REPUBLIC OF UGANDA

UGANDA'S FIRST BIENNIAL UPDATE REPORT TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

MINISTRY OF WATER AND ENVIRONMENT
Climate Change Department

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FOREWORD

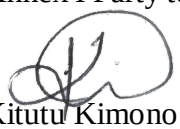
Climate change is one of the greatest challenges affecting the world today. As the world's climate continues to change at rates unprecedented in recent human history, it is clear that the impacts and risks related with these changes are existent.

In Uganda, the economy and wellbeing of the people is highly dependent on climate. The country experiences increased frequency and severity of extreme weather events manifested in more erratic rainfalls and prolonged dry seasons due to climate variability and change. Climate disasters and risks are already negatively impacting the economy with severe negative impacts on the agriculture, water, energy and infrastructure sectors.

Uganda, as a signatory and Party to the United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol and the Paris Agreement is committed to honouring its reporting obligations. Consequently, the country submitted its first National Communication in 2002, the Second National Communication in 2014 and the Nationally Determined Contribution in 2015/2016. The third National Communication currently under preparation is due to be submitted by end of 2020.

The country is also obligated to prepare and submit Biennial Update Reports (BURs) to the UNFCCC in accordance with decision 2/CP.17. Therefore, this report highlights information on the National Circumstances, National Greenhouse Gas Inventory which covers the Energy, Industrial Process and Product use (IPPU), Agriculture, Forest and Other Land Use (AFOLU) and Waste sectors, Mitigation actions and their effects, the Measurement, Reporting and Verification (MRV) system, constraints and gaps as well as support received and needed.

On behalf of the Government of the Republic of Uganda, it is an honour for me to present Uganda's First Biennial Update Report in fulfilment of the country's obligations as a Non-Annex I Party to the United Nations Framework Convention on Climate Change (UNFCCC).



Kitutu Kimono Mary Goretti (PhD)
MINISTER OF STATE FOR ENVIRONMENT

ACKNOWLEDGEMENTS

On behalf of the Ministry of Water and Environment, I sincerely thank the Global Environment Facility (GEF) for providing financial support through UN Environment as the implementing entity for the preparation of the first Biennial Update Report (FBUR) for Uganda.

During the preparation of this report, government used a task force approach, where a team of national experts were drawn up to prepare information on the National Circumstances, National Greenhouse Gas Inventory (NGHG), Mitigation Actions and their effects, including the associated domestic Monitoring, Reporting and Verification (MRV) system. I take this opportunity to acknowledge and thank Mr. Chebet Maikut, Commissioner – Climate Change Department and assisted by Ms. Irene Chekwoti, Senior Climate Change Officer-Mitigation, for the able stewardship to coordinate the preparation of the FBUR.

I am grateful to Hon. Sam Cheptoris, Minister of Water and Environment, Hon. Dr. Mary Goretti Kitutu Kimono, Minister of State for Environment and Hon. Ronald Kibule, Minister of State for Water for the overall political guidance. I equally highly appreciate the support of Members of Parliament through the Parliamentary Standing Committee on Climate Change under the leadership of Hon. Lawrence Biyika Songa.

I would like to thank the various Government Ministries, Departments and Agencies, Local Governments as well as the Civil Society Organisations and individuals that made the work of preparing the country's FBUR possible.

Main contributors

Office of the Prime Minister
Ministry of Finance, Planning and Economic Development
Ministry of Energy and Mineral Development
Ministry of Trade, Industry and Cooperatives
Kampala capital City Authority
National Water and Sewerage cooperation
Uganda National Meteorological Authority
National Forestry Authority
Uganda Wildlife Authority
National Forestry Resources Research Institute
Ministry of Works and Transport
Ministry of Agriculture, Animal Industry and Fisheries
Ministry of Lands, Housing and Urban Development
Ministry of Local Government
National Environment Management Authority
National Planning Authority
Uganda Revenue Authority
Uganda Railways Cooperation
Uganda Bureau of Statistics

I also appreciate the support received from the Coalition of Rain Forest Nations (CfRN) and the Global Green Growth Institute (GGGI) for their contribution towards peer-reviewing of the FBUR.

Alfred Okot Okidi
PERMANENT SECRETARY

EXECUTIVE SUMMARY

National Circumstances

Uganda is characterized by diverse topography, comprising of lowlands, the plateau as well as hills and mountains. The lowest point is the western arm of the great East African rift valley at 620 metres above sea level and the highest point is 5,111 metres above sea level at the peak of Mt. Rwenzori. More than three quarters of Uganda is a plateau lying between 900 meters and 1,500 metres above sea level. About 15% of Uganda is covered by water and another 10% is permanently wet areas, mainly composed of papyrus swamps. The elevation and geographical location of Uganda (at the equator) causes favourable rainfall and temperature that supports agriculture and a diversity of fauna and flora. Natural forests of Uganda are majorly open dry forest commonly classified as woodlands and medium altitude semi deciduous or ever green tropical high forests (Tropical rain forests). However the country's forest cover is fast declining at about 2% per annum but there has also been increased interest in afforestation and reforestation activities growing at about 3% per annum. Unfortunately, increased forest plantations cannot compensate for the loss of natural forests both in value and acreage.

The country has favourable climate conditions and soils which support agriculture, the main stay of Uganda's economy. Agriculture contributes about 20% of GDP, accounts for 48% of exports and employs 73% of the population aged 10 years and older. Though considered to have greatest potential in Africa, the agricultural sector has many challenges, for example, over dependent on small-holder farming, weather based - rain fed, with very little or no improved seed and lowest fertilizer application among others.

Biomass is the primary source of energy in all the sectors apart from transport and service sector. Despite prospects of oil and gas exploration, all the petroleum-based fuels are imported. Electricity generation is mainly from hydropower sources and installed capacity is approx. 925 MW in 2015. Noting that 90% of the transport sector relies on the road network, only 50% accounts for national paved roads. Uganda's industrial structure is still at infant stages and is composed of Manufacturing, Construction, Mining and Quarrying, Electricity and water production. Agro-processing accounts for the largest component within the manufacturing sub-sector whereas the cement industry is largest in the mineral processing industry.

Waste disposal remains a key challenge in the city and urban areas. In addition, wastewater treatment and management of biodegradable materials is also a challenge in Kampala city. Only 55 % of the solid waste generated in Kampala, the capital city is collected and managed.

Institutional framework for climate change response

Government through the National Climate Change Policy (2015) established the Climate Change Department (CCD) within the Ministry of Water and Environment, the national focal point institution to strengthen the implementation of UNFCCC and its Kyoto Protocol (KP) and the Paris Agreement. The department coordinates all climate change response activities in Uganda and is headed by a Commissioner. The Policy Committee on Environment serves as the highest decision making body for national climate action whereas the National Climate Change Advisory Committee serves as the multi stakeholder committee for coordination. The newly established Parliamentary Standing Committee on Climate Change will serve as the oversight body for national climate action. The National Climate Change Bill (2018) is awaiting Parliamentary debate.

National Green House Gas Inventory

Uganda has the basic infrastructure to manage GHG inventory system which includes software (IPCC 2006), a database to hold data from all the sectors and officers to manage the system. Key data providers include Ministry of Energy and Mineral Development (MEMD); Ministry of Works and Transport (MoWT); Ministry of Agriculture, Animal industry and Fisheries (MAAIF); the National Forestry Authority (NFA), National Environment Management Authority (NEMA), Kampala Capital City Authority (KCCA); National Water and Sewerage Corporation (NWSC); Uganda Bureau of Statistics (UBOS); Uganda National Meteorological Authority (UNMA); Uganda Revenue Authority (URA); and other Local Governments.

The National Greenhouse Gas Inventory of Uganda's FBUR covers the period 2005 to 2015. The gases covered in this inventory include the major direct gases - carbon dioxide, (CO_2), Methane (CH_4) and nitrous oxide (N_2O). According to the Good Practice Guidance (2000), the table below highlights the country's key sources of GHG emissions.

Table S. 1. Key category sources (Level Assessment)

IPCC Category code	IPCC Category	Greenhouse gas	2015 Ex,t (Gg CO_2 Eq)	|Ex,t| (Gg CO_2 Eq)	Cumulative Total
3.B.1.a	Forest land Remaining Forest land	CARBON DIOXIDE (CO_2)	39811.401	39811.401	44%
3.A.1	Enteric Fermentation	METHANE (CH_4)	15432.941	15432.941	61%
3.B.2.b	Land Converted to Cropland	CARBON DIOXIDE (CO_2)	10611.342	10611.342	73%
3.C.4	Direct N_2O Emissions from managed soils	NITROUS OXIDE (N_2O)	5595.7377	5595.7377	79%
1.A.4	Other Sectors - Biomass	METHANE (CH_4)	3141.474	3141.474	82%
3.B.3.b	Land Converted to Grassland	CARBON DIOXIDE (CO_2)	2727.1901	2727.1901	85%
1.A.3.b	Road Transportation	CARBON DIOXIDE (CO_2)	2561.9319	2561.9319	88%

3.C.5	Indirect N2O Emissions from managed soils	NITROUS OXIDE (N2O)	1822.6182	1822.6182	90%
4.A	Solid Waste Disposal	METHANE (CH4)	1487.8046	1487.8046	92%
1.A.1	Energy Industries - Biomass	METHANE (CH4)	1390.368	1390.368	93%
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CARBON DIOXIDE (CO2)	870.7512	870.7512	94%
3.C.7	Rice cultivations	METHANE (CH4)	652.54004	652.54004	95%

Key categories based on trends are degradation of forests (forest land remaining forest), conversion of (forests) to cropland, N_2O emissions from biomass burning and CH4 emissions from enteric fermentation of ruminant animals. Land conversion to grassland is a more significant source category than indirect N_2O emissions from managed soils and road transportation.

Table S. 2. Key category sources (ranking by trends)

IPCC Category	Greenhouse gas	2015 Year Estimate Ext (Gg CO2 Eq)	Cumulative Total
Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	39811.40099	37%
Land Converted to Cropland	CARBON DIOXIDE (CO2)	10611.34191	59%
Enteric Fermentation	METHANE (CH4)	15432.94141	65%
Land Converted to Grassland	CARBON DIOXIDE (CO2)	2727.190088	71%
Emissions from biomass burning	METHANE (CH4)	327.2401781	75%
Emissions from biomass burning	NITROUS OXIDE (N2O)	282.7781974	78%
Solid Waste Disposal	METHANE (CH4)	1487.804594	81%
Other Sectors - Biomass	CH4	3141.474	84%
Road Transportation	CARBON DIOXIDE (CO2)	2561.9319	87%
Energy Industries - Biomass	CH4	1390.368	89%
Direct N2O Emissions from managed soils	NITROUS OXIDE (N2O)	5595.737652	91%
Manufacturing Industries and Construction - Liquid Fuels	CO2	870.7512	93%
Rice cultivations	METHANE (CH4)	652.5400443	94%
Indirect N2O Emissions from managed soils	NITROUS OXIDE (N2O)	1822.618196	95%

Uganda's emissions have had a steady rise increasing from 53 thousand Gg tonnes in 2005 to close to 90 thousand Gg tonnes in 2015. The AFOLU sector has remained the most significant source accounting for over 86% of the emissions followed by the energy sector

accounting for 10.8%. At sub sector level, forest degradation, enteric fermentation from ruminant animals, deforestation (conversion of forest to cropland and grassland) and N2O emissions from managed soils are significant sources.
Though lower than the AFOLU Sector, the emission from the energy sector have almost doubled raising from 4.7 thousand Gg tonnes in 2005 to 9.5 thousand Gg tonnes in 2015. The transport subsector accounts for close to 66% of the emissions of Uganda's energy sector (Figure S. 1). Emissions from the Waste sector and IPPU have almost tripled in the same period raising from 757 Gg tonnes to 2 thousand Gg tonnes of CO2 equivalent and from 171 Gg tonnes to 487 Gg tonnes of CO2 equivalent respectively.

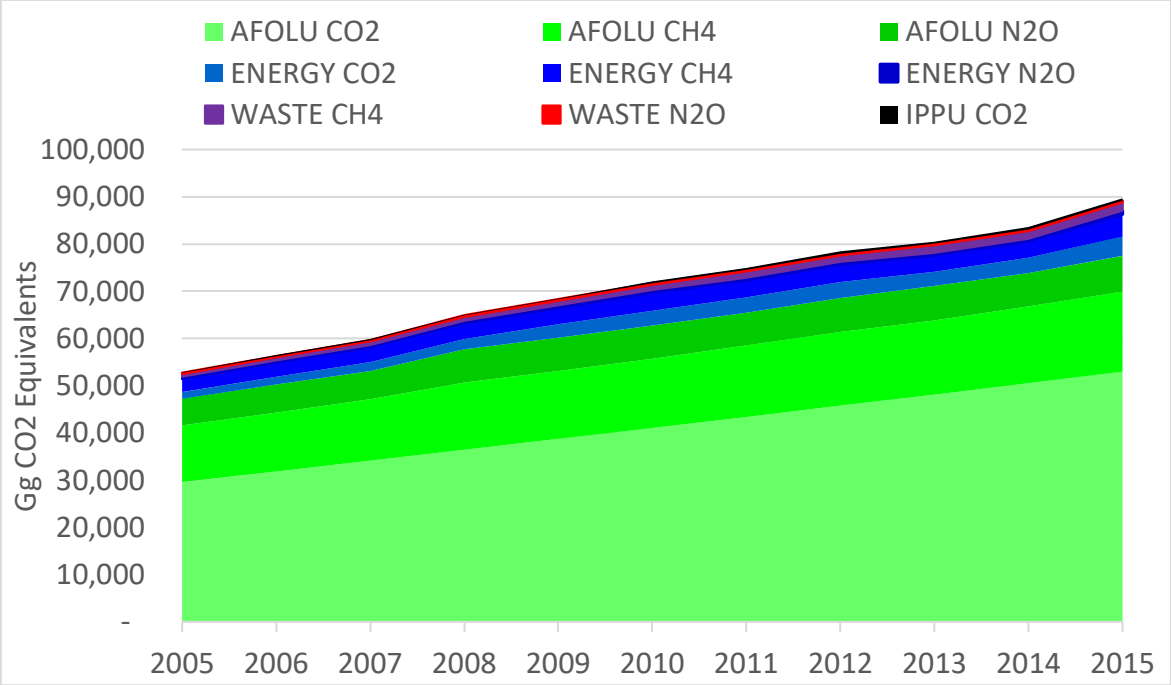


Figure S. 1 Overall emissions trends by sector and by gas

Mitigation actions and their effects
Uganda has made efforts to enhance mitigation actions as required by the UNFCCC. Uganda has participated effectively in the Kyoto Protocol's Clean Development Mechanism. The country has also developed and initiated implementation of Nationally Appropriate Mitigation Actions (NAMAs). Recently, Uganda developed and submitted her Nationally Determined Contributions (NDCs) based on the policy priorities in the Second National Development Plan (NDPII) with specific NDC mitigation commitment of 22% reduction by 2030 compared to business-as-usual scenario to be achieved through nationally and internationally-supported mitigation actions.

Various forms of mitigation actions have received technical support for development and implementation. A prioritized list and full concepts of NAMAs were developed with support from UNDP as shown in Table S.3. The selected concepts were subsequently registered in the UNFCCC NAMA registry as NAMAs seeking support.

Table S. 3 Summary of Ugandas NAMAs

Name of Action	Goal	Scope	Effects
Revolving Loan Facility for the Uptake of Improved Institutional Cook Stoves in Ugandan Schools	To ensure the reduction of GHG emissions by increasing energy efficiency of stoves by replacing the traditional stoves to Improved Institutional Cook Stoves (IICS)	To cover more than 18,000 primary schools, almost 3,000 secondary schools, and about 50 tertiary schools from all over the country	17.41 million tCO2e over 24 years at an average of 669,924 per tCO2e annum.
Integrated Waste Management and Biogas Production in Uganda	To improve waste management practices in towns and municipalities through the introduction of integrated waste management, and deployment of biogas energy generation	To be piloted in five District Local Governments of Mbarara, Mbale, Jinja, Masaka and Kampala Capital City Authority (KCCA)	The consequential GHG emissions reductions are estimated to be 3,771,000 tonnes of CO2eq over a 20 year period
Climate–Smart Dairy Livestock Value Chains in Uganda	To trigger resilient low-carbon development in the dairy sector through the introduction of climate-smart agricultural practices and to bring the dairy production sector of Uganda onto a low carbon and more resilient path	Interventions and measures related to policy development, technical assistance, and access to finance integrated within sustainable commercial oriented investment activities	About 402,500 tCO2e annually from its enteric fermentation component.

Vehicle Fuel Efficiency Initiative in Uganda	To improve the fuel efficiency and reduce emissions from vehicles through a holistic value chain approach	Comprehensive measures that cover policy measures, fuel standards and public awareness, in addition to hardware (vehicle inspection, labelling, assembly and recycling) components.	Baseline emission calculated from Road transport in Uganda in Year 2015 is 2,561,906 tCO_2
Bus Rapid Transit for Greater Kampala	To introduce a Bus Rapid Transit (BRT) system in the Greater Kampala Metropolitan Area (GKMA) to meet the growing demand for mobility	Plan, develop and finance a coordinated urban transportation system around design of routes, linkage between the BRT routes and other modes of transport, facilities and resources	A modern integrated network of BRT, buses and taxi each playing complementary roles with the BRT having a dominant role in the central part of Greater Kampala

Other notable mitigation actions that are categorized as policy measures and initiatives to address national needs and have a recognizable contribution to the mitigation of climate change are energy interventions that include: briquette making from waste project, renewable energy policy, biomass energy strategy, energy efficiency programme and demand side management of energy use in MSMEs of the manufacturing sector project.

Uganda has elaborated plans for the implementation of national REDD+ interventions. The REDD+ Strategy outlines eight action areas of 1) Climate smart agriculture 2) Sustainable fuelwood and (commercial) charcoal production 3) Large-scale commercial timber plantations 4) Restoration of natural forests in the landscape 5) Energy efficient cooking stoves 6) Integrated wildfire management which aims to reduce the destructive impacts of wildfires on forests 7) Livestock rearing in the Cattle Corridor 8) Strengthening of policy implementation for REDD+ as an over-arching option. Uganda submitted her Forest Reference Emission Level for deforestation and has a detailed plan for developing baselines for forest degradation and carbon stock enhancement activities.

On the other hand, policy and strategies are mainly aimed at addressing national developmental challenges and will have an effect on society in form of socio-economic benefits and poverty reduction, and to some extent environmental effects without necessarily explicitly defining emission reduction objectives or levels. In addition, Uganda's mitigation actions will have a range of positive human health, ecosystem functioning, macroeconomic, social, and/or equity side effects. In some cases, these co-benefits outweigh the importance of climate change mitigation benefits.

Uganda has been one of the most active countries in the international market mechanism through the Kyoto Protocol's CDM with 20 projects registered and under validation The projects under implementation in 2015 have a strong focus on forestry (seven projects) and renewable energy, particularly hydro power (six projects). Other standalone CDM projects include; biomass energy (3 projects), a landfill gas project, wastewater treatment (1 project), one domestic lighting and one biodiesel project (UNFCCC, CDM Website, 2019). Cumulative issuance of CERs as of 2015 were 1,641,362 Tones CO2eq.

Under the CDM, Uganda actively participated in the Programme of Activities (PoAs). The overall estimated emission reductions of PoAs with CPA in Uganda is 198,140 CERs/year. As of March 2014, there were 17 PoAs under validation of which 6 PoAs were registered in Uganda, 5 PoAs were registered outside Uganda as a host country. The 6 PoAs with their CPAs in Uganda include Uganda Municipal Waste Compost Programme with planned 83,700 CERs/year.

Domestic MRV

Uganda's domestic MRV has up to now been able to provide information on GHG inventories, baselines for NAMAs, REDD+ and other mitigation actions but mainly in an ad hoc manner. In many instances, axe ante emission reduction targets are stated without clear documentation of methodological approach.

Apart from CDM PoA and VCS projects/programmes that follow a well-established carbon tracking system, the element of measuring and reporting mitigation and their impacts is almost none existent and is not well defined in many of the Uganda's domestic mitigation actions.

The entry into force of the Paris Agreement (2016), of which Uganda is a signatory, has ushered in new reporting requirements that make the need for a robust system that has capacity to continuously measure and track mitigation actions and related benefits more than ever before. Uganda has;

- Developed a draft national MRV framework
- Conducted several trainings in GHG Inventory management
- National Forest Monitoring System (NFMS) with MRV functionality in advanced stages

However, the FBUR project has initiated processes for the establishment of MRV systems for NAMAs and support received.

Constraints and gaps

Comprehensive assessment for finance, technology transfer and capacity building has not been made because the country has no efficient mechanisms for the collection of reliable data, archiving and updating in a manner that meets the minimum IPCC requirements.
Uganda's technical and capacity needs are enormous. Implementation constraints include the limited capacity to undertake mitigation assessments, absence of formalised relations with the private sector especially for the mitigation actions and disclosure of their emission reductions for example in transport, charcoal production, industrial processes and product use.

Financial needs to overcome technical and capacity shortcomings in the establishment of a system to track GHG emissions and mitigation efforts are estimated at USD 11 million. Depending on the adaptation and mitigation activities chosen, the cost of these activities may range from USD 290 million to USD 700 million. It is estimated that from GEF alone, Uganda has since 2005 received of over USD 100 Million in grants with the co-financing proportion estimated to be over USD 700 million (Appendix III).

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List of Acronyms

AFOLU	Agriculture Forestry and Other Land Use
ASL	Above sea levels
BAU	Business As Usual
BOD	Biochemical oxygen demand
BRT	Mass Rapid Transport
BUR	Biennial update reports
CBA	Cost benefit analysis
CCD	Climate Change Department
CCPC	Climate Change Policy Committee.
CDM	Clean Development Mechanism.
CH4	Methane
CO	Carbon monoxide
CO2	Carbon dioxide
CO2eq	Carbon dioxide equivalent
COD	Chemical Oxygen Demand.
DNA	Designated National Authority
ERA	Electricity Regulatory Authority
FAO	Food and Agriculture Organisation
FREL	Forest Reference Emission Level
FRLS	Forest Reference Levels
FSSD	Forestry Sector Support Department
GDP	Gross Domestic Product
GHG	Greenhouse gas
HEP	Hydroelectric power supply
IICS	Improved Institutional Cook Stoves
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
KCCA	Kampala Capital City Authority
ktoe	kilo tonne of oil equivalent
kWh	kilo Watt hour
LC	Local Council
LPG	liquefied petroleum gas
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MEMD	Ministry of Energy and Mineral Development;
MoFPED	Ministry of Finance Planning and Economic Development
MoLG	Ministry of Local Government
MRV	Measurement Reporting and Verification
MSW	Municipal solid waste
MtCO2eq/yr	Metric tonne carbon dioxide equivalent per year.
MTIC	Ministry of Trade, Industry and cooperative
MW	mega watt
MWh	Megawatt hour
MWT	Ministry of Works and Transport
N_2O	Nitrous oxide
NAMAs	Nationally Appropriate Mitigation Actions

NAP	National Adaptation Plan
NARO	National Agricultural Research Organisation
NBS	National Biomass Study
NCCAC	National Climate Change Advisory Committee
NCCP	National Climate Change Policy
NDC	Nationally Determined Contribution
NEMA	National Environment Management Authority,
NFA	National Forestry Authority,
NGO	Non-governmental Organisation
NMVOC	Non-methane organic volatile compounds
NWSC	National Water and Sewerage Corporation,
OPC	Ordinary Portland Cement
PCE	Policy Committee on Environment
PFCC-U	Parliamentary Forum on Climate Change-Uganda
PoA	Program of Activities
PPA	Power Purchase Agreement
QA	Quality assurance
QC	Quality Control
REDD+	Reduced Emissions from Deforestation and Forest Degradation+
SNC	Second National Communication
SO2	Sulphur dioxide
THF	Tropical High Forests
TNA	Technology Needs Assessment
toe	Tonne of oil equivalent
UBOS	Uganda Bureau of Statistic
UCA	Uganda National Climate Change Finance Analysis
UGX	Uganda shillings
UNDP	United Nations Development Program
UNMA	Uganda national Meteorological Authority,
URA	Uganda Revenue Authority
UTGA	Uganda Timber Growers Association
VCS	Verified Carbon Standard

1. NATIONAL CIRCUMSTANCES

1.0 Introduction

The Republic of Uganda has developed the First Biennial Update Report (FBUR) to fulfil its obligations to the UNFCCC (Article 12). The document has been prepared as per requirements of the UNFCCC for BURs and based on Decision 17/CP. 8 / and Decision 2/ CP.17. The report period considered under this document is from year 2005 up to 2015.

Uganda received support from the Global Environment Facility (GEF) through the UN Environment to undertake the FBUR project. This report covers national circumstances and instructional arrangement, national greenhouse gas inventory, mitigation actions and their effects, domestic MRV, constraints and gaps, support received and required.

1.1 Convention Obligations and Reporting Requirement

Uganda signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 and ratified the Kyoto Protocol in 2002 (Table 1-1). The fundamental objective of the UNFCCC is to achieve stabilisation of the concentration of greenhouse gases in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

As party to Kyoto Protocol, Uganda has developed a number of policies, laws and actions for the implementation of the Kyoto Protocol albeit with very limited progress. Uganda is one of the countries that is seriously affected by effects of climate change. The government has formulated a number of adaptation and mitigation measures mainly from external sources and to some very limited extent its own domestic resources.

Table 1-1. Uganda Member of UNFCCC

United Nations Framework Convention on Climate Change		Kyoto Protocol		Paris Agreement	
Date of signature:	13 June 1992	Date of signature:		Date of signature:	22 April 2016
Date of ratification :	08 September 1993	Date of ratification:	25 March 2002	Date of ratification:	21 September 2016
Date of entry into force:	21 March 1994	Date of entry into force:	16 February 2005	Date of entry into force:	4 November 2016

In line with the reporting requirement, Uganda has been complying with UNFCCC reporting considering that each non-Annex I Party, as a part of its national communication, communicates a general description of the steps taken or envisaged to implement the

Convention, taking into account its common but differentiated responsibilities and specific national and regional development priorities, objectives and circumstances. According to UNFCCC commitments under Article 4.1, Non-Annex I Parties may provide information on programmes containing measures to mitigate climate change and measures to facilitate adequate adaptation to climate change. Below is a summary of Uganda's reporting to the UNFCCC presented in Table 1-2.

Table 1-2. Uganda Reporting timelines under the UNFCCC

Report	State	Date
First National Communication	Submitted	October 2002
Second National Communication	Submitted	2014 in Lima, Peru
Uganda Biennial Update Report	Work in Progress	
MRV of GHG Emissions	Work in Progress	
MRV for NAMAs	Work in Progress	
MRV for REDD+	Work in Progress	
The Reference Emission Level and/or Forest Reference Level) (FREL/FRLs developed	Submitted	In January 2018

1.2 Institutional, legal, and procedural arrangements

1.2.1 Government Structure and Climate Change

Uganda has two levels of government; central and local government. Executive power is exercised by the government. The legislative power is vested in both the government and the National Assembly.

Planning and service delivery in Uganda is at local government while central government Ministries Departments and Agencies (MDA) focus on policy formulation, setting standards, regulations, developing capacities of local governments to deliver services and formulation of guidelines. Some key and strategic responsibilities have remained at the centre e.g., security, energy and mineral development.

The local government system is formed by a five-tier pyramidal structure, which consists of the village (LC1), parish (LC2), sub-county (LC3), county (LC4), and district (LC5). The district and the city are the highest local government levels, while the sub-county, municipality, municipal division, town, and city division are referred to as lower local government levels.

The administrative organs of both higher and lower local governments comprise of administrative officers and technical planning committees who are respectively in charge of accounting and coordination as well as monitoring of the implementation of sectoral plans. The district technical planning committees are responsible for collecting and integrating plans of lower local governments in order to allow for bottom-up participatory planning and budgeting.

The district (and city) has several directorates for different sectors; typically, these are directorates for finance and planning, education and sports, health services, management support services, production, works and technical services, and community-based services.

The National Climate Change Policy 2015 (NCCP) provides for the Natural Resources Department as the district level climate change focal point. The National Climate Change Bill 2018 envisages to strengthen coordination between line ministries and the local government implementing agencies.

1.2.2 Legal and Policy Frame work

The heart of any national response to climate change is the set of institutions that are responsible for the implementation of the policies and actions set out by Government.

The Climate Change Department (CCD) within the Ministry of Water and Environment was established as the lead institution with the mandate to coordinate all climate change activities in Uganda and its Commissioner serve as the Focal point for UNFCCC. Uganda has drafted the National Climate Change Bill (2018). The Bill recognizes Uganda's reporting obligation to UNFCCC including preparation and submission of BUR and NC and mandates responsible institutions to provide data and information considered beneficial for regular and sustainable formulation of NC and BUR.

1.2.3 The Role of Climate Change Department (CCD)

Creation of the Climate Change Department (CCD) under the office of the Permanent Secretary within the Ministry of Water and Environment, is one of the national measures to ensure climate change is mainstreamed in government structures. The main objective for the establishment of the CCD was to strengthen Uganda's implementation of the UNFCCC and its Kyoto Protocol (KP). Though CCD has maintained a very lean structure, it is expected to provide several key functions which include;

- Co-ordination of national climate change actions (Mitigation and Adaptation) in different sectors, including the creation of awareness among various stakeholders to enable them internalize their roles and responsibilities under the Convention and its Kyoto Protocol.
- Monitoring the implementation of mitigation and adaptation activities and progressively update Government, the Uganda population and the COP to the UNFCCC and its Kyoto Protocol
- Provision of technical support to the Permanent Secretary, Ministry of Water and Environment to enable him/her coordinate climate change issues more effectively as part of the mandate of the Ministry.

- Initiation of the development and review of appropriate policies, laws and programmes necessary to ensure effective implementation of adaptation and mitigation activities in Uganda.
- Implementation of adopted policies as well as decisions made by the relevant bodies of government including the Policy Committee on Environment.
- Provision of technical advice and secretarial services to the Policy Committee on Environment during deliberations on climate change matters
- Establishment and maintenance of relationship with national, regional and international organizations, institutions and agencies as may be appropriate for facilitating the implementation of the relevant policies, programmes, projects and decisions.
- Guidance on precautionary measures to anticipate, prevent or minimize the causes of climate change and its adverse effects.
- Serve as Secretariat for the Designated National Authority (DNA) for the purpose of facilitating Uganda's participation in CDM in accordance with the Decision of the Seventh Conference of Parties held in Marrakesh, Morocco in 2001.
- Establishment and maintenance of a register of Clean Development Mechanism projects
- Promote and cooperation in the development, application and diffusion, including transfer of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases in all the relevant sectors including energy, transport, industry, agriculture, forestry and waste management.
- Preparation for adaptation to the adverse effects of climate change by guiding the development of elaborate, appropriate and integrated plans for key sectors as well as the rehabilitation of areas affected by drought, desertification and floods.
- Coordination and guidance on the education, training and public awareness programmes on climate change, consistent with Article 6 of the Convention.
- Provision of guidance on public participation in addressing climate change and its effects and developing adequate responses.
- Assist in the identification and mobilization of sources of funds for climate change action.
- Perform such other functions as may be conferred on it by the Permanent Secretary Ministry of Water and Environment.

In its efforts to coordinate and spear head climate change actions and across government agencies, CCD is expected to work closely with the following MDAs; Ministry of Energy and Mineral Development (MEMD); Ministry of Works and Transport (MOWT); Ministry of Trade, Industry and cooperative (MTIC); Ministry of Agriculture, Ministry of Local Government (MOLG), Ministry of Animal industry and Fisheries (MAAIF) and Ministry of Finance and Economic Development (MFED), the National Forestry Authority (NFA), National Environment Management Authority (NEMA), Kampala City Council Authority (KCCA), National Water and Sewerage Corporation (NWSC), Uganda Bureau of Statistic (UBOS), Uganda national Meteorological Authority (UNMA), Uganda Revenue Authority (URA) Kampala Capital City Authority (KCCA) and other Municipalities.

1.3 Institutional arrangements

The Climate Change Policy distinguishes two key institutional functions: coordination and implementation. The coordination role is vested with CCD whereas implementation role is vested with MDAs and District Local governments. Leadership for climate finance is assigned to MoFPED and is thus the National Designated Authority of the Green Climate Fund. However, the current institutional framework does not show clear lines of responsibility and accountability between MoFPED and the other mandated agencies.

It is expected that the Climate Change Bill whose development process is underway, will address many of the shortcomings.

Until the Climate Change Bill is passed into law, the current institutional arrangements intended to address climate change response actions in Uganda are highlighted Table 1-3:

Table 1-3: Domestic institutional arrangements to address climate change response actions

Structure	Function
Parliamentary Forum On Climate Change-Uganda (PFCC-U) However, a Parliamentary Standing Committee on Climate Change has been established.	The Parliamentary Forum on Climate Change-Uganda (PFCC-U) was formed in 2008 by members of the 8th parliament to respond to the pressing environmental, social and economic issues presented by Climate Change. The Forum has a membership of 215 of which 80 are females. Being among the first parliamentary forum on climate change in Africa, the forum has influenced parliamentary climate change dialogue and reforms in many regions of the continent.
The National Climate Change Advisory Committee (NCCAC),	The National Climate Change Policy of 2015 established the NCCAC chaired by the Minister of Water and Environment. NCCAC is a high-level technical multi sectoral stakeholder representation that guides the Minister on issues related to implementation of the policy strategic interventions. Provides overall coordination and inter-sectoral leadership Coordinates policy formulation and implementation on climate change and serves as an official platform for policy level stakeholder participation.

	Ensures working level coordination and provides technical input to the National Climate Change Policy Committee by bringing together technical representatives from various government departments at national and local level and non-state actors.
CCD	Overall coordination of Climate Change
District Committees	The district Environment and Natural Resources Committee established under section 14 of the National Environment Act is the designated committee responsible for climate change matters in the district.

1.3.1 Arrangements for Streamlined Reporting

The development of the FBUR initiated meeting with the personnel from key Ministries, Department and government agencies. Among the ministries visited were: MWE; MEMD; MWT, MTIC, MAAIF, MFED. The agencies and institutions visited were: NFA, NEMA, KCCA, and NWSC among others. Board room meetings were among the consultative processes used to get stakeholder buy-in and support for developing the Biennial Update process

1.3.1.1 Sector Working Groups

With coordination and facilitation from the CCD, several GHG sector working groups have been put in place. The AFOLU – sector working group is the largest. It consists of over 30 experts from NFA, MAAIF, UBOS, NARO, UNMA and other relevant stakeholders from academia and non-governmental organizations. This team has undergone a series of trainings with support from the Coalition of Rainforest Nations (CfRN), the Global Green Growth Institute (GGGI) and the Regional Centre for Mapping of Resources for Development (RCMRD).

In addition to training in GHG compilation, the team identified key GHG personnel, their roles and responsibilities regarding data collection, archiving, QA/QC. The team provided expert knowledge and actions needed to make improvements where gaps were identified in Activity Data and or Emission Factors.

The energy sector, waste sector and industrial processes working groups have received initial trainings and efforts to make them fully operational are ongoing. The energy sector working group is comprised of experts from MEMD and MoWT. In Uganda, the transport sector is predominantly managed by the private sector and modalities of incorporating private sector representation are being worked on.

The waste sector working group is comprised of experts from NEMA, KCCA and NWSC. The process of inclusion of experts from municipalities other than those from Kampala City is underway. All the above working groups have incorporated relevant experts from UBOS and URA to ease access to relevant national statistics.

Experts from Ministry of Trade, Industry and Cooperatives have been identified. Together with representatives from UBOS and URA form the Industrial Processes and Product Use working group.

For the purpose of preparation of national communications and BURs, Uganda has adopted a Task Force approach. The Task Force is comprised of national GHG computation, mitigation and adaptation experts that work with sector working groups to ensure transparency in national reporting.

1.3.2 The National arrangements for development and Implementation of Mitigation Actions

The first BUR development process considered development of the national guidelines including necessary steps to strengthen national arrangements that enable the formulation, registration and implementation of mitigation actions and establish a national mitigation action registry. The task involved two aspects; namely:

- Designing and starting operationalization of approved national governance structure for the establishment and maintenance of mitigation registry
- Setting up of the Uganda's Mitigation registry link on the UNFCCC NAMA Registry

In line with the above, Uganda has put in place the following arrangements:

- A formal national framework for compilation, submission, collection, review and approval of proposed mitigation actions from national actors.
- Interpret and adopt procedure and requirements in the Manual of the mitigation Registry at the UNFCCC to the national context
- Application forms, approval procedures, national registration and issuance letters of approval
- National NAMA Registry comprising of a database of national Mitigation Actions
- Procedure and action plan for periodic review and update of the information

1.3.2.1 Establishment of national governance arrangements for Mitigation Actions

Based on the work that followed the Bali Action Plan concluded at COP 8 which agreed that developing country Parties will undertake Nationally Appropriate Mitigation Actions (NAMAs) in the context of sustainable development. Based on the NAMA guidelines a template for documenting national mitigations actions has been designed.

1.3.2.2 Mitigation Action and Impact Technical Working Group established

Based on the technical working groups already established in National Measuring and Verification Framework. This working group is made up of representatives of the IPCC sectors and other agencies. These include:

- Climate Change Departments
- Government Departments covering the IPCC Sectors
- Key Agencies
- Selected experts

The Climate Change Departments is the convener, facilitator, integrator/aggregator and well as the reporter.

The tasks of the TWG include:

- Setting medium and long-term goals;
- Constructing a national BAU baseline based on an aggregated sector data, and analysing trajectories for national emission reduction;
- Identifying potential mitigation actions, and their aggregate mitigation potential;
- Establishment of carbon budgets for each sector;
- Assessing investment and mitigation costs, system abatement costs, financing and support requirements, and lead time for implementation and impact;
- Providing assistance with design and implementation of policies, measures and instruments.
- Reviewing of the mitigation section of the FBUR

Once the TWG has done its work, the actual elaboration and the identification of mitigation actions are conducted under the guidance of the existing Sector Working Groups (SWG) arrangement within the government structure. The SWG may delegate the work to individual specialized/ad hoc task forces. The later will then undertake the following task:

- Review methodological approaches including: statistical analysis, spreadsheets, cost curves, formal modelling tools, Nationally developed models or tools, analysis of other relevant activities e.g. CDM, REDD+, among others
- Undertaken national mitigation analysis including cost benefit analysis
- SWG to undertake review of the mitigation section of the FBUR

1.3.2.3 Archiving information regarding the mitigation actions or group of actions

Prior to the FBUR project, there were no formal arrangements for reporting the above information. Yet BUR guidelines require that the country reports mitigation actions by giving the following information: name, sector, GHG, coverage, goals, objectives, methodologies and assumptions, inputs and outputs (effects or impacts) of each action.

Uganda has thus used the FBUR to establish a formal process of capturing and archiving information on national mitigation actions. Some of the actions undertaken include;

- Development of template for collection/submission of information
- Establishment of a database with a detailed description of the mitigation or group of mitigation actions, including information on (a) the nature of the action, coverage (i.e. sectors and gases) (b) methodologies and assumptions, (c) objectives of actions and steps taken or envisaged to achieve that action (d) information on progress of implementation, estimated outcomes and emission reduction potential, needs, types and level of support required.
- Operationalization of a national NAMA Registry using infrastructure and software backbone or OS of the already established national GHG system

1.4 Population

Uganda's population remains relatively higher, with rate of population growth at 3.2 %, well above the sub-Saharan Africa's average rate of 2.6 %. The population increased from 5 million people in 1948 to 24.2 million people in 2002, 38.8 million people in 2014 and currently estimated at 42.9 million people in 2017. If unchecked Uganda's population is expected to grow to about 93.4 million people in the 2040s. The high population growth is exerting pressure on the available land and natural resources in general.

1.5 Geographic Profile

Uganda is a landlocked country in the East African region, neighbouring; Kenya in the East, Rwanda in South West, Tanzania in the South, Democratic Republic of Congo in the West and South Sudan in the North. Uganda is located between longitude of 29º34'E and 35 º 0'E and latitude 4 º 12'N and 1º 29'S. The altitude ranges from 620 metres ASL (Albert Nile) to 5,111 metres ASL (Mt. Rwenzori peak). Uganda's eastern and western borders are marked by the Elgon and Ruwenzori mountains, respectively. In the north-eastern part of Uganda, there is Mt. Moroto (3,085 meters ASL), while Imatong mountain (3,029 meters), lies at the boarder of Uganda and South Sudan. According to the 2002 National Biomass Study, Uganda has a total area of 241,550km2, out of which open water bodies cover and permanently wet areas (mainly composed of papyrus swamps) cover 41,740km$^{2.}$ From 2000 to 2015, built-up areas grew by 38% from 900 km2 to 1,360km^2.

1.6 Natural Resources

Uganda is endowed with a variety of natural resources which include fresh water bodies, a diversity of flora and fauna on mountains, middle altitude and valleys. More than half of the Lake Victoria, the largest fresh water lake in Africa is within Uganda's territory. In addition, River Nile follows from Lake Victoria to the north through Lake Kyoga and Lake Albert before to follows out to South Sudan as the White Nile. The western rift valley is part of the Great Rift Valley (a series of contiguous geographical stretches of about 6,000 km in length)

that is shared between Uganda and other East African nations, and a number of southern African countries.

The country is well endowed with minerals e.g. copper, cobalt, limestone, phosphorus, gold among others. However, these minerals have not been well exploited. Commercially viable deposits of hydro carbons have been discovered in the Albertine Graben. Exploration is yet to be carried out to determine the existence deposits in the north eastern parts of Uganda. In addition to a variety of natural resources, Uganda is also endowed with a good climate and reasonably fertile soils.

1.7 Sectoral Economic Profile

The economy of Uganda has grown though at a slower rate, reducing its impact on poverty. Projected growth of 6.2% will be largely driven by agriculture sector benefiting from favourable weather conditions. Over the years, industry, services and agriculture sectors account for large share of the country's GDP growth. The services sector remains the biggest of the three broad sectors of the economy. Future development sectors include, the oil and gas sectors (Figure 1-1).

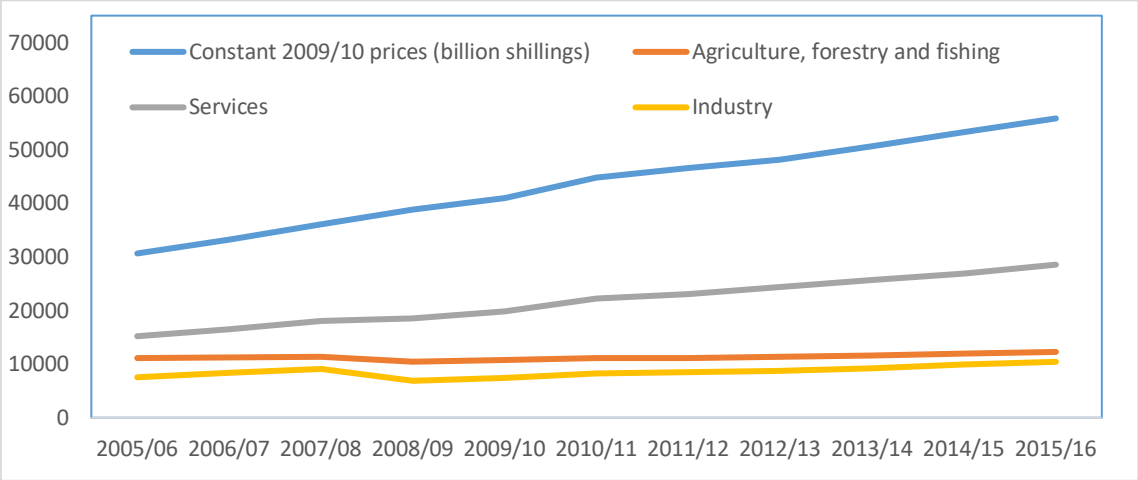

Figure 1-1. GDP and GPD per subsector trend (2005/06-2015/16); source UBOS 2017

The Uganda's total GDP increased from 30,638 billion Uganda shillings (UGX) in 2005/06 to 55,826 billion UGX in 2015/16 financial years, representing 82.2% increase over the last decades (figure 1-2). The contribution of agriculture, forestry and fishing increased from 11,078 billion UGX to 12,268 billion UGX in the same period, thus an increase of 9.8%, which was the slowest growth rate over the decade. The services subsectors registered the highest growth rates. It increased from 15,196 billion UGX in 2005/06 to 28,457 billion UGX in 2015/16. The industrial sector contribution to GPD increased from 7598 billion UGX in 2005/06 to 10,420 billion UGX in 2015/16, thus a moderate increase of 37% over the decade.

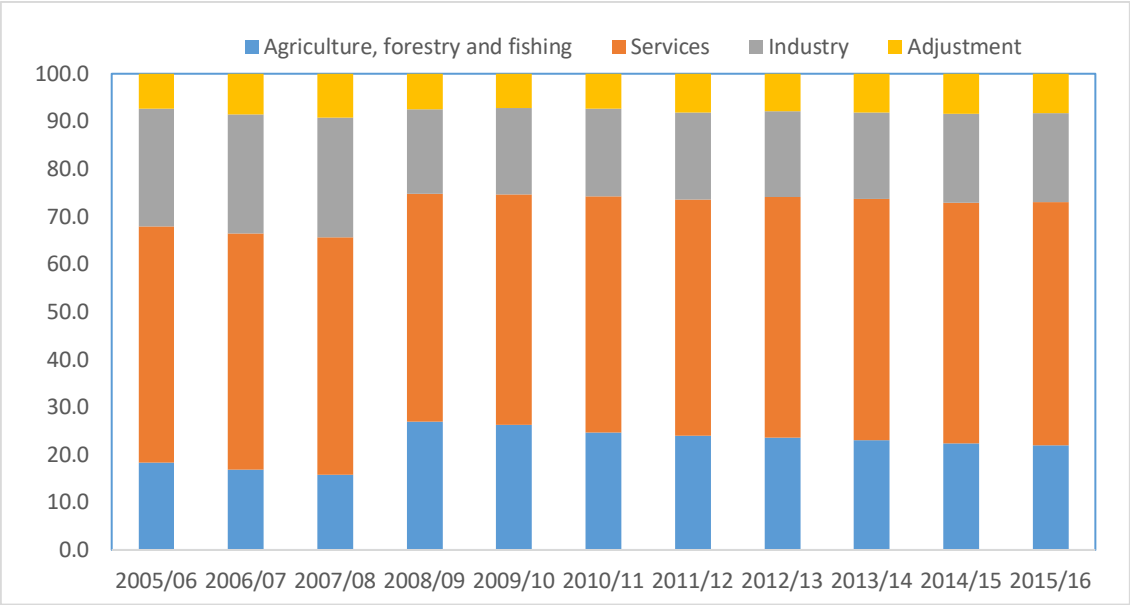

Figure 1-2. The Contribution of sub-sectors to the GDP (2005/06 to 2015/16); source UBOS 2017

The services sector increased from 49.6% in 2005/06 to 51.1% in 2015/16. However, there was a decrease in industrial sector contribution 24.6% to 18.7% over the same period (figure 1-2). There was a slight increase in agriculture, forestry and fishing, contribution to GDP from 18.3% to 22%. The adjustments cover financial transactions such as taxes.

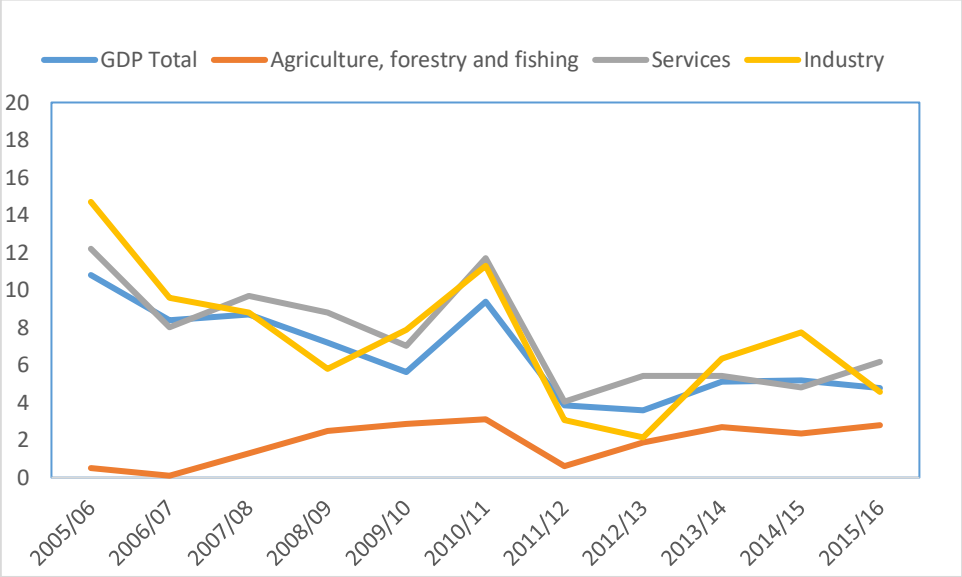

Figure 1-3. Sub sector growth trends; source UBOS 2017

Although there has been an increase in terms of GDP, the rate of increase has been in general a downward trend growth rates for most of the sectors (Figure 1-3). For instance, the GDP of the industry and services sector growth rate decreased from 14.7 to 8.4% and 12.2 to 7.3%,

respectively, in 2005/06-2015/16. On the contrary, the GDP of the agriculture, forestry and fishing sector growth rate increased from 0.5% in 2005/06 to 1.9% in 2015/16 (Figure 1-3).

1.8 Energy

The energy sector is the driver of national economy. The energy sector in the country comprises of both traditional and conventional energy sources, including petroleum and renewable energy sources. The dominant energy sources include fuelwood and charcoal which, if harvested unsustainably may have negative impacts on the vegetation cover in the foreseeable future. Uganda generates its own electricity from hydroelectric power stations supplemented with power from thermal plants. It also generates small amounts of power from other sources like biomass and solar.

1.8.1 Total primary energy consumption,

Biomass remains the most primary energy in all the sectors apart from transport and service sector. All the petroleum-based fuels are imported. The total primary energy consumption in 2005 was 8,711,398 toe, with fuelwood contributing about 89.9%, charcoal and agricultural waste contributing about 5.9 and 4.2%, respectively. The total primary energy supply increased to 18,616,330 toe in 2015.

1.8.2 Petroleum demand and usage

All petroleum is imported into the country, including premium motor spirit (petrol), automotive gas oil (diesel), bulk illuminating kerosene, aviation fuel, liquefied petroleum gas (LPG), lubricants and bitumen. Diesel sales have registered the highest increase (210%) since 2001 to 2011 followed by petrol (88%). The consumption of the petroleum products in 2005 and 2015 are as shown in Table 1.4. The highest increase was in petrol consumption with 3.8 folds, that due to increase in cars in Uganda over the period.

Table 1- 4 Annual sales of petroleum products in cubic meters

Fuel (Cubic meters)	2005	2015
Petrol	174,054	663,649
Diesel	319,574	718,831
Kerosene	39,836	49,117
Aviation fuels	88,932	102,480
LPG	4,488	11,906
Fuel oil	44,423	29,265

Source: Petroleum Department, MEMD Sales, 2015 Statistical Abstract, MEMD,

The trends in petroleum fuel consumption is as shown in Figure 1-4. In 2008, the rate of increase slowed, but there are general increases in consumption of diesel and petrol. The increase in the use of fuel oil from 2008 to 2009 was due to short supply of hydroelectric

power. In the period 2013 to 2015, there was a high rate of petrol consumption. Initially diesel power generators were brought in line to meet the electricity short fall, thereafter heavy fuel oil-based generators were installed to reduce on the cost of electric energy generation.

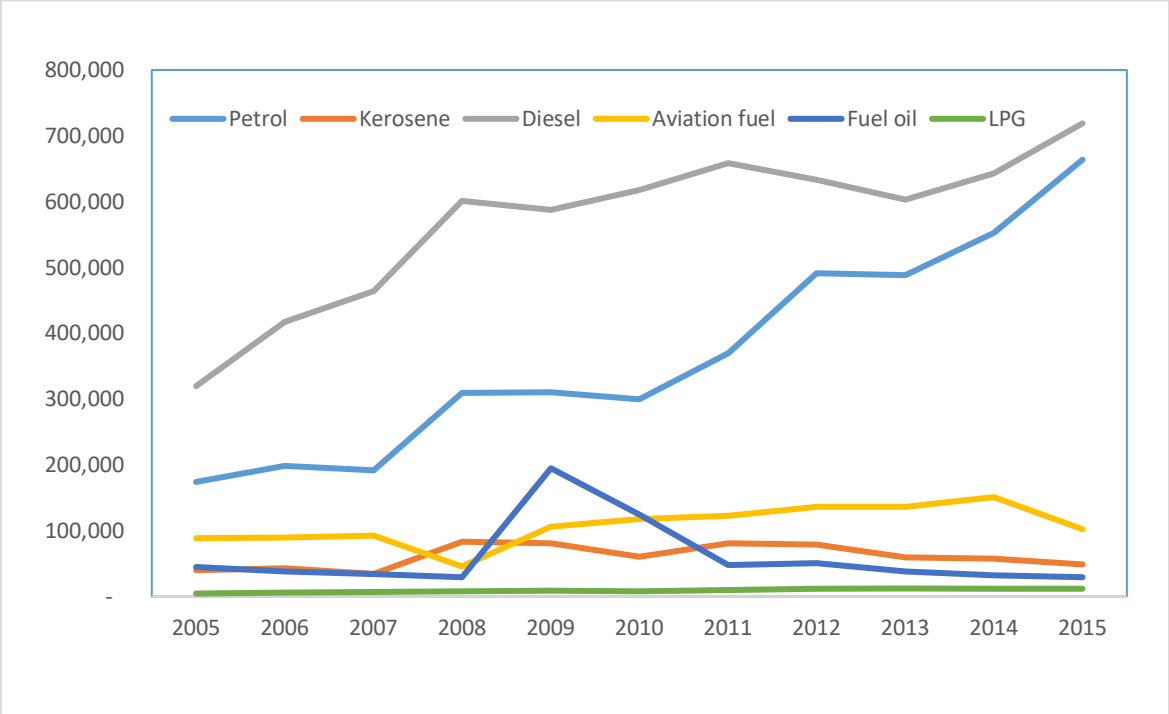

Figure 1-4. Fossil Fuels consumption trends 2005 – 2015; Sources MEMD

1.8.3 Electricity supply

Most of the electricity utilized in Uganda is generated from hydropower sources. As the country develops, the demand for energy is anticipated to increase, thus the need to match the energy supply to the growing energy demand. In 2015, the installed energy capacity was 924.9 MW, with the large-scale hydropower accounting for 69% of the total power, while thermal, cogeneration and small-scale power contributing 15%, 9% and 7%, respectively.

1.8.4 Oil and Gas Subsector

The energy sector profile will change in the foreseeable future. It implies the greenhouse gas emission profile will also change. The upstream covers petroleum exploration development and production. There is ongoing investment in the oil and gas sector by the major international oil companies in exploration. Over US$ 171 million was invested in the oil and gas sector. There are currently four active Production Sharing Agreement with three companies namely Tullow Uganda Operation Pty Ltd, Total E&P and China National Offshore Oil Corporation. By the end of 2015, the cumulative investment in the upstream petroleum subsector was in the order of US$ 3.2 billion. The development of petroleum and gas industry will increase GHG in this sector.

1.9 Transport

The Transport Sector in Uganda is divided into sub-sectors based on transport modes. These are: Road, railway, water and air sub-sectors. These modes collectively comprise the country's transport system.

At the moment up to 90% of the transport sector relies on the road network. While much attention has focused on improving the quality of roads, the quality of all other transport modes ultimately matters more to overall economic and social development.

The country has a road density of 190 m/sq-km with a total road network of approximately 35,700 km (excluding community roads) of which about 8 percent was paved in 2001.

Uganda had a road density of 190 m/sq-km. In 2001, Uganda had a total road network of approximately 35,700 km (excluding community roads) of which about 8 percent was paved. The classified road network consisted of about 9,500 km of which 24 percent was paved. Paved road network increased from 3,112 km in 2010 to 3,264 km in 2011.

The government of Uganda has continued to invest in developing the transport infrastructure. From the fiscal year 2008/09 to the fiscal year 2017/18, the national paved roads increased 3,034.60Km to 4,551 km (Table 1-5). The 2017/18 stock of paved national roads represents 22.2% of the total 21,554 km of national roads, but only 3.2% of the total road network of 144,785 km.

Table 1-5. The changes in road density between 2008 and 2016

Road Category	2008 Length (km)	2016 Length (km)	Change (km)	% change
National	10,800	21,544	10,744	99%
District	27,500	35,556	8,056	29%
Urban	4,800	10,108	5,308	111%
Community	35,000	78,657	43,567	124%
Total network	78,100	144,785	66,685	85%

Source: Ministry of Works and Transport, Annual Sector Performance Report FY 2017/18

1.10 Industry

Uganda industrial structure is composed of Manufacturing, Construction, Mining and Quarrying, Electricity and water production. Manufacturing is currently the largest component of the industry sector, contributing 41% of the industrial sector output in 2017/18. It is largely comprised of agro-processing and mineral processing. Agro-processing is the largest component within the manufacturing sub-sector and comprises mainly of coffee, tea, cotton, tobacco, grains and cereals, meat, dairy, leather and fish. The mineral processing

industry is comprised of cement, ceramics, marble, sand, iron and steel, fertiliser, and lead acid batteries among others.

Emissions from industrial processes are dominated by the cement industry. There are two types cement produced in Uganda; Ordinary Portland Cement (OPC) and Blended Cement (Pozzolana). The latter is a general-purpose cement, and is the most commonly used type of cement in Uganda because it cheaper than ordinary Portland cement. Emissions from industrial processes are dominated by the cement industry.

The other sources of greenhouse gas emission are from food and beverages. During production of beer through fermentation process, malting process is the source for NMOVC. Sugar production and beer have been considered in this FBUR study. Beer and sugar production increased from 152,860 thousand litres and 173,793 tonnes in 2005 to 253,623 thousand litres and 386,613 tonnes respectively in 2015.

1.11 Waste

Waste disposal is mainly a problem in urban settings. There are three types of wastes generated in Kampala, namely domestic waste water, industrial waste water and solid waste. The composition solid waste in the capital city is changing rapidly. Biodegradable materials accounted for 88.5% of the urban waste composition in 1990, but the share decreased to 77% in 2014. The decline in the organic waste is attributed to number of factors which include rapid urbanisation, increase in disposable income, industrialisation and infrastructure development. There is increase in the composition of plastics in the waste over the last decades from 1.6% in 1990 to 12.4% in 2014. Kampala population increased from 1,457,321 in 2012 to 1,517,000 in 2014 with estimated waste generation of 816099 ton/day to 849520 ton/day respectively. Waste generation increased from 816,099 ton/day to 849,520 ton/day from 2012 to 2014 respectively. Approximately 48% of the solid waste generated is collected for dumping at the landfill and the rest remain to be managed in various ways that include open burning, burying, composting, or left unattended. It is estimated that between 400 and 500 ton of waste reach the landfill.

Waste water management is also becoming significant challenge because of limited sewerage systems and connections. The Kampala City Council Authority and National Water and Sewerage Corporation are charged with the responsibility of handling issues related to the domestic waste water and industrial waste water.

The National Water and Sewerage Corporation (NWSC) serves approximately on 6% of the households in Kampala, translated into approximately 10,000 m^3 per day. Projection indicate by 2030, the National Water and Sewerage Corporation will manage to provide services to only 30% of the population. This means that about 70% of urban population will not have sanitation services calling for innovative solutions to deal with waste water disposal.

1.12 Agriculture

1.12.1 Farming systems

The climate of Uganda, i.e., low temperature variability and two rainy seasons in the southern half of the country leading to multiple crop harvests per year makes the agricultural potential to be considered to be among the best in Africa.

The country has eleven farming systems which are related to climatic differences, relief variation, and socioeconomic characteristics. The Farming systems in Uganda are presented in Figure 1-5. Annual cropping and cattle systems are mainly found in the northern part of Uganda and coffee and banana systems are mainly found in southern Uganda.

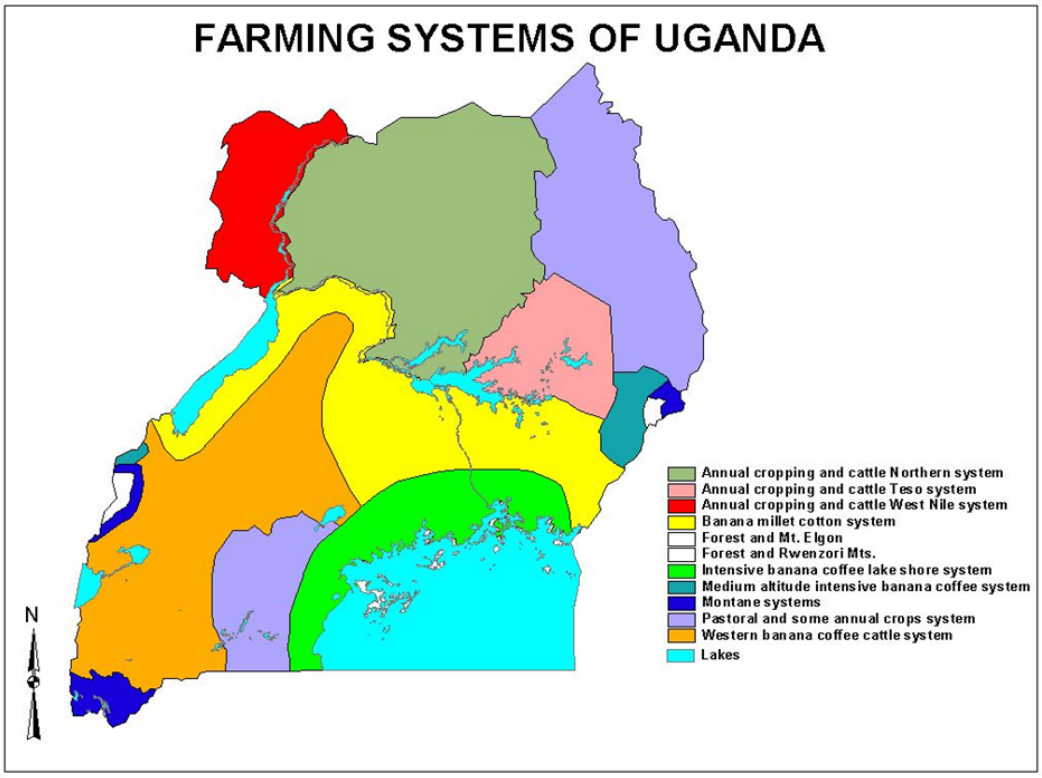

Figure 1-5. Uganda Farming systems; Source UBOS 2008/09

1.12.2 Agriculture and the economy

Currently, the agricultural sector substantially contributes to employment, export trade, food security, household incomes and thus to the GDP. Agriculture contributes about 20 percent of GDP, accounts for 48 percent of exports and provides a large proportion of the raw materials for industry. The sector employs 73 percent of the population aged 10 years and older.

In spite of being a key pillar to Uganda's economy, agriculture is predominately rain fed and thus highly sensitive to rain fall variability and climate change. In turn, the high dependency on climate, affects the economy through inflation.

For example, according to the Uganda Bureau of Statistics, in 2015, the inflation rate rose sharply in December to 5.7%, the highest rate in six months, mainly because of an increase in the price of food crops to 10.8%. The increase in annual food crops inflation, which came in at 7.2% in the year ended November 2016, was mainly due to a rise in core inflation to 24.8% compared to 13.6% in the previous month.

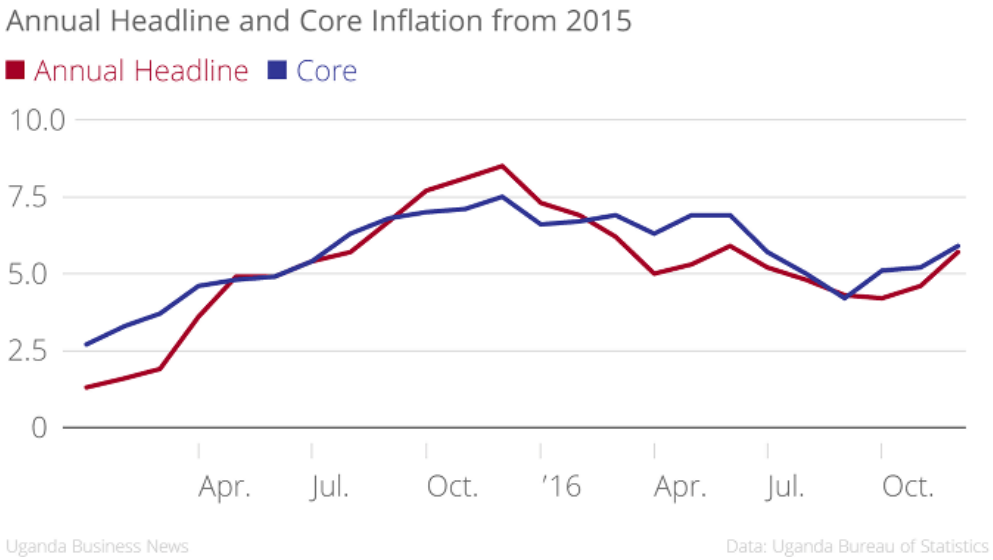

Figure 1-6. Annual Headline and core inflation, 2015: Source UBOS

1.12.2.1 Challenges and opportunities in the Agricultural sector

Though agriculture is one of the most important sectors of the Ugandan economy, it is confronted with the challenges of low productivity. About 4.0 million households in Uganda survive on small-holder farming and a significant proportion, (about 30%), of the population live below the poverty line and suffer food insecurity.

According to UNHS 2016/17, Uganda had a 15 million working persons of which 9 million people were regarding as employed. About 43 percent of the working population was engaged in the subsistence agriculture sector only. It is also estimated that 31 percent of youth population was engaged in purely subsistence agriculture production.

Agriculture has the potential to significantly increase its contribution to economic growth and poverty reduction. According to the Uganda Bureau of Statistics (UBOS), 80% of Uganda's land is arable, but only 35% is currently utilised effectively for meaningful agriculture.

It is worth noting that Uganda has one of the lowest fertiliser application and improved seed rates in Sub-Saharan Africa. To meet the ever-growing demand for food, increase in production is mainly through conversion of other land forms (mainly forests) to agriculture. From 2005 to 2015, agricultural land increased from 70,300 km^2 to 105,300 km^2. Experts believe that with increased responsible use of agricultural inputs Uganda could quadruple its agricultural production.

1.13 Forestry

1.13.1.1 Uganda's forestry diversity

The elevation and location of Uganda being at the equator causes favourable rainfall and temperature for a diversity of fauna and flora and subsequently, human settlement and a variety of land use types. In 2015, Uganda's total forest cover (natural forests and forest plantations) was estimated at 2.5 million hectares. In addition to several forest products that are derived from these forests, they provide a variety of non-tangible environmental and amelioration services. For example, using a conservative approach, carbon pools in the forest in 2015 are estimated at 125 million tonnes which translates into over 400 million tonnes of CO_2 equivalent.

Uganda is at confluence of four global ecological zones of tropical dry forest, tropical moist forest in north and tropical mountain system and tropical rainforest in the south (Figure 1-7).

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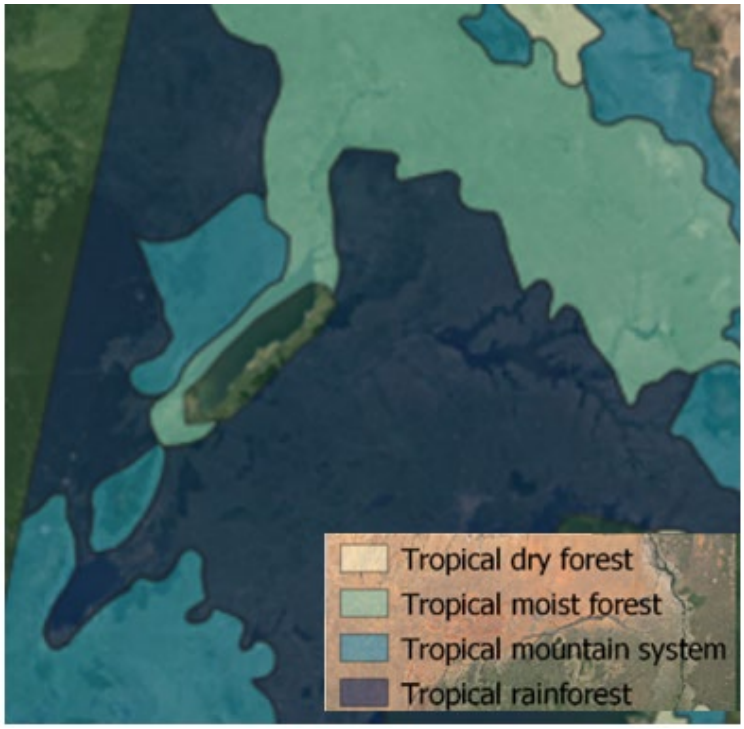


Figure 1-7. Uganda's diversity, four forest system within a stretch of 500km by 500km

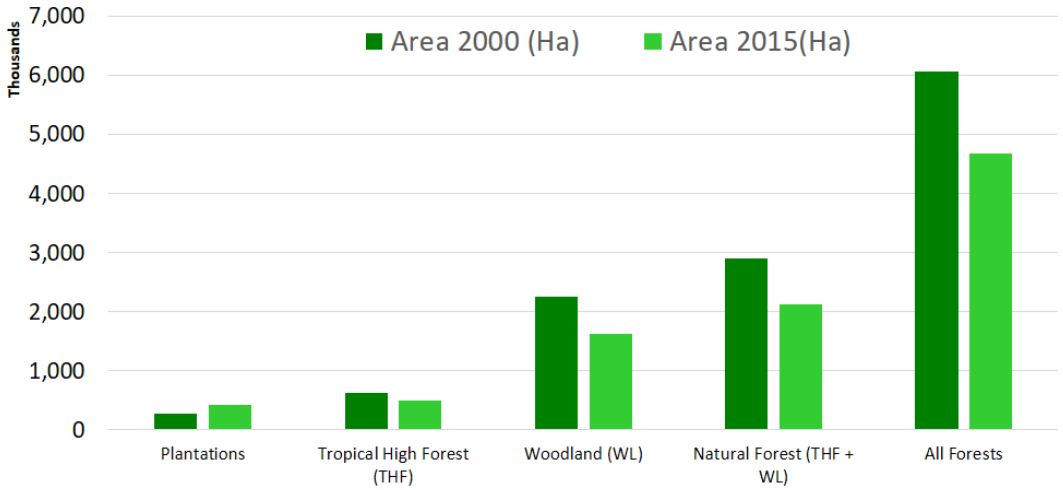
Based on the Yangambi classification, Uganda's natural forests fall into two closed forest types or categories and one type of mixed forest and grass. Most of Uganda closed forests are medium altitude semi deciduous or ever green forests also known as Tropical High Forests (THF) or Tropical rain forests. Closed forests at higher elevation (e.g. above 2,000 MSL) are differentiated as moist Montane, Dry Montane forest and Montane bamboo. The open mixed forest and grass types commonly classified as woodlands, globally known as open dry forests.

In addition to the natural forests, forest plantations and trees outside forests are of great importance to Uganda. As natural forests dwindle, plantations, both broadleaved and coniferous, increasingly becoming source of timber, poles and some extent fuelwood. Trees outside forests, though technically not classified as forests, provide a myriad of services especially to rural communities and serve as the main source of fuelwood, fruits, shade, fodder, medicine among others. There is nascent momentum for continuous monitoring of biomass dynamics (including carbon stock changes) of trees on cropland and rangelands both for national strategic objectives and as a fulfilment international obligation like the National Communication and Biennial Update reports to UNFCCC.

Like most Least Developed countries, Uganda predominantly depends on biomass as the main source for thermal energy at household level, in institutions, small and medium scale commercial establishment and even some industries. Over 90% of Uganda's energy is biomass based which means that forests and trees outside forests contribute tremendously powering the country's economy.

1.13.1.2 Degradation of Natural Forests

The open dry forests or woodlands experienced the highest decline of 2.2% from 2.26 million hectares in 2000 to 1.62 million hectares in 2015. Tropical high forests declined by 1.5% from 0.63million hectares in 2000 to 0.5 million hectares in 2015. There was however, an increase afforestation and reforestation activities. Area under forest plantation grow by 3% from 0.26milion hectares to 0.4 million hectares (Figure 1-8). More than 65% of the forest plantation is attributable to small woodlots scattered all over farmland.



Forest Type	Plantations	Tropical High Forest (THF)	Woodland (WL)	Natural Forest (THF + WL)	All Forests
Area 2000 (Ha)	268,363	633,864	2,260,718	2,894,582	3,162,945
Area 2015(Ha)	415,958	505,617	1,622,588	2,128,205	2,544,163
Rate /yr	+2.96% A/Reforestation	-1.5% Deforestation	-2.2% Deforestation	-2.03% Deforestation	-1.4% Deforestation

Figure 1-8. Rate of forest change in Uganda 2000 to 2015, Source Uganda FREL 2018

2. NATIONAL GREENHOUSE GAS INVENTORY

The National Greenhouse Gas Inventory (NGHGI), of Uganda's FBUR covers the period 2005 to 2015. In accordance to the IPCC 2006 guidelines for national greenhouse inventory, sources of emission and removal from sinks for four sectors: Energy (including Transport), Industrial Processes and Product Use ((IPPU), Agriculture Forestry and Other Land Uses (AFOLU) and Waste are covered. The level of accuracy of the estimates is largely influenced by the availability of reliable data and use of appropriate coefficients.

The gases covered in this inventory include the major direct gases such as carbon dioxide, (CO2), Methane (CH_4) and nitrous oxide (N_2O). The precursor gases included in this inventory are nitrogen oxides (NO+NO2, NOX), carbon monoxide (CO), non-methane organic volatile compounds (NMVOCs) and Sulphur dioxide (SO_2).

The development of FBUR benefited from the task force composed of representatives from Ministries, Department and government agencies including: MWE; MEMD; MWT, MTIC, MAAIF, MEMD, NFA, NEMA, KCCA, NWSC among others. The preparation of the FBUR was highly consultative bringing on board a number of stakeholders including representatives of private sector, academia and civil society.

2.1 Arrangements for NGHGI

Uganda has the basic infrastructure to manage GHG inventory system established during the Low Emission Capacity Building Project supported by UNDP in 2011. Software and a Database to hold data from all the sectors are hosted at CCD. The CCD has initiated the institutionalization of various components of climate change mainly GHG compilation by mandated MDAs. Personnel in these MDAs have received training in data GHG computation and compilation. Weaknesses in reporting structures notwithstanding, there are mechanisms of transmitting GHG inventory data to CCD.

In the time being, CCD has focused on coordination and training of personnel in the relevant MDAs given that some of the responsibilities described in section 2.2.1 cannot be implemented with current staffing levels.

The Database management system officer based at the CCD is responsible for management of the inventory system. There is however need for adjustments and improvements especially regarding clear definition of roles and responsibilities and data sharing mechanisms. The proposed QA/QC is yet to be operationalized.

2.2 Key Institutions Responsible for NGHGI Compilation

The responsibility for compilation of GHG for the four sectors (Energy, IPPU, AFOLU and Waste) lies in various MDAs that are graphically presented in Figure 2-1. CCD's role is supposed to aggregate and compute the national GHG emissions by source categories.

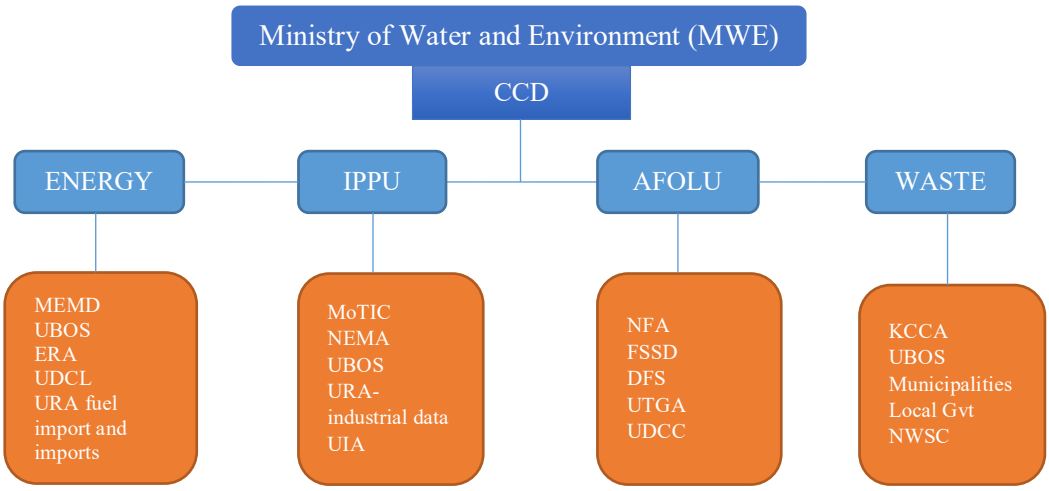


Figure 2-1. Current GHG data compilation arrangement

Data for the four sectors is provided by several institutions whose acronyms are presented in Figure 2-1 and details in Table 2-1. Given the involvement of many players from different MDAs, the need for good coordination needs to be emphasized.

Table 2-1. Key MDAs that provide data for GHG compilation

Ministry of Energy and Mineral Development	Ministry of Trade, Industry and Cooperatives	Ministry of Agriculture, Animal Industry and Fisheries	Kampala Capital City Authority
Uganda Bureau of Statistics	National Environment Management Authority	National Forestry Authority	National Water and Sewerage Cooperation
Electricity Regulatory Authority	Uganda Revenue Authority	Uganda Wildlife Authority	Uganda Timber Growers Association
Uganda Electricity Distribution company LTD	National Agricultural Research Organisation	Uganda Railways Cooperation	Ministry of Works and Transport
Ministry of Water and Environment	Ministry of Lands, Housing and Urban Development	Ministry of Local Government	

2.2.1 Key Category analysis

According to the Good Practice Guidance 2000, key categories are those which contribute 95 % of the total annual emissions, when ranked from the largest to the smallest emitter. Alternatively, a key source is one that is prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of direct GHGs in terms of the absolute level of emissions, the trend in emissions, or both (IPCC, 2000).

Ranked from the largest to the smallest sources of emissions, conversion of land (mainly forests) to cropland and grassland, enteric fermentation, degradation of forests (forest land remaining forests) and direct N2O emissions from managed soils are the five major sources. The sixteen sources that contribute 95% of the emissions are listed in Table 2-2. These sources include emissions from the road sub sector and CH4 from biomass fuels (under energy) plus CH4 from solid waste disposal.

Table 2-2. Key category analysis, Level assessment

IPCC Category code	IPCC Category	Greenhouse gas	2015 Ex,t (Gg CO2 Eq)	|Ex,t| (Gg CO2 Eq)	Cumulative Total
3.B.1.a	Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	39811.401	39811.401	44%
3.A.1	Enteric Fermentation	METHANE (CH4)	15432.941	15432.941	61%
3.B.2.b	Land Converted to Cropland	CARBON DIOXIDE (CO2)	10611.342	10611.342	73%
3.C.4	Direct N2O Emissions from managed soils	NITROUS OXIDE (N2O)	5595.7377	5595.7377	79%
1.A.4	Other Sectors - Biomass	METHANE (CH4)	3141.474	3141.474	82%
3.B.3.b	Land Converted to Grassland	CARBON DIOXIDE (CO2)	2727.1901	2727.1901	85%
1.A.3.b	Road Transportation	CARBON DIOXIDE (CO2)	2561.9319	2561.9319	88%
3.C.5	Indirect N2O Emissions from managed soils	NITROUS OXIDE (N2O)	1822.6182	1822.6182	90%
4.A	Solid Waste Disposal	METHANE (CH4)	1487.8046	1487.8046	92%
1.A.1	Energy Industries - Biomass	METHANE (CH4)	1390.368	1390.368	93%
1.A.2	Manufacturing Industries and Construction - Liquid Fuels	CARBON DIOXIDE (CO2)	870.7512	870.7512	94%
3.C.7	Rice cultivations	METHANE (CH4)	652.54004	652.54004	95%

Key sources using trends include degradation of forests (forest land remaining forest), conversion of (mainly forests) to cropland, and N2O emissions from biomass burning and CH4 emissions from enteric fermentation of ruminant animals (Table 2 3). Land conversion to grassland becomes a more significant source than indirect N2O emissions from managed

soils and road transportation. Manufacturing and construction industries and use of biomass in industries also become source categories.

Table 2-3. Key category analysis, trend assessment

IPCC Category	Greenhouse gas	2015 Year Estimate Ext (Gg CO2 Eq)	Cumulative Total
Forest land Remaining Forest land	CARBON DIOXIDE (CO2)	39811.40099	37%
Land Converted to Cropland	CARBON DIOXIDE (CO2)	10611.34191	59%
Enteric Fermentation	METHANE (CH4)	15432.94141	65%
Land Converted to Grassland	CARBON DIOXIDE (CO2)	2727.190088	71%
Emissions from biomass burning	METHANE (CH4)	327.2401781	75%
Emissions from biomass burning	NITROUS OXIDE (N2O)	282.7781974	78%
Solid Waste Disposal	METHANE (CH4)	1487.804594	81%
Other Sectors - Biomass	CH4	3141.474	84%
Road Transportation	CARBON DIOXIDE (CO2)	2561.9319	87%
Energy Industries - Biomass	CH4	1390.368	89%
Direct N2O Emissions from managed soils	NITROUS OXIDE (N2O)	5595.737652	91%
Manufacturing Industries and Construction - Liquid Fuels	CO2	870.7512	93%
Rice cultivations	METHANE (CH4)	652.5400443	94%
Indirect N2O Emissions from managed soils	NITROUS OXIDE (N2O)	1822.618196	95%

2.3 Methodology

IPCC 2006 Guidelines for national Greenhouse Gas Inventory and the IPCC 2006 software (version 2.54) have been used in the estimation GHG emissions and removals. Mainly due to data limitations, Tier 1 has been widely used.

Where applicable, European Monitoring and Evaluation Program/ European Environment Agency (EMEP/EEA) and Air Pollutant Emission Inventory guidebook are used especially in the compilation of estimates of non-methane volatile organic compounds (NMOC) sulphur dioxide (SO_2), carbon monoxide and nitrogen oxide (NOx).

Like for most developing countries, reliable activity data may not be regularly available. In some instance interpolations and expert judgement is used to derive Activity Data. However, it is important to note that there have been some slight improvements in activity data collection across all sectors since the Second National Communication.

2.3.1 Assessment of Completeness

Uganda's ultimate goal is to estimate and report on all relevant categories of sources and sinks, and gases. Apart from the forestry sector where country specific coefficients were applied, computation of GHG is based on default emission factors as provided in the IPCC guidelines. Availability of reliable activity data is used as an indicator for assessing completeness of each source category using the following criteria (Table 2-4):

Table 2-4.Score for Assessing Completeness

M	Measured (metered or any other regular measurement)
MP	Measured partially (measurement does not cover entire source category)
DM	Derived from other measurements (based statistics or special studies, may not adequately represent the source category)
EO	Estimated from Other (estimated or interpolated from one off survey)
EJ	Expert judgement (available statistics do not adequately cover the source category, adjustments made based expert in key institution and academia)
X	Not known and not estimated
F	For future consideration, not relevant today but considered very important source in near future (within 5 years)

Table 2-5 shows that most source categories in the energy sector are measured apart from charcoal production which is based on special studies and the manufacturing industries where data is not disaggregated to capture individual industries. Estimation of emissions from energy in the transport sub sector is constrained by paucity of data on fleet of vehicles. This makes estimation of emissions in the energy sector using the sectoral approach a big challenge (Table 2-5).

The land sub sector under AFOLU ranks highest in categories that rely on regular measurements of activity data. On the other hand, activity data on livestock and crop production mainly relies on estimates (Table 2-5).

IPPU is less complete because activity data is only partially available. Cement and lime production are the only ones with reliable estimates. Little or no activity data is available on other industrial processes. The industrial sector is still young in Uganda and this partly explains lack of activity data in these source categories.

Waste disposal is a major issue in cities and this explains why activity data is only available in municipalities. Even then, not all municipalities have reliable data.

Table 2-5. Ugandas GHG state of completeness in terms of Activity Data

Sector /Sub Sector	Activity Data Requirements - IPCC 2006	Description	State
ENERGY			
Fuel combustive activities / Energy industries			
Electricity Generation	Mass or Volume fuel consumed to per kWh	Data available and well documented	M
Combined Power / Heat	Mass or Volume fuel consumed to per kWh	Data available and well documented at CHP facilities	M
Petroleum Refining	Not Applicable may be after 2022		F
Manufacture of Solid Fuel (Charcoal)	Mass or Volume fuel consumed to per unit of Charcoal produced	Data on charcoal production and use is based on special studies	DM
Manufacturing Industries	Consumption (Mass or Volume) and Conversion factor (TJ/UNIT output)	Data not desegregated to capture individual industries	DM
Fuel combustive activities / Transport			
TRANSPORT/CIVIL AVIATION	Aggregate fuel consumption domestic and international (LTO and cruise) and average emission factors	The aviation fuel consumption is available in national energy statistics and the energy balance	DM
TRANSPORT\ROAD \RAIL	Fuel consumed by fleet category (distance and or tonnage)	Data on fleet of vehicles is incomplete, thus emissions cannot be computed by the sub sector	DM
TRANSPORT\WATER & OTHER	Fuel consumed by water transport category and others (distance and or tonnage)	Data on fleet of vehicles is incomplete, thus emissions cannot	DM

		be computed by the sub sector, and estimates were made based on national energy balance for 2015.	
IPPU			
Mineral Industry			
Cement	Data of cement production, import and export is available in national statistics. Clicker import data is available.	All data is available	M
Lime	There is no activity data for lime in the national statistics.	Data not well documented	EO
Chemical, Metal, Electronics and other Industries			X
AFOLU			
Livestock			
Livestock Enteric Fermentation	Livestock numbers (annual) disaggregated by key breed categories	Interpolated based on 2007 livestock census, disaggregation by breed types based on expert judgement	EO
Livestock Manure Management (Ch4 And N2O Direct)	Manure management systems disaggregated by key breed categories	Manure management systems based expert judgement	EO
Aggregate Sources Lime Application	Annual amount of lime application	Lime imports / Exports coupled with expert judgement	EJ
Aggregate Sources Urea Application	Annual amount of urea application	Fertilizer imports /Exports coupled	EJ

		with expert judgement	
N2O From Managed Soils (Direct)	Annual organic and chemical fertilizer application (Tonnes) and N fraction in fertilizer	Fertilizer imports / Exports coupled with expert judgement	EJ
N2O From Managed Soils (Indirect)	Annual organic and chemical fertilizer application (Tonnes) and fraction that volatilizes	Fertilizer imports / Exports coupled with expert judgement	EJ
Land			
LAND REMAINING THE SAME LAND	Wood extraction and or change in biomass in land remaining the same	Based on periodic satellite image interpretation and analysis, Wood extraction statistics	M
LAND CONVERSIONS	Spatially explicit data on land conversions and biomass stocks	Based on periodic satellite image interpretation and analysis	M
AGGREGATE SOURCES BURNING	Area burnt, fuel available for burning and EF burning by land strata	Burnt area estimated based on NASA data on burnt area, active fire also provides clues	DM
N2O From Manure (Indirect)	Annual nitrogen excretion and fraction that N that volatilizes	Expert judgement /IPCC default values	EJ
CH4 Rice Cultivation	Annual rice area cultivated or harvested by flood management and agricultural inputs	FAOSTAT - harvested area	DM
WASTE			
Managed Disposal Sites	Degradable Organic Carbon (DOC) and Methane fraction of waste by population and waste	Data partly available on key Municipalities	MP

	type (food, paper, textile, sludge, industrial waste, nappies etc.)		
Unmanaged and un categorized disposal Sites	Degradable Organic Carbon (DOC) and Methane fraction of waste by population and waste type (food, paper, textile, sludge, industrial waste, nappies etc.)	Data not well documented	X
Biological Treatment	Waste category amount (food, paper, textile, sludge, industrial waste, nappies etc) treated mainly by municipalities (anaerobic and or Composite systems)	Data partly available on key Municipalities	MP
Waste Incineration	Amount of waste incinerated by (food, paper, textile, sludge, industrial waste, nappies etc) fraction of dry matter content, fraction of carbon in dry matter, fraction of fossil carbon in total carbon	Data partly available on key institutions	MP
Open Burning	Population by region, fraction of population that burn waste, Kg waste /person/day, fraction burnt (compared to treated), days in a year	Data not available	X
Waste Water treatment and discharge (Domestic and Industrial)	Low /High income rural and urban (discharge pathways i.e., sewer type, latrine by depth, latrine type, lagoon type)	Data partly available in key Municipalities	MP

This assessment is informed by discussions of the sector working group discussions and the data needs assessment and capacity needs assessment carried in Uganda with support from Conservation International (CI, 2019).

2.3.2 Recalculation

There have been some changes in methodologies since the last National Communication. During the SNC, the emission from charcoal product was calculated based on the IPCC 1996 guidelines. In the current version of IPCC inventory software, the charcoal production falls under manufacture of solid fuel and other energy industries (1.A.I.c).

The two types of cement produced, Pozollana and Portland, have different proportions of clinker. In the SNC this data was not disaggregated. In addition, the emission from manufacture of cement was based on the cement production data since there was no information on clinker imports. Data on clinker imports is now readily available from the Uganda Revenue Authority.

In the SNC, emissions in the energy sector were highly aggregated. Data disaggregation has tremendously improved - energy statistical abstract. The main challenges are still with the consumption biomass.

In the SNC the stock change method was used to estimate sources and sinks for land use / land use change. The forest inventory data used then is over 15 years and thus may adequately represent the current biomass stock levels. The gain- loss method has been used in the FBUR but it is highly recommended in the Third National Communication, the gain loss method be applied using the forest inventory data being collected by the REDD+ programme.

2.3.3 Quality assurance and quality control (QA /QC)

Uganda appreciates the need for Quality Assurance / Quality Control (QA/QC) and verification system that will improve in the estimation of level of certainty plus overall improvement of the NGHI in terms of transparency, consistency, comparability, completeness, and accuracy. With support from the REDD+ programme, the forestry sector has introduced QC protocols in data collection processes for the estimation of forest carbon stocks. Land use land cover mapping has introduced map accuracy assessment as a quality control protocol.

Discussions on data flow processes and quality assurance (QA) processes in all source categories are still going. Currently, QA is sourced outside Uganda. The option of having in country QA[1] in addition to the international processes being considered. CCD may consider initially using consultants with a plan to later on institutionalize the process through trainings and recruitments.

2.3.4 Uncertainty assessment

Uncertainty analysis was performed using in built IPCC 2006 software tools. Details are provided in appendix II. Default IPCC uncertainty assessment show that emissions from liquid fuels under road transport have the highest level of activity data uncertainty (table 2-6). This is followed by liquid fuels in other sectors, cement and lime production respectively.

Table 2-6. High uncertainty, Activity data basis

2006 IPCC Categories	Gas	Base Year emissions or removals	Year T emissions or removals	Activity Data Uncertainty (%)

[1] In country independent reviewers of experts not involved in the preparation of the inventory

		(Gg CO2 equivalent)	(Gg CO2 equivalent)	
1.A.3.b - Road Transportation - Liquid Fuels	CO2	1067.461	2561.932	10
1.A.3.b - Road Transportation - Liquid Fuels	CH4	4.492	14.052	10
1.A.3.b - Road Transportation - Liquid Fuels	N2O	7.304	21.750	10
1.A.4 - Other Sectors - Liquid Fuels	CO2	214.447	453.907	10
1.A.4 - Other Sectors - Liquid Fuels	CH4	0.606	1.285	10
1.A.4 - Other Sectors - Liquid Fuels	N2O	0.527	1.121	10
2.A.1 - Cement production	CO2	163.957	348.610	35
2.A.2 - Lime production	CO2	7.700	138.600	15

When activity data and emission factors are combined, liquid fuels in energy industries show the highest level of uncertainty followed by biomass use in energy industries. Liquid fuels in manufacturing industries follow, (Table 2-7).

Table 2-7. Combined uncertainty

2006 IPCC Categories	Gas	Base Year emissions or removals (Gg CO2 equivalent)	Year T emissions or removals (Gg CO2 equivalent)	Activity Data Uncertainty (%)	Emission Factor Uncertainty (%)	Combined Uncertainty (%)
1.A.1 - Energy Industries - Liquid Fuels	CH4	0.000	0.046	5	228.78788	228.84251
1.A.1 - Energy Industries - Liquid Fuels	N2O	0.000	0.134	5	228.78788	228.84251

1.A.1 - Energy Industries - Biomass	CH4	291.262	1042.776	5	245.45455	245.50547
1.A.1 - Energy Industries - Biomass	N2O	107.489	384.834	5	304.54545	304.5865
1.A.2 - Manufacturing Industries and Construction - Liquid Fuels	CH4	0.309	0.646	5	228.78788	228.84251
1.A.2 - Manufacturing Industries and Construction - Liquid Fuels	N2O	0.913	1.909	5	228.78788	228.84251
1.A.2 - Manufacturing Industries and Construction - Solid Fuels	CH4	0.000	0.252	5	200	200.06249
1.A.2 - Manufacturing Industries and Construction - Solid Fuels	N2O	0.000	0.557	5	222.22222	222.27847
1.A.2 - Manufacturing Industries and Construction - Biomass	CH4	24.612	64.607	5	245.45455	245.50547
1.A.2 - Manufacturing Industries and Construction - Biomass	N2O	48.442	127.162	5	281.81818	281.86253

1.A.3.a - Civil Aviation - Liquid Fuels	CH4	0.031	0.048	5	100	100.12492
1.A.3.a - Civil Aviation - Liquid Fuels	N2O	1.829	2.833	5	150	150.08331
1.A.3.b - Road Transportation - Liquid Fuels	CH4	4.492	14.052	10	346.98572	347.12979
1.A.3.b - Road Transportation - Liquid Fuels	N2O	7.304	21.750	10	302.93989	303.1049
1.A.3.c - Railways - Liquid Fuels	CH4	0.000	0.079	5	150.60241	150.68539
1.A.3.c - Railways - Liquid Fuels	N2O	0.000	0.233	5	200	200.06249
1.A.4 - Other Sectors - Liquid Fuels	CH4	0.606	1.285	10	400	400.12498
1.A.4 - Other Sectors - Liquid Fuels	N2O	0.527	1.121	10	468.98529	469.09189
1.A.4 - Other Sectors - Biomass	CH4	1981.783	2356.106	7.0710678	321.41217	321.48995
1.A.4 - Other Sectors - Biomass	N2O	378.691	448.086	7.0710678	421.04995	421.10932

2.3.5 National Inventory Improvement Plan (NIIP)

Based on the constraints and gaps listed under the national circumstances, the assessment of completeness under the 2.3.1 and the general and challenges encountered during the preparation of the present inventory, a list of the most urgent improvements has been

identified. These are listed below and will be addressed in a phased approach during subsequent greenhouse inventories.

2.3.5.1 Immediate plans (1 to 3 years)

Capacity building and strengthening of the existing institutional framework to provide improved coordinated action for data collection and accessibility is a priority and needs urgent action. In addition, put in place mechanisms for the following improvements;

- Initiate data measures to start data measurements in sectors where data is based on expert judgment or is estimated from other sources
- Initiate and quality control QC measures in sectors where data is being measured.
- Discuss with data compiling institutions to build data validation protocols
- Discuss with data compiling institutions on the most appropriate data storage and retrieval mechanism with a view of making improvement to future inventories.

2.3.5.2 Mid-term to long term plans (5 to 10 years)

Put in place mechanisms of improving data collection and documentation in sectors where data is missing or is considered inadequate e.g. livestock, IPPU. Specific actions include the following:

- Refine data collection for determining disaggregated data on livestock including documentation of manure management systems
- Emission factors (EFs) more representative of the national context need to be developed;
- Improve the existing QA/QC system to reduce uncertainty and improve inventory quality;
- Find the necessary resources to establish fully-fledged GHG inventory units in each of the data compiling institutions listed in section 2.2.

2.4 Overview GHG emissions and Sinks for 2015

2.4.1 Global Warming Potential used

The values of Global Warming Potential (GWP) of GHGs for 100 years which have been used in this inventory cycle are shown in Table 2-8 is the based on the values for 100-year time horizon of Fifth Assessment Report (AR5). These values differ from the default values in the IPCC 2006 version 5.4 software which are based on the Second Assessment Report.

Table 2-8, Second, fourth and fifth Assessment Global warming potential (GWP) values relative to CO2

Industrial designation or	Chemical	Second Assessment	Fourth Assessment	Fifth Assessment

common name	formula	Report (SAR)	Report (AR4)	Report (AR5)
Carbon dioxide	CO2	1	1	1
Methane	CH4	21	25	28
Nitrous oxide	N2O	310	298	265

2.4.2 Emissions over view 2015

In 2015, Uganda's total emissions were estimated at to 77,381 Gg. The AFOLU sector was the most significant source of emissions for the three gases (i.e., CO2, CH4 and N2O), accounting for 86.4% of the total emissions (Figure 2-2). The energy sector was the second most important source (accounting for 10.9%). The contribution from the waste sector and IPPU was 2.1% and 0.6% respectively.

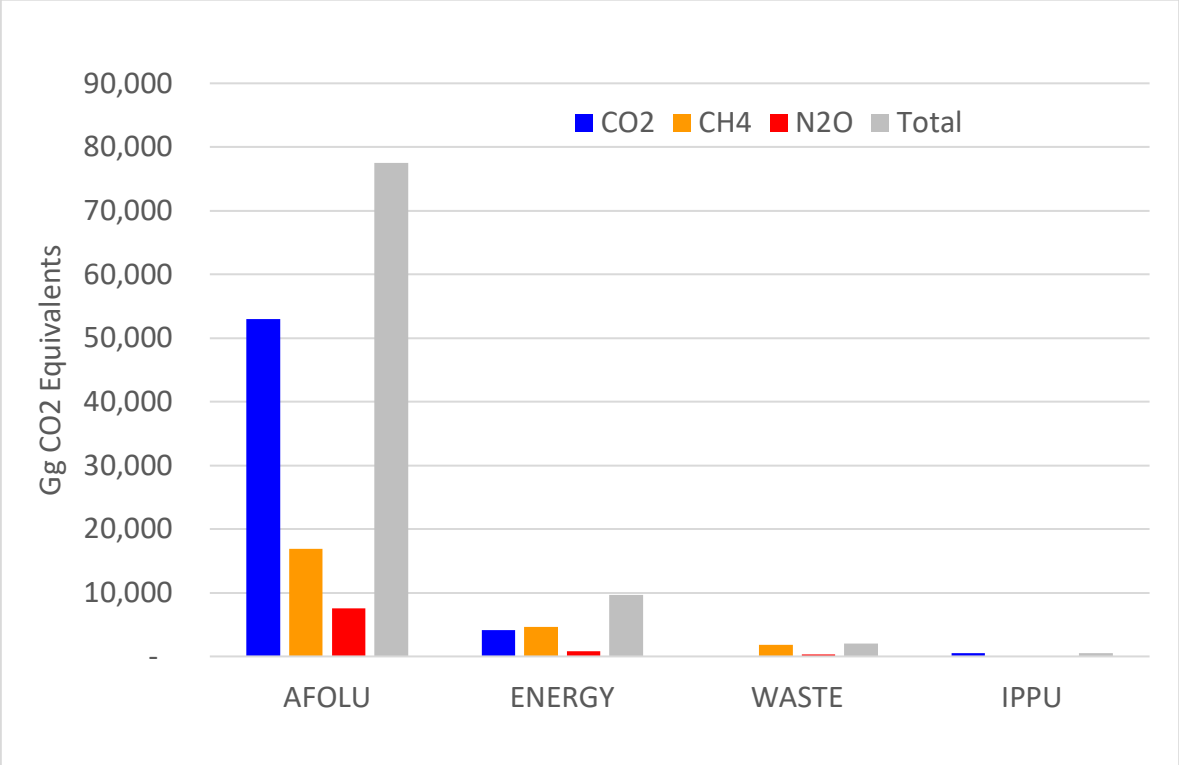


Figure 2-2. Uganda Emissions CO2 Equivalents, by sector and by gas 2015.

Expressed in terms of CO2 equivalents, CO2, CH4 and N20 contributed 63%, 23% and 14% of the total emissions respectively. At sub sector level, most of the CO2 were from land, CH4 emissions were mainly from livestock and burning and N2 O emissions were from direct and indirect emissions form managed soils

2.4.3 Time series

For all sectors and all gases, there is general upward trend in emissions. Total emissions have rose from 64,300 Gg in 2005 to 77,381 Gg in 2015 (Figure 2-3). Over this period, emissions from AFOLU increased from 59,735 (about 93% of total emissions) to 66,829 Gg (86% of national emissions). Emissions from the energy sector doubled from 4,016 Gg (about 6% of the national emissions) to 8,452 (about 13% of total emissions). Though they have the smallest share, emissions from IPPU tripled and those from the waste sector quadrupled between 2005 and 2015 rising from 171 Gg and 378 Gg to 490Gg and 1,610 Gg respectively

CO2 accounts for the largest share of emissions and there has been an upward trend (Figure 2-3). However, CO2 emissions in the energy dropped down in the year 2011 to 2013 and gained an upward trend again since then up to 2015. This is related to the reduction of thermal based power generation between 2011 and 2013. All the diesel-based power plants were decommissioned, while heavy fuel oil -based plants were brought on line. At the same time more hydropower plants were feeding to the national grid.

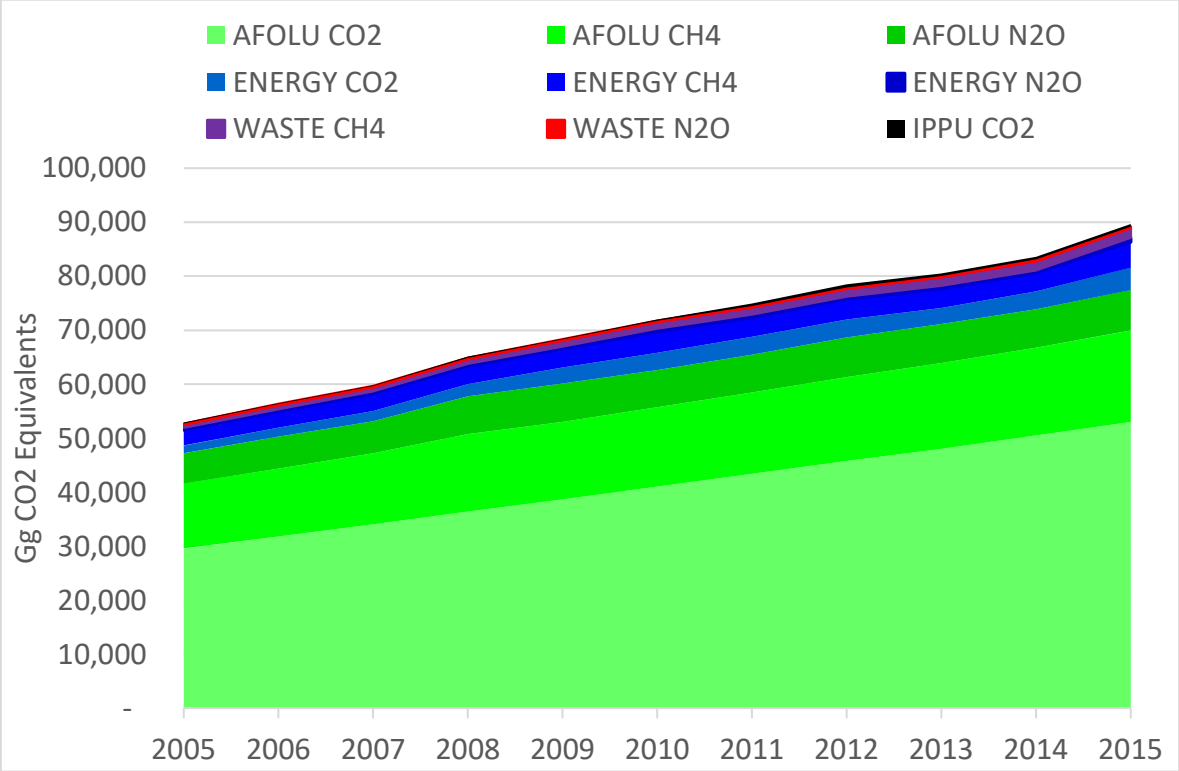


Figure 2-3. Trends in CO2 Equivalents 2005 to 2015

Compared to the 2000 (SNC), emissions from land have tripled while emissions from enteric fermentation of ruminant animals have doubled over the last 10 years. Though not a major contributor, emissions from industrial processes, mainly attributable to cement production have tripled.

Increased trends of emissions in the AFOLU and waste are highly related to demographic trends. Increased demand for land and wood products result in the extraction of wood beyond

natural replenishment levels. Increased in emissions of CH4 from enteric fermentation of ruminant livestock is directly related by the steady increase of livestock number. A steady increase of emissions from the waste sector can be explained by the rate of urbanisation which is estimated at 6% per annum.

2.4.4 Indirect GHG Precursor

The energy sector is the major source of precursor gases (Figure 2-4). The indirect emission or the precursor gases are mostly from combustion of biomass. The release of NOx is leading (5,282 Gg) flowed CO (1.942 Gg) and NMVOC (278 Gg) respectively. The release of SO_2 is very low (9 Gg) compared to other precursor gases and is only by the energy sector (Figure 2- 4). The main sources of NOx energy (fuel combustion) and to a very limited extent fires on land. Fuel combustive activities and fire are also sources of CO. Fuel combustive activities are the main sources of NMOVC and to every limited extent food and beverage industries under IPPU.

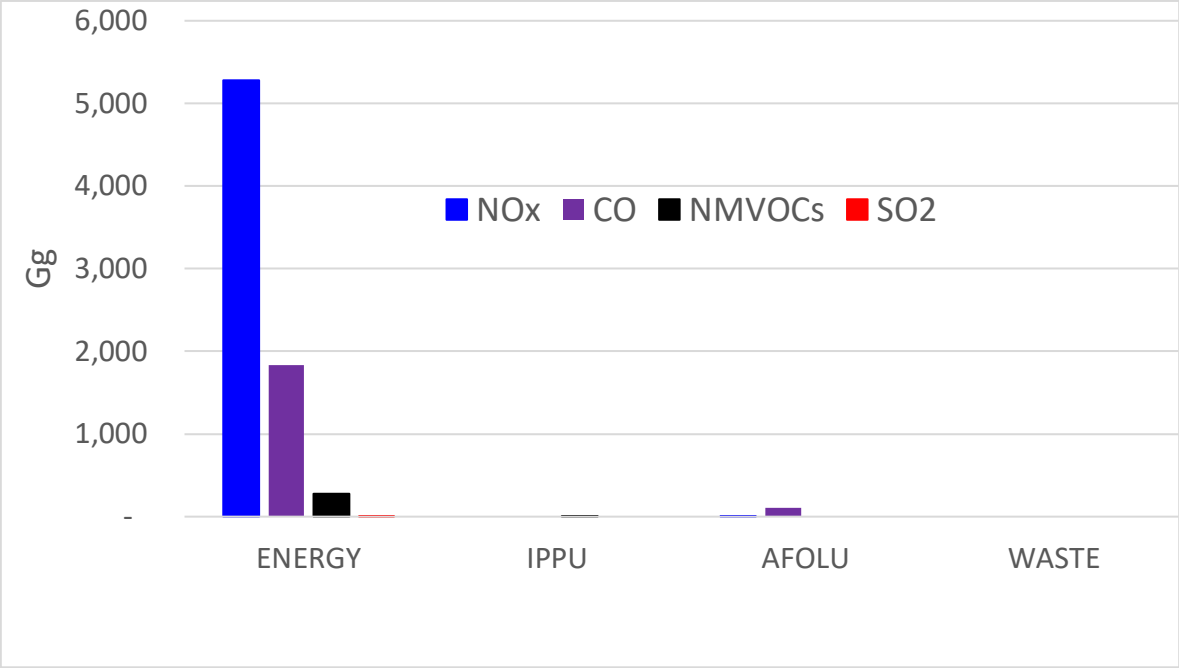


Figure 2-4. Precursor gases

The low levels of emissions of the precursor gases in 2005 was attributed to high dependence on hydropower for electricity generation. The thermal power plants were at their peaks around 2010. Thereafter there was a drop up to 2013. In 2014 thermal power plants were back in line to support the growing electric energy demand.

2.5 Energy sector;

The energy sector in Uganda is currently dominated by use of biomass in form of fuel wood, charcoal and agricultural residues. The biomass use finds applications in the residential, commercial and industrial subsector. Fossil fuels find applications in all subsectors. Most of

the fossil fuel is used in the transport subsector and some extent in energy generation. It is for this reason most of the anthropogenic GHG is from the transport sector. There were improvements in the last decades in the activity data collection in the energy sector

It is envisaged the landscape of greenhouse gas emission in the energy sector will change drastically in the near foreseeable future when the oil exploitation starts.

The combustion of fuel is used to produce energy e.g. motive power, heat and electricity. As the result of combustion, the following GHG are emitted: Carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). The other gases are Nitrogen Oxides (NOX), Sulphur dioxide (SO2) and Non-Methane Volatile Organic Compounds (NMVOC).

2.5.1 Methodology:

There two approaches of estimating emissions from the energy sector; the reference approach and the sectoral approach.

The reference approach is theoretically an upper bound to sectoral approach. This is a straightforward top-down methodology where emissions of GHG from combustion of mainly fossil fuels are estimated relatively easily from available energy supply statistics.

The sectoral or bottom up approach is used based on the 2006 Greenhouse gas Invitatory Guidelines and the IPCC software. Due to unavailability of national emission factor, Tier 1 is used although it is likely to provide the least accurate estimates of emissions. Applying a Tier 1 emission estimate requires the following information for each source category and fuel: Data on the amount of fuel combusted in the source category and the associated emission factor based on the end use equipment. The Activity data can be obtained from national statistics. Sectoral Approach and Reference Approach, the emissions factors of the Direct GHG is readily available in the IPCC Inventory Guidelines. The emission factors are given based on the types of the fuels and the end use equipment

2.5.1.1 The Direct GHG

For computation of direct GHG equation 1 is generally used.

Equation 2-1 GHG Emissions fuels; General Equation, direct GHG

$$Emissions_{GHG,\,fuel} = Fuel\ \ Consumption_{fuel} \bullet Emission\ \ Factor_{GHG,\,fuel}$$

2.5.1.2 The indirect gases

For computation of indirect GHG equation 2 is generally used

Equation 2-2, Pollutant from fuels; general equation indirect gases

$$E_{pollutant} = AR_{fuel,pollutant} * EF_{pollutant}$$

Most of the emission factors from the indirect GHG are from the EMEP/EEA Air Pollutant Emission Inventory guidebook. The fuel can be in form of solid or liquid. The precursor gases can be computed using the equation.

2.5.1.3 Activity Data

The activity data in the energy sector is based on the national statistics. The main document referred to are the Energy Statistical Abstract, Annual Energy Report, Uganda Electricity Regulatory Authority and other sources. The activity data is presented in the Appendix I.

2.5.2 Results based on Reference Approach

The emission from fossil fuels (combustive activities) increased almost three-fold rom about 1,744 Gg in 2005 to about 4,745 Gg in 2015. The period 2014 to 2015 experienced the sharpest rise in emissions (from 3,777 to 4,745 Gg). An increment of more than 20% in one year, may be attributed to increase in the importation of diesel and petrol that is closely linked to a rapid increase in the importation of vehicles and electric energy demand. Emissions from solid fuels in 2014 and 2015 are form anthracite and bituminous coal, which are mainly used in some cement industries.

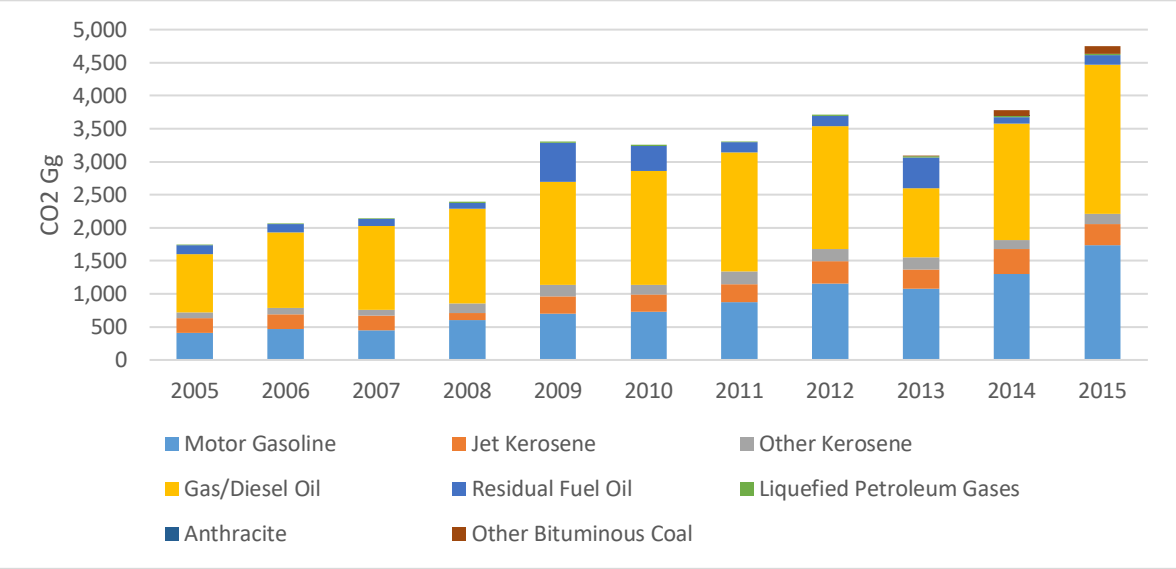


Figure 2-5. CO2 emissions from fuel combustion activities based on reference approach.

2.5.3 Results based of the Sectoral Approach

2.5.3.1 Energy (fuel Combustion activities)

There was a general upward trend of emissions from the energy sector from 2005 to 2015. Throughout the period (2005 to 2015), the transport subsector was the highest in terms amount of CO2 emissions followed by energy use in the manufacturing industries and construction (Figure 2-6). CH4 and N2O emissions was mainly from use of liquid fuels in commercial / institutional establishments and residential sector (denoted as other sectors). CH4 and N2O emissions from the energy industries are mainly from charcoal production processes.

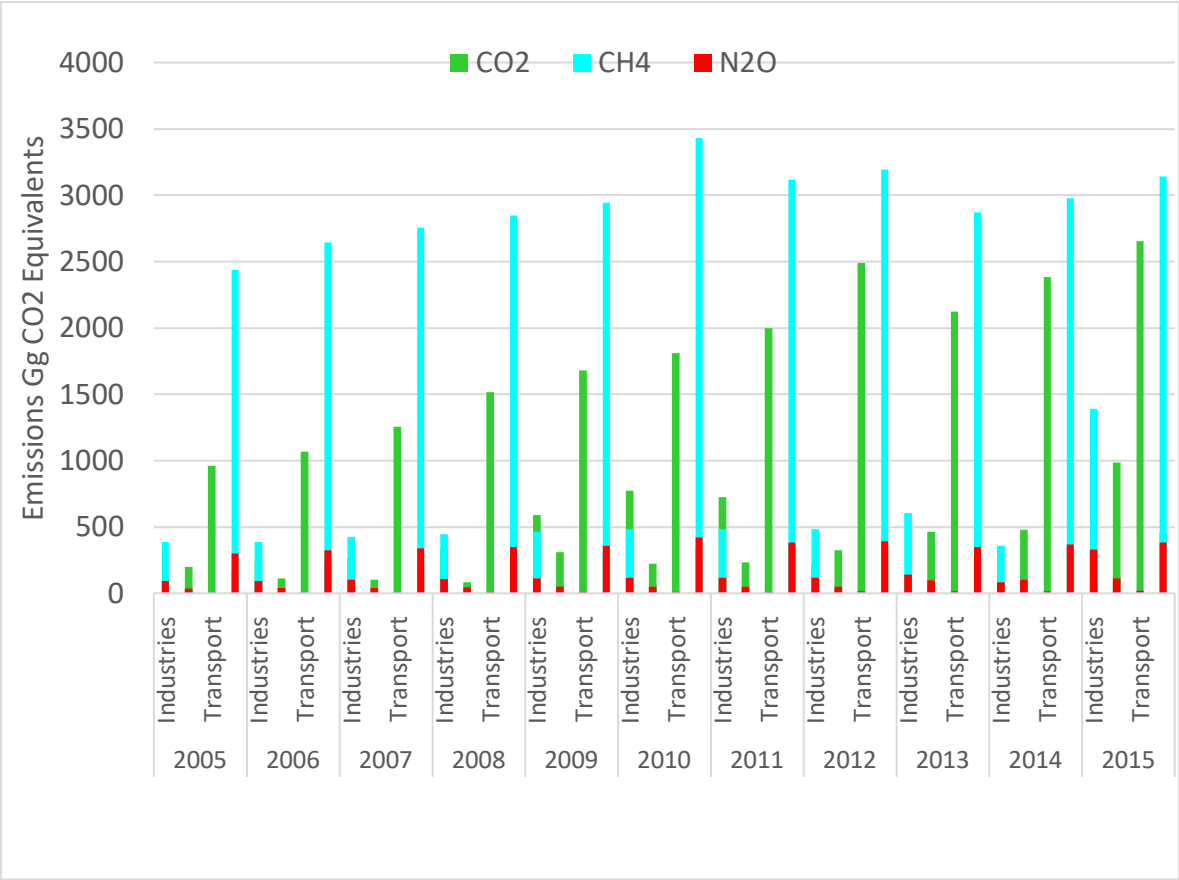


Figure 2-6. Emission trends in the transport and manufacturing industries and construction sectors, 2005 to 2015

From 2005 to 2010, there were significant emissions of CH4 and N2O emissions commercial, institutional establishments and residential sector (Figure 2-6). Emissions from the transport sector (mainly CO2) have increased steadily over the years with a slight depression in 2013.

Emissions from energy industries have relatively been low and mainly CH4 and N2O from charcoal production. The introduction thermal power plants in the energy supply system from 2009 to 2011, resulted in spikes in CO2 emissions in the energy industries (Figure 2-6). Later on, CO2 from energy industries become insignificant with increase in the electricity power supply to national grid coming from hydropower and cogeneration.

2.6 Industrial Process and Product Use (IPPU)

Industrial Processes and Product Use (IPPU) covers greenhouse gas emissions occurring from industrial processes, the use of products which emits greenhouse gases and from non-energy uses of fossil fuel carbon. Due to low level of industrialisation, the emission in this sector is not significant. Emissions in this sector are mainly from cement and lime industries and to some extent food and beverages processing.

Activity Data for cement production

There is increasing activity in the construction sector over the last decade. Large infrastructure such as dams and commercial buildings. There increasing population demands more buildings. All these factors contribute to increase in cement demand. The activity data for cement production is as shown in Table 2-9.

Table 2-9 Cement production in the 2005-2015.

Year	2005	2007	2009	2011	2013	2015
Tonnes	692,710	995,807	1,347,000	1,666,000	2,023,000	2,340,000

Source: Uganda Bureau of Statics.
The cement production increased by over 3.3 folds in the period 2005-2015.

2.6.1 Methodology

Emissions of CO2 occur during the production of clinker that is an intermediate component in the cement manufacturing process. During the production of clinker, limestone, which is mainly (95%) calcium carbonate (CaCO3), is heated (calcined) to produce lime (CaO) and CO2 as a by-product.

2.6.1.1 Emissions from Related to Cement Production

Equation 2-3. CO2 from cement production

$$CO_2\ Emissions = \left[\sum_i (M_{ci} \bullet C_{cli}) - Im + Ex\right] \bullet EF_{clc}$$

Where:

- CO2 Emissions = emissions of CO2 from cement production, tonnes
- Mci = weight (mass) of cement produced of type i, tonnes
- Ccli = clinker fraction of cement of type i, fraction
- Im = imports for consumption of clinker, tonnes
- Ex = exports of clinker, tonnes
- EFclc = emission factor for clinker in the particular cement, tonnes CO2/tonne clinker. The default clinker emission factor (EFclc) is corrected for CKD.

Uganda produces two types of cement. The Portland cement and Pozzolana Portland Cement

Lime Production. The clicker fraction the Portland cement and Pozzolana Portland Cement are 95% and 72%. The emission factors for cement is 0.52 tonnes CO2/tonne of cement.

The activity data for lime production.

There is high uncertainty in lime production because there is data on lime production in mainly carried by artisanal and small-scale mining. Lime production in Uganda is intermitted depending on the need of the market. There is limited information about lime production in Uganda. The estimated production of lime is as shown in Table 2.10.

Table: 2.10: Estimated lime production 2005-2015

	2005	2007	2010	2013	2015
Lime (tonnes)	10,000	10,000	17,000	18,000	18,000

Source: U.S. Geological Survey Mineral Yearbook 2010, 2015.

2.6.1.2 Emission Factor for Lime Production can be calculated using equation 2-4 below

Equation 2-4, CO2 emissions from Lime Production

$$EF_{Lime} = 0.85 \bullet EF_{high\ calcium\ lime} + 0.15 \bullet EF_{dolomitic\ lime}$$
$$= 0.85 \bullet 0.75 + 0.15 \bullet 0.77^{a}$$
$$= 0.6375 + 0.1155$$
$$= 0.75 \text{tonnes } CO_2 \text{ / tonne lime produced}$$

The most common type of lime produced in Uganda is dolomite. The emission factor is 0.77 tonnes of CO2/tonne of lime.

The emissions from the Mineral Industry

Emissions from the IPPU are mainly from the mineral industry, accounting for 99.5% of the emissions and are dominantly CO2. Mineral industry emissions rose from 171 Gg in 2005 to a record high of 526 Gg in 2011, thereafter slightly falling to 487 Gg of CO2 in 2015. CO2 emissions from cement production rose from 163 Gg in 2005 to 347 Gg in 2015. Emissions from cement production were however highest between 2011 and 2014 reaching the peak of 428 Gg of CO2 in 2012 (Figure 2-7).

CO2 emissions from lime production were below 10Gg between 2005 and 2010 but rose sharply to over 100Gg in 2011 and remained at same level up to 2015. CO2 emission from Lubricant use (non-energy product use from fuels and solvents use) rose from 0 in 2005 to 2.3 Gg CO2 in 2015 (Figure 2-7).

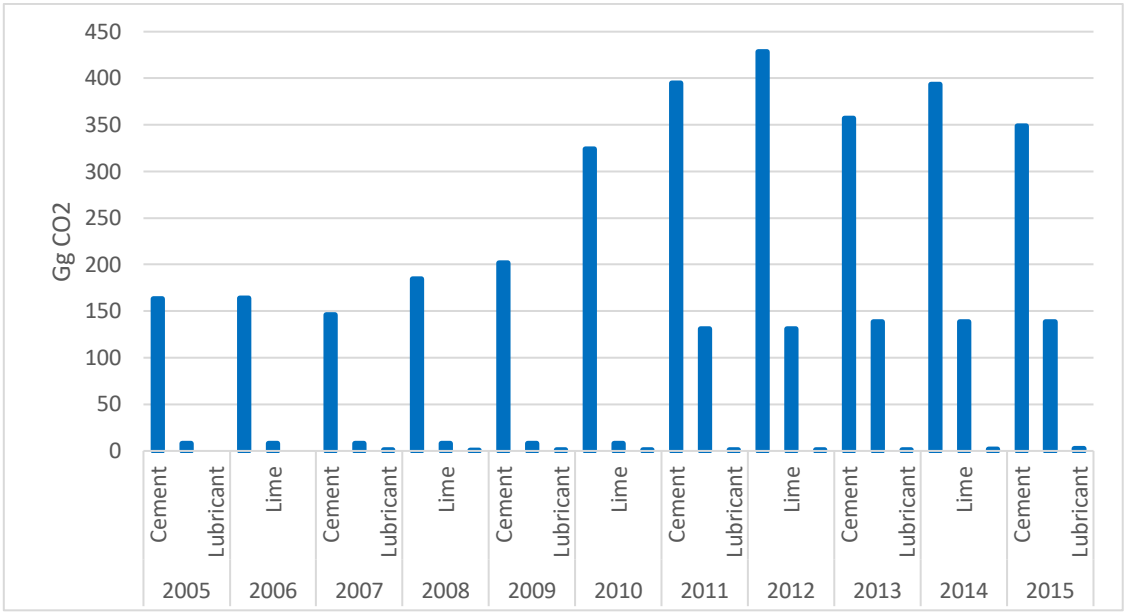


Figure 2-7. CO2 emissions from IPPU from 2005 to 2015

There is general trend of increase in emission from cement production. The anomalies seen in emissions from the lime production was because there was limited information about lime production from 2005 up to 2010. Emission estimates are based on internal publications.

2005 emissions from cement production in the FBUR are lower by (171 Gg) compared to those of SNC (299 Gg). That due to availability of more accurate data of clinker imports used in cement production process in Uganda.

2.6.2 Food Industry

NMVOCs are produced during the processing of cereals and fruits in preparation for the fermentation processes. The beverages in this category include wine, beer and spirits. Emissions also occur in the process of bread making and other food processing. The emission is very low in these sectors. The activity data from selected food industry as shown in the Table 2-11.

Table 2-11: Activity Data from selected food in industries.

	2005	2007	2009	2011	2013
Beer (thousand litres)	152,860	169,374	192,800	244,757	255,107
Soft drinks (thousand litres)	173,598	188,366	205,901	279,317	276,157
Sugar (tonnes)	173,793	192,568	308,005	263,105	310,026

Source: Uganda Bureau of Statistics

Methodology

The emission is calculated based on the European Environment Agency (EMEP/EEA) Air Pollutant Emission Inventory guidebook is used for compiling is estimates for non-methane volatile organic compounds (NMOC). IPPU emissions are associated with precursor gases.

Equation 2-5, CO2 emissions from food industry

$EE_{pollutant} = AR_{product} x EF_{pollutant}$

The emission factor of the pollutant is 2kg per Mg of the product.

NMVOCs emissions from sugar production and beer increased from 0.653 Gg 2005 to 1.280 Gg in 2015.

The activity data non- energy petroleum products.

Activity data from other petroleum products such as lubricant which is not used for energy purposes are as stated in Table 2-12

Table 2-12 Non energy use of lubricant

Year	2007	2009	2011	2013
Lubricant (thousand cubic meters)	8,493	8,695	10,202	11,030

Source: Energy Statistics, Ministry of Energy and Mineral Development

The computation of emission is based on the IPCC inventory software. Tonnes of carbon per TJ by default is 20, while fraction of carbon oxidized is 0.05.

2.7 Agriculture, Forestry and Other Land Use (AFOLU)

This sector is the widest because it deals with anything that involves land management that is not considered under energy, industries and waste treatment. The net carbon uptake or emission of the land sub-sector is dependent on two basic biophysical processes; changes in forest/woody carbon stocks due to the net annual biomass growth and removals from existing forest and non-forest stands and possible biomass regrowth in abandoned lands. Emissions from processes and practices such as biomass burning, organic matter decay, manure and fertilizer application, water management regimes in rice cultivation, drainage of organic soils are also considered under this sector.

2.7.1 Activity data for the Agriculture

2.7.1.1 Livestock Numbers

Livestock can generate GHG emissions both through CH_4 production from enteric fermentation and CH_4 and N_2O emissions from the decomposition of manure in managed systems. Tier 1 IPCC methods were applied to estimate such GHG emissions based on Uganda's livestock populations and manure management systems.

Livestock populations were determined over the period of 2000 to 2016 for cattle (dairy cattle and non-dairy cattle), sheep, goats, pigs (market swine and breeding swine) and poultry (chickens, ducks and turkeys). Livestock population data (table 2-13) was based on Uganda's 2008 national livestock census and annual surveys conducted by MAAIF and UBOS from 2009 to 2016. Data was not available for all years and methods used for gap filling include linear regressions (trend extrapolation). Details of AFOLU sector working group consultations are provided in the AFOLU annex of this report.

Table 2-13 Estimated Livestock numbers

Livestock Category	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Dairy cattle	657,312	690,197	723,082	798,612	822,570	847,247	872,665	898,845	911,400	953,610	982,192
Other cattle	8,732,861	9,169,761	9,606,660	10,610,128	10,928,432	11,256,285	11,593,973	11,941,792	12,108,600	12,669,390	13,049,119
Buffalo	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Sheep	2,515,670	2,693,115	2,870,560	3,413,340	3,515,740	3,621,213	3,729,849	3,841,744	3,937,000	3,842,000	4,197,978
Goats	10,148,594	10,676,153	11,203,711	12,449,656	12,823,146	13,207,840	13,604,075	14,012,198	14,614,000	14,011,000	15,311,507
Breeding Swine	128,397	135,280	142,163	159,215	163,991	168,911	173,979	179,198	183,650	179,200	195,814
Market Swine	2,439,547	2,570,319	2,701,091	3,025,085	3,115,838	3,209,313	3,305,592	3,404,760	3,489,350	3,404,800	3,720,473
Poultry	35,434,761	36,457,753	37,480,745	37,443,880	39,270,000	43,201,000	47,502,011	51,468,000	43,396,127	44,498,010	45,144,990

2.7.1.2 Enteric Fermentation Emission Factors

IPCC 2006 provides Tier 1 emission factors for African and developing countries to estimate CH_4 emissions from enteric fermentation (IPCC 2006, Vol 4, Ch 10, Table 10.10, 10.11). Emission factors by livestock type are provided in 2-14.

Table 2-9. Livestock emission factors by livestock type (IPCC 2006, Vol 4, Ch 10)

Livestock Category	Enteric Fermentation CH_4 Emission Factor ($EF_{EF.T}$)	Manure Management CH_4 Emission Factor ($EF_{MM.T}$)	Typical Animal Mass (TAM_T)	N Excretion Rate ($N_{ex.T}$)
Unit	[kg CH_4 head^{-1} yr^{-1}]	[kg CH_4 head^{-1} yr^{-1}]	[kg head^{-1}]	[kg N (Mg mass)$^{-1}$ day^{-1}]
Dairy Cattle	46	1	275	0.6
Non-Dairy Cattle	31	1	173	0.63
Sheep	5	0.2	28	1.17
Goats	5	0.22	30	1.37
Breeding Swine	1	1	28	0.55
Market Swine	1	1	28	1.57
Poultry	NA	0.02	1.8	0.82

2.7.1.3 Manure management in Uganda

CH_4 and N_2O emissions from manure management were estimated for dairy cattle, non-dairy cattle, sheep, goats, breeding swine, market swine and poultry. The fraction of N excreted by manure management systems and livestock type was estimated based on expert knowledge during the AFOLU-sector working group meetings (Kampala, July 2018) and is provided in Table 2-15. The livestock numbers used as the one provided in table 2-13.

Table 2-15. Fraction of manure managed in each manure management system by livestock type (expert knowledge from Uganda's AFOLU sector working group;

Livestock Category	Pasture Range and Paddock	Solid Storage	Pit Storage below Animal Confinement	Anaerobic Digester
Dairy Cattle	90%	5%	4%	1%
Non-Dairy Cattle	90%	10%	-	-
Sheep	100%	-	-	-
Goats	80%	20%	-	-
Breeding Swine	-	90%	10%	-
Market Swine	-	30%	70%	-
Poultry	70%	30%	-	-

2.7.1.4 Manure management Emission Factors

The IPCC 2006 software provides Tier 1 emission factors for the estimation of direct and indirect N_2O emissions from manure management for African and developing countries (IPCC 2006, Vol 4, Ch 10, Table 10A-4 to Table 10A-9) and N excretion rates (IPCC 2006, Vol 4, Ch 10, Table 10.19).

2.7.2 Estimation of emissions from Agriculture

Emissions from the agriculture sub sector are mainly methane (CH4) emissions from enteric fermentation from ruminant animals (e.g. cattle) and to some limited extent from non-ruminant animals (e.g. swine). These emissions depend on the type, age, and weight of the animal, the quality and quantity of feed and the energy expenditure of the animal. In addition, livestock are associated with CH4 emissions from the manure management that is as a result of manure decomposition under anaerobic conditions, which usually occur in manure storage. During storage of manure, some nitrogen in manure are oxidized and converted into N2O.

2.7.2.1 Estimation of Emissions from Enteric Fermentation

CH_4 emissions from enteric fermentation are estimated using equation using IPCC Tier 1 equation (IPCC 2006, Vol 4, Ch 10, eq. 10.19, 10.20).

1.13.1.1 Estimation of CH4 from manure management

CH_4 emissions from manure management are using IPCC 2006, Vol 4, Ch 10, eq. 10.22.

1.13.1.1 Estimation of Direct N2O from manure management

Equation 3 below, for direct N_2O emissions from manure management is also embedded in the software (IPCC 2006, Vol 4, Ch 10, eq. 10.25, 10.30)

2.7.2.2 Emissions from Livestock, manure management and soil management

CH4 from enteric fermentation from ruminant animals is the most dominant gas in the livestock sector and has doubled from 7,704 Gg CO2 equivalents (367Gg of CH4) in 2005 to 11,575 Gg CO2 equivalents or (551 Gg of CH4) in 2015 (Figure 2-8). CH4 from manure management has remained at around 479 Gg CO2 equivalents. Direct N2O emissions from managed soils rose by 31% over the same period while CO2 from Urea application has remained at around 5 Gg.

2.7.3 Estimation of Emissions from Aggregate Sources

Covered here are non- CO2 emissions from biomass burning, liming, Urea application, direct and indirect N2O from managed soils (due to volatilization and leaching) and manure indirect emissions from manure management (due to volatilization. Methane emissions from management practices under paddy rice cultivation are also considered here.
Note that CO_2 emissions from biomass burning have already been accounted for under C losses from disturbance within the relevant LULUC source categories. Thus, only non-CO_2 emissions are included here.

2.7.3.1 Emissions from Biomass Burning

Non-CO_2 emissions, including CH_4, N_2O, carbon monoxide (CO), non-methane volatile organic compounds (NMVOCs), and nitric oxides (NO_x), result from incomplete combustion during biomass burning. Non-CO_2 emissions resulting from anthropogenic activities on forest lands, grasslands and croplands is accounted for under this section, such as wildfires on managed lands, prescribed burning, crop residue burning and other uses of fire as a land management tool.

2.7.3.1.1 Burnt area Data

Burned area monthly products (MCD64A1 shapefiles) for Uganda (table 2-16) that is derived from MODIS 500m pixel daily surface reflectance was downloaded from fuoco FTP server (fuoco.geog.umd.edu) that hosts fire data sets from the University of Maryland.

Table 2-16. Adjusted Burnt Area data for Uganda; Source MODIS

Year	Burnt Area (Ha)	Percent that is Forest
2005	2,344,971	19%
2010	1,549,058	8%
2015	1,145,985	8%

Given that MODIS burned area product is based a land grid of 500m by 500m having sufficient valid observations for algorithm to function. The level on uncertainty can be

assumed to be high because over generalization in area of ½ Kilometre. To cater for the impact of over generalization, half of the area computed is considered actual burnt area.

2.7.3.1.2 Emission Factors for biomass burning

To estimate non-CO_2 emission from biomass burning Tier 1 emission factors were applied. Mass of fuel available for combustion was adjusted based on a consensus reached on the AFOLU sector working group. Area of vegetation types burnt are derived from process described section 3.5.1.2 above. Biomass burning emission factors (table 2-17) are summarised from IPCC guidelines and are in built in the IPCC2006 software.

Table 2-12 *Emission factors for estimating non-CO_2 emissions from biomass burning; Fuel combustion and Combustion factor are adjusted*

Table 2-17. Emission factors used for biomass burning, CO, CH4, N2O, NOx

Land Use Category	**Mass of Fuel Available for Combustion**	**Combustion Factor**	**Biomass Burning Emission Factor – CO**	**Biomass Burning Emission Factor – CH_4**	**Biomass Burning Emission Factor – N_2O**	**Biomass Burning Emission Factor – NO_x**
Unit	[Mg ha^{-1}]	[Mg ha^{-1}]	[g CO (kg d.m. burnt)$^{-1}$]	[g CH_4 (kg d.m. burnt)$^{-1}$]	[g N_2O (kg d.m. burnt)$^{-1}$]	[g NO_x (kg d.m. burnt)$^{-1}$]
Forest Land – Woodlands and Forest plantations	15	0.5	65	2.3	0.21	3.9
Cropland – Subsistence and large scale Cropland	5	1	65	2.3	0.21	3.9
Grassland – (Shrubland and Open grassland)	2.6	1	65	2.3	0.21	3.9
Other land – Mainly papyrus	5	0.5	65	2.3	0.21	3.9

2.7.3.2 Data on liming

Data on agricultural lime use in Uganda was not available. The Uganda AFOLU-sector working group plans to work with the Ministry of Animal Industries and Fisheries and the Uganda Revenue Authority to identify potential data sources for agricultural lime use in Uganda.

2.7.3.3 Data on Urea application

The amount of urea applied to soils Table 2-18. Annual apparent fertilizer and organic amendment use calculated from data on fertilizer production, import, export and non-fertilizer use (IFIA, 2017). N content derived from the Fertilizers by Product dataset (FAOSTAT, 2018) or expert knowledge

Table 2-18. Estimated N Applied to Managed soils from fertilizer application

Amendment Type	N Content	Amendments Applied to Managed Soils (Mg yr^{-1})										
	(% N)	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Ammonium nitrate	33.50 %	497	743	989	1,235	1,481	1,727	1,973	2,219	2,465	2,711	2,957
Ammonium sulfate	21.00 %	1,106	1,131	1,156	1,181	1,205	1,230	1,255	1,279	1,304	564	1,735
Calcium nitrate	15.50 %	2,094	2,007	1,919	1,831	1,743	1,655	1,568	1,480	1,392	1,714	619
CAN	26.00 %	-	-	-	-	-	-	-	-	152	529	1,263
DAP	18.00 %	-	-	-	-	-	148	487	827	1,167	1,822	1,837
MAP	11.00 %	5,974	5,516	5,058	4,600	4,142	3,684	3,226	2,768	2,310	91	4,448
NP compounds	10.00 %	738	676	615	554	493	432	370	309	248	181	164
NPK blend (specified)	100 %	-	-	-	-	-	-	-	-	-	49	1,069
NPK blend (unspecified)	17.00 %	930	3,337	5,743	8,150	10,557	12,963	15,370	17,776	20,183	28,468	20,900

Other N fertilizer	10.00 %	1,690	1,541	1,392	1,243	1,094	945	796	647	498	495	5
Other straight N	100 %	3	3	3	3	2	2	2	1	1	1	-
Potassium nitrate	13.00 %	-	-	-	-	-	-	-	-	-	-	395
Sodium nitrate	16.00 %	-	-	-	-	-	-	-	-	-	-	-
Urea	46.00 %	-	-	-	-	-	-	-	1,742	3,596	5,690	6,900
Organic fertilizer	10.00 %	-	-	-	-	-	-	-	-	-	54	224
Compost	-	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Sewage sludge	-	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

2.7.4 Direct and Indirect N_2O Emissions from Managed Soil

Soil N_2O emissions can occur both directly, where N is applied or deposited, and indirectly from transformation of the N volatilized and deposited elsewhere and N lost to leaching and runoff.

N_2O is produced in soils as a by-product of microbial N transformation during nitrification and denitrification. Both direct and indirect N_2O emissions were estimated based on the N inputs which include synthetic N fertilizers (F_{SN}), organic N amendments including manure (F_{ON}), urine and dung N deposited on pasture, range and paddock by grazing animals (F_{PRP}), N inputs from crop residues (F_{CR}), N mineralized during changes in land use or management of mineral soils (F_{SOM}) and N mineralized from managed or drained organic soils (F_{OS}).

Indirect N_2O emissions were estimated by applying the IPCC Tier 1 equations for both atmospheric deposition of N volatilized from managed soils (IPCC 2006, Vol 4, Ch 11, eq. 11.9) and N lost to leaching or runoff on managed soils (IPCC 2006, Vol 4, Ch 11, eq. 11.10).

N inputs from synthetic fertilizers were estimated based on the amount of synthetic fertilizer applied and the N content of each fertilizer type (table 2-18). The annual amount of synthetic fertilizers applied to managed soils was determined based on the annual apparent fertilizer use data from the International Fertilizer Industry Association. Where annual estimates were not available, linear regressions were applied to extrapolate trends in annual fertilizers applied by fertilizer type back to 2000. Annual fertilizers applied by fertilizer type are provided in table 2-18.

2.7.4.1 Fertilizer Emissions factors

The N content of different synthetic fertilizers was determined using FAO's Fertilizers by Product dataset (FAOSTAT, 2018) and expert knowledge from Uganda's AFOLU-sector working group (Kampala, 2018). The IPCC Tier 1 emission factor for N inputs (0.01 kg N_2O-N (kg N inputs)$^{-1}$) was used to estimate soil N_2O emissions (IPCC 2006, Vol 4, Ch 11, Table 11.1).

N inputs from organic N additions were estimated based on the IPCC Tier 1 equations (IPCC 2006, Vol 4, Ch 11, eq. 11.3). N inputs from animal manure N additions were estimated based on the IPCC Tier 1 equations (IPCC 2006, Vol 4, Ch 10 & 11, eq. 11.4, 10.34, 10.30). The values are in built in the IPCCC software.

N inputs from crop residue N additions were estimated based on the IPCC Tier 1 equations (IPCC 2006, Vol 4, Ch 11, eq. 11.6). Annual above-ground residues were estimated using the IPCC above-ground residue dry matter regression (IPCC 2006, Vol 4, Ch 11, Table 11.2). Estimates of annual above-ground residues were then used to derive the ratio above-ground and below-ground residue dry matter to harvest yield (IPCC 2006, Vol 4, Ch 11, pg 11.14).

2.7.4.2 Data on crop residues

The data on annual harvested areas and fresh yield was obtained from the FAOSTAT database (FAO, 2018). This internationally reported data was derived from Uganda's national agricultural census (MAAIF/UBOS, 2009) and annual surveys from 2009 - 2016 (MAAIF/UBOS, 2016). The harvest area and yield data by cropping system is provided in Table App-1.1 and Table App 1- 2 in Appendix 1.

Weighted emission factors were developed for the two Ugandan cropland subcategories based on the top 10 annual crop types (maize, cassava, beans, sweet potatoes, groundnuts, sorghum, sunflower, sesame, millet, vegetables and rice) and top 5 perennial crop types (plantains and banana, coffee, tea, sugarcane and cocoa) which account for 91.3% of the total harvested area. Weighted emission factors were estimated based on the annual proportion of harvested area by each crop type occurring within subsistence and commercial croplands.

2.7.4.3 Emission Factors for crop residues

Nitrogen content was derived by applying fresh weight to dry weight yield and later on ratio of yield to crop residue. Nitrogen from maize stocks is not included given that serve a variety of uses (animal feeds, source of energy, roofing, mulching etc). These are assumed to compensate crop residues that are not ploughed back to the soil.

Emission factors for each crop type were derived using IPCC Tier 1 emission factors (IPCC 2006, Vol 4, Ch 10, Table 11.2). Due to a lack of data, all croplands were assumed to have no burning of crop residues. The IPCC Tier 1 emission factor for N inputs (0.01 kg N_2O-N (kg N inputs)$^{-1}$) was used to estimate soil N_2O emissions (IPCC 2006, Vol 4, Ch 11, Table 11.1).

2.7.4.4 Data on Paddy Rice Cultivation

The area of paddy rice production was estimated based on harvested area data from the 2008-2009. Uganda national agricultural census and annual estimates from MAAIF and UBOS from 2009 - 2016. Where annual estimates were not available, a linear regression was applied to extrapolate trends in paddy rice area back to 2000. These values were cross-checked against internationally reported values from FAOSTAT and found to be comparable. The values for paddy rice area are the same as those used for weighting the area of various cropping systems presented in Appendix 1.

1.13.1.1 Emission Factors for Paddy Rice

Paddy rice cultivation can result in the production of CH_4 emissions during the decomposition of rice residues, organic amendments and soil organic matter under water-saturated, anaerobic conditions. The extent of the CH_4 emissions from rice cultivation is dependent on the water management both before and during cultivation, amount and type of organic amendments, soil type and rice cultivars.

IPCC Tier 1 default values were applied to estimate CH_4 emission from rice cultivation. The IPCC baseline emission factor for rice cultivation of 1.3 kg CH_4 ha^{-1} $days^{-1}$ was selected as no country-specific emission factor was available (IPCC 2006, Vol 4, Ch 5, Table 5.11). A cultivation period of 125 days was applied based on expert knowledge from the National Agricultural Research Organization (NARO) indicating that rice cultivation periods in Uganda range from 110 to 140 days. A scaling factor of 1 was selected for the preseason water management as typical rice management in Uganda is to flood 12 days before planting (expert knowledge; NARO, 2018). A scaling factor of 1 was selected for the water management during cultivation as it is assumed that all paddy rice fields are flooded without any aeration events during the cultivation period (expert knowledge; NARO, 2018). Likewise, a scaling factor of 1 was applied for use of organic amendments as it was assumed that no organic amendments are applied in paddy rice management.

2.7.5 Emissions from Livestock and Aggregate Sources

From 2005 to 2015, CH4 and N2O emissions from biomass burning reduced six fold from 2,238 Gg and 3,016 Gg of CO2 equivalents to 404Gg and 492 of CO2 equivalents respectively (Figure 2-8).

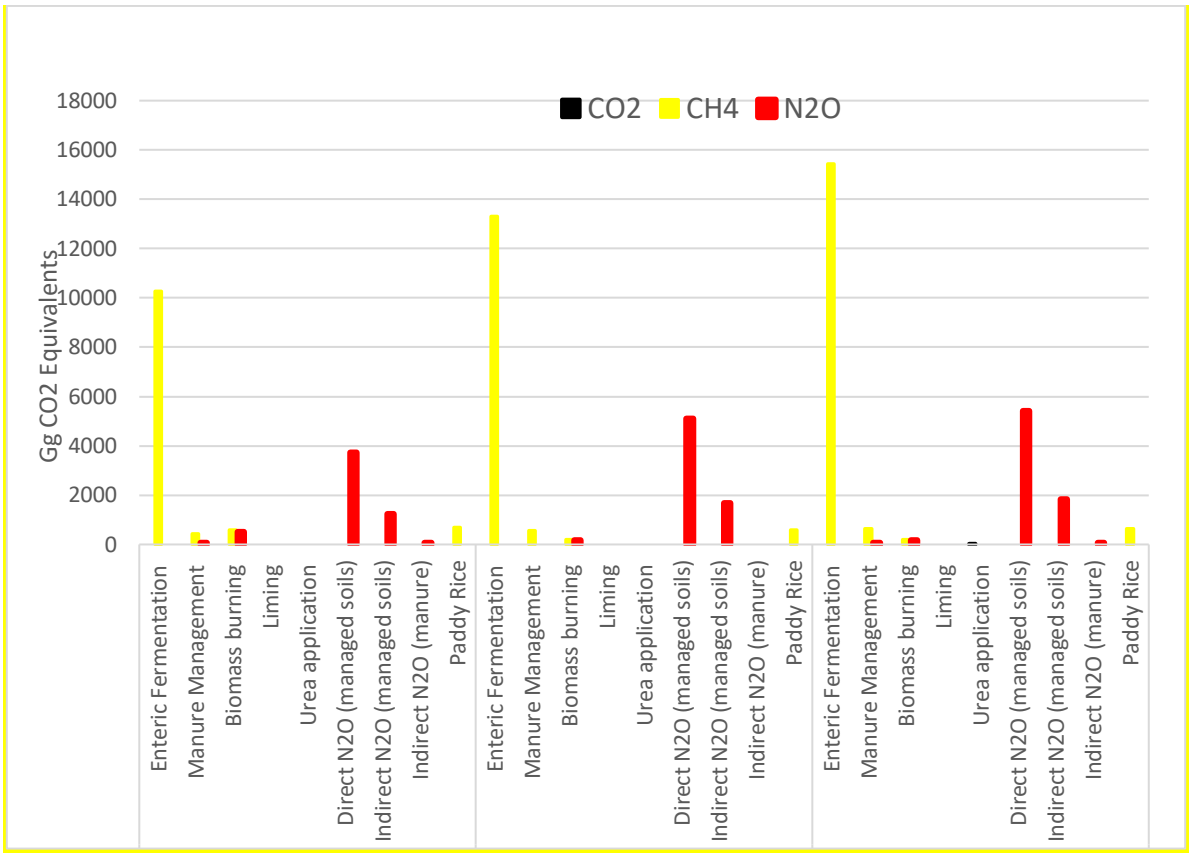


Figure 2-8. Emission trends from livestock and aggregate sources, 2005 to 2015

CH4 emissions from enteric fermentation are comparable to those reported in the SNC when the animal population was about a half of 2015. However, this is need to re-calculate N2O emissions which is reported to be 52 Gg in 2000 compared to 22 Gg in 2015.

CH4 emissions from paddy rice in the FBUR are comparable to 21 Gg that were estimated in 2000 in the SNC.

Emissions associated with fires have dropped steadily which is proportion to reduction of area burnt over time. There is a significant reduction of forest land and rangeland areas in the fire prone areas of northern eastern Uganda.

CH4 emissions from paddy rice has almost remained stable at around 252 Gg CO2 equivalent (figure 2-9) or 25Gg of CH4 which is comparable to 21 Gg of CH4 in 2000. Emissions related to changes in biomass stocks.

2.7.6 Land area, Land Conversion and Biomass Stock

Land area and land conversion statics used in the GHG inventory are based on bias-corrected area estimates (Table 2-19) through a process known as Map Accuracy Assessment. This a recommended "Good practices" (Olofsson et al. 2014) and details on "Map Accuracy Assessment and Area Estimation – A Practical Guide" is available (FAO 2016).

Table 2-10. Bias Corrected Area Estimates Forest – Non- Forest Statistics, Source: FREL 2018

Initial / Final	Plantations	Tropical High Forest	Woodland	Non-forest	**2000**
Plantations	261,300	0	0	7,063	268,363
Tropical High Forest	3,846	505,617	0	124,401	633,864
Woodland	17,391	0	1,622,588	620,739	2,260,718
Non-forest	133,421	0	0	17,118,000	17,251,421
2015	415,958	505,617	1,622,588	17,870,203	20,414,366

The approach to estimate changes in C stocks from land use and land use change, is consistent to what was used in the construction of Uganda's FREL for REDD+ 2018, albeit with some modification to cater for derive area statements for some key non-forest classes (Table 2-20).

Table 2-20. Uganda's Forest and non-Forest land categories

IPCC Land Use Category	Uganda's Forest and non-forest Land categories
Forest	THF (Well stocked and Low stocked)
	Woodland
	Forest Plantations (broad leaved and coniferous)
Non- Forest	Grassland
	Cropland
	Wetland
	Settlement
	Other Land

Key the methodology used is forest area, biomass stock and biomass stock increment in forests where wood extracted. In Uganda, no wood is extracted from areas under UWA's jurisdiction. To minimize the complexity of the land use change matrix, area under UWA were initially excluded from the data preparation and data input stage (figure 1 and Table 9).

2.7.6.1 Forest Area with significant Biomass Stock Changes

Emissions from forest land are estimated for those forest where it is presumed significant biomass stock changes are happening. These areas are Tropical High forest, Woodland and Forest Plantations outside UWA areas (table 2-21)

The approach to estimate changes in C stocks from land use and land use change, is consistent to what used in the construction of Uganda's FREL for REDD+ 2018, albeit with some modification to cater for derive area statements for some key non-forest classes (Table 2-21).

Table 2-21. Forest area presumed to have biomass stock changes (UWA area excluded)

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Plantations	286,684	296,524	306,364	316,203	326,043	335,883	345,722	355,562	365,402	375,241	385,081
THF	439,621	431,071	422,521	413,971	405,421	396,872	388,322	379,772	371,222	362,672	354,123
Woodland	1,485,424	1,442,882	1,400,340	1,357,798	1,315,256	1,272,714	1,230,172	1,187,630	1,145,088	1,102,546	1,060,004
Non-Forest	15,858,208	15,899,460	15,940,712	15,981,964	16,023,216	16,064,468	16,105,721	16,146,973	16,188,225	16,229,477	16,270,729

Key the methodology used is forest area, biomass stock and biomass stock increment in forests where wood extracted. In Uganda, no wood is extracted from areas under UWA's jurisdiction. To minimize the complexity of the land use change matrix, area under UWA were initially excluded from the data preparation and data input stage.

2.7.6.2 Wood Extraction from forest area

UBOS and National Forest Authority published data on the production of round wood by forest product from 2012 to 2016 were used to estimate timber and fuelwood removals. Where annual estimates were not available, linear regressions were applied to extrapolate trends in production by forest product back to 2005. To apply IPCC equations for estimating C losses from wood extraction the AFOLU sector working ground estimated that 50% fuelwood and wood needed for charcoal production was harvested from non-forest land and the balance from forest land. It was estimated that 39% of all wood fuel was harvested from woodlands, 10% from THF and 1% forest plantations (Table 2-22).

Table 2-22. Estimated Annual Forest Harvest of Poles, Timber and other wood; Source UBOS/NFA, Adjusted based on AFOLU SWG

	Tones demand based on (UBOS/ NFA)	Tones annual Supply based Estimates (AFOLU WG)	
Year	Total Harvest	Harvested from non-Forested land	Harvested from Forests land

	Annual Wood Harvest	Crop and grassland (includes bush)	Forests Combined	From Woodland	from THF(s)	From Plantation(s)
	100%	50%	50%	39%	10%	1%
2005		13,747,500	13,747,500	10,709,913	2,749,500	288,087
2006		14,619,100	14,619,100	11,388,929	2,923,820	306,351
2007		15,490,700	15,490,700	12,067,944	3,098,140	324,616
2008		16,362,300	16,362,300	12,746,959	3,272,460	342,881
2009		17,233,900	17,233,900	13,425,974	3,446,780	361,146
2010		18,105,500	18,105,500	14,104,989	3,621,100	379,411
2011	38,147,000	18,977,100	18,977,100	14,784,004	3,795,420	397,676
2012	39,720,000	19,860,000	19,860,000	15,471,823	3,972,000	416,177
2013	41,400,000	20,700,000	20,700,000	16,126,220	4,140,000	433,780
2014	43,160,000	21,580,000	21,580,000	16,811,779	4,316,000	452,221
2015	45,006,000	22,503,000	22,503,000	17,530,837	4,500,600	471,563

2.7.6.3 Wood Extraction from forest area

UBOS and National Forest Authority published data on provided about 80% of the production of Roundwood by forest product from 2012 to 2016 were used to estimate timber and fuelwood removals. Where annual estimates were not available, linear regressions were applied to extrapolate trends in production by forest product back to 2005. To apply IPCC equations for estimating C losses from wood extraction the AFOLU sector working ground estimated that 50% fuelwood and wood needed for charcoal production was timber (including transmission poles, construction poles and posts) harvested from non-forest land and the balance from forest land, woody formations in cropland and grassland. It was estimated that THF provides over 46% of timber, posts and poles followed by forest plantations. Woodlands were estimated to supply less than 1%. (Table 2-23).

Table 2-23. Estimated Annual Forest Harvest of Poles, Timber and Posts; Source UBOS/NFA, Adjusted based on AFOLU SWG

	Tones demand based on (UBOS/ NFA)	Tones annual Supply based Estimates (AFOLU WG)				
	Total Harvest	Harvested from non-Forested land	Harvested from Forests land			
	Annual Wood Harvest	Crop and grassland (includes bush)	Forests Combined	From Woodland	from THF(s)	From Plantation(s)

	Estimated Annual Harvest		80%	0.27%	46%	33%
2005		2,039,705	1,631,764	10,000	951,173	670,590
2006		2,164,589	1,731,671	10,000	1,010,195	711,476
2007		2,297,430	1,837,944	10,000	1,072,879	755,065
2008		2,438,786	1,951,029	10,000	1,139,452	801,577
2009		2,589,270	2,071,416	10,000	1,210,157	851,259
2010		2,749,550	2,199,640	10,000	1,285,249	904,391
2011	3013000	2,920,358	2,336,286	10,000	1,365,000	961,286
2012	3170000	3,102,500	2,482,000	10,000	1,449,700	1,022,300
2013	3338000	3,285,000	2,628,000	10,000	1,534,400	1,083,600
2014	3513000	3,476,250	2,781,000	10,000	1,621,900	1,149,100
2015	3700000	3,682,500	2,946,000	10,000	1,717,100	1,218,900

2.7.6.4 Biomass Stock by Land Category

Emission factors are derived from Uganda's National Forest Inventory are provided in Table 2-21. Where values were not available, IPCC Tier 1 default values were selected for the relevant forest type. For changes in mineral forest C stocks, the IPCC default stock change factor for forest lands, 1, was applied (IPCC 2006, Vol 4, Ch 4, pg 4.42).

Table 2-23 Changes in biomass C stock across Uganda land use subcategories. Source; Forest Types: FREL 2009, Non Forest Categories; NBS 2002 report, figures for natural forests adjusted

Land Use Sub-category	Above-ground Biomass	Annual Above-ground Biomass Growth
Unit	[Mg d.m. ha^{-1}]	[Mg d.m. ha^{-1} yr^{-1}]
Forest Land – Tropical High Forest	231	3*
Forest Land – Woodlands	40	2.5*
Forest Land – Forest Plantations	114	12
Cropland – Subsistence Cropland	12	2.4
Cropland – Large scale	2	-
Grassland – Rangeland (open and bush grassland)	8	2
Wetlands - Wetland	0	NA
Settlements	0	NA
Other Land	0	NA
Wetlands – Open Water	0	NA

*The figures were adjusted to IPCC default values. The NBS data was biased towards high population density areas where forests have high level of disturbance and thus high levels of

regrowth and annual increment. The growth of rate in less disturbed areas is expected to be close to IPCC default value of 1.5 Mg d.m. ha^{-1} $yr^{-1.}$

2.7.6.5 Estimating emissions from Forest land

2.7.6.5.1 Carbon Stock Changes in Living Biomass

Above-ground living tree biomass considered in Uganda' forest inventory includes C stocks of live trees, with a minimum DBH of 10 cm for tropical high forests and 3 cm for woodlands and other woody formations. Above-ground biomass in high forest is derived from forest inventories carried out by NFA.

Below-ground living biomass is considered in the form of roots that are 2mm in size and above. Root biomass is not measured directly in the field but is rather estimated using standard relationships with above-ground live biomass, known as root:shoot ratios provided by the IPCC. Below ground biomass considered in this GHG inventory is calculated applying the relevant root:shoot ratios by forest type (IPCC 2006, Vol 4, Ch 4, Table 4.4) to the above-ground biomass acquired from the available NFI data.

The Gain – Loss method or Tier1 approach was used for the estimation carbon stock changes in land remaining the same. This approach compares annual removals of the various forms of wood extraction (timber, pole, firewood etc) including losses due to disturbances and carbon losses from drained organic soils with annual increase in biomass carbon.
Under the IPCC2006, the forest land category is given special treatment in that it is the only category where growth is computed by the software as a product of area and growth per hectare.
The equation for computing annual increase in biomass carbon of forest land remaining forest land is in built, Ref to (IPCC 2006, Vol 4, Ch 2, eq. 2.9 & 2.10).

Changes in biomass C stocks resulting from land use conversion were estimated using the software in built IPPC equation for Tier 1 (IPCC 2006, Vol 4, Ch 2, eq. 2.16):

2.7.6.5.2 Dead Organic Matter Carbon (3.B.a and b)

With support from the REDD+ programme, Uganda has included collection of data on standing deadwood and fallen deadwood in the forest inventories. This data was being processed at the time of writing the FBUR. This data will add value to subsequent GHG inventories.
Litter C stocks are not currently sampled for the national forest inventory and there is no data from previous inventories to be able to use for reporting on emissions from this carbon pool. To estimate the contribution of changes in litter C stocks IPCC default values for tropical broadleaf and needle leaf forests we applied to the relevant forest types (IPCC 2006, Vol 4, Ch 2, Table 2.2). Changes in litter C stocks between land use change were estimated applying the IPCC Tier 1 equation (IPCC 2006, Vol 4, Ch 2, eq. 2.23),

2.7.6.6 Estimating emissions from non- forest land

To estimate changes in biomass C on perennial woody croplands remaining croplands, NBS data was used. NBS data shows that cropland has got the highest annual increment over 15% if only tree growth is considered. When biomass from bush and forest remnants is considered

sustainable biomass supply from cropland is close 4 tonnes per hectare per year. Given that cropland covers over 4million hectares, cropland is estimated to supply about a half of country's total wood demand. NBS data shows that in general, biomass stocks in cropland has remained stable since 1995.

For dead organic matter, the Tier 1 assumption that dead organic matter C stocks remain in equilibrium on croplands remaining croplands was applied. For lands converted to croplands we applied the land use conversion equations relevant to each carbon pool as described in section.

2.7.7 Reporting on Emissions from Biomass stock Changes

The emissions from land are predominated by CO2 from deforestation and forest degradation (Figure 2-9). Net emissions from forest land rose from about 15,900 to almost 40,000 from 2005 to 2015. In 2005, forestland area estimated to have a CO2 sink of 4,000 Gg. CO2 emissions attributable for conversion of forests to cropland and grassland are estimated at 36,830 Gg.

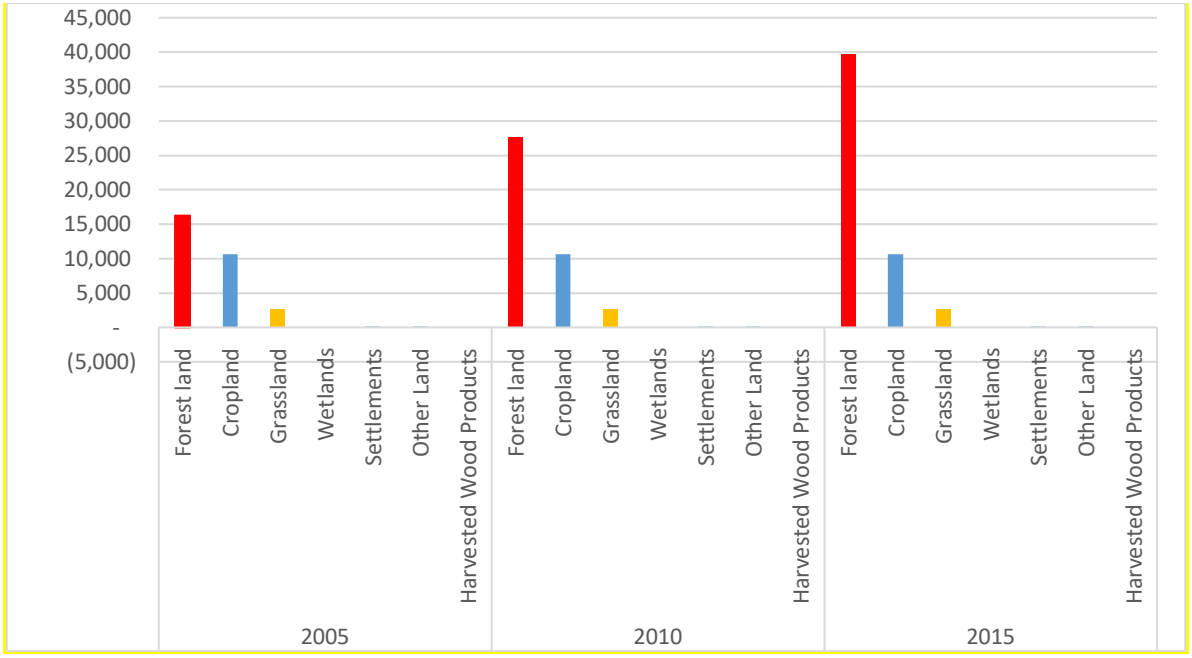


Figure 2-9. Emissions trends from land, 2005 to 2015

In the SNC, emissions from LULCF was estimated to have had a net emission of 10,388 Gg of CO2. Given the high rate of deforestation, it is reasonable to expect emissions of up to 40,000 Gg of CO2. The biggest challenge in comparing FBUR and SNC emissions is the data requirements and assumptions between the gain – loss method (used in the FBUR) and stock change method, used in the SNC. The latter provides a more realistic attribution than the gain- loss method. This issue is discussed in more details in chapter 5, under constraints, gaps and support needed.

2.8 Waste

CH4 emissions from the solid waste is the dominant source of emissions in the waste sector followed by waste water treatment and discharge. Waste water treatment emits both N2O and CH4 (Figure 2-14). Waste generation rate vary between 0.58 kg/cap/day and 1 kg/cap/day within the urban area. The estimated waste per capita per year is 237 kg. The activity data for the 2005, 2010 and 2015 are tabulated below. There is high uncertainty in the waste water discharge. There is need to improve on the data. 10).

Activity Data

Table 2-24. The activity data for solid waste

Year	2005	2010	2015
Urban population (million)	3.41	5.78	7.588
Waste generated (Gg)	808.28	2369.98	1561.38
Waste deposited at waste sites (Gg)	444.55	753.49	936.83
Inert	22.67	105.59	138.65

It is estimated that about 6% of the population in urban centres are connected to the national sewerage system. The estimated number of people connected to the national sewage system is as illustrated in Table 2-25

Table 2-25. The estimated number of people connected to the national sewage system.

Year	2005	2010	2015
Population connected sewerage	204,600	342,000	450,000

Industrial waste water from industries with high water discharge. These industries are beer, beverages sugar and fish processing.

Table 2.26: Industrial Waste water discharge cubic meter per year.

Year	2005	2010	2015
Beer	2,774,410	3,309,181	4,603,260
Beverages	1,597,103	2,229,473	3,031,923
Sugar	696,908	1,180,851	1,274,275

Fish (possessed tonnes)	435,131	259,474	200,377
Total Industrial waste water (cubic meters)	**5,503,552**	**6,978,978**	**9,109,835**

Methodology of the waste sector.

The data sources for the Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) are from National Water and Sewerage Corporation and Directorate of Water Resources Management (DWRM) in the Ministry of Water and Environment (MWE) is responsible for issuing waste water abstraction and discharge permits. The wastewater BOD and COD contents are 319.8 mg/l and 792.5 mg/l respectively on average.

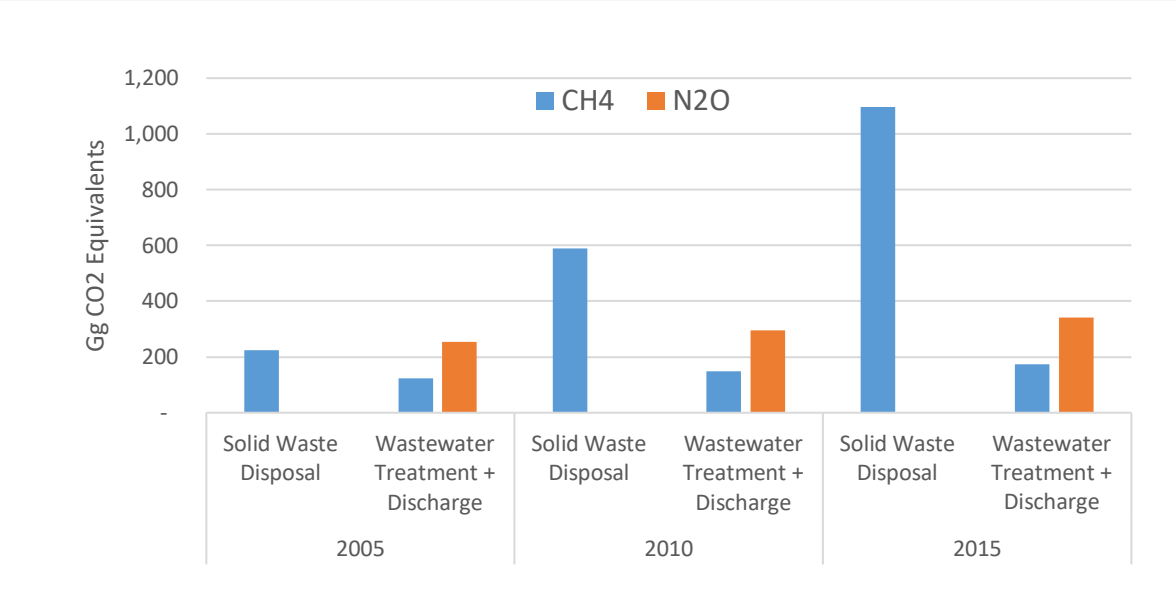


Figure 2-10. Emissions from the solid waste; 2010

From 2005 to 2015, emissions from the waste sector have tripled rising from 545Gg to to 1,610 Gg of CO2 equivalents. CH4 from the solid waste disposal have risen six- fold from 168 Gg to 1,097 Gg. Over the same period, CH4 and N2O from waste water treatment and discharge rose by 39% and 34% respectively.

When compared with the SNC, CH4 emissions from solid waste in 2000 was estimated at 30 Gg (630 Gg CO2 equivalents) which is almost equal to estimates for 2010 in BUR. In addition, the SNC did not estimate N_2O from waste water while the BUR estimates N_2O from waste water treatment and discharge.

3. MITIGATION ACTIONS AND THEIR EFFECTS

3.1 General Overview of Mitigation Actions and their Effects

Uganda has made efforts to comply with UNFCCC requirements by formulating and promoting the implementing mitigation actions as per COP decisions and subject to availability of resources, both financial and human. Uganda has been a keen participant in the Clean Development Mechanism of the Kyoto Protocol right from the time of its commencement in 1997. In addition, from 2010, Uganda initiated the process of developing Nationally Appropriate Mitigation Actions (NAMAs). Furthermore, in 2015, Uganda approved a National Climate Change Policy and its costed implementation strategy in which mitigation actions were explicitly outlined. More recently, in 2016, Uganda developed and submitted her Nationally Determined Contributions (NDCs) in accordance with the Paris Agreement with specific mitigation commitments to be achieved through national and internationally-supported mitigation actions.

The preparation of the FBUR has been informed by stock take of various forms of mitigation actions. A number of the mitigation projects undertaken in the country have received certified emission reduction credits under the UNFCCC procedures. A number of these projects have contributed to Uganda's sustainable development notably through provision of clean energy and employment, among other benefits.

This chapter reports on mitigation actions and their impacts in Uganda as at 2015. It should be noted that only brief descriptions of the actions are presented due to lack of capacity in not only reporting but also in planning the mitigations actions.

The Chapter categorizes the actions as follows:

a) NAMAs that have been registered in the UNFCCC Registry including those for which funding support has been received
b) Other mitigations actions including national policies and strategies
c) Status report on participation in international market mechanisms

3.2 Nationally Appropriate Mitigation Actions

In line with the UNFCCC decisions related to NAMAs, commonly referred to as the Bali Action Plan, Uganda has been keen to contribute to climate change mitigation. Uganda has followed a systematic process of developing and implementing NAMAs. The initial activity was the adoption of a NAMA Framework developed with support from the African Development Bank in 2011 in which a long list of mitigation options were identified. This was taken up under the UNDP-supported Low Emission Capacity Building Project from 2014 that helped prioritise NAMA options and develop full concepts. The selected concepts were subsequently registered in the UNFCCC NAMA registry as NAMAs Seeking Support. At least one of these has received funding and is being implemented.

Overall, Uganda's national mitigation actions are at different stages of development and implementation. The mitigation actions have been developed based on the Intergovernmental

Panel on Climate Change (IPCC) categorised sectors, namely: energy, transport, AFOLU, IPPU and waste. Across the different sectors, the steps taken to develop mitigation actions differ based on the source and availability of resources. The distribution of mitigation actions across sectors are often driven by the demand for implementation in each sector in an effort to ensure the sector contributes its fair share to national development priorities and subsequently mitigation of climate change.

Following are brief outlines of the NAMAs under implementation or planned as at 2015.

3.2.1 NAMA on Greening Schools through Uptake of Improved Institutional Cook Stoves in Uganda

Name of the action: Revolving Loan Facility for the Uptake of Improved Institutional Cook Stoves in Ugandan Schools
Sector: Energy – Biomass
GHG: CO2
Coverage Quantitative goals / Objectives:
The geographical scope of the NAMA covers the whole country of Uganda, targeting schools in urban, semi-urban and rural areas; in the long term, the NAMA should cover all types of schools and educational institutions in Uganda–government-aided and private, primary, secondary, and tertiary, as well as institutions with educational activities (not having the status of a school). This translates to more than 18,000 primary schools, almost 3,000 secondary schools, and about 50 tertiary schools.

The goal of the NAMA is to ensure the reduction of GHG emissions by increasing energy efficiency of stoves by replacing the traditional stoves to Improved Institutional Cook Stoves (IICS), in line with the targets set in Uganda's Nationally Determined Contributions (NDC).

The outcomes will be:

- Reduction in GHG emissions from schools due to use of fire wood cook stoves with increased efficiency.
- Increased fuel cost savings for schools due to a decrease in the amount of fire wood consumed leading to a reduction in expenditure on fire wood.
- The development of a robust and sustainable IICS market resulting in significant job creation in the country.

Institutions Involved:
Ministry of Energy and Ministry Development, Ministry of Educations and Sports, Local Government Staff, Stove Manufacturers, Uganda National Bureau of Standards, Non-government organizations, Microfinance institutions

Methodologies / Assumptions:
The NAMA Support Programme aims to promote the uptake of Improved Institutional Cook Stoves (IICS) is about 21,460 public and private schools in Uganda. Currently, majority of the schools in Uganda are using inefficient traditional three-stone fire which consume high

amount of fire wood. Three-stone fire stove is the cheapest way in which the majority of schools use to prepare meals. It is easy to construct as it requires only three suitable stones on which a cooking pan is balanced on fire. This makes it the most preferred option amongst schools in Uganda.

Therefore, the BAU scenario applicable for this NSP is the continued use of firewood in the existing traditional inefficient three stone fire cook stoves to meet their thermal energy needs.

The methodology used for estimation of GHG emissions is the CDM - small scale methodology for energy efficiency measures in thermal applications of non-renewable biomass - AMS- II.G: Version 9. The methodology is applicable for projects aiming to introduce efficient thermal energy generation units utilizing non-renewable biomass or retrofitting of existing units reducing the use of non-renewable biomass for combustion.

Steps taken/ envisaged:

1) Marketing and fundraising to generate the financing pool, together with activities needed to identify and establish individual entities for the implementation (especially the NAMA Implementing Entity for everyday operation, and the Financial Trustee for operating the Revolving Loan Facility);
2) Procurement for provision of services (technical assistance and capacity building) will be performed to develop capacity of IICS manufacturers: NAMA initiation activities such as cook stove testing, screening and selection of manufacturers, preparation of stove catalogue, and development of MRV system.
3) Development of a business model to identify ways and potential to pay back the investment of PV systems will be identified, piloted and tested in conjunction with technical assistance measures in the first year. This will include entrepreneurial activities by the school itself (sale of services based on electricity, rent of electrified space, etc.);
4) MRV of NAMA: Finalization and capacity building of project management team which includes hiring of National staff coordinator and UNDP technical manager, finalization of project management team, and trainings to new staff meetings with education and environment departments.
5) Implementation of RLF includes selection of schools and their respective chosen technology for participation in Revolving Loan Facility (RLF) and installation of IICS.
6) MRV of NAMA includes preparatory activities for MRV such as selection of extension officers, purchase of magpi/tablets, trainings to extension officers and staff, and dry tests; and MRV activities along with gender evaluations

Outcomes achieved: None. The NAMA implementation was planned to commence in 2016.

Estimated emission reductions:

The NAMA is expected to reduce about 16.383 million tCO2 over 10 years which is based on the 10-year lifetime of the last Improved Institutional Cook Stoves to be installed.

3.2.2 NAMA on Integrated Waste Management and Biogas in Uganda

Name of the action: Integrated Waste Management and Biogas in Uganda
Sector: Waste management
GHG: CH4
Coverage Quantitative goals / Objectives:

The overall objective of the project is improved waste management practices in towns and municipalities through the introduction of integrated waste management, and deployment of biogas energy systems based on organic fraction of MSW, agro-processing waste (where combined with municipal wastes), sewerage sludge and wastewater for biogas energy generation.

This project aims to provide environmental benefits and reduce greenhouse gas emissions (estimated 223,000 tonnes of CO2eq and from methane reduction) from improper and inadequate management and treatment of wastewater and organic waste in towns, municipalities and agro-processing industry in Uganda. The project combines demonstration and investment in integrated waste treatment and biogas plants in agro-processing industry and municipalities (including biogas-based, on-grid electricity generation) with institutional strengthening, capacity building for improved waste management, and an improved regulatory framework that interventions are sustainable and can be replicated in other municipalities and across agro-processing industry.

Progress indicators:
Policies developed and adopted, Number of municipalities undertaking Integrated Waste Management and Number of Associated investments in waste management facilities.

Institutions Involved:
Ministry of Energy and Mineral Development, National Environment Management Authority (NEMA), National Water Sewerage Corporation (NWSC and five District Local Governments of Mbarara, Mbale, Jinja, Masaka and Kampala Capital City Authority (KCCA).

Methodologies / Assumptions:
The methodology used for calculating emissions was based on avoided GHG emissions and the reduction of methane emissions. The direct and consequential reductions related to increased renewable energy (biogas based power) and continued reduction in methane emissions were estimated using the methodology described in the document "Manual for calculating GHG benefits of GEF Projects: Energy Efficiency and Renewable Energy Projects".

Steps taken/ envisaged:
1) Establishing enabling market conditions, institutional strengthening and capacity building for improved waste management and promotion of MSW-based biogas systems
2) Demonstration and investment in integrated wastewater treatment and biogas plants
3) Scale up the use of biogas technologies in other municipalities
4) Knowledge Management and Monitoring and Evaluation

Outcomes achieved: The project commenced in 2018.

Estimated emission reductions:
The total reductions are estimated as follows:

- Direct GHG reductions: 88,315 tonnes CO2eq per year and 1,766,000 tonnes CO2e over the 20-year lifetime of investments
- Consequential GHG reductions: Between 3,533,000 tonnes CO2eq (estimated using the bottom-up methodology) and 3,771,000 tonnes CO2eq (estimated using top-down methodology)

3.2.3 NAMA ON Climate-Smart Dairy Livestock Value Chains in Uganda

Name of the action: Climate–Smart Dairy Livestock Value Chains in Uganda
Sector: AFOLU
GHG: CH4
Coverage Quantitative goals / Objectives:

The objective of this NAMA is to trigger resilient low-carbon development in the dairy sector through the introduction of climate-smart agricultural practices and to bring the dairy production sector of Uganda onto a low carbon and more resilient path. The NAMA focuses on a set of interventions and measures related to policy development, technical assistance, and access to finance that will be integrated within sustainable commercial oriented investment activities that contribute to enhanced agriculture productivity, climate change mitigation and adaptation, improved food security, and increased incomes.

The objectives of the NAMA are:

(i) Sustainably increasing agricultural milk productivity and incomes;
(ii) Adapting and building resilience to climate change along the milk production value chain; and
(iii) Reducing greenhouse gas emissions. Mitigation measures which will be considered under climate-smart resilient agriculture are those that reduce emissions from enteric fermentation and animal manure management.

Progress indicators:
Policies developed and adopted, new practices introduced and implemented

Institutions Involved:
Ministry of Agriculture, Fisheries and Animal Industry, Ministry of Water and Environment, Feed producers, hay procures, cooperatives, NGOs, milk facilities and dairy farmers

Methodologies / Assumptions:
The GHG baseline assumed the continuation of the current agricultural practices in Uganda. According to Uganda's Second National Communications to the UNFCCC, enteric fermentation and animal manure management was the most significant emitter of methane in the agriculture sector which generated 241.23 Gg of CH4 in 2000. Uganda's Nationally

Determined Contribution (NDC) also indicates that this is projected to increase four times by 2030.

The baseline emissions from enteric fermentation and animal manure management are calculated based from the 2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories. In the absence of sufficient disaggregated data for a more detailed calculation, the Tier 1 method using default emission factors was used.

The NAMA focuses on the dairy sector therefore, the species and category of livestock considered for baseline determination are specific to dairy cattle. The number of dairy cattle populations in Uganda was obtained from the Food and Agriculture Organization of the United Nations (FAO) food and agricultural data statistics page, FAOSTAT.

The project emissions are calculated based on an FAO report on reducing enteric methane for improving food security and livelihoods that suggests that the mitigation potential of improving feed quality in dairy production in East Africa reaches 19 percent of baseline emissions. A conservative estimate that the NAMA results in a 10 percent improvement in digestibility of feeds, and hence, decrease in enteric methane production is made.

Steps taken/ envisaged:
1. Introduction of Feed Standards and Certification System
2. Introduction of a Labelling System
3. Production of Improved Animal Feed
4. Production and Supply of Hay
5. Establishment of Milk Collection and Storage Points
6. Livestock Manure Management and Biogas Production
7. Capacity-Building and Public Awareness

Outcomes achieved: None

Estimated emission reductions:
The NAMA is estimated to result in emission reduction of about 402,500 tCO2e annually from its enteric fermentation component.

3.2.4 NAMA on Vehicle Fuel Efficiency Initiative in Uganda

Name of the action: Vehicle Fuel Efficiency Initiative in Uganda
Sector: Energy - transport
GHG: CO2

Coverage Quantitative goals / Objectives:
The objective of this NAMA is to improve the fuel efficiency and reduce emissions from vehicles through a holistic value chain approach. The NAMA will go beyond regulating emissions from the vehicle fleet, particularly high emitting vehicles older vehicles and poorly maintained vehicles, and would also look at options for vehicle recycling, and local vehicle manufacturing. The NAMA is designed in a comprehensive manner and covers policy

measures, fuel standards and public awareness, in addition to hardware (vehicle assembly and recycling) components.

The objectives of the NAMA involve comprehensive measures that cover policy measures, fuel standards and public awareness, in addition to hardware (vehicle inspection, labelling, assembly and recycling) components.

Progress indicators:
Policies developed and adopted, Inspections, labelling and initiatives introduced implemented.

Institutions Involved:
Ministry of Energy and Mineral Development, Ministry of Works and Transport, Ministry of Internal Affairs, Uganda Revenue Authority, National Environment Management Authority, Uganda National Bureau of Standards, Kampala Capital City Authority, vehicle inspection agencies, vehicle importers and vehicle owners.

Methodologies / Assumptions:
The GHG baseline assumes the continuation of current practice of importing old vehicles without any restrictions on minimum required fuel efficiency. Thus, the existing old vehicles can be used on without any modifications to improve their fuel efficiency.

The methodology used to compute emissions is IPCC 2006, Volume 2, Chapter 3. Mobile Combustion.

The baseline emissions calculated from Road transport in Uganda in Year 2015 is 2,561,906 tCO2.

Steps taken/ envisaged:

1) Develop and implement relevant Policy Interventions – Vehicle emission limits and Fuel Standards
2) Introduction of labelling for compliance upon completion of vehicle import inspection
3) Prescribe Periodic Vehicle Inspection to restrict use of vehicles emitting within prescribed limits are on the road
4) Introduction of Fuel Standards
5) Introduction of Vehicle Age Limit
6) Establishment of a Vehicle Recycling Industry
7) Establish Vehicle Assembly in Uganda
8) Establish Production of Electric Motor Bikes in the country
9) Conduct Public information and awareness

Outcomes achieved: The infrastructure for vehicle inspection has been constructed. Inspections also commenced but mandatory enforcement encountered difficulties.

Estimated emission reductions:
No emission reductions have been computed.

3.2.5 NAMA on Bus Rapid Transit for Greater Kampala

Name of the action: Bus Rapid Transit for Greater Kampala

Sector: Energy - transport and its infrastructure

GHG: CO2

Coverage Quantitative goals / Objectives:

The objective of this NAMA is to introduce a Bus Rapid Transit (BRT) system in the Greater Kampala Metropolitan Area (GKMA) to meet the growing demand for mobility.

The purpose of this NAMA is to improve the efficiency of public transport, by moving commuters from private vehicles to public transportation to address both traffic and pollution problems. The NAMA will reduce transport emissions in the Kampala metropolitan region from a business as usual baseline.

This NAMA will assist Uganda in planning, developing and financing a coordinated urban transportation system around design of routes, linkage between the BRT routes and other modes of transport, facilities and resources to increase ridership, operational mechanisms of efficiency such as scheduling, on time repairs, maintenance, buses, pricing, park and ride facilities. The activities of the NAMA include building 9 routes of the BRT, non-motorised transport (NMT) routes linked to the bus routes, park and ride facilities, programming and scheduling buses along the routes, and ensuring systems for operational efficiency.

Progress indicators:
The investment is sourced and the annual amount of bus kilometres for the BRT pilot project number of buses operating at the peak hour.

Institutions Involved:
Kampala Capital City Authority, Ministry of Works and Transport, Uganda National Roads Authority

Methodologies / Assumptions:
The baseline scenario is the present transport industry in Kampala, mainly consisting of taxis and motorcycles for hire (*boda-bodas*) which cannot accommodate the growing transport demand, cannot deliver the quality that customers ask for and, by its number, has become part of the congestion problem.

The project scenario is a city transit industry is transformed into a modern integrated network of BRT, buses and taxi each playing complementary roles with the BRT having a dominant role in the central part of Greater Kampala and the existing transport industry is motivated to modernise and expand their business to the fast growing suburbs by up scaling of the fleet and improving the quality of service through a fully regulated transport market by means of concessions.

Steps taken/ envisaged:

a. Feasibility, Preliminary Engineering Design and Operations
b. Detailed Engineering Designs, Operations & Business Plan and Bidding Documents
    a. Pilot phase (phase A) will focus on the implementation of the BRT
    Future implementation of the full BRT

Outcomes achieved:
Feasibility study, detailed design and plan completed.

Estimated emission reductions: Not estimated.

3.2.6 Other NAMA in the UNFCCC Registry

Uganda communicated another NAMA to the UNFCCC Registry described below:

Title: Promoting cultivation of high-yielding upland rice in Uganda

Sector: AFOLU – Crop Agriculture

GHG: NO2

Objective:

To increase rice production in Uganda for both domestic and export markets by promoting the cultivation of high-yielding upland rice, as opposed to lowland paddy rice, in various parts of the country.

3.3 Other Mitigation Actions

Other mitigation actions are categorized as policy measures and initiatives that address national needs and have a recognizable contribution to the mitigation of climate change. A summary is presented in Table 3.1.

Table 3.1: Summary of Other Mitigation Actions

Sector	Name of the Mitigation Action	Objectives	Progress	GHG emission reduction
Energy	Briquette making; Lubigi waste water treatment	To introduce sludge re-use as part of the	Partially implemented (sludge treatment plant	Not estimated

	plant; sludge re-use (Kampala, Uganda)	waste water treatment	constructed operational, briquette making not implemented)	
	Renewable Energy Policy 2005	Policy has a vision of making modern renewable energy a substantial part of the national energy consumption and set a target of increasing the use of modern renewable energy, from 4% to 61% of the total energy consumption by the year 2017.	Implementation undertake through various programmes: • Power generation using renewable energy achieved through large, mini and micro hydro, biomass co-generation and solar systems • Rural and peri-urban electrification through subsidized community-based projects with increased connections • Modern energy services; through dissemination of improved cook stoves and charcoal making kiln projects • Limited progress in biofuels programme	Not estimated
	Biomass Energy Strategy (BEST) 2013	• Develop a communication strategy specially tailored to various audiences: end users, policy makers and technocrats • Create a biomass information System • Enhance Institutional Capacity to regulate use of the biomass resources • Increase Fuel Efficiency and	Planned	Not estimated

		clean cooking environment through awareness, financing, dissemination of technologies and better supply		
	Energy Efficiency programme	• Energy Efficiency improvement in industry and households through energy audits and distribution of LED lamps, respectively	• Implemented	Not estimated
IPPU	Demand Side Management of Energy Use in MSMEs of the manufacturing sector - Switch Africa Green Project (NOVEMBER 2015-JUNE 2018)		Implemented	Not estimated

In line with the requirements under the Paris Agreement (2015), Uganda submitted her nationally determined contributions (NDCs) that include emission reductions target of 22% below the business as usual by 2030. Table 3.2 summarizes the emission reduction actions envisaged under Uganda's NDC.

Table 3.2: Summary of Mitigation Actions in the NDC per sector

Sector	Name of the Mitigation Action	GHG emission reduction
Energy	Construction of enabling Infrastructure for electricity sector development including power lines, substations and transmission facilities	Achieve a total of at least 3,200 Mega Watts renewable electricity generation capacity by 2030 up from 729 Mega Watts in 2013
	Sustainable energy solutions in public buildings: Energy efficiency in hospitals	Unknown 82 ktCO2e/a from 1,000 schools in

Sector	Name of the Mitigation Action	GHG emission reduction
	National Appropriate Mitigation Action for Integrated Sustainable Energy Solutions for Schools in off-grid areas	pilot
	Promotion and wider uptake of energy efficient cooking stoves or induction cookers (Residential biomass burning: ~30 MtCO2e in 2000)	Approx. 40% efficiency saving over traditional cooking stoves
	Promotion and wider solar uptake of solar energy systems	Emission reduction potential of about 1.5 million MtCO2eq/yr in 2030
	Development and enforcement of building codes for energy efficient construction	Unknown
	Development and Implementation of long-term transport policy accounting for climate change mitigation concerns	Unknown
	Development and implementation of a long-term transport policy accounting for climate change mitigation concerns.	Unknown
AFOLU	Climate Smart Agriculture techniques for cropping Agricultural Soils 36% of national GHG emissions (13.5Million tons $MtCO_2eq/yr$ in 2000	~ 2.7 million tons of carbon dioxide equivalent per year (MtCO2eq/yr). in 2030 (0.33-0.35 tons carbon dioxide equivalent per hectare) (Smith et al 2008)
	Livestock breeding research and manure management practices (Enteric fermentation: 19% of national GHG emissions (7 Million tons of carbon dioxide equivalent per year (MtCO2eq/yr).) in 2000.Projected to increase by 4 times by 2030)	4% economic potential for emission reduction in East Africa, rising to 20% in other regions. (Smith et al 2008).
	Developing enabling environment for wetland management	Increase wetland coverage to 12% by 2030 from approx. 10.9% in 2014 through demarcation, gazettement and restoration of degraded wetlands
	Development of enabling environment for forestry management	Reverse deforestation trend to increase forest cover to 21% in 2030, from approximately 14% in 2013, through forest protection, afforestation and

Sector	Name of the Mitigation Action	GHG emission reduction
		sustainable biomass production measures.

3.4 REDD+ Activities

In accordance with decision 1/CP.16, paragraph 70, the Conference of the Parties encouraged developing country Parties to contribute to mitigation actions in the forest sector by undertaking the following activities: reducing emissions from deforestation; reducing emissions from forest degradation; conservation of forest carbon stocks; sustainable management of forests; and enhancement of forest carbon stocks. Data and information on REDD+ to be reported as "technical annexes" to the BURs. Inclusion of REDD+ as part of the Annex in the BUR is Voluntary; applicable only for those developing country Parties seeking to obtain and receive payments for results-based actions.

Uganda being an active REDD+ party, its FBUR, features an update on the progress of the REDD+ programme in the country.

a) Out of the Cancun/Warsaw REDD+ Elements, Uganda has completed and submitted the REDD+ Strategy Preparation and Reference Emissions Level/Reference Levels. The country is still working on the Monitoring Systems for Forests and Safeguards information System (SIS) to be completed in 2020.
b) On results-based actions, Uganda expects to transition, in accordance with *Decision 1/CP.16*: Paragraph 73, into results-based actions that should be fully measured, reported and verified. However, this will not happen in the tenure of Uganda's first Biennial Update Reporting period.
c) With regard Reference Levels, in 2017, Uganda, on a voluntary basis, submitted its proposed forest reference emission level (FREL), in accordance with decision 13/CP.19 and in the context of results-based payments. The FREL proposed by Uganda covers the activity "reducing emissions from deforestation", which is among the activities included in decision 1/CP.16, paragraph 70. The FREL presented in the submission, for the reference period 2000–2015, corresponds to 8,047,420 tonnes of carbon dioxide equivalent per year (t CO2 eq/year). As a result of the facilitative process during the technical assessment, the FREL was modified to 8,254,691 t CO2 eq/year.
d) The methodologies applied for estimating GHG emissions are consistent with the IPCC good practice guidance for LULUCF and the 2006 IPCC Guidelines. .

Uganda has elaborated plans for implementation of national REDD+ activities, especially in the context of Uganda's NDC. Under the LULUCF sector the main mitigation actions will be from REDD+ based on the REDD+ Strategy. The strategy outlines 8 action areas:

1. Strategic option 1. Climate smart agriculture2 has three sub-options, which all aim to reduce the need for agricultural expansion to forest areas by intensifying and increasing agricultural production on existing agricultural land, include

[2] Deforestation-free agricultural supply chains sub-option was considered to be relevant in future, current options concentrate on small holders.

a. SLM and agroforestry practices;

b. Rainwater harvesting with collection tank and drip irrigation;

c. Greenhouse cultivation of vegetables;

2. Strategic option 2. Sustainable fuelwood and (commercial) charcoal production has three sub-options, which aim to reduce need of use of wood sourced from natural forest by providing energy wood, charcoal and construction materials from forest plantation, include

    a. Commercial small-holder and community bioenergy woodlots;

    b. Commercial small-holder and community poles and timber plantations;

    c. Improved charcoal kilns linked to bioenergy woodlots;

3. Strategic option 3. Large-scale commercial timber plantations strategic option has three sub-options, which aim to reduce the need of wood sourced from natural forest by providing construction materials and charcoal from forest plantation, include

    a. Commercial transmission pole and timber plantation;
    b. Commercial pole and saw log plantation;
    c. Improved charcoal kilns linked to plantation sites;

4. Strategic option 4. Restoration of natural forests in the landscape3 has three sub-options, which aim to restore and maintain the still existing forested areas. Aim is also to involve local people and the forest dependent communities with the activities including

    a. Designated areas for natural forest regeneration;

    b. Restoration of degraded protected natural forest (i.e. national parks and forest reserves and forests on privately owned land);

    c. Devolution of forest management through PFM and similar set-ups;

    d. Traditional/customary forest management practices;

5. Strategic option 5. Energy efficient cooking stoves has two sub-options aiming at making use of wood more efficient and that way reduce the pressure on natural forests.

    a. For fuelwood;

    b. For charcoal;

6. Strategic option 6. Integrated wildfire management aims to reduce the destructive impacts of wildfires on forests.
7. Strategic option 7. Livestock rearing in the Cattle Corridor has three sub-options aiming at improving and intensifying livestock management to reduce the need for clearing up forests for pasture lands.

    a. Livestock breeding programme;

    b. Establishment of drinking water dams for livestock;

[3] Forest certification and responsible management (to address leakage) was analyzed as sub-option, but considered not relevant options at the moment.

c. Establishment of fodder agroforestry plantations;

8. Strategic option 8. Strengthening of policy implementation for REDD+ is an over-arching option, which aims to facilitate the implementation of the other options.

Ultimately the amount of carbon that will be abated upon implementation of each of the strategic option, for a period of 25 years range from 3.6 to 16,049 MtCO2eq tons. The maximal abatement potential of the proposed strategic options is 31,284 MtCO2eq, which is an average 341 Mt carbon per year and/or 1,251 MtCO2eq per year. This is above the expected BAU scenario for the national carbon emissions. Strategic option 7 does not have a set carbon mitigation target as the carbon mitigation target for livestock management has been included in scope of other strategic options. Even the strategic sub-option 7.3 Establishment of agroforestry fodder plantations focuses on annual fodder production, which means that most carbon sequestration will be used as fodder for livestock and is therefore not available for carbon trading. Strategic Option 8 is an over-arching option as it strives to increase the efficiency of the others, while it is not bringing additional carbon emission reduction impacts by itself (MWE. 2017. National Redd+ Strategy and Action Plan) (ANNEX Table)

Out of the Cancun/Warsaw REDD+ Elements, Uganda has completed and submitted (1) REDD+ Strategy Preparation; (2) Reference Emissions Level/Reference Levels. The country is still working on the (3) National Forest Monitoring System and (4) Safeguards information System (SIS). The two latter elements will be completed in 2020. National REDD+ Strategy and Action plan was completed in October 2017and launched at UNFCCC COP 23. The development of the Strategy undertook a complete assessment of the drivers of deforestation and forest degradation, land tenure issues, forest governance issues, gender considerations and the safeguards identified in paragraph 2 of appendix I to this decision, ensuring the full and effective participation of relevant stakeholders, inter alia indigenous peoples and local communities.

3.5 Effects of Mitigation Actions

3.5.1 GHG Emission Reductions

The direct effect of a mitigation action is the reduction of GHG emissions. In order to obtain this effect, an appropriate methodology must be utilized. Referring to outline 3.2, each NAMA is expected to reduce emissions from the business-as-usual case once the mitigation action is implemented as planned in Uganda.

The policy and strategies are mainly aimed at addressing national developmental challenges in which the objectives and justification is based on their developmental objectives and the impact on society in terms of economic benefits and poverty reduction and to some extent environmental effects without necessarily explicitly defining emission reduction objectives or levels. This is a gap that may need to be addressed.

With respect to the Uganda's NDC, estimates were undertaken and the country envisages a cumulative impact of the policies and measures from the mitigation ambitions to be approximately 22% reduction below BAU by 2030 as shown in Figure 3.1. Energy mitigation impact from renewable energy supply is forecast to be between 2.7 to 3.7 Million tons carbon

dioxide equivalent per year (MtCO2e/a). The indicative NDC Business as Usual emissions projection for Uganda, including Land Use Land Use Change and Forestry, is 77.3 MtCO2eq/yr in 2030 although the total emissions in 2000 were 36.5 MtCO2eq/yr.

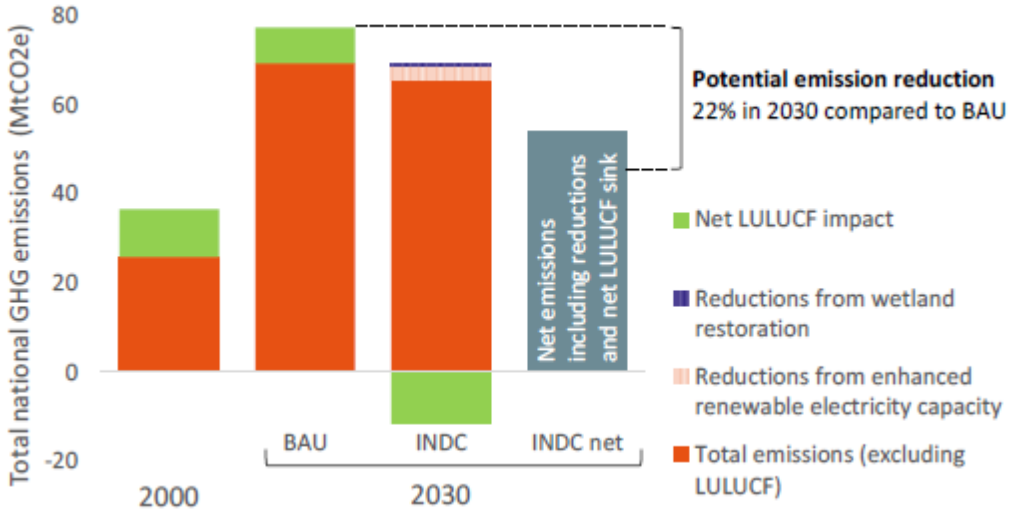


Figure 3.1: Mitigation Effects based on NDC estimates.

3.5.2 Co- benefits of the Mitigation Actions

Mitigation measures have a range of positive human health, ecosystem functioning, macroeconomic, social, and/or equity side effects. In some cases, these co-benefits outweigh the importance of climate change mitigation benefits.

Generally, the direct benefits of the mitigation actions implemented under the energy sector include diversification and conservation of energy sources for energy security and independence, more efficient use of fossil fuels, rural electrification water supply and demand, and improved road networks. The energy sector in the long term will improve health, contribute to gender equality, improve air quality by reducing local air pollution, particulates and increase the availability of qualified, highly efficient, productive national manpower.

The implementation of mitigation Actions in the AFOLU sector leads direct benefits of **i**ncreased energy access, increased forest cover, protection of biodiversity, protection of cultural and important sites. Indirect co benefits of implementing mitigation actions in the AFOLU sector include improved health, quality of life, sustainable development and improved resilience of rural communities by providing, more secure access to forest resources, participation in forest governance, employment and economic stimulus, Supply of sustainable timber and improved infrastructure facilitating market access.

Direct co-benefits from waste sector are clean and renewable energy sources and alternative sources of fertilizers and other soil conditioners as well as improved waste collection. The long term co benefits are improved sanitation through faecal management, improved air

quality by reducing methane and other trace gases (reduce strong odours), reduced environmental pollution within Lake Victoria catchments, improved air quality, conserve foreign exchange by using local biogas and created employment opportunities in Waste collecting centres especially in the 12 municipalities.

Mitigation actions implemented under IPPU sector have resulted in co-benefits of improved health, quality of life and employment opportunities.

3.5.3 Effects on Sustainable Development

Uganda's effort to address climate change impacts and their causes through appropriate measures promote sustainable development and green growth. Uganda's contribution to emission reduction is multidimensional and is not limited to goal 13 of the United Nations Sustainable Development Goals. Sustainable development Co-benefit tool[4] designed by UNFCCC which is mainly used for CDM assessment for sustainability has been tailored to assess impact of migration actions under the different sectors Table 3-3

Table 3-3. Mitigation Actions and Impacts on sustainable Development

	GHG emissions and key indicators of SDG	**Energy**	**AFOLU**	**Waste**	**IPPU**
Key to rate impacts for each sector: Blank - N/A ♦ Partly there is Impact by the Mitigation Action ♦♦ Medium Impact by the Mitigation Action, ♦♦♦ Substantial Impact by the Mitigation Action					
A. The extent of Environmental Co-benefits					
Air	Reducing SOx				
	Reducing NOx				
	Reducing Suspended Particulate matter (SPM)				
	Reducing Non Methane Volatile Organic Compounds (NMVOCs)				
	Reducing Noise Pollution				
	Reducing Odours			♦	
	Reducing Dust				♦

[4] Sustainable development co-benefit tool: Sustainable Development co-Benefits Tool. The sustainable development (SD) tool enables you to showcase the sustainable development benefits of your project. The tool asks you to complete a survey about your projects co-benefits. The results of this survey are used to create a detailed report that is then published on the UNFCCCs website. https://www4.unfccc.int/sites/sdcmicrosite/Pages/SD-Tool.aspx

	GHG emissions and key indicators of SDG	Energy	AFOLU	Waste	IPPU
Key to rate impacts for each sector: Blank - N/A ♦ Partly there is Impact by the Mitigation Action ♦♦ Medium Impact by the Mitigation Action, ♦♦♦ Substantial Impact by the Mitigation Action					
	Other air quality improvements				
Land	Preventing end of life products /equipment (Solid waste)			♦♦	
	Producing using compost			♦	
	Producing/using manure, mineral fertilizer or other soil nutrients		♦♦	♦	
	Irrigation		♦♦	♦	
	Prevention of soil erosion		♦♦	♦	
	Minimum tillage		♦♦	♦	
Water	Improving management of waste water			♦♦	♦
	Saving/conserving of water			♦	♦
	Improving reliability/accessibility of water supply			♦	
	Purification/cleaner water supply	♦♦	♦	♦	
	Improving ecological state of water bodies	♦	♦	♦	♦
	Other means to improve water	♦	♦	♦	♦
Natural resources	Protecting Mineral Resources		♦		
	Protecting/enhancing plant life		♦		

	GHG emissions and key indicators of SDG	Energy	AFOLU	Waste	IPPU
Key to rate impacts for each sector: Blank - N/A ♦ Partly there is Impact by the Mitigation Action ♦♦ Medium Impact by the Mitigation Action, ♦♦♦ Substantial Impact by the Mitigation Action					
	Protecting/enhancing species diversity		♦		
	Protecting/enhancing forests	♦♦	♦	♦	♦
	protecting/enhancing other depletable natural resources	♦	♦	♦	♦
B. The extent of Social Co- Benefits					
Jobs	New Long Term Jobs	♦♦♦	♦	♦	♦♦♦
	New Short term Jobs	♦	♦♦	♦♦	♦
	New Sources of Income Generation	♦♦	♦	♦♦	♦
	Other Employment Opportunities	♦♦	♦	♦	♦
Health Safety	Disease Prevention			♦	
	Reducing accidents				
	Reducing Crime				
	Preserving Food				
	Reducing Health damaging indoor air pollution				
	Enhancing health services				
	Improving sanitation and waste management			♦	
	Other health and safety improvement	♦			

	GHG emissions and key indicators of SDG	Energy	AFOLU	Waste	IPPU
Key to rate impacts for each sector: Blank - N/A ♦ Partly there is Impact by the Mitigation Action ♦♦ Medium Impact by the Mitigation Action, ♦♦♦ Substantial Impact by the Mitigation Action					
Education	Job Related training	♦	♦	♦	♦
	Enhanced Education Services				
	Project-related knowledge dissemination				
	Other Education Benefits				
Welfare	Improving working Conditions		♦		
	Community or rural advancement		♦		
	Poverty alleviation (more people above poverty level)				
	Improving wealth distribution/generation of income assets			♦	
	Increased Municipal revenues			♦	
	Optimized Women's Empowerment	♦			
	Reduced Traffic Congestion				
	Other welfare benefits				
C. The Extent of Economic Co-Benefits					
Growth	New Investments			♦	♦
	New Industrial/Commercial activities				
	New Infrastructure				
	Enhancement of Productivity	♦			

	GHG emissions and key indicators of SDG	Energy	AFOLU	Waste	IPPU
Key to rate impacts for each sector: Blank - N/A ♦ Partly there is Impact by the Mitigation Action ♦♦ Medium Impact by the Mitigation Action, ♦♦♦ Substantial Impact by the Mitigation Action					
	Reduction of Production Cost (Services)	♦♦	♦		
	New Business Opportunities	♦		♦	♦
	Other economic Benefits				
Energy	Improving Supply of energy	♦♦♦			♦
	Access to energy	♦♦♦	♦		
	Affordability and /or reliability of energy	♦♦			
	Other Energy Improvements	♦♦			
Technology	Introducing/developing/diffusing imported technology	♦			♦
	Introducing /developing/diffusing local technology				
	Adaptation of new technologies to local circumstances	♦		♦	♦
	Know-how activities for a technology other technological benefits				
Balance of Payments	Reduction of foreign dependency				
	Other macro-economic benefits				

3.6 Status report on participation in international market mechanisms

Uganda is one of the most active countries in the international market mechanism through the Kyoto Protocol's CDM. Participation of Uganda started with the implementing of the Kyoto Protocol's Clean Development Mechanism (CDM).

The projects under implementation since 2015 have a strong focus on forestry (seven projects) and renewable energy, particularly hydro power (six projects). In total Uganda has 20 projects registered and under validation. Other standalone CDM projects include three biomass energy, one landfill gas, one wastewater treatment, one domestic lighting and one biodiesel project (UNFCCC, 2019). Table 3-4 shows a summary of CDM projects in Uganda.

Table 3-4. Summary of CDM Projects by Sector

Sector	Name of the Mitigation Action	Planned/ Implemented	Type of CDM Project	GHG emission reduction	Total CER's issued
Energy	Institutional Improved Cook Stoves for Schools and Institutions in Uganda	Implemented	PA5	31,286 tCO2e/year	0
	Up Energy Improved cook stove Programme, Uganda (PoA)	Implemented	PoA6	53,9654 tCO2e/year	131,057
	Secure Safe Water in Developing Countries	Implemented	PoA	36,340 tCO2e/year	0
	Anaerobic digestion and heat generation at Sugar Corporation of Uganda Limited	Implemented	PA	46,974 tCO2e/year	139,121
	Nakivubo Wastewater Treatment Plant Methane Capture and Utilisation Project	Implemented	PA	27,591 tCO2e/year	0
	Production of biodiesel from non-food oil seeds	Implemented	PA	40,120 tCO2e/year	0

[5] Project Activity

[6] Programme of Activity

	Nuru Lighting Project - Uganda	Implemented	PA	14,839 tCO2e/year	0
	Bujagali Hydropower Project	Implemented	PA	858,173 tCO2e/year	5,234,813
	Buseruka Mini Hydro Power Plant	Implemented	PA	31,468 tCO2e/year	28,276
	Mpanga 18 MW Run-of-River Hydropower Project	Implemented	PA	36,839 tCO2e/year	25,335
	West Nile Electrification Project (WNEP)	Implemented	PA	14,885 tCO2e/year	49,262
	Ishasha 6.6 MW Small Hydropower Project	Implemented	PA	21,084 tCO2e/year	44,502
	Bugoye 13.0 MW Run-of-River Hydropower Project	Implemented	PA	51,074 tCO2e/year	98,524
AFOLU	Kachung Forest Project: Afforestation on Degraded Lands	Implemented	PA	25,702 tCO2e/yr	30,492
	Namwasa Central Forest Reserve Reforestation Initiative	Implemented	PA	11,328 tCO2e/yr	0
	Uganda Nile Basin Reforestation Project No 1	Implemented	PA	5,881 tCO2e/yr	0
	Uganda Nile Basin Reforestation Project No 2	Implemented	PA	4,861 tCO2e/year	0
	Uganda Nile Basin Reforestation Project No 3	Implemented	PA	5,564 tCo2e/year	4,732
	Uganda Nile Basin Reforestation Project No 4	Implemented	PA	3,969 tCO2e/year	0
	Uganda Nile Basin Reforestation Project No 5	Implemented	PA	5,925 tCO2e/year	30,492
Waste	Mpererwe Landfill Gas Project	Implemented	PA	182,612 tCO2e/year	0
	Uganda Municipal Waste Compost Programme (PoA)	Implemented	PoA	115,237 tCO2e/year	16,549

Table 3-5. CERs issuance of CDM and PoAs projects in Uganda

Year	Issuance	Cumulative
2012	20,095.00	20,095.00
2013	105,679.00	125,774.00
2014	1,463,026.00	1,588,800.00
2015	52562	1,641,362.00

Regarding issuance of CERs to standalone CDM projects in Uganda, a total of 185,000CERs had already been issued by 2013. The West Nile Electrification project received its first 20,095CERs on 4th July 2012 for the period between 1 January 2005 and 31 October 2009.

Uganda also actively participated in the Programme of Activities (PoAs). The overall estimated emission reductions of PoAs with CPA in Uganda is 198,140CERs/year. As of March 2014, there were 17 PoAs under validation of which six PoAs are registered in Uganda, five PoAs were registered without Uganda as a host country. The six PoAs with their CPAs in Uganda include Uganda Municipal Waste Compost Programme with planned 83,700CER/year, but received 14,399tCO2 emission reductions for the period of 12 April 2010 to 30 April 2012, Improved Cook stoves for East Africa (ICSEA) with planned 40,577CER/year has achieved emission reductions of 4,051tco2 for over a period of six months between 15 September to 14 March 2013, International water purification programme with planned 6,254 CER/year, Up energy improved cook stove programme Uganda with planned 36,787CER/year, PoA for the reduction of emissions from non-renewable fuel from cooking at household level with planned 30,822 CER/year and secure safe water in developing countries with planned 39,414CER/year. Table 3-5 provides a summary of the projects and PoAs in Uganda.

3.7 Cost Benefit Analysis of Mitigation Action

This section presents an overview of costed mitigation actions which are further subjected to an elaborate cost benefit analysis to guide investment decision making. The cost benefit analysis is undertaken against a criteria that entails contribution to reduction in greenhouse gases, potential adaptation co-benefits and the magnitude of technological, financial and institutional risk thereof.

Cost Benefit Analysis of Climate Change Mitigation Option

Uganda aspires to build a resilient economy along a low carbon development pathway. Achieving the low carbon development trajectory is fully reliant on optimal implementation of climate change mitigation measures as highlighted in the national climate change responsive documents. The mitigation options are outlined the Nationally Determined

Contributions, REDD+ draft strategy, Uganda Green Growth Development Strategy and the costed implementation strategy of the National Climate Change Policy.

Methodology

A qualitative methodology has been used in the analysis as depicted in Figure 3-1. It builds from the collation of climate change mitigation actions from various sectors whose associated benefits, costs and risks were ranked in terms of intensity (High, Medium and Low). Types of risks assessed include; financial, institution, social and technological.

The analysis was highly consultative and involved extensive engagement with NDC prioritized sectors.

Mitigation and Adaptation Options: A Tool for Climate Action Planning

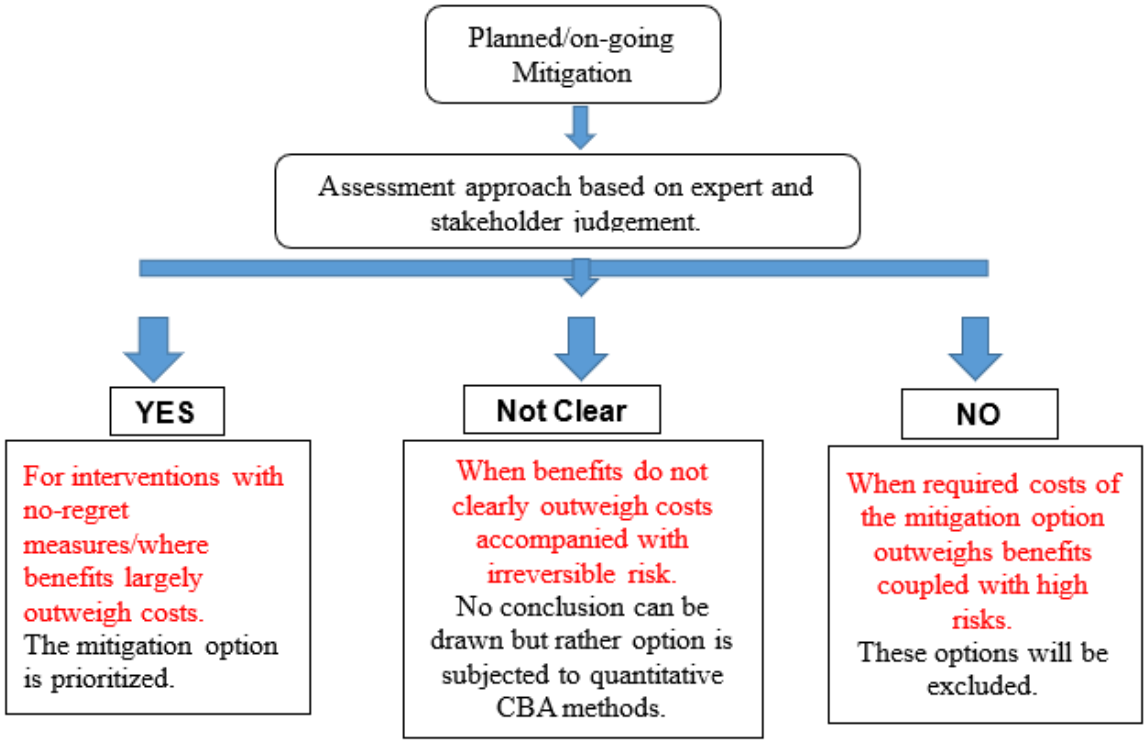


Figure 3-21. Conceptual Framework for the Qualitative CBA of Mitigation Options; Source: World Bank, A Risk Analysis and Screening Approach for Climate Change

Results of the Cost Benefit of Analysis

Tables 3- 6 to 3- 11 show the results of the analysis.

Table 3-6. Summary of the recommended energy sector mitigation options

Energy Sector	
Sector Specific Mitigation Option	Recommendation
Energy and Transport Sector	
Construction of power lines, substations and transmissions	Should be adopted with an in-depth CBA.
Energy Efficiency Measures in Hospitals	Should be adopted without in depth CBA
NAMA for sustainable energy solutions for schools in off-grid areas	Should be adopted with an in depth CBA
Promotion of wide uptake of energy efficient cooking stoves or induction cookers.	Should be adopted with an in depth CBA

Promotion of wider solar uptake of solar energy systems.	Should be adopted with an in depth CBA
Development and enforcement of building codes for energy efficient construction and renovation.	Should be adopted with an in depth CBA
NAMA for fuel efficiency	Should be adopted with an in depth CBA
Introduction of Mass Rapid Transport (BRT)	Should be adopted without an in depth CBA

Table 3-7 Summary of the recommend Industrial Processes and Product Use (IPPU) Mitigation actions

Industry Sector Mitigation Actions	
Sector Specific Mitigation Option	Recommendation
Industrial Processes	
Promote cleaner production in the industrial sector (waste reduction	YES
Promote and encourage waste-to-energy programmes to reduce GHG emissions and increasing energy generation and access. (from Municipal waste)	YES
Energy generation by anaerobic systems (biogas)	YES

Table 3-8. Recommendation for Agriculture, Forestry and Other land Use (AFOLU) Mitigation actions

Agriculture Sector	
Sector Specific Mitigation Option	Recommendation
Agriculture, Forestry and Other Land Use (AFOLU) (Source: NDC)	
Implement Climate Smart Agriculture techniques.	Highly Recommended
Establish livestock breeding research	Medium Recommendation
Manure management practices	Highly Recommended
Reverse deforestation trend to increase forest cover up to 21 percent in 2030	Highly recommended

Establish community forest management mitigation.	Highly recommended
Strengthen forest institutions responsible for forest management and development	Highly recommended
Creation of national information database through re-inventory and assessment of all wetlands.	Highly recommended
Design and implement 11 RAMSAR site wetland research, ecotourism & education centers.	Medium Recommendation
Design and implement 111 district wetland action plans with carbon sink potential.	Highly recommended
Demarcation and gazettement of 20 critical and vital wetland systems and their maintenance country wide as carbon sinks.	Highly recommended
Strengthen Wetland Management Institutions responsible for wetlands management and conservation	Highly recommended
Land Use and Land-Use Change	
Sector Specific Mitigation Option	Recommendation
Demarcate areas reserved for industrial use and other land development	Highly recommended
Strengthen urban development authorities by providing funds and the ability to enforce regulations	
Promote human resource development in land management (capacity development)	
Strengthen law enforcement and regulate activities on land	
Reduced Emissions from Deforestation and Forest Degradation+ (REDD+)	
Conserve the existing forests and implement REDD+ programmes to access additional funds from carbon markets.	Highly recommended
Set-up mechanisms to regulate the implementation of REDD+ projects and the set-up of equitable benefit sharing schemes.	Highly recommended
Wetlands	
Promote and intensify wetland protection and restoration in order to enhance sinks of greenhouse gases	Highly recommended

Promote sustainable use of wetlands	Highly recommended
Promote and encourage conservation agriculture and ecologically compatible cropping systems and agricultural practices to increase GHG sinks	Highly Recommended
Promote the sustainable management of rangelands to reduce GHG emissions from soil and land degradation	Highly Recommended
Promote the sustainable utilisation of agricultural products	
FORESTRY SECTOR	
Sector Specific Mitigation Option	Recommendation
Ensure that the forest sector continues providing global services in mitigation of climate change while supporting sustainable development needs of the country.	Highly recommended
Provide financial support, technology transfer and provision for capacity building, especially to forest-dependent communities.	Highly recommended
Provide incentives for farmers to establish commercial woodlot plantations, including peri- urban plantations	Highly recommended
Implement a system for supporting research and regular data collection and monitoring the status of the forests in terms of areal extent, distribution, plantation species introductions and biodiversity	Highly recommended

Table 3-9 Table. Recommendation for the waste sector mitigation actions

Waste Sector Mitigation Actions	
Sector Specific Mitigation Option	Recommendation
Increased waste reuse, recovery and recycling (policy)	YES
Energy generation by anaerobic systems (biogas)	YES

Table 3-10. Recommendation options for the works and transport mitigation actions

Works and Transport Sector Mitigation Actions	
Sector Specific Mitigation Option	Recommendation

Improved road infrastructure, and traffic management in urban centers to reduce congestion and GHG emissions.	YES
Improve existing railway transport to reduce road traffic and Greenhouse gas emissions.	YES
Develop accessible non-motorized modes of transport.	YES
Develop NAMAs in the Transport Sector.	YES
Develop and enhance low carbon transport modes such as bus rapid transport, light rail transport and inland water transport systems.	YES

3.8 Sectoral Specific Prioritized Climate Change Mitigation Options

This sub-section presents the categorization of mitigation measures into no- regret, low-regret and high risk. This categorization is based on overall climate change benefits and the associated risks in terms of finances, institutional, social and technological. The climate change benefits are perceived in terms of greenhouse gas emissions and the adaptation co-benefits. The risk assessment was undertaken as a proxy for the costs of the interventions since there was a dearth of data on financial costs of the intervention to follow up with an in-depth quantitative analysis.

3.8.1 Financing and financial risks

Realistic financial costs and sustainability will be essential for successful implementation of mitigation actions.

3.8.1.1 Social Risk

Climate change affects social groups differently with severe effects on women, youths, people with disabilities and other vulnerable groups. Therefore, when selecting the mitigation action issues of equity and gender equality should be paramount..

3.8.1.2 Institutional Risks

Institutional barriers and coordination challenges may pose systemic risk that undermined successful implementation of planned mitigation actions.

3.8.1.3 Technological Risk

Several mitigation options must be efficient and less emissive in terms of greenhouse gases. Mitigation options that can be implemented using appropriate clean technologies will be prioritized.

Categorization of Mitigation Options by Sector

The qualitative analysis of the proposed and ongoing mitigation options is based on the appreciation that well intended mitigation actions can have negative spill overs that may compound climate change in the absence in depth analysis.

The high-risk measures that are not only costly with higher risks but low climate change benefits. The recommendation is that these mitigation options are subjected to a further in-depth quantitative cost benefit analysis

The No-Regret measures that generate vast climate mitigation benefits with wider social benefits and lower risks and costs;

The low regret measures with medium benefits, costs and risks that can be contained in the context of implementation.

Below is the cost benefit assessment by sector categorised by no-regret and low regret

Table 3-11. Categorization by sector

Sector	**Categorization**	
	No regret measures	**Low regret measures**
Energy	NAMA for sustainable energy solutions for schools in off-grid areas.	Construction of power lines, substations and transmissions.
	Energy Efficiency Measures in Hospitals.	Promotion of wider solar uptake of solar energy systems
		Development and enforcement of building codes for energy efficient construction and renovation
		NAMA for fuel efficiency
		Introduction of Mass Rapid Transport (BRT)
Industrial Processes and Product Use (IPPU)		Promote cleaner production in the industrial sector (waste reduction)
		Promote and encourage waste-to-energy programmes to reduce GHG emissions and increasing energy generation and access. (from Municipal waste)
Agriculture, Forestry and other Land Use (AFOLU)	Implement climate smart agriculture measures	Promote sustainable management of rangelands to reduce greenhouse gas emissions from soil and land degradation
	Establish livestock breeding research and manure management practices	

	Strengthen urban development authorities by providing funds and the ability to enforce regulations	
Land use, Land use Change and Forestry	Reverse deforestation trend to increase forest cover up to 21 percent in 2030	
	Design and implement 111 district wetland action plans with carbon sink potential	
	Creation of national information databases through re-inventory and assessment of all wetlands	
	Conserve the existing forests and implement REDD+ programmes to access traditional funds from carbon markets	
Waste Sector	Increased compost production (fertilizer) from wastes	
	Increased waste reuse, recovery and recycling (policy).	
Other (Works and Transport) Sector	Improved road infrastructure, and traffic management in urban centres to reduce congestion and GHG emissions.	
	Improve existing railway transport to reduce road traffic and Greenhouse gas emissions	
	Develop accessible non-motorized modes of transport	
	Develop NAMAs in the transport sector	
	Develop and enhance low carbon transport modes such as bus rapid transport, light rail	

	transport and inland water transport systems	

3.9 General Overview of the Categorization and Assessment.

The above assessment and categorization was based on sector consultation and expert judgement. It was noted that some mitigation measures are interrelated and as such, the assessment may not include all mitigation options in every climate change responsive document.

Also, some interventions have already been implemented for instance, the Land Use intervention on demarcating areas reserved for industrial use and other land development. The Government has gazetted twenty-two industrial and business parks as part of its industrialization strategy. Such mitigation measures that are already implemented or whose implementation is at its tail end were not considered in the assessment.

3.10 Conclusion

All climate change mitigation options are critical to Uganda's response to climate change and meeting the NDC targets. Nonetheless, the financial constraints require prioritization and implementation of measures with the highest multiplier effect in terms of climate change mitigation, reduction in greenhouse gas emissions, adaptation co-benefits and overall social benefits to society.

As such, the categorization may inform investment decisions on what to implement first as financial and other forms of facilitative resources trickle in. The NDC target of reducing greenhouse gas emissions by 22 percent by 2030 is highly feasible if the country augments its climate finance mobilization efforts to implement the planned mitigation measures.

4. INFORMATION ON DOMESTIC MEASUREMENT, REPORTING AND VERIFICATION (MRV)

4.1 Roadmap to Uganda's MRV

The entry into force of the Paris Agreement ushered in new reporting requirements for Uganda. The new reporting requirement to commence by 2024 will require a robust system has and institutional capacity to continuously measure and track mitigation actions and related benefits more than ever before. Additionally, Uganda needs to generate evidence to inform domestic investment in mitigation, motivate for access to climate finance and other support and equip the country to engage more effectively on what represents a fair contribution to the global climate change mitigation effort.

The need to build a robust MRV system is well recognized amongst key government institutions. Though the private sector is potentially a bigger player in mitigation actions, its participation in the MRV process is not well defined and not evident. Processes and regulations that require private sector to collect and report data and approaches used to estimate anticipated or achieved mitigation impacts with government are not in existence.

4.1.1 Uganda's MRV

Based on the requirements for domestic and international reporting for Uganda's MRV may be described as still in its infancy with many elements not yet well developed and many facets not well connected. The required data sets is available in institutions listed in section 2.2.1 but a lot is yet to be done in terms of data collection processes, regular updates, GHG computation approaches including QA QC processes.

The current system has been able to provide GHG inventories, baselines for NAMAs, REDD+ and other mitigation actions but mainly in an ad hoc manner. In many instances, axe ante emission reduction targets are stated without clear documentation of methodological approach- see list of proposed NAMAs in section 3-2.

Apart from CDM PoA and VCS projects \ programmes that follow a well-established carbon tracking system, the element of measuring and reporting mitigation and their impacts is almost none existent and is not well defined in many of the Uganda's domestic mitigation actions.

4.1.2 Efforts to build a sustainable Domestic MRV

Uganda is endeavouring to improve its capacity in all aspects that will enable it fulfil its obligations in respect to the current international MRV Framework (i.e., submit National Communications (NCs) every 4 years and Biennial Update Reports (BURs) every two years including assessment of needs and providing specific information towards access to international support (figure 4-1).

Though not a requirement under the existing UNFCCC MRV Framework, Uganda is undertaking additional voluntary actions such as National Adaptation Plans (NAPs) and Technical Needs Assessment Reports (TNAs). All these actions are intended to improve the

information on climate change planning and actions including technical, financial and capacity needs required to implement climate change actions.

For the implementation of the Paris Agreement, a more robust MRV known as the Enhanced Transparency Mechanism (EF) is expected to be established. Uganda's domestic MRV is to be anchored within this framework (Figure 4-1).

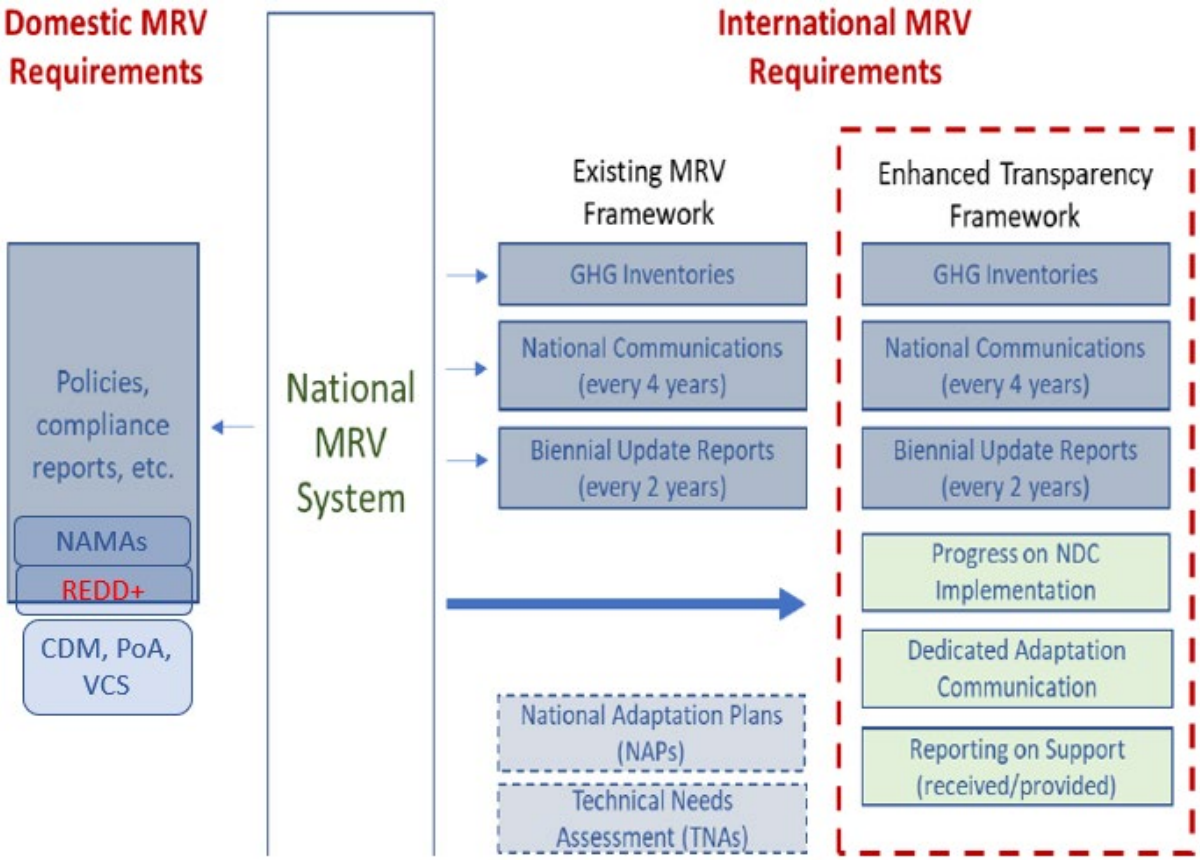


Figure 4-1. Domestic MRV to be anchored to the existing framework

Uganda has developed draft MRV framework document which has been discussed by key stakeholders including taskforce members of FBUR. The frame work emphasizes coordination and institutionalization of the MRV. Proposed MRV action centres, roles and responsibilities are presented in table 4-1.

4.1.3 Coordination Entities

To address barriers related to institutional arrangements a number of improvements in coordination are proposed in the draft framework. The Climate Change Department within the Ministry of Water and Environment remains the coordination entity and has 9 elements or levels. The three that are in bold are already in existence. Six more levels to will support the current system.

- **Permanent Secretary,**
- **National Focal Point for UNFCCC**
- Administrative and Financial Specialist,
- Communication Specialist,
- Team leader GHG Emissions Inventory,
- Team Leader Mitigation Actions
- Team Leader Adaption Action,
- Team Leader for NC and BUR
- **Sector QA Coordinator**
- Administrative and Technical Linkages

The framework proposes close linkages between administrative and technical teams. At a technical level, QA\ QC coordinators are to be in regular contact with both GHG compilers and team leaders for Mitigation, Adaptation, NC and BUR. At the same time, QA\ QC coordinators and Team Leaders will regularly consult with the administrative and commination specialist (figure 4-2). CCD focal person will regularly consult with the heads of all the teams.

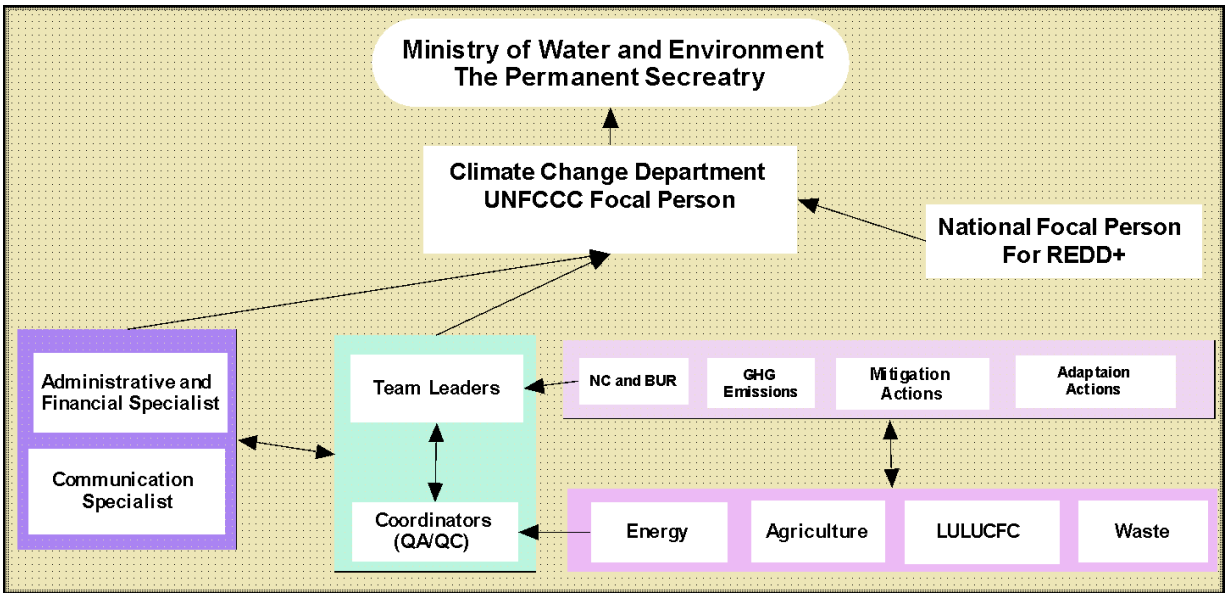


Figure 4-2. The proposed coordination structure of the National MRV; source: draft MRV framework

The key roles and responsibilities for the coordinating entities that are anticipated address barriers related to institutional arrangements are elaborated in Table 4-1.

Table 4-1. Technical and Administrative coordination entities roles and responsibilities; Source: draft report MRV framework for Uganda

Coordinating Entity	Roles
Permanent Secretary,	Reporting to the UNFCCC
National Focal Point for UNFCCC	Reporting to the UNFCCC

	Coordinating the teams working on different aspects in other sectors Coordinate the MRV systems activities Keep the country team fully informed about the Processes
Administrator and Finance Specialist	Coordinating logistics and administrative activities Ensure day today management of the Coordinating entity Support development of the work plans and budgets
Communication Coordinator (Outreach),	Developing Communication materials Communicating to stakeholders
Team Leader Mitigation Actions Team Leader Adaptation Action, Team Leader for NC and BUR Team leader GHG Emissions Inventory,	Coordinating with the team on technical aspects Scheduling the reporting timelines Drafting work programme for reporting Taking lead in implementing the GHG work plan Drafting work plan for GHG reporting updating the Team Leader Ensure Periodic reviews by independent entity/expert Provides additional assurance that information is transparent, accurate, complete, consistent, and comparable Ensure Methods for QC at source - Self-certification by data provider; - Review by programme administrator/ competent authority; - Third party verification Choose procedures that continuously improve the quality of the inventory Guide on the level of data collection/information and the level of detail appropriate to the method used Leading the team on activities for Key categories, largest emissions, greatest potential change and highest uncertainty Guide teams on review, data collection activities and methodological needs on a regular basis Guide on Periodic reviews by independent entity/expert – Guide on additional assurance that information is transparent, accurate, complete, consistent, and comparable Guide on Methods for QA at source - Self-certification by data provider; - Review by programme administrator/ competent authority; - Third party verification
Sector QA\ QC Coordinators (checks data collection processes, GHG computation approach and methods	Review data collection activities and methodological needs on a regular basis Check for Data Source – Activity data compiled from the source, standards Ensure peer review of emission factor Ensure reasonable data – that emission factor is consistent with scientific understanding of emissions process,

	Ensure consistence with IPCC guidelines and time series of activity data with economic trends Quality of data collection process recognised at national or international standards Ensure that Assumptions and criteria for selection - Descriptions of activity data and emission factors properly recorded and archived Transcription errors in data input and references- Bibliographical data references are properly cited -Sample of input data from each category checked Emissions and removals calculated correctly - Reproduce set of emissions and removals calculations - Use a simple approximation method to check calculations Compare between sites Units and conversion factors correct - Units properly labelled in calculation sheets - Conversion and adjustment factors are correct Consistency of data between categories - Parameters that are common are used consistently between categories Correct movement of data between processing steps - Emissions and removals data are correctly aggregated - Emissions and removals data are correctly transcribed between different intermediate products Uncertainties estimated correctly- Qualifications of experts providing judgement appropriate -Assumptions and expert judgements recorded - Duplicate uncertainty calculations on a small sample of the probability distributions used by Monte Carlo analyses Check for total GHG emissions checked - Check sum by gas - Check sum by source categories – Time series consistency checked - Temporal consistency across years for each category - Consistency in the algorithm/method used for calculations throughout the time series Completeness checked -All gases are estimated -All source categories are estimated
National focal Person REDD+	Reporting to the UNFCCC Focal Point for Uganda Coordinating the teams working on REDD+ aspects

4.2 GHG Inventory System

The GHG Inventory System is described in the Inventory chapter of this report. Section 2.2.5 specifically assesses availability and reliable of activity data. Direct measurements as a method of data collection is only in 4 out of 14 source categories assessed. Even where measurements are done, regular updating was in most instance lacking.

The GHGI for the SNC was mainly based on IPCC 1996 apart from the LULUCF which used the IPCC 2006 guidelines. NGHI for FBUR is based on the IPCC 2006 for all source categories. Even when the most recent guidelines are followed, lack of reliable activity data compromises the appropriateness of default emission factors the MRV guiding principle of TACCC.

4.3 Mitigation Actions (including NAMAs).

Although several mitigation actions including NAMAs are registered, a system for tracking progress of mitigation activities, support provided, and general progress in implementation is yet to be established. Action required for the current NAMAs include the following:

- Establishment of a mechanism for updating information on mitigation efforts that is currently scattered in different MDAs and on a number of websites. Specific reference is information on CDM, NAMAs, and VCS that is elaborated in section 3.2. This information needs to be organized in a database that can be easily updated. CCD is envisaged to take the lead on this.
- Building a system to track NAMAs and other mitigation actions that have gone through the development cycle.
- Operationalization of in country QA/QC processes

Establish Mitigation Working Groups (MWG) with representation of institutions responsible for collecting and reporting data related to mitigation actions in source categories of Energy, IPPU, AFOLU and Waste.

4.4 MRV for Support

Uganda does not have a climate change fund and thus it becomes relatively hard to accurately estimate spending on climate change. The Ministry of Finance (MoFPED) is the designated national entity and has key responsibility on tracking climate change finance received and spent. The National Climate Change Policy (2015) mandates MoFPED to facilitate the introduction of relevant financial mechanisms and tools to the relevant stakeholders, as per the implementation strategy, to support financial resource mobilisation and investment. Positively, MoFPED is working on the climate change budget tagging process but still at infant stages. Currently, the country's MRV system for support provided is not yet fully functional.

4.5 Information Gap

Weaknesses in the institutional arrangement, limited financial resources and to some extent technical capacity to develop a comprehensive MRV is serious challenge for Uganda to account for GHG emission reductions and the related benefits locally and internationally. Additional support to establish such a system is required.

5. CONSTRAINTS AND GAPS, and RELATED FINANCIAL, TECHNICAL AND CAPACITY NEEDS

Uganda is facing considerable challenges related to identification, characterisation and quantification of information on constraints and gaps, and related financial, technical and capacity-building needs. The information provided should be considered as not being complete. Information on the support received by the country is limited to the Global Environment Facility only.

5.1 Technical and capacity needs

Uganda's technical and capacity needs are enormous. However, the national circumstance, the NGHG inventory and the MRV section all indicate the key factor and pressing factor across board is lack of mechanisms to collect and update the reliable data that meets the minimum requirements i.e. Tier1 reporting as per IPCC guidelines.

There are a several efforts to develop systems and build capacity in key institutions to at least carry out GHG inventory in accordance with the IPCC guidelines and standards. However, there are still a number of challenges as presented in table 5-1 and they are summarized in the following areas:

Availability of data, capacity to collect the required, computation of GHG and availability of resources required to gather and utilize the data to fulfil the minimum requirements.

The explorations of oil in Uganda are ongoing. There several sites which ready for commercial drilling. There is ongoing plan to construct oil pipeline to the sea via Tanzania and a refinery in Hoima. It implies that the GHG inventory profile of Uganda will change by 2025. The potential sources of emissions are venting, flaring, exploration, transporting, refining and distribution of oil and gas. There is a need of capacity development in the area of greenhouse gas emission study. The oil and gas will be one of the key emission sectors in the near future.

Table 5-1: Summary of Constraints, gaps and needs identified

Sector \ Sub sector	Constraints	Gaps	Need as Identified
Climate Change Activity: National Circumstances			
All	Full domestication of international climate change obligations constrained by the on-going protracted enactment of the Policy, Legal and Regulatory Frameworks for climate change (derived from Chapter 1 of the FBUR report)	Whereas the national Climate Change Policy was passed, the supporting Climate Change Law and possible Regulations are still not complete	Financial support to complete the enactment of the Policy, Legal and Regulatory Frameworks for climate change
		Mainstreaming of climate change adaptation requirements and mitigation potential in national (sectoral) and district development plans	Financial support to mainstream climate change adaptation requirements and mitigation potential in national (sectoral) and district development plans
Climate Change Activity: National Green House Gas Inventory (GHG Inventory)			
All	Inadequate and sometimes un-availability of reliable data and their appropriate coefficients (derived from Chapter 2: paragraph 1of the FBUR report)	Inadequate and sometimes un-availability of reliable data and their appropriate coefficients	Establish relevant sub-sector work groups to develop a costed data improvement plan with the aim of improving reliability of data Mobilize resource for implementation of the plan

All	Uncertainty estimates are based on default values provided by IPCCC – Transparency, Accuracy.	About 70% of activity data in Uganda is not based on regular measurements but is rather estimated (derived from imports and exports, special studies, extrapolated from one off survey or in worst case scenario based on expert judgement). The level of uncertainty assessment is high in all sectors	Establish relevant sub-sector work groups to develop a costed data improvement plan with the aim of improving certainty estimates in the activity data and emission factors. Mobilize resource for the implementation of the plan
Energy	Apart from the electricity, data in other sectors is not desegregate by source category. Use of sectoral approach is thus remains limited- Consistency.	There is lack of energy use by industries. Data on transport sector is only reported by fuel type and not vehicle category	Formalize arrangements between MEMD, UNRA, Civil aviation authority, Uganda Railways cooperation, MAAIF water transport, etc for regular monitoring fuel use in the sub sectors. Mobilize resource for the operationalization of such a system
IPPU	Apart from the cement industry Uganda cannot adequately report on other industrial processes	Data is currently available on cement industries only. Other industrial processes like the form industry and aerosol industry are potentially key sources but there is paucity of data	Formalize arrangements between CCD, Ministry of Trade and Industries, NEMA and put in place mechanisms for data collection on potential sources in industrial processes. Identify and mobilizes resources for such

AFOLU	The time series in the latest GHGI does not extend back to the first inventory year reported in the NC1 - Consistency.	The draft GHGI does include some extrapolation of activity data which could be extended to 1994 using relative datasets however, Uganda still needs to Extend the GHG emission estimates back to 1994 and address inconsistencies with previous NCs	Where possible obtain data using similar datasets or extrapolate activity data back to 1994. Some recalculations may be necessary, and they should be explained in the next report.
	QA/QC procedures – Transparency, Accuracy	Include a section in the NIR on QA/QC procedures	Formalize Uganda's QA/QC procedures, implement them on the current inventory and report on the process and any improvements resulting from this work
	Archiving system - Transparency	Include a section in the NIR on archiving procedures	Formalize Uganda's archiving procedures, implement them for the current inventory and report on the work
3.B.1 Forest Land - KEY	Attribution for wood extraction (timber, poles and fuel wood) has high levels of uncertainty. This poses serious challenges in the estimation of GHG for LULUCF subsector using the gain loss method, the only approach available in the IPCC2006 version 2.54 of software	Estimation of wood extraction and attribution has high levels of uncertainty. In the SNC, Uganda used the gain loss method based on the forest inventory repeated measurements for the period 1992 to 2002. This data is however considered not representative of the current situation given the high rates of forest degradation especially in	Formalize arrangements (between NFA, FSSD, Local government) for regular monitoring of wood extractions. Mobilize financial support for the operationalization of the biomass information system as recommended in the Uganda's Biomass Energy Strategy 2014 Mobilize resources to speed up and increase the coverage of forest inventory that has been rejuvenated under the REDD+ so that Uganda can once again use the gain loss method which does not need wood extraction attribution

		the open dry forests (woodlands)	
3.C.1 Biomass Burning - KEY	Estimates for biomass burning have high levels of uncertainty despite being a key category – Completeness	Reliable estimates of area burnt and development of appropriate coefficients	Improve data collection protocols within NFA for estimating areas of biomass burning, biomass burnt and ratio of biomass the is burnt
3.B.1 Forest Land - KEY	There is limited data supporting the C stock factor for woodlands – Accuracy	Increase the number of sample plots in woodlands to improve the country-specific C stock factor. NFA is currently working to update factors as data comes in	Integrate the latest data collected from woodland plots into the emission factors. Also, we need to add new sampling plots as needed to improve accuracy.
3.B. Land - KEY	The minimum mapping unit applied for many of the LUC maps ranges from 0.5 ha to 5 ha. For forested areas may go up to 2 ha which does not align with the forest definition (1 ha) – Accuracy	Mapping approaches have evolved over time, mainly determined by the technological limitations. For example, in the 1990s, computer aided mapping was not available and the approach was tracing homogenous units on paper prints of satellite imagery. For many features, it was practically impossible to trace 1 ha units i.e, 2mm by 2 mm on 1:50,000 print.	Apply latest computer aided satellite image interpretation and analysis and re-analyze LULUC data from earlier maps applying the smaller minimum mapping unit using the same technology

3.B Land - KEY	Boundaries for climate, soil and land use change maps do not align – Consistency	Mapping standards among various government institutions not define and are not harmonized	Organize meetings to define mapping standards and form a technical team comprised of of NFA, NARO and UMI teams that will enforce the agree upon spatial data standards
3.B. Land - KEY	While preparing activity data for the 2017 \2018 FREL for REDD+, Uganda conducted an accuracy assessment on the 2000 to 2015 land use and land use change spatial data set. However the activity data was not disaggregated by all non-forest land uses class to allow for the estimation of conversion within non forest classes and estimation of post deforestation regrowth – Accuracy	Bias corrected area statistics are not available for all forest and non-forest land use change classes. Statistics on rate of conversions and associated GHG in non-forested areas can only be derived based on map unit ratios	Expand the accuracy assessment to develop bias-corrected area estimates for all land use change classes. This could be included as part of the re-analysis of the maps described above.

3.B. Forest Land - KEY	The current LULUC data structure does not distinguish between temporarily un stocked forest plantations and deforested forest plantation i.e., forest plantations that are harvested and not replanted or are not allowed to coppice – Accuracy	Criteria for distinguishing forest plantations deforestation and temporary loss of tree cover (harvesting but with a plan to reforest) is not in place. This issue is partially address by accuracy assessment but the long time period used (15 years) is not adequate. Given a short rotation period (8 to 15 years) 15 years is too long to capture the forest dynamics.	Shorten the period of change assessment to five years or less as the country builds consensus and develops criteria for distinguishing between temporary forest plantations harvest and deforestation by defining a threshold time span when a harvested forest plantation is considered deforested. Mobilize resource to conduct times series assessment of short time intervals
3.B Land - KEY	Improve estimates of changes in soil C in forest lands converted to other land and from soil and residue management on croplands and drained or managed organic soils – Accuracy	The spatial resolution of the soils data is at a scale 1:250,000 while the land use data set is at a scale of 1:50,000 and higher. There is no data on soil and residue management practices by cropping system and areas of drained or managed organic soils	Speed up the process of updating Uganda's soil spatial data to a scale of 1:50,000 or higher. Collect data using existing MIAAF/ UBOS annual agricultural surveys to estimate the extent of different soil and residue management and initiate new research studies where necessary
3.B Land - KEY	Default values currently used to estimates changes in C stock in land types – Completeness	Country specific activity data and emission factors deadwood by land category is not available	Integrate the latest data collected from the NFI supported by REDD+. Mobilize resource for adequate sampling across all land categories to estimate C pools in deadwood

3.A.1 Enteric Fermentation - KEY	No reliable livestock statistics and livestock categorization for proper application of default emission factors– Accuracy	Apart from the 2007/8 livestock census, livestock data for other years is based on estimates (projections, interpolations etc.). Disaggregation of cattle by dairy and non-dairy is mainly based on expert judgment	Put in place a data collection mechanism that allows regular updating of the livestock database categorized by dairy and non-dairy cattle, reliable estimation of number of goats, sheep, camels, donkeys, horses, breeding swine and market swine breeds Mobilize resource for the operationalization of such a system
3.A.2 Manure Management	Estimates of GHG emissions from manure management rely on expert judgement – Accuracy	There is no established mechanism for collecting data on manure management systems	Put in place a data collection mechanism that allows collection and regular updating of the manure management systems by livestock categories. Mobilize resource for the operationalization of such a system.
3.C.7 Paddy Rice Cultivation	Information on area of paddy rice and management practices varies from one source to the other and mainly relies on expert judgement – Accuracy	There is no established mechanism for collecting data on paddy rice. Traditionally, there has not been any need to document area under paddy rice and management practices.	MAAIF, UBOS, NFA and District Agricultural services need to collaborate such that NFA provides information on area under paddy rice by use of remote sensing, MAAIF, UBOS and District Agriculture office collect information on management practices, days of rice cultivation, water management regimes and application organic amendments etc.

3.D.1 Harvested Wood Products -	Changes in C stocks from Harvested Wood Products are not included in the GHGI - Completeness	Include estimates of Harvested Wood Products. Some data on HWPs does exist but no estimates of changes in C stock have been complied	Put in place a data a multi sectoral data collection mechanism that allows collection and regular updating of data on wood import and export, harvests and wood value chain to establish products categories. Mobilize resource for the operationalization of such a system
3.C.2,3 & 4 Liming, Urea application and N from both synthetic and organic fertilizer application	Emissions from soil management practices are either estimated based auxiliary data or estimated based on expert judgement Completeness	No mechanism to document soil inputs in terms of lime, urea, and fertilizer (synthetic and organic)	Put in place a data a multi sectoral data collection mechanism (with MIAAF and UBOS as sector leads) that will enable collection and regular updating data on lands inputs in terms of liming, Urea application and N application of synthetic and organic fertilizers. Mobilize resource for the operationalization of such a system
WASTE	Waste is predominantly a concern of urban setting. Kampala, the capital city remains the only urban centre with substantial information on waste. Even then, about 80% of the solid waste is on unmanaged sites and is under preserve of KCCA. NWSC is directly responsible for domestic	Estimation of emissions of waste sector remain problematic mainly due to paucity of data. In addition, management and responsibilities are distributed among different government institutions depending on waste type. Prior to the requirements of the national GHG inventory, there	Organize meetings to define data requirements and collection procedures for the waste sector (key institutions being KCCA, NEMA, Local government, Industries, Housing finance, Local government). Formalize arrangements between CCD, identified government agencies and private sector for collecting relevant data on waste. Identify and mobilizes resources for data collection

	water treatment while NEMA is responsible to the industrial waste water discharge.	has not been need for harmonisation and comprehensive data collection on wastes		
Climate Change Activity: Mitigation actions and their effects				
Mitigation		Elaboration, planning and reporting inadequate	Limited institutional capacity	Regular activities of the Technical Working Group Further capacity building
Climate Change Activity: MRV				
	As discussed in the MRV section		Costed MRV to be provided after a national dialogue	

5.2 Implementation Constraints

Implementation of National mitigation actions in Uganda within the UNFCCC framework remains a great challenge given the aforementioned barriers and constraints. CDM, PoA and VCS have had some success but has limited participation. Uganda's implementation capacity and constraints can be summarized in as follows;

Capacity to undertake mitigation assessments; and formalised roles and responsibilities to which institutions and individuals are held accountable.

Capacity to formalise relations with the private sector especially those mitigation actions that are majorly managed by the private sector (e.g., transport, charcoal production, industrial process and product use).

5.3 Reporting

Compared to some of the developing countries, Uganda has great constraints in fulfilling its reporting obligations. Uganda has only submitted the first and second national communication while others are on the fourth National Communication. Uganda is currently undertaking the first biennial update report when some of the sister developing have already submitted the second biennial update report and are starting on the third. Even then, Uganda has got very limited exposure to international reporting processes. For instance, Uganda has so far achieved the following;

1. Only the land use change and forestry under the AFOLU sector got a chance to undergo external review or Technical Assessment when Uganda's first Forest Reference Emission Level (FREL) for REDD+ was submitted to UNFCCC in 2017.
2. Quality controls \ Quality assurance measures are yet to applied in determining levels of certainty for the National GHG Inventory include generic quality checks of the calculations, data processing, completeness and applicable documents.

5.4 Financial needs

It is estimated that Uganda needs about USD 11 million for it to overcome its technical and capacity shortcomings in the establishment of a system to track GHG and mitigation efforts see table 1- 6 in appendix.6. Depending on the adaptation and mitigation activities chosen, the cost of these activities may be in the range USD 290 million and USD 700 million respectively (table 1- 7, table 1-8 in appendix IV).

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The Global Environment Facility (GEF), through the UN Environment provided funds to the tune of USD 352 000 to support the preparation of the FBUR.

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BIBLIOGRAPHY

1. ACTADE 2017, An Outlook of Uganda's Climate Finance Landscape, Konrad Adenauer Stiftung Uganda, Plot. 51A Prince Charles Drive, Kololo, Uganda
2. German Development Institute, 2016: Private Finance for Climate Change Adaptation: Challenges and Opportunities for Kenya.
3. Government of Uganda (2002), Ministry of Water and Environment, (2002). Initial National Communication
4. Government of Uganda (2014), Uganda Second National Communication to the United Nations Framework Convention on Climate Change.
5. Government of Uganda (2015), Second National Development Plan
6. Government of Uganda (2017), Green Growth Development Strategy (UGGDS 2017/18 – 2029/30)
7. Government of Uganda 2015: National Climate Change Policy Costed Implementation Strategy.
8. Government of Uganda 2015: Nationally Determined Contributions
9. Government of Uganda 2017: Uganda Green Growth Development Strategy.
10. Government of Uganda, April 2015: National Climate Change Policy.
11. Green Climate Fund 2015: Private Sector Facility: Approaches to Mobilizing Funding at Scale. Green for Growth Fund (n.d.), "About Green for Growth Fund". Available at http://www.ggf.lu/aboutgreen- for-growth-fund/.
12. Green for Growth Fund (n.d.), "About Green for Growth Fund". Available at http://www.ggf.lu/aboutgreen- for-growth-fund/.
13. International Finance Corporation (Shilpa Patel), November 2010: Climate Change and the Private Sector.
14. J.C. Jansen and S.J.A. Baker December 2006: Social Cost Benefit Analysis of Climate Change Mitigation Options.
15. Jane Ellis – Challenges of regarding MRV of Climate Support (PPT presentation); Tirpak D, Brown LH and Ballesteros A. 2014. Monitoring Climate Finance in Developing Countries: Challenges and Next Steps. World Resources Institute. Available at http://www.wri.org/publication/monitoring-climate-finance-developing-countrieschallenges-and-next-steps.
16. Kampala Capital City Authority (2016), Kampala Climate Change Action
17. Kampala City Council Authority (2015), Kampala Kable Kar Feasibility Study.
18. Langdale-Brown, I. ;Osmaston, H. A. ; Wilson, J. G., 1964, The Vegetation of Uganda and Its Bearing on Land-Use
19. MEMD 2014, Biomass Energy Strategy (BEST) for Uganda
20. Ministry of Energy and Mineral Development (2007), the Renewable Energy Policy for Uganda.
21. Ministry Of Energy And Mineral Development (2015), Uganda's Sustainable Energy for All (Se4all) Initiative Action Agenda

22. Ministry of Water and Environment (2007). Climate Change – Uganda National Adaptation Programme of Action (NAPA)
23. Ministry of Water and Environment (2012). The Uganda National Climate Change Costed Implementation Strategy
24. Ministry of Water and Environment (2013). Uganda National Climate Change Policy
25. Ministry of Water and Environment (2015a), Uganda's Intended Nationally Determined Contribution (INDC).
26. Ministry of Water and Environment (2015b), Uganda National Climate Change Policy.
27. Ministry of Water and Environment (2017), Forest Investment Program for Uganda.
28. Ministry of Water and Environment (Climate Change Department), 2015: Economic Assessment of the Impacts of Climate Change on Uganda.
29. Ministry of Water and Environment (Climate Change Department), 2015: Nationally Determined Commitments.
30. Ministry of Water and Environment (Climate Change Department), 2015: National Climate Change Policy.
31. Ministry of Water and Environment (Climate Change Department), 2015: Economic Assessment of the Impacts of Climate Change on Uganda.
32. Ministry of Water and Environment (Climate Change Department), 2015: National Climate Change Policy.
33. Ministry of Water and Environment, 2015, Uganda National Climate Change Costed Implementation Strategy
34. Ministry of Works and Transport (2014), Bus Rapid Transit for Greater Kampala Final Report.
35. Nachmany, M, Fankhauser, S, Davidová, J., Kingsmill, N., Landesman, T., Roppongi, P., Setzer, J., Sharman, A., Stolle Singeton, C., Sundaresan, J., Townshend, T. (2014) The GLOBE climate legislation study: a review of climate legislation study: a review of climate change legislation in 66 countries. GLOBE International and the Grantham Research Institute, London School of Economics, London; 2014. Available: http://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2015/05/Global_climate_legislation_study_20151.pdf
36. Namanya, B., Muygeni, O. (2015). Shapeing National Climate Change Legislation in Uganda. *Environmental Management for Livelihood Improvement Bwaise Facility (EMLI).* Available: http://www.bwaisefacility.org/userfilesbf/A5%20Final%20Briefing%20Paper.pdf
37. Namanya, B., Muygeni, O. (2015). Shapeing National Climate Change Legislation in Uganda. *Environmental Management for Livelihood Improvement Bwaise Facility (EMLI).* Available: http://www.bwaisefacility.org/userfilesbf/A5%20Final%20Briefing%20Paper.pdf
38. National biomass Study 2002

39. National Planning Authority 2015/16: Second National Development Plan 2015/16 – 2019/20.
40. Netherlands Environmental Assessment Agency: Costs and Benefits of Climate Change Adaptation and Mitigation.
41. Organisation for Economic Cooperation and Development (OECD), 2017: Private Sector Engagement to Address Climate Change and Promote Green Growth.
42. Project Design Documents for small scale and large scale CDM projects. https://cdm.unfccc.int/Projects/projsearch.html
43. SIMOSHI (2017), Progress Report July 2017. Institutional Improved Cook Stoves for Schools and Institutions in Uganda
44. Steiner S. 2006; Decentralisation in Uganda: Exploring the Constraints for Poverty Reduction;
45. The Republic of Uganda , Ministry of Energy and Mineral Development, Annual Report 2005
46. The Republic of Uganda , Ministry of Energy and Mineral Development, Annual Report 2010
47. The Republic of Uganda , Ministry of Energy and Mineral Development, Annual Report 2015
48. The Republic of Uganda , Ministry of Energy and Mineral Development, 2015 Statistical Abstract
49. The Republic of Uganda , Ministry of Energy and Mineral Development, 2011 Statistical Abstract
50. The Republic of Uganda of Uganda, Ministry of Energy and Mineral Development 2015 Statistical Abstract
51. The Republic of Uganda, Ministry of Energy and Mineral Development, Sector Performance Report 2018.
52. The Republic of Uganda, Ministry of Energy and Mineral Development, Statistical Abstract, 2011.
53. The Republic of Uganda, Ministry of Energy and Mineral Development, Statistical Abstract 2017, Energy and Mineral Statistics.
54. The World Bank – Europe and Central Asia Region 2014: A Risk Analysis and Screening Approach for Climate Mitigation and Adaptation Options.
55. Tumushabe,G. Muhumuza, T., Natambe, E. Neil Bird, Bryn W. and Lindsey J. (2013): Uganda National Climate Change Finance Analysis.
56. Uganda Bureau of Statistics (UBOS), 2016, Uganda Demographic and Health Survey. Kampala, Uganda
57. Uganda Bureau of Statistics 2010 Summary Report on Uganda Census of Agriculture 2008/09
58. Uganda MRV draft framework, 2018
59. UNFCC (2018), Training Material for The Preparation of Biennial Update Reports

from Non-Annex I Parties: Finance, Technology and Capacity-Building Needs And Support Receive.

60. UNFCCC (2019), The Sustainable Development (SD) Tool. https://www4.unfccc.int/sites/sdcmicrosite/Pages/SD-Tool.aspx
61. United States Agency for International Development (USAID) 2011: Climate Change and Conflict in Uganda: The Cattle Corridor and Karamoja.
62. The Republic of Uganda, Energy and Mineral Development, Joint Sector Review Report 2015-2016.
63. IPCC 2006 Inventory Guidelines
64. IPCC 1996
65. EMEP/EEA Inventory guidebook 2013 updated July 2015.
66. Uganda Bureau of Statistics, Statistical Abstract 2007
67. Uganda Bureau of Statistics, Statistical Abstract 2010
68. EEA Technical Report No 12/2013, EMEP/EEA air pollutant emission inventory, guidebook 2013, Technical guidance to prepare national emission inventories

APPENDIX I: ENERGY ACTIVITY DATA AND EMISSION FACTORS

Sector Energy	Fuels Types	Activity data (toe)		Activity data (TJ)		Emission Factor (kg/TJ)			Emission Factor (g/GJ)			
Subsector		2005	2015	2005	2015	CO2	CH4	N20	NOX	CO	NMVOC	SO2
Energy Industries												
Thermal power plants	Diesel/Gas oil			1418	0	74,100	3	0.6	65	16.2	0.8	46.5
Thermal Power plants	HFO	0	26	20.6	866	77,400	3	0.6	142	15.1	2.3	495
Solid fuel manufacturing Charcoal	Charcoal	550,955	1,976,680	23,067	82,760	112000	30	4	81	90	7.31	10.8
Manufacturing Industries and Construction												
	Fuel wood	819,079	2,449,370	34,293	102,550	112,000	100	4	91	570	300	11
	Diesel /Gas oil	59,268	218,220	1642	9,136	74,400	3	0.6	513	66	25	47
	Residual oil	40,070	6.2	1,678	258	77400	3	1.5				
	LPG	538	0	23	0	63,100	1	0.1	74	29	23	0.67
	Bituminous Coal	0		0	11988.8	94600	10	1.5	173	931	88.8	900
	Anthracite Coal	0		0	0	0	0	0	173	931	88.8	900
Transport												
Civil Aviation	Aviation fuel	69634	109140	2,915	4569	71500	0.5	2	4	1200	19	1
Road Transport												

	Diesel /gas oil	183,192	407,480	7,670	17,060	74,100	3	0.6	600	8000	1500	6.7
	Petrol /Gasoline	137,718	447,270	5,640	18,726	69300	33	3.2	800	1000	200	28
Railway	Gas oil/diesel	0	28,960	0	1,212	74100	3	0.6	5.2	10.7	4.65	0
Agriculture : Note* emission g/tonne of fuel	Diesel /gas oil	26,940	29,600	1,128	1,254	74100	10	0.6	35043	10939	3366	0
	Fishing/gasoline		29,600		1,254	69,300	10	0.6				
Other Sectors												
Institution /commercial												
Cooking	firewood	1,103,707		46,210		112,000	300	4	91	570	300	11
	charcoal	147,869		6,191		112,000	200	1	91	570	300	11
	LPG					63,100	5	0.1	74	29	23	0.67
	Kerosene	29,686		1,243		71,900	10	0.6	513	66	25	47
Residential												
cooking	Firewood	5,424,771		227,124		112,000	300	4	80	400	600	11
	Charcoal	376,850		15,778		112,000	200	1	80	400	600	11
	Agric. Waste	443,972		18,558		100,000	300	4				
	LPG	2150		90		63,100	5	0.1	80	4000	600	11
	Kerosene	26,717		1,119		71,900	10	0.6	51	2.6	1.9	0.3

APPENDIX II: UNCERTAINTIES DETAILS

2006 IPCC Categories	Gas	Base Year emissions or removals (Gg CO2 equivalent)	Year T emissions or removals (Gg CO2 equivalent)	Activity Data Uncertainty (%)	Emission Factor Uncertainty (%)	Combined Uncertainty (%)	Contribution to Variance by Category in Year T	Inventory trend in national emissions for year t increase with respect to base year (% of base year)	Uncertainty introduced into the trend in total national emissions (%)
1.A.1 - Energy Industries - Liquid Fuels	CO2	0.001	55.960	5	6.136158302	7.91532935	7.58302E-06	7551983.806	2.15082E-05
1.A.1 - Energy Industries - Liquid Fuels	CH4	0.000	0.046	5	228.7878788	228.842508	4.1993E-09	7230000	8.51747E-09
1.A.1 - Energy Industries - Liquid Fuels	N2O	0.000	0.134	5	228.7878788	228.842508	3.66034E-08	7230000	7.4243E-08
1.A.1 - Energy	CO2	3051.312	10924.320	5	18.69416668	19.35127561	1.727244447	358.0204188	1.652440902

Industries - Biomass									
1.A.1 - Energy Industries - Biomass	CH4	291.262	1042.776	5	245.4545455	245.5054661	2.533087304	358.0204188	1.866372262
1.A.1 - Energy Industries - Biomass	N2O	107.489	384.834	5	304.5454545	304.5864966	0.531023735	358.0204188	0.391013508
1.A.2 - Manufacturing Industries and Construction - Liquid Fuels	CO2	369.352	764.053	5	6.136158302	7.91532935	0.001413612	206.8632725	0.002454521
1.A.2 - Manufacturing Industries and Construction - Liquid Fuels	CH4	0.309	0.646	5	228.7878788	228.842508	8.45823E-07	208.9107567	1.75434E-07
1.A.2 - Manufacturing Industries and	N2O	0.913	1.909	5	228.7878788	228.842508	7.37266E-06	209.1165382	1.53557E-06

Construction - Liquid Fuels									
1.A.2 - Manufacturing Industries and Construction - Solid Fuels	CO2	0.000	113.406	5	12.46005477	13.425832	8.95992E-05	0	0.00020685
1.A.2 - Manufacturing Industries and Construction - Solid Fuels	CH4	0.000	0.252	5	200	200.0624902	9.80413E-08	0	1.98895E-07
1.A.2 - Manufacturing Industries and Construction - Solid Fuels	N2O	0.000	0.557	5	222.2222222	222.2784651	5.9339E-07	0	1.20366E-06
1.A.2 - Manufacturing Industries and Construction - Biomass	CO2	4375.392	11485.600	5	18.69416668	19.35127561	1.909291959	262.5044796	1.272654785

1.A.2 - Manufacturing Industries and Construction - Biomass	CH4	24.612	64.607	5	245.4545455	245.5054661	0.009723453	262.5044796	0.004142243
1.A.2 - Manufacturing Industries and Construction - Biomass	N2O	48.442	127.162	5	281.8181818	281.8625332	0.04965182	262.5044796	0.021133808
1.A.3.a - Civil Aviation - Liquid Fuels	CO2	210.925	326.684	5	4.170829171	6.511206952	0.000174873	154.8813559	0.000419079
1.A.3.a - Civil Aviation - Liquid Fuels	CH4	0.031	0.048	5	100	100.124922	8.91766E-10	154.8813559	2.0753E-11
1.A.3.a - Civil Aviation - Liquid Fuels	N2O	1.829	2.833	5	150	150.0833102	6.98612E-06	154.8813559	1.23505E-07
1.A.3.b - Road Transportatio	CO2	1067.461	2561.932	10	8.29629129	12.99340022	0.003621005	240.0023911	0.006268347

n - Liquid Fuels									
1.A.3.b - Road Transportation - Liquid Fuels	CH4	4.492	14.052	10	346.9857219	347.1297901	0.000276979	312.7986212	0.000151196
1.A.3.b - Road Transportation - Liquid Fuels	N2O	7.304	21.750	10	302.9398928	303.1048971	0.000417912	297.7637101	0.000228294
1.A.3.b - Road Transportation	CO2	0.000	0.000	0	0	0	0	100	0
1.A.3.c - Railways - Liquid Fuels	CO2	0.000	92.921	5	2.024291498	5.394233594	9.71039E-06	0	3.66016E-05
1.A.3.c - Railways - Liquid Fuels	CH4	0.000	0.079	5	150.6024096	150.6853868	5.47727E-09	0	1.1117E-08
1.A.3.c - Railways - Liquid Fuels	N2O	0.000	0.233	5	200	200.0624902	8.41585E-08	0	1.70731E-07

1.A.4 - Other Sectors - Liquid Fuels	CO2	214.447	453.907	10	12.2723166	15.8306587	0.000131845	211.6644369	0.000146262
1.A.4 - Other Sectors - Liquid Fuels	CH4	0.606	1.285	10	400	400.1249805	6.67601E-07	212.2420669	3.48574E-07
1.A.4 - Other Sectors - Liquid Fuels	N2O	0.527	1.121	10	468.9852868	469.0918879	6.93981E-07	212.4713488	3.64154E-07
1.A.4 - Other Sectors - Biomass	CO2	35823.364	43017.520	7.071067812	26.43754405	27.36683642	24.46010401	120.0823016	6.772063827
1.A.4 - Other Sectors - Biomass	CH4	1981.783	2356.106	7.071067812	321.4121733	321.4899456	10.26850257	118.8881919	0.529615073
1.A.4 - Other Sectors - Biomass	N2O	378.691	448.086	7.071067812	421.049947	421.1093182	0.649179139	118.3251568	0.03558919
1.B.1 - Solid Fuels	CO2	0.000	0.000	5	0	5	0	100	0
1.B.1 - Solid Fuels	CH4	0.000	0.000	7.071067812	0	7.071067812	0	100	0
1.C - Carbon dioxide	CO2	0.000	0.000	12.24744871	0	12.24744871	0	100	0

Transport and Storage									
2.A.1 - Cement production	CO2	163.957	348.610	35	0	35	0.005753875	212.6219082	0.023331034
2.A.2 - Lime production	CO2	7.700	138.600	15	0	15	0.000167053	1800	0.000677374
2.A.3 - Glass Production	CO2	0.000	0.000	5	0	5	0	100	0
2.A.4 - Other Process Uses of Carbonates	CO2	0.000	0.000	0	0	0	0	100	0
2.B.1 - Ammonia Production	CO2	0.000	0.000	5	0	5	0	100	0
2.B.2 - Nitric Acid Production	N2O	0.000	0.000	2	0	2	0	100	0
2.B.3 - Adipic Acid Production	N2O	0.000	0.000	5	0	5	0	100	0
2.B.4 - Caprolactam, Glyoxal and Glyoxylic	N2O	0.000	0.000	10	0	10	0	100	0

Acid Production									
2.B.5 - Carbide Production	CO2	0.000	0.000	5	10	11.18033989	0	100	0
2.B.5 - Carbide Production	CH4	0.000	0.000	5	10	11.18033989	0	100	0
2.B.6 - Titanium Dioxide Production	CO2	0.000	0.000	5	0	5	0	100	0
2.B.7 - Soda Ash Production	CO2	0.000	0.000	5	0	5	0	100	0
2.B.8 - Petrochemical and Carbon Black Production	CO2	0.000	0.000	24.49489743	0	24.49489743	0	100	0
2.B.8 - Petrochemical and Carbon Black Production	CH4	0.000	0.000	24.49489743	0	24.49489743	0	100	0

2.C.1 - Iron and Steel Production	CO2	0.000	0.000	10	0	10	0	100	0
2.C.1 - Iron and Steel Production	CH4	0.000	0.000	10	0	10	0	100	0
2.C.2 - Ferroalloys Production	CO2	0.000	0.000	5	0	5	0	100	0
2.C.2 - Ferroalloys Production	CH4	0.000	0.000	5	0	5	0	100	0
2.C.3 - Aluminium production	CO2	0.000	0.000	2	0	2	0	100	0
2.C.4 - Magnesium production	CO2	0.000	0.000	5	0	5	0	100	0
2.C.5 - Lead Production	CO2	0.000	0.000	10	0	10	0	100	0
2.C.6 - Zinc Production	CO2	0.000	0.000	10	0	10	0	100	0
2.D - Non-Energy Products	CO2	0.000	0.000	14.14213562	0	14.14213562	0	100	0

from Fuels and Solvent Use									
2.G - Other Product Manufacture and Use	N2O	0.000	0.000	0	0	0	0	100	0
3.A.1 - Enteric Fermentation	CH4	11574.706	11574.706	0	0	0	0	100	0
3.A.2 - Manure Management	N2O	220.107	165.493	0	0	0	0	75.18751348	0
3.A.2 - Manure Management	CH4	479.948	470.083	0	0	0	0	97.944617822	0
3.B.1.a - Forest land Remaining Forest land	CO2	4813.684	21213.251	0	0	0	0	440.6863875	0
3.B.1.b - Land Converted to Forest land	CO2	4028.450	6305.679	0	0	0	0	156.5286588	0
3.B.2.a - Cropland	CO2	4783.156	4783.156	0	0	0	0	100	0

Remaining Cropland									
3.B.2.b - Land Converted to Cropland	CO2	3549.142	3470.058	0	0	0	0	97.77173338	0
3.B.3.a - Grassland Remaining Grassland	CO2	0.000	0.000	0	0	0	0	100	0
3.B.3.b - Land Converted to Grassland	CO2	0.004	1781.023	0	0	0	0	48573365	0
3.B.4.a.i - Peatlands remaining peatlands	CO2	0.000	0.000	0	0	0	0	100	0
3.B.4.a.i - Peatlands remaining peatlands	N2O	0.000	0.000	0	0	0	0	100	0
3.B.4.b - Land Converted to Wetlands	N2O	0.000	0.000	0	0	0	0	100	0

3.B.4.b - Land Converted to Wetlands	CO2	0.000	0.000	0	0	0	0	100	0
3.B.5.a - Settlements Remaining Settlements	CO2	0.000	0.000	0	0	0	0	100	0
3.B.5.b - Land Converted to Settlements	CO2	0.000	0.000	0	0	0	0	100	0
3.B.6.b - Land Converted to Other land	CO2	0.000	0.000	0	0	0	0	100	0
3.C.1 - Emissions from biomass burning	CH4	2.473	2.473	0	0	0	0	100	0
3.C.1 - Emissions from biomass burning	N2O	0.000	0.000	0	0	0	0	100	0
3.C.2 - Liming	CO2	0.000	0.000	0	0	0	0	100	0

3.C.3 - Urea application	CO2	5.060	5.060	0	0	0	0	100	0
3.C.4 - Direct N2O Emissions from managed soils	N2O	6529.543	6436.699	0	0	0	0	98.57809664	0
3.C.5 - Indirect N2O Emissions from managed soils	N2O	2131.828	2131.828	0	0	0	0	100	0
3.C.6 - Indirect N2O Emissions from manure management	N2O	132.503	132.503	0	0	0	0	100	0
3.C.7 - Rice cultivations	CH4	25973.108	25973.108	0	0	0	0	100	0
3.D.1 - Harvested Wood Products	CO2	-0.133	0.000	0	0	0	0	0	0

4.A - Solid Waste Disposal	CH4	187.797	1097.025	0	0	0	0	584.1539941	0
4.B - Biological Treatment of Solid Waste	CH4	0.000	0.000	0	0	0	0	100	0
4.B - Biological Treatment of Solid Waste	N2O	0.000	0.000	0	0	0	0	100	0
4.C - Incineration and Open Burning of Waste	CO2	0.000	0.000	0	0	0	0	100	0
4.C - Incineration and Open Burning of Waste	CH4	0.000	0.000	0	0	0	0	100	0
4.C - Incineration and Open Burning of Waste	N2O	0.000	0.000	0	0	0	0	100	0

4.D - Wastewater Treatment and Discharge	CH4	162.943	217.765	0	0	0	0	133.6447102	0
4.D - Wastewater Treatment and Discharge	N2O	261.456	340.302	0	0	0	0	130.156721	0

APPENDIX III REDD+

Description of REDD+ Strategic Option, Coverage (Ha), Target 1 on Adaptation (expressed as potential beneficiaries), Target 2 on Mitigation (Estimated emission abatement potential (tCO2e)/Ha/Year and tCO2e)/Ha/Year/Target area), Baselines (where available) and notes

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
		Potential Beneficiaries (HHs)	Estimated emission abatement potential (tCO2e)/ Ha/Year	Estimated emission abatement potential (tCO2e)/Year/target area	Estimated Baseline (tCO2e/ha/year)	Estimated Baseline (tCO2e)/Target area		Draft National REDD+ Strategy and Action Plan
Sub-option 1. Sustainable land management (SLM) and agroforestry practices	2,382,357	2,382,357.00	3.76	8,957,662.32	13.40	31,918,819.09	The abatement potential estimate combines carbon Stock enhancement on open farmlands ((3tC/Ha/Year: Estimate from SLMP II Project) and on home gardens (Agroforestry)	Draft REDD+ Strategy: Chapter 9.0 Annexes: Annex 1: Hectare based financial assessment of proposed interventions. Baseline Source:

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
							(7tC/Ha/Year: Negash 2013) whereby the estimated share of home gardens to total farmlands is 30%	MWE/NFA 2016 (The Baseline carbon stock for subsistence farmland (8.7 tBiomass/Ha) in Uganda Appendix IV: Lauri Vesa, John Begumana, Deogratius Nteza. 2016. Overview on Uganda Forest Inventory Data)
Strategic Option 1: Climate smart	1,949,053	1,949,053.00	6.04	11,772,280.12			For Sub-strategy 1.2. it has been	Draft REDD+ Strategy

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
agriculture: Rainwater harvesting with collection tank and drip irrigation							calculated that rainwater irrigation can both intensify the carbon sequestration per farmland area as well as reduce the farmland expansion into natural forest Thus the irrigation adds 69 tC/ha and the avoided expansion adds another avoided emission of saved forestlands (25% saved annually) of 82 tC/ha and thus the total	

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
							avoided carbon emission of 151 tC/ha (I seem to have mixed tCO2 and tC here in the REDD+ Strategy Report submitted in 2017).	
Strategic Option 1: Climate smart agriculture: Greenhouse cultivation of vegetables	10,394.9	649,684.00	3.28	34,095.42			20x8 metres per greenhouse and with replication totally 10.4 ha of green houses.649, 684 HHs. This covers the 15 % wealthiest farmer households.	Draft REDD+ Strategy

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
Strategic Option 2: Sustainable fuelwood and charcoal use: Small-holder and community bioenergy woodlots	866,246.0	866,246.00	24.24	20,997,803.04			866,246 HHs or 20 % of farming households. A good alternative for poor households.	Draft REDD+ Strategy
Strategic Option 2: Sustainable fuelwood and charcoal use: Improved charcoal burning kilns	-	600,000.00	17.36	1,736,000.00			100,000 Charcoal Kilns. A Casamance, Adam Retort or similar retort charcoal kiln should be based with a cluster of ca 6 small-holder bioenergy woodlots.	Draft REDD+ Strategy
Strategic Option 2: Sustainable	108,281	108,281	278.00	30,102,118.00			108,281 HH or 2.5 % of all farming HHs.	Draft REDD+ Strategy

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
fuelwood and charcoal use: Small-holder and community poles and timber plantations with coffee agroforestry								
Strategic options 3: Large-scale commercial timber plantations: Commercial eucalypt transmission pole and timber plantation	40,000.0	500.00	**29.16**	1,166,400.00			Uganda Timber Growers' Association members and other private land owners (not members of SPGS)	Draft REDD+ Strategy
Strategic options 3: Large-scale commercial	30,000.0	**500.00**	**17.80**	534,000.00			Uganda Timber Growers' Association	Draft REDD+ Strategy

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
timber plantations: Commercial pine pole and sawlog plantation							members and other private land owners (not members of SPGS)	
Strategic options 3: Large-scale commercial timber plantations: Improved charcoal kiln working next to timber plantations	15,000.0	**90,000.00**	**22.83**	342,450.00			Uganda Timber Growers' Association members and other private land owners (not members of SPGS)	Draft REDD+ Strategy
Strategic Option 4: Rehabilitation of natural forests in the landscape: Closures of deforested areas for	100,000.0	100,000	**12.00**	1,200,000.00			Approx. 100,000 HHs living closely adjacent to these forest areas	Draft REDD+ Strategy

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
natural forest regeneration								
Strategic Option 4: Rehabilitation of natural forests in the landscape: Restoration of degraded protected natural forest (i.e. national parks and forest reserves): woodland	**76,000.0**	76,000.00	1.05	79,800.00			Approx. 100,000 HHs living closely adjacent to these forest areas	Draft REDD+ Strategy
Strategic Option 4: Rehabilitation of natural forests in the landscape: Restoration of degraded protected	**24,000.0**	24,000.00	23.20	556,800.00				

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
natural forest (i.e. national parks and forest reserves): THF								
Strategic Option 4: Rehabilitation of natural forests in the landscape: Devolution of forest management through PFM and similar set-ups & Traditional/ customary forest management practices:							PFM and traditional/customary forest management only implemented together with tree plantations or small-holder/ community woodlots.	Draft REDD+ Strategy

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
Strategy Option 5: Energy efficient cooking stoves: Improved fuelwood stoves: HOUSEHOLDS	-	4,003,368.00	0.89	3,562,997.52			22.2 (tCO2) for each HH and 150.6 (tCO2) for each institution. From start potentially 2,807,882 households and further 1,195,486 HHs for 12 years on average. From start potentially 15,586 institutions and later 6,636 institutions for 12 years on average	Draft REDD+ Strategy

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
Strategy Option 5: Energy efficient cooking stoves: Improved fuelwood stoves: INSTITUTIONS		22,222.00	6.02	133,776.44			2807882 HHs from start & 1195486 HHs from 12 years onward + 15586 inst. from start and 6636 from 12 years onwards. Then, emissions are: 75.6 for HHs and 2.85 for institutions	
Strategy Option 5: Energy efficient cooking stoves: Improved charcoal stoves: HOUSEHOLDS	-	2,662,032.00	4.50	11,979,144.00			35.8 (tCO2) for each HH and 668.1 (tCO2) for each institution. From start potentially 1,867,096 households and further 794,936 HHs	Draft REDD+ Strategy

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
							for 12 years on average. From start potentially 33,866 institutions and later 14,419 institutions for 12 years on average	
Strategy Option 5: Energy efficient cooking stoves: Improved charcoal stoves: INSTITUTIONS		41,066.00	12.60	517,431.60				
Summary for Strategic Option 6: Integrated	11,864,873.0	40,091,553.00	14.74	174,935,687.51			11,864,873 ha of plantations, woodlands and bushlands.	Draft REDD+ Strategy

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
wildfire management							Calculation is for national level	
Strategic options 7: Livestock rearing in the Cattle Corridor: Establishment of fodder agroforestry plantations	100,000	0.35	-				It is foreseen that at least some 100,000 ha of such fodder agroforestry plantations should be established in the Cattle Corridor. The area can later be expanded as is seen needed	Draft REDD+ Strategy
Strategic options 7: Livestock rearing in the Cattle Corridor: Change to exotic cattle	0	40,000.00	-				Start up the programme with 40,000 indigenous cows and 775 improved bulls.	Draft REDD+ Strategy

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
varieties and crossbreeding								
Strategic options 7: Livestock rearing in the Cattle Corridor: Establishment of drinking water dams	**72.0**	-	-				Current data shows total of 1,043 valley tanks and 33 dams (MWE/Water Atlas). it is envisaged that the REDD+ programme could support the construction and restoration of 12 drinking water dams and 60 valley tanks to hold a total of 2 million m3 of water	Draft REDD+ Strategy
Strategic Option 8: Strengthen								Draft REDD+ Strategy

Description of the REDD+ Strategic Option / Intervention	Coverage (Area: Ha) Except (see notes)	Target1 (Adaptation)	Target2a	Target2a	Baseline1	Baseline2	Notes on assumptions	Sources
Policy Enforcement for REDD+ Implementation								

APPENDIX IV: FINANCE REQUIRED AND RECEIVED

GHG- Inventory Information financial, technical and capacity-building needs

Need identified	Support needed	Specific type of support requested [technology transfer, capacity building, financial support]	When and for how long is support needed?	Where financial support is needed, please indicate	
				National budget available in US$	Financial support needed in US$
To complete the enactment of the Policy, Legal and Regulatory Frameworks for climate change	Support the full enactment of the Policy, Legal and Regulatory Frameworks for climate change	Financial and Technical	Medium-term so that by the 2nd Biennial Update Report		500,000
To mainstream climate change adaptation requirements and mitigation potential in national (sectoral) and district development plans	Support the mainstreaming of climate change adaptation requirements and mitigation potential in national (sectoral) and district development plans including preparation of the requisite guidelines for good practice	Financial and Technical	Medium-term so that by the 2nd Biennial Update Report		1,500,000

To complete collection of all reliable data and their appropriate coefficients	Improvement and completeness of data sources for all sectors	Financial support	Short-term for 1st Biennial Update Report and also for Long-term for the 3rd Biennial Update Report		2,000,000
Where possible obtain data using similar datasets or extrapolate activity data back to 1994. Some recalculations may be necessary, and they should be explained in the next report.	Requires CCD or relevant sub-sector team staff hours for data collection and analysis	Financial support	Short-term for the 1st Biennial Update Report		250,000
Establish relevant sub-sector work groups to develop uncertainty estimates given the uncertainties in the activity data and emission factors	Requires CCD or relevant sub-sector team staff hours for workshops, relevant training and data analysis	Financial support	Short-term for the 1st Biennial Update Report		50,000
Formalize Uganda's QA/QC procedures, implement them on the current inventory and report on the process and any improvements resulting from this work	Requires CCD or relevant sub-sector team staff hours to conduct QA/QC	Financial support	Short-term for the 1st Biennial Update Report		50,000
Formalize Uganda's archiving procedures, implement them for the current inventory and report on the work	Requires CCD or relevant sub-sector team staff hours to archive data	Financial support	Short-term for 1st Biennial Update Report		50,000

Conduct QA/QC on the fuelwood and timber removal activity data for the current inventory. Refine data collection protocol for fuelwood and timber removal data or identify improved methods for estimating emissions from forest degradation	Requires NFA staff hours to conduct QA/QC on the fuelwood and timber removal data. Requires funding to improve data collection on fuelwood and timber removals or implement new protocols	Financial and Technical	Short-term for 1st Biennial Update Report and also for Long-term for the 3rd Biennial Update Report		50,000
Develop data collection protocols within NFA for estimating areas of biomass burning or develop estimates from international data sources	Requires funding for new data collection and analysis	Financial and Technical	Long-term for 3rd Biennial Update Report		1,500,000
Integrate the latest data collected from woodland plots into the emission factors. Also we need to add new sampling plots as needed to improve accuracy.	Requires NFA staff hours to complete the analysis. Also requires funding for more permanent sampling plots within woodlands	Financial and Technical	Short-term for 1st Biennial Update Report and also for Long-term for the 3rd Biennial Update Report		50,000
Re-analyze LULUC data from earlier maps applying the smaller minimum mapping unit	Requires NFA staff hours to complete the analysis	Financial support	Short-term for the 2nd Biennial Update Report		50,000
Organize a workshop between NFA, NARO and UMI teams to define mapping standards, apply them to relevant spatial data sets and reassess GHG emission estimates. Note: This will be included as part of the re-analysis of the maps described above.	Requires staff time for each of the relevant teams to convene and analyze the data	Financial support	Short-term but for the 2nd Biennial Update Report		50,000

Expand the accuracy assessment to develop bias-corrected area estimates for all land use change classes. This could be included as part of the re-analysis of the maps described above.	Requires significant NFA staff hours for additional analysis of non-forest land uses across the full time series and development/ training on conducting an accuracy assessment on all LUC classes	Financial support	Long-term by the 3rd Biennial Update Report		150,000
Identify options for criteria to distinguish between loss of tree cover and implement these for the full LUC time series	Requires NFA staff hours for additional analysis of LULUC maps during accuracy assessment or other forest C modelling	Financial support	Long-term by the 3rd - 4th Biennial Update Report		50,000
But we still need to develop emission factors for post-deforestation regrowth from existing data within the National Biomass Study. Also add new sampling plots as needed to develop such emission factors.	Requires NFA staff hours for data analysis. Requires funding for new permanent sampling plots in non-forest land uses	Financial support	Short-term for the 2nd Biennial Update Report; and also Long-term by the 3rd Biennial Update Report		1,500,000
Collect data using existing MAAIF/ UBOS annual agricultural surveys to estimate the extent of different soil and residue management and initiate new research studies where necessary	Requires funding and coordination with the agricultural survey team to collect and analyse data on soil and residue management and additional research on drainage or management of organic soils	Financial and Technical	Long-term by the 3rd – 4th Biennial Update Report		2,500,000

Integrate the latest data collected from the NFI. Add new sampling requirements to estimate deadwood C in permanent sampling plots.	Requires NFA staff hours to complete the analysis. Also, Requires funding to increase sampling on permanent sampling plots	Financial and Technical	Short-term for the 1st Biennial Update Report; and also Long-term by the 3rd Biennial Update Report		150,000
Commission new studies to estimate country-specific CH4 emission factors from indigenous livestock breeds	Requires funding to commission new research studies working with Makerere University and/or ILRI's Mazingra Center	Financial and Technical	Long-term and by the 5th+ Biennial Update Report		150,000
Collect data using existing MAAIF/ UBOS annual agricultural surveys to estimate rice management practices and initiate new research studies where necessary	Requires funding and coordination with the agricultural survey team to collect and analyse data on rice management or implement new research with NARO	Financial and Technical	Long-term and by 3rd – 4th Biennial Update Report		100,000
Collect data using existing MAAIF/ UBOS annual agricultural surveys to estimate the % of manure managed in different manure management systems	Requires funding and coordination with the agricultural survey team to collect and analyse data on manure management systems	Financial and Technical	Long-term and by 3rd – 4th Biennial Update Report		100,000
Obtain data from NFA and UBOS on production, import and export or harvested wood products and establish a working group to estimate the full time series	Requires NFA and UBOS staff hours to analyse the existing data and collect new data as needed.	Financial and Technical	Long-term and 3rd Biennial Update Report		150,000

Collect data using existing MAAIF/ UBOS annual agricultural surveys to estimate agricultural lime use	Requires funding and coordination with the agricultural survey team to collect and analyse data on agricultural lime use	Financial and Technical	Long-term and best by 3rd – 4th Biennial Update Report		150,000
					11,100,000

Adaptation financial, technical and capacity-building needs (Policy wide)

Need identified	**Support needed**	**Specific type of support requested [technology transfer, capacity building, financial support]**	**When and for how long is support needed?**	**Where financial support is needed, please indicate**	
				National budget available in US$	**Financial support needed in US$**
Agriculture	To promote climate change adaptation strategies that enhance resilient, productive and sustainable agricultural systems and to promote value addition and improve food storage and management systems in order to ensure food security at all times, as a factor of resilience	Technical, Technology and financial	Short to medium term		297,097,466
Water	To support on-going efforts to ensure that climate change concerns are integrated into national efforts for sustainable and long-term	Technical, Technology and financial	Medium to long-term		202,912,829

	conservation, access and effective utilisation and management of water resources.				
Fisheries	To strengthen efforts to promote integrated fisheries resource management and improve aquaculture in order to ensure sustainable fisheries production	Technical, Technology and financial	Short to medium term		163,125,744
Transport and Works	To develop and ensure integrated planning and management of transport and other physical infrastructure that build on insights from climate predictions	Technical, Technology, Capacity and financial	Medium to long-term		1,053,904,000
Forestry	To ensure the sustainable management of forestry resources so that they can continue to provide global services, including mitigating climate change, while supporting the sustainable development needs of communities and the country	Technical, Technology, Capacity and financial	Short to medium term		24,286,880
Wetlands	To promote long-term wetland conservation and restoration of degraded wetlands so that they can continue to provide global services, including mitigating climate change, while supporting the sustainable development needs of communities and the country	Technical, Technology, Capacity and financial	Short to medium term		2,303,463
Biodiversity	To effectively address the challenges posed by climate change impacts on biodiversity and ecosystems, so as to ensure ecosystem health and provision of ecosystem services that are	Technical, Technology, Capacity and financial	Short to medium term		6,349,130

	crucial to sustainable and resilient development				
Health	To strengthen adaptive mechanisms and enhance early-warning systems and adequate preparedness for climate change–related diseases	Technical, Technology, Capacity and financial	Short to medium term		732,694,136
Energy	To promote sustainable energy access and utilisation as a means of sustainable development in the face of uncertainties related to climate change	Technical, Technology, Capacity and financial	Medium to long-term		382,441,000
Wildlife and Tourism	To ensure the conservation of wildlife resources and plan for improved resilience of tourism resources and infrastructure to climate change	Technical, Technology, Capacity and financial	Medium to long-term		24,419,000
Human Settlements	Human settlements and social infrastructure	Technical, Technology, Capacity and financial	Medium to long-term		13,637,000
Disaster Risk Management	To ensure disaster mitigation and adequate preparedness for climate change–induced risks, hazards and disasters	Technical, Technology, Capacity and financial	Medium to long-term		12,144,075
Vulnerable Groups	To give special attention to the improvement of the resilience of vulnerable groups to climate change	Technical, Technology, Capacity and financial	Short to medium term		3,626,076
Sub-Total Adaptation					2,918,940,799

Mitigation financial, technical and capacity-building needs (Policy wide)

Need identified	Support needed	Specific type of support requested [technology transfer, capacity building, financial support]	When and for how long is support needed?	Where financial support is needed, please indicate	
				National budget available in US$	Financial support needed in US$
LULUCF – Forestry	Policy priority (Forestry) To continue and step up efforts targeted at effective forest management To make a deliberate departure from "business as usual" by formulating sectoral policies that address issues associated with increased unit productivity in plantation forestry To promote and develop afforestation and reforestation programmes in non-forested areas and intensify afforestation and reforestation efforts in other areas	Technical, Technology, Capacity and financial	Short to medium term		20,071,111
LULUCF - Landuse and LandUse Change	Policy priority (Land Use and Land Use Change): To promote and enforce urban and rural planning of settlements To control and monitor land development and other land-use	Technical, Technology,	Short to medium term		1,120,500

	changes in a sustainable manner so as to better manage GHG sources and sinks	Capacity and financial			
LULUCF-REDD+	Policy priority (REDD+): To contribute to mitigation actions in the forest sector by: (a) Reducing emissions from deforestation; (b) Reducing emissions from forest degradation; (c) Conservation of forest carbon stocks; (d) Sustainable management of forests; and (e) Enhancement of forest carbon stocks;	Technical, Technology, Capacity and financial	Short to medium term		
	Technical Coordination Unit (TCU) office & sector support	Technical, Technology, Capacity and financial	Short to medium term		32,967,200.00
	SO 1. Climate smart agriculture	Technical, Technology, Capacity and financial	Short to medium term		106,600,000.00
	SO 2. Sustainable fuel wood and (commercial) charcoal production	Technical, Technology, Capacity and financial	Short to medium term		73,900,000.00
	SO 3. Large-scale commercial timber plantations	Technical, Technology, Capacity and financial	Short to medium term		7,150,000.00

	SO 4. Restoration of natural forests in the landscape	Technical, Technology, Capacity and financial	Short to medium term		69,500,000.00
	SO 5. Energy efficient cooking stoves	Technical, Technology, Capacity and financial	Short to medium term		62,700,000.00
	SO 6. Integrated wildfire management	Technical, Technology, Capacity and financial	Short to medium term		23,500,000.00
	SO 7. Livestock rearing in Cattle Corridor	Technical, Technology, Capacity and financial	Short to medium term		40,500,000.00
	SO 8. Strengthening of policy implementation for REDD+	Technical, Technology, Capacity and financial	Short to medium term		6,400,000.00
	Sub-Total LULUCF-REDD+				423,217,200.00
Wetlands	Conservation and sustainable use of wetlands	Technical, Technology, Capacity and financial	Short to medium term		8028444

Agriculture	To mainstream climate change mitigation issues in the efforts underway to promote and improve the management of natural resources, in order to ensure resilient, productive and sustainable agricultural systems with reduced GHG emissions	Technical, Technology, Capacity and financial	Short to medium term		65,189,000
Energy Generation	Policy priority: To support and accelerate the implementation of the Renewable Energy Policy (REP), in particular with respect to the promotion and development of new clean energy technologies in order to reduce GHG emission	Technical, Technology, Capacity and financial	Short to medium term		6,603,729
Energy Utilisation	Policy priority: To promote conservation and efficient utilisation of energy to reduce GHG emissions, especially at consumer levels (industries, households, commercial and institutional buildings) To encourage the use of alternative fuels instead of heavily relying on biomass	Technical, Technology, Capacity and financial	Short to medium term		25,988,871
Industry	Policy priority: To promote the development, approval and effective implementation of a long-term national transport policy and plan that will take GHG mitigation concerns into account To effect a gradual shift to the use of less carbon-intensive fuels (including compressed natural gas, ethanol and LPG) in vehicles instead of relying heavily on gasoline and diesel fuels	Technical, Technology, Capacity and financial	Short to medium term		4,004,500

	To promote modes of transport that take GHG emission reduction into account Strategic				
Transport	Policy priority: To promote cleaner production processes in industries to contain the increase in GHG emissions	Technical, Technology, Capacity and financial	Short to medium term		186,339,000
Waste Management	Policy priority: To promote sustainable use of solid and liquid wastes for energy generation and other uses, such as fertilisers	Technical, Technology, Capacity and financial	Short to medium term		1,120,500
Monitoring, Detection, Attribution and Prediction	Policy priority: To continue the on-going efforts to strengthen the capacity of the Department of Meteorology in its functions in climate change monitoring and detection in Uganda	Technical, Technology, Capacity and financial	Short to medium term		
Sub-Total Mitigation					741,682,855

APPENDIX V: GEF LINKED CLIMATE-BIODIVERSITY AND DEGRADATION FINANCIAL SUPPORT RECEIVED BY ORIGIN

ID	Title	Focal Areas	Grant and Co-financing	Implementing Agencies	Fund Source	Period	Status
9814	Strengthening the Capacity of Institutions in Uganda to Comply with the Transparency Requirements of the Paris Agreement	Climate Change	$1,100,000 $619,455	Conservation International	Capacity-building Initiative for Transparency	GEF - 6	Project Approved
9513	Energy for Rural Transformation Project (Phase III)	Climate Change	$8,200,000 $168,200,000	The World Bank	GEF Trust Fund	GEF - 2	Project Approved
9481	Institutional Capacity Strengthening for Implementation of the Nagoya Protocol on Access to Genetic Resources and Benefit Sharing in Uganda	Biodiversity	$2,560,842 $9,235,000	United Nations Environment Programme	GEF Trust Fund	GEF - 6	Concept Approved
9335	Strengthening Institutional Capacity for Effective Implementation of Rio Conventions in Uganda		$900,000 $1,050,000	United Nations Development Programme	GEF Trust Fund	GEF - 6	Project Approved
9210	NAMA on Integrated Waste Management and Biogas in Uganda	Climate Change	$2,170,030 $15,138,000	United Nations Development Programme	GEF Trust Fund	GEF - 6	Project Approved

9137	Food-IAP: Fostering Sustainability and Resilience for Food Security in Karamoja Sub Region	Land Degradation, Biodiversity, Climate Change	$7,139,450 $58,000,000	United Nations Development Programme	GEF Trust Fund	GEF - 6	Project Approved
8035	Reducing the Climate Change Vulnerability of Local Communities in Uganda through EbA in Forest and Wetland Ecosystems	Climate Change	$4,350,000 $17,500,000	United Nations Environment Programme	Least Developed Countries Fund	GEF - 6	Concept Approved
7997	Integrating Climate Resilience into Agricultural and Pastoral Production in Uganda, through a Farmer/Agro-Pastoralist Field School Approach	Climate Change	$6,886,838 $29,269,269	Food and Agriculture Organization	Least Developed Countries Fund	GEF - 6	Concept Approved
5718	Integrated Landscape Management for Improved Livelihoods and Ecosystem Resilience in Mount Elgon	Climate Change, Land Degradation	$1,620,320 $8,831,384	United Nations Development Programme	GEF Trust Fund	GEF - 5	Project Approved
5625	Enabling Activities to Review and Update the National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants (POPs)	Persistent Organic Pollutants	$185,000 $42,000	United Nations Industrial Development Organization	GEF Trust Fund	GEF - 5	Project Approved

5603	Reducing Vulnerability of Banana Producing Communities to Climate Change Through Banana Value Added Activities - Enhancing Food Security And Employment Generation	Climate Change	$2,820,000 $7,065,502	United Nations Industrial Development Organization	Least Developed Countries Fund	GEF - 5	Project Approved
5204	Building Resilience to Climate Change in the Water and Sanitation Sector	Climate Change	$8,370,000 $38,000,000	African Development Bank	Least Developed Countries Fund	GEF - 5	Project Approved
5042	Support to Alignment of Uganda's National Action Programme and Reporting Process to the UNCCD Ten-Year Strategy	Land Degradation	$136,364 $190,000	United Nations Environment Programme	GEF Trust Fund	GEF - 5	Project Approved
4993	Strengthening Climate Information and Early Warning Systems in Africa to Support Climate Resilient Development and Adaptation to Climate Change	Climate Change	$4,000,000 $26,270,000	United Nations Development Programme	Least Developed Countries Fund	GEF - 5	Project Approved
4644	Addressing Barriers to the Adoption of Improved Charcoal Production Technologies and Sustainable Land Management Practices through an Integrated Approach	Climate Change, Land Degradation	$3,480,000 $14,662,108	United Nations Development Programme	GEF Trust Fund	GEF - 5	Project Approved

4456	Conservation and Sustainable Use of the Threatened Savanna Woodland in the Kidepo Critical Landscape in North Eastern Uganda	Biodiversity	$3,080,000 $10,684,700	United Nations Development Programme	GEF Trust Fund	GEF - 5	Project Approved
3892	Energy for Rural Transformation Project II	Climate Change	$9,000,000 $84,000,000	The World Bank	GEF Trust Fund	GEF - 2	Completed
3854	Development of a National Clearing House Mechanism and Capacity Assessment for Taxonomy and Indigenous Knowledge(Add-on) (New title as of March 19, 2009)	Biodiversity	$300,000 $42,000	United Nations Environment Programme	GEF Trust Fund	GEF - 4	Completed
3682	Developing an Experimental Methodology for Testing the Effectiveness of Payments for Ecosystem Services to Enhance Conservation in Productive Landscapes in Uganda	Biodiversity	$870,000 $1,232,400	United Nations Environment Programme	GEF Trust Fund	GEF - 4	Completed
3393	SIP: Enabling Environment for SLM to overcome land degradation in the cattle corridor of Uganda.	Land Degradation	$1,830,730 $2,600,000	United Nations Development Programme	GEF Trust Fund	GEF - 4	Completed
3392	SIP: Sustainable Land Management Country Program	Land Degradation	$7,200,000 $117,900,000	The World Bank	GEF Trust Fund	GEF - 4	Project Approved

2668	Enabling activities for the Stockholm Convention on Persistent Organic Pollutants (POPs): National Implementation Plan for Uganda	Persistent Organic Pollutants	$493,000 $40,000	United Nations Environment Programme	GEF Trust Fund	GEF - 3	Completed
2168	National Adaptation Programme of Action (NAPA)	Climate Change	$199,790 $0	United Nations Environment Programme	Least Developed Countries Fund	GEF - 3	Project Approved
1837	Extending Wetland protected Areas through Community Based Conservation Initiatives	Biodiversity	$800,000 $3,033,250	United Nations Development Programme	GEF Trust Fund	GEF - 4	Completed
1831	Energy for Rural Transformation Project (APL)	Climate Change	$12,100,000 $111,100,000	The World Bank	GEF Trust Fund	GEF - 2	Completed
1830	Protected Areas Management and Sustainable Use (PAMSU)	Biodiversity	$8,000,000 $30,000,000	The World Bank	GEF Trust Fund	GEF - 1	Completed
1823	National Capacity Self-Assessment for Global Environmental Management		$130,000 $5,800	United Nations Environment Programme	GEF Trust Fund	GEF - 3	Completed
1366	Support for the Implementation of the Uganda National Biosafety Framework (NBF) within the context of the Cartagena protocol	Biodiversity	$560,000 $82,000	United Nations Environment Programme	GEF Trust Fund	GEF - 2	Completed

1175	Conservation of Biodiversity in the Albertine Rift Forest Areas of Uganda	Biodiversity	$3,395,000 $7,953,189	United Nations Development Programme	GEF Trust Fund	GEF - 3	Completed
1006	Climate Change Enabling Activity (Additional Financing for Capacity Building in Priority Areas)	Climate Change	$100,000 $0	United Nations Development Programme	GEF Trust Fund	GEF - 2	Project Approved
562	Biodiversity Strategy, Action Plan and National Report	Biodiversity	$125,000 $0	The World Bank	GEF Trust Fund	GEF - 1	Completed
490	Kibale Forest Wild Coffee Project	Biodiversity	$750,000 $3,400,000	The World Bank	GEF Trust Fund	GEF - 2	Completed
332	Enabling Uganda to Prepare its First National Communication in Response to its Commitments to UNFCCC	Climate Change	$83,430 $10,000	United Nations Development Programme	GEF Trust Fund	GEF - 1	Completed
295	Uganda photovoltaic pilot project for rural electrification	Climate Change	$1,756,000 $1,200,000	United Nations Development Programme	GEF Trust Fund	GEF - 1	Completed
101	Institutional Capacity Building for Protected Areas Management and Sustainable Use (ICB-PAMSU)	Biodiversity	$2,000,000 $11,850,000	The World Bank	GEF Trust Fund	GEF - 1	Completed

54	Bwindi Impenetrable National Park and Mgahinga Gorilla National Park Conservation	Biodiversity	$4,000,000 $2,310,000	The World Bank	GEF Trust Fund	Pilot Phase	Completed

APPENDIX VI: FINANCE RECEIVED FROM GEF

ID	Title	Focal Areas	Grant	Co-financing	Implementing Agencies	Country	Fund Source	Period	Status
9814	Strengthening the Capacity of Institutions in Uganda to Comply with the Transparency Requirements of the Paris Agreement	Climate Change	$1,100,000	$619,455	Conservation International	Uganda	Capacity-building Initiative for Transparency	GEF - 6	Project Approved
9210	NAMA on Integrated Waste Management and Biogas in Uganda	Climate Change	$2,170,030	$15,138,000	United Nations Development Programme	Uganda	GEF Trust Fund	GEF - 6	Project Approved
8035	Reducing the Climate Change Vulnerability of Local Communities in Uganda through EbA in Forest and	Climate Change	$4,350,000	$17,500,000	United Nations Environment Programme	Uganda	Least Developed Countries Fund	GEF - 6	Concept Approved

	Wetland Ecosystems								
7997	Integrating Climate Resilience into Agricultural and Pastoral Production in Uganda, through a Farmer/Agro-Pastoralist Field School Approach	Climate Change	$6,886,838	$29,269,269	Food and Agriculture Organization	Uganda	Least Developed Countries Fund	GEF - 6	Concept Approved
5718	Integrated Landscape Management for Improved Livelihoods and Ecosystem Resilience in Mount Elgon	Climate Change, Land Degradation	$1,620,320	$8,831,384	United Nations Development Programme	Uganda	GEF Trust Fund	GEF - 5	Project Approved
5603	Reducing Vulnerability of Banana Producing Communities to Climate Change Through Banana Value Added Activities - Enhancing Food	Climate Change	$2,820,000	$7,065,502	United Nations Industrial Development Organization	Uganda	Least Developed Countries Fund	GEF - 5	Project Approved

	Security And Employment Generation								
5204	Building Resilience to Climate Change in the Water and Sanitation Sector	Climate Change	$8,370,000	$38,000,000	African Development Bank	Uganda	Least Developed Countries Fund	GEF - 5	Project Approved
4993	Strengthening Climate Information and Early Warning Systems in Africa to Support Climate Resilient Development and Adaptation to Climate Change	Climate Change	$4,000,000	$26,270,000	United Nations Development Programme	Uganda	Least Developed Countries Fund	GEF - 5	Project Approved
4644	Addressing Barriers to the Adoption of Improved Charcoal Production Technologies and Sustainable Land Management	Climate Change, Land Degradation	$3,480,000	$14,662,108	United Nations Development Programme	Uganda	GEF Trust Fund	GEF - 5	Project Approved

	Practices through an Integrated Approach								
2168	National Adaptation Programme of Action (NAPA)	Climate Change	$199,790	$0	United Nations Environment Programme	Uganda	Least Developed Countries Fund	GEF - 3	Project Approved
9513	Energy for Rural Transformation Project (Phase III)	Climate Change	$8,200,000	$168,200,000	The World Bank	Uganda	GEF Trust Fund	GEF - 2	Project Approved
3892	Energy for Rural Transformation Project II	Climate Change	$9,000,000	$84,000,000	The World Bank	Uganda	GEF Trust Fund	GEF - 2	Completed
1831	Energy for Rural Transformation Project (APL)	Climate Change	$12,100,000	$111,100,000	The World Bank	Uganda	GEF Trust Fund	GEF - 2	Completed
1006	Climate Change Enabling Activity (Additional Financing for Capacity Building in Priority Areas)	Climate Change	$100,000	$0	United Nations Development Programme	Uganda	GEF Trust Fund	GEF - 2	Project Approved

332	Enabling Uganda to Prepare its First National Communication in Response to its Commitments to UNFCCC	Climate Change	$83,430	$10,000	United Nations Development Programme	Uganda	GEF Trust Fund	GEF - 1	Completed
295	Uganda photovoltaic pilot project for rural electrification	Climate Change	$1,756,000	$1,200,000	United Nations Development Programme	Uganda	GEF Trust Fund	GEF - 1	Completed
			$66,236,408	$521,865,718					

APPENDIX VII: DONOR OFF-BUDGET LINKED CLIMATE, BIODIVERSITY, DEGRADATION, AGRICULTURE AND WATER RELATED FINANCIAL SUPPORT RECEIVED BY ORIGIN

Donor Agency	Project Title	Agreement Title + Code	Fiscal Year 2007 - 2008	Fiscal Year 2008 - 2009	Fiscal Year 2009 - 2010	Fiscal Year 2010 - 2011	Fiscal Year 2011 - 2012	Fiscal Year 2012 - 2013	Fiscal Year 2013 - 2014	Fiscal Year 2014 - 2015	Totals
			Actual Disbursements	Actual Disbursements	Actual Disbursements	Actual Disbursements	Actual Disbursements	Actual Disbursements	Actual Disbursements	Actual Disbursements	Actual Disbursements
Austria											-
Belgium	Clean Development Mechanism		-	-	-	-	13,234.26	476,544.39	-	-	489,778.64
China											-
Denmark/DANIDA											-
	Mainstreaming Climate Change Project	Mainstreaming climate change - G-2043	-	20,000.00	304,056.08	-	-	-	-	-	324,056.08
European Union											-
	Regional Cassava Initiative In Support Of Vulnerable Smallholders In		-	-	-	1,152,917.51	1,003,357.68	-	1,063,642.19	-	3,219,917.38

	Central And Eastern Africa										
	Farmer's Voice "Improving Food Security Governance In East Africa"		-	-	-	-	-	779,758.49	-	-	779,758.49
	GCCA-Global Climate Change Alliance-Contribution Agreement With FAO		-	-	-	-	2,392,947.10	2,480,417.75	-	-	4,873,364.86
	Establishing An Export Market For Certified Responsible Coffee With Smallholder Producer Groups In Uganda		172,639.57	157,648.46	138,621.92	162,901.59	-	-	-	-	631,811.54
Germany											-
International Development Association			-	-	-	-	-	-	-	87,571.66	87,571.66
Japan											-
	The Project For Improvement Of Access To Safe Water In Rubirizi District		-	-	-	-	66,319.03	83,651,487.00	-	-	83,717,806.03
	The Project For Improvement Of		-	-	-	-	33,350.14	34,134.11	-	-	67,484.25

	Access To Safe Water In Manafwa District										
	The Project For Improvement Of Access To Safe Water In Kitgum And Lamwo District		-	-	-	-	83,753.73	-	-	-	83,753.73
	The Project For Improvement Of Access To Safe Water In 17 Schools In Koboko District		-	-	-	-	67,477.47	22,492.49	-	-	89,969.96
	The Project For Installing Rain Water Harvesting Tanks In Kisoro District		-	-	-	-	43,236.94	43,236.94	-	-	86,473.88
	The Project For Supporting Farmers' Group In Lango Region		-	-	-	-	45,033.04	67,549.57	-	-	112,582.61
	The Project For The Emergency Relief Assistance To Populations Affected By The Landslides And Floods In Eastern Uganda		-	-	50,993.89	51,016.86	-	-	-	-	102,010.75

	The Project For Improvement Of Access To Safe Water In Amuria District		-	-	-	77,904.13	16,617.02	-	-	-	94,521.15
	The Project For Improvement Of Access To Safe Water In Three Districts In Lango Sub-Region		-	-	-	33,452.11	30,943.40	-	-	-	64,395.51
	The Project For Improvement Of Access To Safe Water For Returnees In Lira And Dokolo District		-	-	30,117.10	26,995.82	-	-	-	-	57,112.92
	The Project For Improvement Of Access To Safe Water In Bukomero Town In Kiboga District		-	-	21,638.67	40,133.46	8,560.50	-	-	-	70,332.64
	The Project For Improvement Of Access To Safe Water In Sironko District		-	-	-	51,601,690.93	-	-	-	-	51,601,690.93
	The Project For Improvement Of Access To Safe Water And Sanitation In Kyakarafa Parish, Kamwenge District		-	-	-	60,583.12	-	-	-	-	60,583.12

	The Project For Improving Access To Safe Water In Mbale District		-	-	64,194.53	14,617.60	-	-	-	-	78,812.13
	The Project For Water Provision To Rwakaterere Primary School & Surrounding Communities		-	7,919.31	16,204.76	3,689.95	-	-	-	-	27,814.02
	The Project For Street Lights Installation In Tororo Municipality		-	24,744.21	50,632.46	11,529.41	-	-	-	-	86,906.09
	The Project For Improving Agricultural Productivity Through Promoting Animal Traction In 5 Districts In Eastern Uganda		-	-	-	-	-	113,666.59	-	-	113,666.59
	The Project For Installation Of Electric Facilities At The Amugu Health Centre		-	-	-	-	-	29,971.50	-	-	29,971.50
	The Project For Installation Of Electric Facilities At The Omoro Health Centre		-	-	-	-	-	25,131.15	-	-	25,131.15
Norway									-	-	-

	Poverty Alleviation Through Commercialisation Of Agriculture		-	-	-	53,833.30	-	-	-	-	53,833.30
	UTGA-Uganda Timber Growers Association		-	-	-	946,723.59	669,128.36	-	-	-	1,615,851.96
	Merecp Implementation EAC		-	-	-	538,333.02	-	-	-	-	538,333.02
	Test Production Of Jatropha Oil As Out grower Scheme		-	-	-	61,258.59	54,828.44	-	-	-	116,087.03
	Environmental Movements In The South		-	-	-	2,088,360.87	-	-	-	-	2,088,360.87
	Policy Seminar On The Challenges Associated With The Oil And Gas Seminar		-	-	-	-	171,559.96	-	-	-	171,559.96
	ICGLR Special Summit On SGBV Kampala 2011		-	-	-	-	366,727.79	-	-	-	366,727.79
	Gender In Energy		-	-	-	-	41,673.61	-	-	-	41,673.61
	Joint Water & Environment Support Prog (JWESSP)-Process Consultant		-	-	-	-	60,433.10	-	-	-	60,433.10

	Monitoring Of Energy Programme Implementation		-	-	-	-	1,678.70	-	-	-	1,678.70
	Support To Ministry Of Water And Environment-IPCC Conference		-	-	-	-	30,005.00	-	-	-	30,005.00
United Nations Development Programme	Uga06218 MDG Country Report		-	-	-	-	-	-	-	-	-
	Extending Wetland Protected Areas Through Community Conservation Initiatives-Albertine Rift		-	-	-	-	-	100,000.00	-	-	100,000.00
United States of America									-	-	-
	Development Grants Program- Nebbi For Water		-	-	-	104,000.00	2,000.00	-	-	-	106,000.00
	Livelihoods And Enterprises For Agricultural Development (Lead)		-	-	-	10,190,000.00	4,439,000.00	866,000.00	-	-	15,495,000.00
	Feed The Future		-	-	-	-	203,400.00	32,300.00	-	-	235,700.00

	Program For Bio Safety Systems		-	-	-	210,000.00	253,000.00	60,000.00	-	-	523,000.00
	Water Sanitation Hygiene-Kigezi		-	-	-	100,000.00	260,800.00	85,700.00	-	-	446,500.00
	Water Infrastructure For Kitgum And Pader		-	-	-	-	1,794,000.00	336,000.00	-	-	2,130,000.00
	Water Consultancy		-	-	-	-	208,000.00	48,100.00	-	-	256,100.00
	Support To The Development Of Strategic Agricultural Commodity Value-Chains		-	-	-	-	3,750,000.00	6,250,000.00	-	-	10,000,000.00
World Health Organization									-	-	-
			-	-	-	-	-	6,405,943.00	-	-	6,405,943.00
Report Totals (369)			172,639.57	210,311.98	676,459.41	67,529,941.88	16,111,065.30	101,908,432.97	1,063,642.19	87,571.66	187,760,064.95

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