco to cope with these impacts and to fulfill the obligations required by the Convention, it is necessary to have the available resources likely to foster capacity building, systemically, institutionally and individually. More particularly, priority is accorded to areas such as vulnerability and adaptation, systematic monitoring, safety precautions and data banks, restriction of GHG emissions, appropriate development mechanism, technology transfer and synergy among the Conventions.

The existing institutions are in urgent need for consolidation, strengthening and expertise. Research institutes and specialized NGOs need to be supported and qualified in order to serve as a basis for the elaboration of feasibility studies related to adaptation and mitigation programs.

These institutions should also be involved in the processes of control and certification of GHG emissions. This will require the transfer of scientific and technological knowledge, and relies on specific competencies.

To attain the goals of capacity building as well as those of adaptation projects, Morocco urgently seeks additional financial resources .

To achieve sustainable development and to contribute towards the ultimate goal of the

Convention, Morocco needs to impose the choice of clean technologies in its social and economic development policy, which requires resorting to new resources. The financial mechanisms provided for the implementation of the Kyoto Protocol give economic operators an opportunity to find part of these resources. This is the reason for which Morocco has encouraged large-scale economic operators to enter the emerging carbon market without delay. It is with this frame of mind that a first series of mitigation projects for GHG emissions were prepared by various economic operators and are presented in this communication.





# Appendix A

## Adaptation Projects

### Water

“Water savings in irrigation”

This project seeks to reduce water losses in some distribution networks and optimize consumption to adapt it to the needs of different crops.

### Alternative Water Use

“Implementation of a pilot irrigation scheme for the use of treated wastewater in irrigation».

The demonstration project, located in the ORMVA of the Haouz, is equipped with an urban wastewater treatment unit and uses recycled water in irrigation. Extending the project to cover other Moroccan cities is in consideration.

“Brackish water use in the Irrigation of the Low Moulouya”.

The project will seek to identify salinity-tolerant plant species and to develop techniques adapted to using brackish water for irrigation.

### Water resource protection

“Limitation of perimeters to protect potable water facilities”

The project will focus on protecting water tables against pollution risks, while ensuring steady supply of potable water to the cities of Tangier, Azilal and Sidi El Mokhtar (Chichaoua province).

“Treatment of effluents from drinking water production facilities”

These effluents are a source of pollution to the recipient environment and therefore present a potential health hazard to the nearby populations. The project aims to install six drinking water production plants.

“Establishment of sanitary landfills”

The project seeks to implement a controlled waste-dump for household solid wastes in the city of Guelmim. The Oued Seyyad well field, which supplies both Guelmim and TanTan with drinking water, is threatened by pollution originating from uncontrolled household refuse deposits. The project needs to be implemented in all cities that do not have such facilities.

### Harvesting new water resources

“Collection and use of storm water”

This project aims to introduce appropriate technologies for collecting and storing storm water in rain fed areas (arid and semi arid zones).

“Sea water desalination”

This project aims to supply the coastal cities located along the Agadir-Tarfaya axis with drinking water. This area, endowed with a huge touristic potential, often suffers from lack of water resources.

### Dry farming

“Restructuring and development of Oases”

The project seeks to maintain agricultural activities of the populations living in oases and to restore the date palm heritage.

“Extension of olive oil plantations”

Among the vegetative species best adapted to marginal zones, the olive tree represents an asset for all countries in the Mediterranean basin. The project aims to expand olive tree plantation in favorable areas of Morocco.

### Adaptation of farming techniques

“Supplemental irrigation”

This project proposes to carry out the required land development activities, especially in rain-fed cereal crop areas to ensure supplemental irrigation (70-100 mm) to save crops from seasonal drought occurring at the end of growth cycles.

### Supporting projects

“In-depth research on the CC impacts on water and agriculture”.

“Establishment of a research center for CC impacts”  
“Modeling of climate projections in the Maghreb”

“Establishment of a climate databank”

“Development of the agro-meteorology network”

“Tapping of deep water tables in western High Atlas”

“Mapping of major water tables prone to pollution”

# Appendix B

## Mitigation Projects

### Project list

	Topic	Code	Project Title
Energy Module	Energy management	ME1	Rational use of energy in the industrial sector
		ME2	Rational use of energy in administrations and public buildings
		ME3	Upgrading of boilers in industrial and tertiary sectors
		ME4	Beet pulp drying with overheated steam in Doukkala sugar factories
		ME5	Development of cogeneration
		ME6	Spreading the use of enhanced boilers in socio-economic sectors (i.e. Turkish baths and public ovens)
		ME7	Establishment car clinics for motor vehicles
		ME8	Heat trapping systems in Safi and Jorf Lasfar chemical facilities.
	Alternative fuels	SC1	Development natural gas use in industrial sector
	Renewable energies	ER1	Funding of decentralized rural electrification projects
		ER2	Development of solar energy use to heat water
		ER3	Desalination of seawater using wind energy in Tan Tan
		ER4	Production of power energy using wind energy
		ER5	Increase in the number of hydroelectrical power plants
		ER6	Development of renewable energy
Forests	Development of forest formations	FF1	Support to the reforestation programme Plan
		FF2	Development of agro-forestry
		FF3	Rehabilitation of stripped mining sites in Khouribga
Waste	Biogas recovery from waste	RB1	Recovery of biogas from the wastewater treatment units of Benslimane and Agadir
		RB2	Recovery of biogas from solid waste dumps of Mediouna and Marrakech.
Ind. P.	Building materials substitution	SM1	Partial substitution for clinker using fly ashes from thermal power stations
		SM2	Use of damp phosphate instead of dry phosphate rock in the Jorf Lasfar chemical facility
		SM3	Partial substitution for black phosphate rock with light phosphate in Youssoufia



# Abbreviations

## Institutions, Programs and Conventions

CB	: Convention sur la biodiversité
CCD	: Convention sur la lutte contre la désertification
CCNUCC	: Convention Cadre des Nations Unies sur le changement climatique
CDER	: Centre de développement des énergies renouvelables
CIERD	: Centre d'études et de recherches démographiques
CIAT	: Comité interministériel pour l'Aménagement du territoire
CIEDE	: Centre d'information sur l'énergie durable et l'environnement
CMPP	: Centre marocain de production propre
CNCC	: Comité national des CC
CNE	: Conseil national de l'environnement
CNRST	: Centre national de recherche scientifique et technique
CNST-CC	: Comité national scientifique et technique sur les CC
CRTS	: Centre royal de télédétection spatiale
CSEC	: Conseil supérieur de l'eau et du climat
CNUED	: Conférence des Nations Unies sur l'environnement et le développement
COP	: Conférence des parties
DE	: Département de l'environnement
DGH	: Direction générale de l'hydraulique
DMN	: Direction de la météorologie nationale
GIEC	: Groupe intergouvernemental d'experts sur l'évolution du climat (IPCC en anglais)
INRA	: Institut national de la recherche agronomique
MATUHE	: Ministère de l'aménagement du territoire, de l'urbanisme, de l'habitat et de l'environnement
MDP	: Mécanisme de développement propre
ONG	: Organisation non gouvernementale
PANE	: Plan d'action national pour l'environnement
PNUD	: Programme des Nations Unies pour le développement
PROTARS	: Programme thématique d'appui à la recherche scientifique

## Gases

CFC	: chlorofluorocarbures
CH <sub>4</sub>	: méthane
CO	: oxyde de carbone
CO <sub>2</sub>	: gaz carbonique ou dioxyde de carbone
COVNM	: composés organiques volatils non méthaniques (NMVOC en anglais)
E-CO <sub>2</sub>	: équivalent – CO <sub>2</sub>
GES	: gaz à effet de serre
HFC	: hydrofluorocarbures
NMVOC	: non-méthane volatile organic compound (COVNM en français)
N <sub>2</sub> O	: oxyde nitreux
NO <sub>x</sub>	: oxydes d'azote NO et NO <sub>2</sub>
PFC	: perfluorocarbures
SF <sub>6</sub>	: hexafluorure de soufre
SO <sub>2</sub>	: dioxyde de soufre

## Units

Dh	: dirham marocain
GWh	: gigawattheure = 10 <sup>6</sup> kWh
ha	: hectare
hab	: habitant
kt	: kilotonne = 1000 tonnes
ktep	: kilotep = 10 <sup>3</sup> tep
kW	: kilowatt = 10 <sup>3</sup> watts
kWh	: kilowattheure
m <sup>3</sup>	: mètre cube
Mj	: mégajoule = 10 <sup>6</sup> joules
Mtep	: mégatp = 10 <sup>6</sup> tep
MW	: mégawatt = 10 <sup>6</sup> watts
TJ	: térajoule = 10 <sup>12</sup> J
t	: tonne
tep	: tonne équivalent pétrole
t E-CO <sub>2</sub>	: tonne équivalent-CO <sub>2</sub>
US\$	: dollar des Etats Unies
d'Amérique	





## References

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### **General data**

1. Annuaire Statistiques du Maroc, années 1985, 1990, 1995, 1996, 1997, 2000.
2. Les Atouts Economiques : Livre blanc des potentialités économiques du Maroc ; Direction des Investissements extérieurs, Ministère de l'Economie et des Finances, 2000.
3. Le Territoire marocain : état des lieux ; Direction de l'aménagement du territoire, 2000.
4. Résumé du projet de Plan de Développement Economique et Social 2000-2004, MPEP, Direction de la Programmation.
5. Rapport National sur le développement humain 1997, PNUD, Février 1998.
6. Situation et perspectives démographiques du Maroc, CERED, 1997.

### **Environment**

1. PANE : Programme d'Action National pour l'Environnement, MATUHE, Département de l'Environnement, Juillet 2001.
2. Stratégie nationale pour la protection de l'environnement et le développement durable, MATUHE, Département de l'Environnement, 1995.
3. Action 30, contribution du Maroc au développement durable, MATUHE, Département de l'Environnement, 1997.
4. Rapport sur l'Etat de l'Environnement du Maroc, MATUHE, Département de l'Environnement, 1999.
5. Etude Nationale sur la Biodiversité, MATUHE, Département de l'Environnement, 1998.

### **Energy**

1. Note informative sur le secteur de l'énergie, MICEM-Département de l'Energie, juillet 2001.
2. Plan National de la Biomasse-Energie, CDER, Décembre 1998.
3. Emissions de CO<sub>2</sub> dues à la combustion d'énergie, Agence Internationale de l'Energie, OCDE, 1998.
4. Actes du séminaire "Stratégies alternatives pour la sauvegarde des ressources en biomasse-énergie", MEM-CDER, MAMVA-DAF, 1997.

### **Water**

1. CSEC, 9<sup>ème</sup> session, 2001 : Plan Directeur pour le Développement des Ressources en Eau des bassins du Tensift.
2. CSEC, 9<sup>ème</sup> session, 2001, la Gestion de l'Economie de l'Eau.
3. Direction Générale de l'Hydraulique (DGH), 2001 : L'Hydraulique en chiffres.
4. Direction Générale de l'Hydraulique (DGH), 2000 : l'Etat de la qualité des ressources en eau au Maroc.
5. DGH, 1998 : loi N° 10-95 sur l'eau. Textes d'application adoptés, Décrets, Arrêtés et Circulaires.
6. DGH., 1995 : Le point sur la sécheresse au Maroc.

### **Agriculture**

1. Stratégie 2020, colloque national, Ministère de l'Agriculture, juillet 2000.
2. Stratégie de développement des terres de parcours au Maroc, Ministère de l'Agriculture, 1995.
3. Plan National d'Irrigation, Administration du Génie Rural, Ministère de l'Agriculture, 1995.
4. Recensement général de l'agriculture de 1996-1997, Direction de la Programmation des Affaires Economiques, Ministère de l'Agriculture, 1998.







5. Plan d'Action National de lutte contre la Désertification, Ministère de l'Agriculture, 2000.
6. Plan National d'Aménagement des Bassins Versants, Ministère de l'Agriculture, 1990.

### **Forest**

1. Programme Forestier National, Synthèse, Ministère Chargé des eaux et Forêts, Août 1999.
2. Le Grand Livre de la Forêt marocaine, Ouvrage collectif, Editions Mardaga, 1999.
3. Inventaire Forestier National (Rapport de présentation générale), Service de l'IFN, DDF, Ministère chargé des Eaux et Forêts, mai 1998.
4. Etude sur la consommation nationale de bois de feu, AEFCS, MARA, 1994.
5. La forêt, source d'énergie, A. El Abid, DEFCS, MARA, 1990.
6. Plan Forestier National, Ministère chargé des Eaux et Forêts.
7. Plan directeur de reboisement, Ministère chargé des Eaux et Forêts, 1998.

### **Waste**

1. Etude sur les Directives Nationales pour la Gestion des Déchets, JICA-MATUHE-Département Environnement, 1997.
2. Schéma Directeur National d'Assainissement Liquide, ONEP, 1998.
3. Collecte et traitement des ordures ménagères au Maroc, Direction de l'Eau et de l'Assainissement, DGCL, Ministère de l'Intérieur, novembre 1995.
4. Valorisation énergétique des ordures ménagères au Maroc, A. Aït Khabba, Rapport de fin d'études, Ecole Nationale des Ponts et Chaussées, Paris, 1987.
5. L'épuration des eaux usées au Maroc, Synthèse des études expérimentales, Direction de l'Eau et de l'Assainissement, DGCL, Ministère de l'Intérieur, avril 1995.
6. Promotion de l'utilisation du biogaz produit dans des stations d'épuration du Maroc, CDER, PSE, GTZ, novembre 1997.
7. Utilisation du biogaz à la station de Ben Sergao (Maroc), méthodes et résultats, GTZ, juin 1997.

### **Industry**

1. Les industries de transformation en 1997, 1998 et 1999, MICEM.
2. Plan d'Action pour un Développement Industriel Ecologiquement Durable, MICEM-ONUDI.

### **Climate Change**

1. Inventaire national des gaz à effet de serre : émissions par les sources et absorptions par les puits, MATUHE, Département de l'Environnement, 1999.
2. Etude des possibilités d'atténuation des gaz à effet de serre au Maroc, MATUHE, octobre 2001
3. Etude de Vulnérabilité du Royaume du Maroc face aux impacts des changements climatiques, MATUHE, septembre 2001.
4. Communications nationales des pays suivants : Australie (1994), Canada (1994), Danemark (1994), France (1997), Japon (1997), Norvège (1997), Nouvelle Zélande (1994), Tunisie (2001), Pologne (1998), Ile Mauritius (1999), Salvador (2000).

