FOREWORD

It is widely recognized and accepted that the global climate system is changing. Scientific information reveals that global warming poses a serious environmental problem with far reaching social and economic consequences, particularly in poor countries such as the least development countries and the small island developing states whose very existence is threatened by sea level rise. Although there were many uncertainties in the early 1990s, the international community decided that the risks are simply too big to ignore. Over 180 States signed and ratified the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC aims at stabilizing the concentration of greenhouse gases in the atmosphere and reduce suffering of the people from impacts of negative effects of climate change.

The Convention represents a global spirit of cooperation irrespective of the contribution of individual countries. It is in this context and the potential impacts of global warming on Uganda's people and its natural resources that Uganda signed the Convention on 13th of June 1992 at the Earth Summit in Rio de Janeiro, Brazil and subsequently ratified it on 8th of September, 1993. Uganda committed itself to fully participate and contribute to the attainment of the objective of the Convention. This Initial National Communication is in response to its commitment under Article 4 and 12 of the Convention.

The good climate of Uganda is reflected in its natural beauty once described elegantly by the Prime Minister of the United Kingdom, Winston Church Hill, as the Pearl of Africa. This beauty, which is reflected in its natural resources such as soils, water resources, wild life and biodiversity is now threatened by global warming. These resources are the basis, of the national economy and other key sectors such as health, agriculture and tourism, which are sensitive to climate variability and climate change.

The impacts of adverse effects of climate change are not limited to poor countries but even the rich countries. The floods of 2002, which occurred in some parts of Europe, have clearly demonstrated the magnitude of the damage climate change can inflict on people and their properties. The disparity in the ability between the developed and developing countries to respond to such catastrophe must be recognized. We in the developing world have no means to avert such dangers and our united call is for immediate action to reverse Climate Change. Indeed the cost of no action outweighs the cost of action. It is upon this basis that all countries of the world must put the issues of climate change on top of the Agenda. Uganda is committed to play its part and is therefore responding to its commitments under Article 4 and 12 of the Convention. It is Uganda's hope that the information contained in this report will provide Parties with clear information about Uganda, and more particularly vulnerability of its people and natural resources.

I am privileged and honoured to present to you, on behalf of the people and the government of Uganda, this Initial National Communication of Uganda to the Conference of the Parties to the United Nations Framework Convention on Climate Change.

Hon. Dr. Kezimbira Miyingo
MINISTER OF STATE FOR ENVIRONMENT

ACKNOWLEDGEMENTS

The First National Communication for Uganda is the product of the **"The Enabling Uganda Project".** The Project was financed by the Global Environment Facility (GEF) through the United Nations Development Programme (UNDP) and was coordinated by the Department of Meteorology within the Ministry of Water, Lands and Environment in its capacity as National Climate Change Focal Point. The Communication was compiled using mainly the results of two previous studies:

- The Inventory of Sources and Sinks of Greenhouse Gases in Uganda which was financed by GEF through the United Nations Environment Programme (UNEP), 1993/94; and

- The Assessment of Vulnerability and Adaptation (V&A) to Climate Change as well as Adaptation and Mitigation Options which was sponsored by the United States Government under the US Country Studies Programme, 1995/96

The Government of Uganda would like to take this opportunity to express its gratitude to the GEF and UNDP for the financial and technical support in preparing the National Communication, GEF and UNEP for the financial and technical support in preparing the GHG Inventory and the United States Government for the V & A Assessment Study. Thanks also go to the members of the Interdepartmental - Interministerial Committee (IIC), Members of the various study Task Forces and all the organizations and individuals who contributed to the production of this Communication. Special thanks go to the following people:

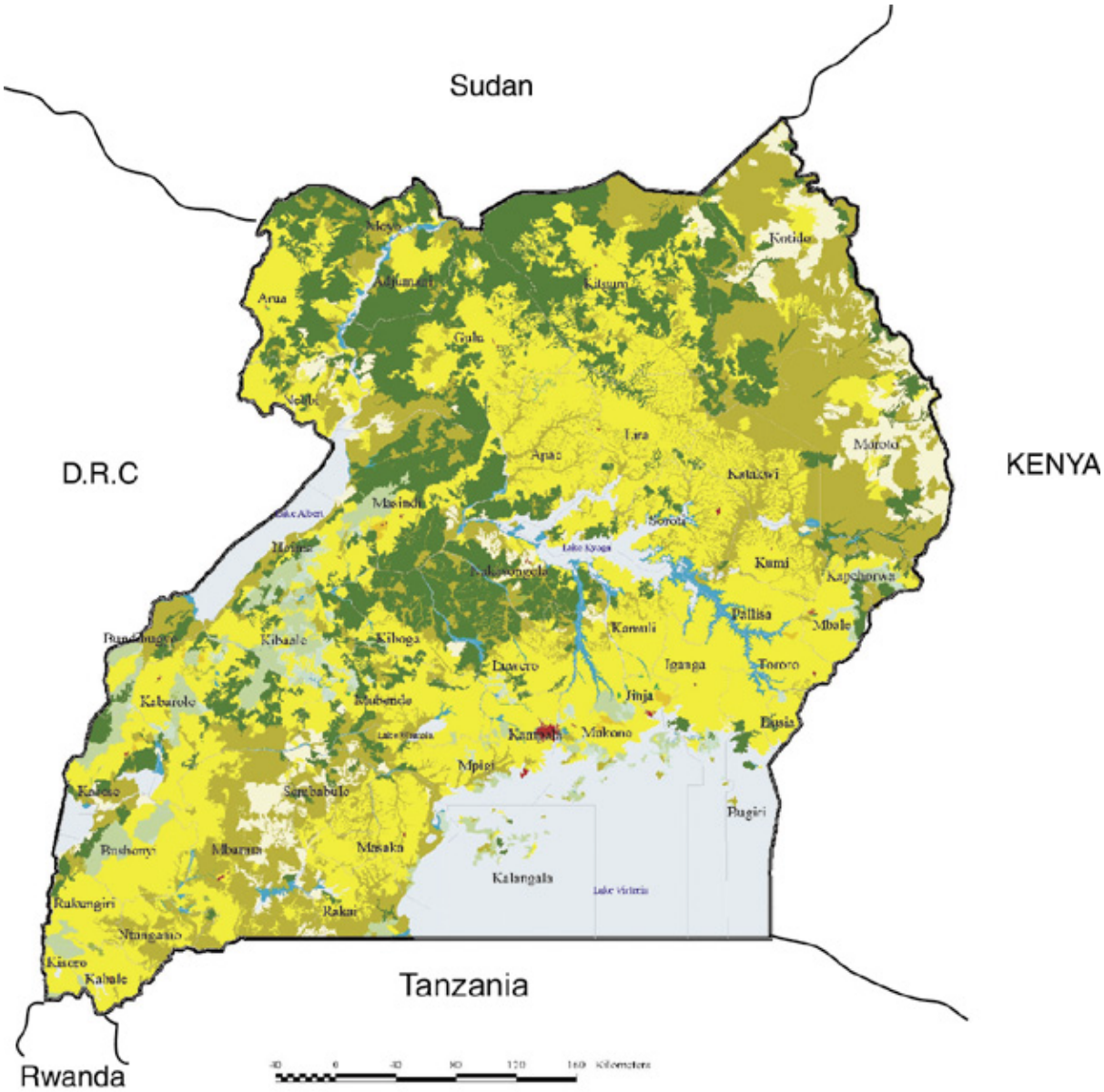
- The Permanent Secretary, Ministry of Lands, Water and Environment for his valuable guidance as Chairman of the National Climate Committee;
- The Commissioner of Meteorology who is also the National Focal Point;
- Project Staff (Messers. Philip Gwage, Magezi-Akiiki and Julius Mugisa);
- Consultants(Messers S. A. K. Magezi and Fred Onduri);
- Alex Karekaho, Programme Officer, GEF/UNDP, Uganda;
- Ademola Salau, Regional Coordinator for Africa, GEF/UNDP, New York.

The National Communication is a result of a collaborative effort among experts from government, Non-Governmental Organizations (NGOs) and the private sector. Thanks particularly go to the following Government Ministries, District administrations and other organisations for their various contributions during the workshops:

(i) Ministry of Water, Lands and Environment;
(ii) Ministry of Finance, Planning and Economic Development;
(iii) Ministry of Agriculture, Animal Industry and Fisheries;
(iv) Ministry of Tourism, Trade and Industry;
(v) Ministry of Works, Housing and Communication;
(vi) Ministry of Foreign Affairs;
(vii) Ministry of Energy and Mineral Development;
(viii) Ministry of Health;
(ix) Ministry of Local Government;
(x) Ministry of Education and Sports;
(xi) Masaka District Administration;
(xii) Mbarara District Administration;

(xiii) Masindi District Administration;
(xiv) Jinja District Administration;
(xv) Lira District Administration;
(xvi) Mbale District Administration;
(xvii) Masaka District Administration;

The exercise of preparing the First National Communication under "the Enabling Uganda Project" has enabled us to meet our commitments under the United Nations Framework Convention on Climate Change (UNFCCC) and also provided an opportunity to build capacity, which can be used to undertake similar work in the future.


Sudan
D.R.C
KENYA
Tanzania
Rwanda
Arua
Gulu
Kitgum
Kotido
Lira
Apac
Moroto
Katakwi
Soroti
Kumi
Kapchorwa
Pallisa
Mbale
Tororo
Iganga
Jinja
Busia
Kamuli
Mukono
Kampala
Luwero
Kibaale
Kiboga
Kabarole
Mpigi
Sembabule
Rukungiri
Kasese
Kabale
Mbarara
Masaka
Kalangala
Rakai
Ntungamo
Bushenyi
Rugiri
Lake Victoria
Lake Albert
Lake Kyoga
Lake Mutanda
Kilometers
District boundary
National boundary
Broad-leaved tree plantation / woodlot
Coniferous plantation
Tropical high forest (fully stocked)
Tropical high forest (degraded / encroached)
Savanna woodland
Bushland
Grassland
Wetland
Small-scale farmland
Large-scale farmland
Built-up area
Open water
N

EXECTIVE SUMMARY

Introduction

The Ministerial Declaration of the Second World Climate Conference, noting the huge risk posed by potential climate change, called upon the United Nations to take immediate action to protect the global climate system. In December 1990 at its 45th session the General Assembly responded by establishing the Intergovernmental Negotiating Committee (INC), which negotiated and adopted the United Nations Framework Convention on Climate Change (UNFCCC) on 9th of May 1992. The UNFCCC was opened for signature at the Earth Summit held in Rio de Janeiro, Brazil in June 1992. Uganda signed the Convention on 13th of June, 1992 and ratified it on 8th of September 1993.

Aware of the increasing evidence of climate change and its impacts on socio-economic development, WMO and the United Nations Environment Programme (UNEP established the Intergovernmental Panel on Climate Change (IPCC) in 1988 to assess, available scientific information on Climate Change, its environmental and Socio-economic impacts and advise governments on possible course of action. The IPCC has guided and continues to guide the climate change process through its assessment reports and other scientific papers.

The ultimate objective of the UNFCCC is to achieve stabilisation of green house gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a timeframe sufficient to allow ecosystems to adapt naturally to climate change and to enable achievement of sustainable economic development.

All countries are vulnerable to adverse effects of climate change, however, the poorer countries, particularly the least developed countries, are more vulnerable because of their low adaptive capacity. The major impacts of adverse effects of climate change for Uganda include:-

- Food insecurity arising from occurrences of droughts and floods;
- Outbreak of diseases such as malaria, dengue fever, water borne diseases (such as cholera, dysentery) associated with floods and respiratory diseases associated with droughts;
- Heavy rainfalls which tend to accelerate land degradation;
- Damage to communication infrastructure by floods;

The last few decades have seen an increase in the frequency and intensity of these extreme weather events with serious socio-economic consequences. For instance the El Nino of 1997/98 is one of such event whose impacts were estimated to include:-

- 525 people died and over 11,000 were hospitalised and treated for cholera triggered by the El Nino induced floods and land slides;
- 1,000 people were reported to have died in flood related accidents;
- 150,000 people who were displaced from their homes;
- Damage to trunk and rural roads infrastructure was estimated at US 400 million;
- Infiltration of water resources and flooding of some pumping stations (submerging of pumping stations).

There was inadequate capacity to fully assess the monetary value of the losses especially in the agricultural and marketing sectors (inaccessible markets).

National Communication Process

The preparation of the National Communication, which was coordinated by the Department of Meteorology, commenced with the GHG Inventory Study followed by the Vulnerability and Adaptation Assessment Study. In both cases key stakeholders were involved in the actual studies. The compilation of the Draft Initial National Communication was done by two consultants. The output of the consultants, the Draft Initial National Communication, was then discussed at small technical workshops followed by national technical and policy workshops. The Initial National Communication was therefore enriched by a wide cross section of stakeholders.

National Circumstances

Uganda is a land-locked country located in the eastern part of Africa within the Great Lakes region. It occupies 241,038 square kilometres, of which open water and swamps constitute 43,941 square kilometres. Most parts of Uganda lie at an average height of 1,200 metres above sea level. The minimum altitude is 620 meters (within the Albert Nile) above sea level and the maximum altitude is 5110 meters (Mt. Rwenzori Peak) with a permanent ice cap.

Uganda is endowed with a considerable amount of natural resources such as fertile soils, minerals and vegetation. For example, over 40% of Uganda's population derives considerable economic benefits from Lake Victoria in the form of fishing, water supply, transport, hydro-energy and tourism, among others. The Ugandan vegetation is mainly composed of Savannah grassland, bushland and tropical high forests. While Uganda's land reserves hold considerable potential for agricultural development, tourism and water/energy resources development but they can easily be degraded due to either uncontrolled and or poor land-use practices or climate change.

Uganda experiences moderate climatic conditions throughout the year and its location across the equator gives it two rain seasons in a year although these two seasons merge into one long rain season as you move away from the equator. The first rain season is from March to June, while the second one is from August to October. The mean annual rainfall varies from 750 to 2000 mm. In Uganda, rainfall is the most sensitive climate variable that affects social and economic activities

Despite the general favourable climatic conditions, in recent years Uganda has experienced frequent and severe droughts in most parts of the country. The incidences have been more pronounced in the western and northeastern parts of the country especially during the year 2001. These incidences have led to severe food insecurity as well as social conflicts arising from search for pasture and water for animals across local boarders.

Uganda experiences a variety of temperature regimes. Mean daily temperature is 28^0C. However, temperatures below 0^0C are experienced on the higher mountain ranges of Rwenzori and Elgon. Rwenzori has a permanent ice cap, which is vulnerable to global warming. The temperature trend analysis shows a sustained warming particularly over southern parts of Uganda with the minimum temperature rising faster than the maximum temperature.

According to the National Census of 2002Uganda's population is 24.6 million people. The population is characterised by a high fertility rate with an average growth rate of 3.1%.

By 2000 the Ugandan population living below the absolute poverty line was 35 percent having fallen from 56 percent in 1992. Regional comparisons of incidence of poverty in

Uganda reveals that poverty continues to be more concentrated in the North and the East primarily because of the civil conflicts.

Uganda's Domestic revenue performance has exhibited tremendous improvement from about Shs.12 billion in 1990/91 to about Shs.1100 billion in the FY 2000/01. Overall revenue, which includes non-tax revenue, was 11.5% of GDP in 2000/01 down from 11.7% in 1999/2000. Net tax revenue (excluding taxes on government purchases and tax refunds) for the FY 2000/01 was estimated at Shs.1069, billion below the budget levels by Shs. 42.6 billion representing a 3.8% shortfall. The main sources of tax revenue include Income tax, Indirect tax, Customs and Excise duties, VAT and Non-tax revenue. The recurrent expenditure is wholly funded by locally generated revenue while a bigger part of the development expenditure is funded through grants or borrowing from development partners

Different sectors contribute differently to both the economy and to the GDP. The relative contributions are shown in Table 1 below, which shows that agriculture is the backbone of Uganda's economy. It constitutes about 42% of GDP, over 90% of export earnings and employs about 81% of the labour force.

Table 1: GDP at Factor cost at constant 1991 prices and percentage contributions

Sector	1995/96	1996/97	1997/98	1998/99	1999/00
Total GDP	2,852,756	2,982,180	3,143,090	3,375,940	3,546,662
Agriculture(%)	45.7	44.2	42.7	42.5	41.5
Mining and Quarrying(%)	0.4	0.6	0.7	0.7	0.7
Manufacturing(%)	7.9	8.6	9.3	9.7	10.0
Electricity and water(%)	0.9	1.0	1.0	1.0	1.1
Construction	7.5	7.7	7.9	7.9	8.1
Wholesale, retail, Hotels & Restaurants(%)	14.8	14.6	14.7	14.9	14.9
Transport and Communication(%)	4.7	5.0	5.2	5.2	5.4
Community services	11.8	11.9	12.0	11.7	11.6
Rent and owner-occupied dwellings (%)	6.2	6.4	6.5	6.5	6.6
Total GDP %	100	100	100	100	100

Source: Uganda Bureau of Statistics

Systematic Observations

Article 4.1 (g) of the UNFCCC commits Parties to co-operate in research, systematic observations and development of data archives related to the climate system. Uganda continues to fulfil this commitment in spite of a series of constraints related to her limited capacity and lack of resources. The Network of climate observing stations is shown in table 2 below.

Table 2: Network of Climate Monitoring Stations in Uganda

NO	STATION TYPE	OPERATIONAL STATIONS (NO)	OPTIMUM STATIONS (NO)
1	Synoptic station	7	15
2	Hydrological stations	6	18
3	Agrometeorological Stations	5	14
4	Other climate stations	10	N/A
5	Rainfall Stations	112	500
6	Upper Air Stations	1	2
7	Radar Station	1	2

Source: Department of Meteorology

Uganda has carried out research in the following areas:

- El Nino and Southern Oscillation Studies;
- Climate change studies including the:
  - Inventory of GHGs;
  - Vulnerability and adaptation assessments;
  - Policy implications of implementing the UNFCCC;
  - Clean Development Mechanism (CDM) Studies;
- Temperature and rainfall trends;
- Hydroclimatic studies; and
- Rainfall variability.

Biodiversity

Uganda's position astride the equator coupled with its wide range of altitude and climatic conditions makes it rich in biodiversity. Africa has a number of distinct biogeographic regions; or *phytochoria*; and Uganda is located in an area where several of them meet. Uganda is in a privileged position because of its hypothetical Pleistocene forest *refugium* of the Eastern Democratic Republic of Congo, known as the Albertine Rift area of Regional Endemism (National Biodiversity Unit, 1992). Uganda benefits from her extensive biodiversity in terms of tourism, variety of foods and crops, forestry and biofuels, and medicinal plants, among others.

Most of Uganda's Bio-diversity can be found in Natural Forests, but a considerable amount is found in open waters, wetlands, and dry/moist savannah. Uganda's bio-diversity such as wild life is vulnerable to adverse effects of climate change especially prolonged droughts, floods and rapid change in climate parameters.

Energy

The energy sector is predominantly dependent on wood fuel, which accounts for up to 93% of the countries total energy needs. The high demand for fuel wood has resulted into depletion of forests leading to land degradation. The other sources of energy are petroleum and hydroelectricity accounting for 5% and 1.5% respectively. Fortunately, Uganda is endowed with renewable energy resources, which include biomass supplies, hydropower potential (over 2000 MW), solar and biomass residues from agricultural production.

The transport sector is the major consumer of fossil fuels. It accounts for about 75% of the fossil fuel import bill. The vehicle fleet is dominated by private motor vehicles and low

efficiency mini buses. Over 60% of the motor vehicle fleet operates within the capital city, Kampala. It is estimated that there are approximately 200,000 vehicles (2000/2001 F/Y) in the country with an estimated average growth of 10,000 vehicles per year. Air transport also does play an important role in Uganda's economic development with an average annual growth rate of 13.1 % between 1991 and 2000.

National Inventory of Greenhouse Gases

The UNFCCC aims at stabilizing concentration of greenhouse gases in the atmosphere and commits Parties; in accordance with the principle of common but differentiated responsibility and taking into account their national priorities and aspirations; to take measures to mitigate GHG emissions. Uganda has carried out GHG inventories using the IPCC developed guidelines for computation of GHGs (by Parties). The GHG inventory was based on the 1994 emissions and the IPCC guidelines were used (to enable comparisons).

The emission categories covered in this inventory are energy, industrial processes, agriculture, solvents, landuse change and forestry as well as waste. The gases addressed from these sectors are: Carbon dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_20), Nitrogen Oxides (NO_X), sulphur dioxide (SO_2) and Non-Methane Volatile Organic Compounds (NMVOC).

In order to carry out the inventory of GHG emissions and removals a number of assumptions were made and included the following: -

- Conversion and emission Factors: There were no country specific values. Default values were used as provided by the IPCC.
- In calculating CO_2 emissions in the energy sector, it was assumed that 99% of the carbon was oxidised.
- All petroleum sales represent petroleum consumption in Uganda.
- Emissions from bio-fuels are included in the total inventory.

For emissions in the Energy sector, two approaches were used. These are the bottom up methodology as well as the top down methodology starting with end use devices.

Analysis and Results

Apart from emissions from bio-fuels, other emissions are minimal.

Emissions from fossil fuels: Using the top down methodology in estimating the CO_2 emissions from petroleum products, an estimated total of 708.61 Giga grammes of CO_2 were emitted from a total carbon content of 195.07 Giga grammes. This figure excludes 105.5 Giga grammes of CO_2, which was an emission due to jet fuel. Most jet fuel is used on international aircraft and is considered as bunker fuel.

In adopting a bottom-up approach, estimates were made for a number of end-use devices. Both stationary and mobile end-use devices were considered.

In estimating emissions from bio-fuels, national figures for the carbon content, nitrogen content, C/N and N/C ratios were experimentally determined. Using these conversion factors, the total CO_2 emission from wood-fuel, charcoal, and from wood to charcoal respectively was 11,605.42 Gg, 773.67 Gg and 1,384.64 Gg. Smaller amounts of emissions from bagasse were estimated at about 76.28 Gg.

Greenhouse Gas Emissions and Removals

The key GHG is CO_2. Agricultural activities are the biggest contributor to all the other GHG emissions including methane, Nitrousoxide, Carbon monoxide, and Nitrogen oxides. Agriculture does not contribute to emissions of Non-Methane Volatile Organic Compounds (NMVOC). The energy sector is the major contributor of NMVOC, which contributes 4.9956 out of the total 5.9876 Gg of NMVOC. The details of the emissions are in the summary report for National Green House Gas inventories (Part I) shown as Table 3. This summary report for the national GHG inventory shows fairly high GHG emissions. These are reflected in biomass burned for energy, agricultural waste burning, and savannah burning and grassland conversion.

SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (PART 1) IN Gg

Table 3.7: Summary Report for National Greenhouse Gas Inventories (Part 1)

No.	GREENHOUSE GAS SOURCE AND SINK CATEGORY	CO2 (Gg)	CH4 (Gg)	N2O (Gg)	NOX	CO	NMVOC
	Total (Net) National Emission						
1	All Energy (Fuel Combustion + Fugitive)						
	A Fuel Combustion	* 708.610					
	Energy & Transformation including	--	--	--	--	--	--
	Industry (SIC)	--	0.207	0.053	--	--	--
	Transport	507.150	0.126	0.540	3.950	27.270	4.990
	Commercial/Institutional	63.000	--	--	--	--	--
	Residential	114.140	--	--	--	--	--
	Agriculture/Forestry	0.979	0.001	0.014	0.000	0.006	0.002
	Other (UEB Generators)	1.483	0.001	0.000	0.021	0.010	0.004
	Biomass Burned for Energy	13,763.000	74.520	4.704	22.810	822.930	--
	B Fugitive Fuel Emission						
	Oil Natural Gas Systems						
	Coal Mining						
2	Industrial Processes	--	--	--	--	--	--
	A Iron and Steel	--	--	--	--	--	--
	B Non-Ferrous Metals						
	C Inorganic Chemicals						
	D Organic Chemicals						
	E non-metallic Mineral Products	43,4300.000					
	F Other (Foam)	0.070					
3	Solvent Use						
	A Paint Application	--	--	--	--	--	0.935
	B Degreasing and Dry Cleaning						0.057
	C Chemical Products Manufacture/Processing	--	--	--	--	--	--
	D Other	--	--	--	--	--	--
4	Agriculture						
	A Enteric Fermentation	--	197,400		--	--	--
	B Animal Wastes	--	7.050	--	--	--	--
	C Rice Cultivation	--	23.536	--	--	--	--
	D Agriculture Soils (Fertiliser Use)			0.002			
	E Agricultural Waste Burning	# 264.500	1.780	0.380	8.540	37.050	--
	F Savannah Burning	# 72,130.0	960.000	40.000	1,165.000	16,830.000	--

		00					
5	Lands Use Change and Forestry						
	A Forest clearing & On-Site Burning of Cleared Forest	2,834.750	1.971	0.014	0.319	17.243	--
	B Grassland conversion	6,641.900	4.015	--	--	--	--
	C Abandonment of Managed Lands	--	--	--	--	--	--
	D Managed (Forests Removals)	-1,354.000	--	--	--	--	--
6	Waste						
	A Landfills	--	2.926	--	--	--	--
	B Waste water	--	--	--	--	--	--
	C Other (Pit Latrines)	--	1.600	--	--	--	--

* - Total emission

\# - Part of the natural cycle

Source: Ministry of Natural Resources 1996.

Mitigation Options And Measures

Uganda has put emphasis on no-regrets mitigation option measures through the Uganda Enabling Project and the East African power study which carried out a GHG mitigation assessment in the energy sector. Four measures were considered by the studies, and these are: -

- Petrol/Ethanol Blending,
- Elimination of Residual/fuel oil in Industry,
- Hydro power based mitigation options, and
- Photovoltaic-based mitigation options

For reduction of GHG in East Africa, a hydropower export strategy has been proposed under the East African power study. Studies on a number of sites have been completed.

In the transport Sector, the preferred mitigation option is aimed at reducing traffic congestion on all roads in Kampala city. Measures to do this include the following: -

- Encouraging vehicles with lower energy consumption intensity with respect to transportation capacity
- Implementing the National and the Greater Kampala Transportation Master Plans;
- Engineering design of roads where one-way streets and by-pass roads can reduce traffic congestion**,**
- Establishing dedicated Non-Motorised Transport (NMT) lanes.
- Putting in pace suitable regulatory measures to reduce traffic congestion

In the forestry sector, the major mitigation option is through the enhancement of sinks for CO_2. To this effect, Uganda has put in place a Forest Action Plan whose goal is to increase forest cover and ensure sustainable management of the forest estate.

In the Agriculture sector, a number of mitigation measures have been proposed mostly aimed at improving the efficiency of live stock feed.

Vulnerability And Adaptation

IPCC findings indicate that the poorer countries such as Uganda will suffer disproportionately despite their little contribution to climate change. Climate change will have far reaching consequences for Uganda for various reasons such as weak institutional capacity, lack of skills in disaster management, lack of equipment for disaster management, limited financial resources and above all an economy, which depends entirely on exploitation of its natural resources. Uganda's economy is totally dependent on climate and therefore vulnerable to adverse effects of climate change.

A limited preliminary vulnerability and adaptation assessment was done under the US Climate Change Country Study Programme (1996). The study covered agriculture (crop and livestock), water resources and forestry sectors. Vulnerability assessment was done based on climate scenarios derived from General Circulation Models (GCMs) listed below.

- The Canadian Climate Centre Model (CCCM),
- The Geophysical Fluid Dynamics Laboratory's Model (GFDs) and
- The United Kingdom Meteorological Office - 1989 Model (UK 89).

The results showed that all the models predicted an increase in temperatures of between 2 and 4^{o}C. There was variation in the predicted rainfall. The CCCM model gives an overall decrease in rainfall while the other two models gave a slight increase in rainfall.

Uganda's economy is particularly vulnerable to climate variability and climate change, because of its reliance on exploitation of natural resources with agricultural sector being a major contributor. Over 80% of the population derives their livelihood either directly or indirectly from agricultural-related activities. Agricultural performance in Uganda fluctuates with changes in climate. Consequently, GDP growth and inflation rates often correspond with performance of rainfall seasons.

In the Agricultural sector, vulnerability assessment was done using maize. Maize was analysed using the CERES - maize model. The selected site for the study was Namulonge Agricultural and Animal Research Institute ((00o 31'N, 32o 38'E) at an altitude of 1128.8m above MSL.

The results from the model are considerably lower than the mean observed values for the area, highlighting the need for calibration of the model to make it appropriate to local conditions.

Crop vulnerability to climate variability and change is dependent on ecological zone. There is high uncertainty in onset and cessation of rainfall seasons. This coupled with high evaporation rates, particularly in northern Uganda, affects agricultural production.

In the livestock sector, it is estimated that 56.9% of Uganda's total area is potential for feeding ruminant livestock (MWL&E, 1996). The livestock population is dominated by cattle most of which is found within the cattle corridor, an area of lower rainfall with increasing frequency of droughts.

The model " Simulation of Production and Utilization of Rangelands (SPUR2)" which incorporates the Colorado Beef Cattle Production Model (CBCPM) was used to carry out a vulnerability and adaptation assessment. The vulnerability assessment used the following different plant species, which are prevalent in the grasslands:

- Warm (dry) season grass - *Hyparrhenia rufa;*
- Cool (wet) season grass - *Set aria sphaceleta;*
- Warm (dry) season forbe - *Trip scum laxum;*
- Cool (wet) season forbe - *Pennisetum purpurum; and*
- Shrub - *Acacia hockii.*

Further consideration of potential vulnerability of high yielding dairy cattle was considered. High yielding cows are susceptible to heat stress compared to the low yielding ones such as the traditional cattle found in the cattle corridor.

An increase in temperature is therefore most likely to reduce the total optimum area where high yielding dairy cattle can be economically reared. This increases vulnerability of this sector.

In assessing vulnerability in the forestry sector, the forest cover was simulated using the Holdrige Life Zone Classification model whose results were not satisfactory. It was concluded that for the time being, vulnerability assessment should be based on analogue periods and historical experiences of droughts and floods.

In the water Resources Sector, three GCMs predicted a 10 - 20% increase in run-off under future climate change scenarios. As a consequence, results of the hydrological vulnerability assessment using three river basins in Uganda generally indicated a 10% - 20% increase in run-off for most of the country. However, this may not be the case with the semi-arid areas where the run-off may instead reduce. It was not possible to justify this reduction due to lack of sufficient data in the catchment of the semi-arid zone.

Overall, limited vulnerability assessment of a few sectors (agriculture, water resources and forestry) was done, however the model outputs differ significantly from observed values. Nonetheless recent occurrences of droughts and floods clearly give some magnitude of impacts of climate change.

In the Agricultural Sector, it was found that the government policy on PMA contained significant adaptation elements such as development of drought resistant cultivars and provision of water for production. A number of strategies have been suggested during the assessment of adaptation options. These include irrigation, diversification of crops, improved farming methods, and putting in place processing and storage facilities.

In the Livestock Sector, proposed options were aimed at improving the carrying capacity of the rangelands. Others include, reduction of animal population, improving pastures and rangeland management, reducing silting of river banks and lake shores, and encouraging water harvesting

In the forestry Sector, proposed adaptation options include developing of drought resistant species, improving the management of forests, carrying out research into new pests and diseases and the preservation of indigenous species.

In the water Resources Sector, **a**daptation measures will call for improved water management systems throughout the country. These options include increased water conservation, pollution control, construction and maintenance of water storage structures, increased water harvesting, and improved river basin and catchments planning.

National Policies And Measures

The primary focus of government is poverty eradication. Poverty Eradication Action Plan (PEAP) is Uganda's Comprehensive Development framework, which has guided the formulation of government policies since 1997. PEAP aims at transforming Uganda into a modern economy. The Poverty Eradication Plan programme operates on the basis of following four pillars:-

- Fast and sustainable economic growth and structural transformation;
- Good governance and security;
- Increased ability of the poor to raise their incomes; and
- improved quality of life of the poor.

The government gives priority support to activities and programmes that have direct and positive implications to the 4 pillars of PEAP. For any project to be included in the government development programme for financial or material support it must address poverty eradication directly.

Although sectoral policies were developed to support PEAP these policies do provide a good basis for implementation of the Convention. The relevant policies are:

- Plan for Modernisation of Agriculture (PMA):
- Population Policy.
- Health Policy
- Disaster Management and Preparedness Policy
- Forestry Policy (2001)
- Environment Policy
- National Water Policy
- Energy Policy
- Waste Management
- National Wetlands Policy (1995)
- Climate Monitoring.

Implementation Strategy for the UNFCCC and the Kyoto Protocol

Considering the cross cutting nature of climate change issues, no single sector or institution can independently handle all the aspects of climate change. Implementation of the UNFCCC requires the involvement of stakeholders at all levels. At the national level; as evidenced by the sectoral polices which Uganda is already implementing; coordination, collaboration and cooperation with government, private and NGO institutions is critical. Indeed this has already been done. Proposed measures to address climate change, particularly adaptation, should also take into account inputs from the local communities. In order to develop effective measures to implement the Convention, Uganda will take the following into account:-

- Capacity development;
- Strengthening climate and climate change monitoring institutions; and
- Development of Adaptation Action Plan.
- Applying participatory and consultative approaches

- Establishment of legal and institutional framework

A number of Policy Gaps and Constraints to the implementation of the Convention still do exist. These include the following: -

- The lack of a comprehensive Land-use Plan
- Inadequate Capacity
- Lack of awareness

Regarding awareness it is recognised that effective implementation of the Convention depends on the level of awareness of the population at the various levels of society. Public awareness as well as education and training must be an integral component of national programmes to address climate change and its adverse effects.

In this regard Uganda has already taken advantage of climate change meetings and workshops to invite the media to cover climate change events with the objective of raising the level of awareness of the public. Lack of financial and technical assistance remains the main barrier to education, training and public awareness.

Conclusion

National communication is important for monitoring and evaluating contribution of a party to the attainment of the objective of the Convention and also to reduce impacts of adverse effects of climate change on its people and economy. Collection and analysis of data to support preparation of national communication must be on continuous basis. It is therefore necessary to strengthen the capacity of institutions directly involve in the collection of this data.

The preparation of the initial national communication has clearly revealed weakness in the area of vulnerability and adaptation assessment. Models used were inappropriate and also generally there is lack of capacity to carry out vulnerability and adaptation assessment. Capacity building remains a serious problem if Uganda is to improve preparation of its national communication.

CHAPTER 1

INTRODUCTION

1. Introduction

1.1 Historical Perspective

The First World Climate Conference, held in Geneva, Switzerland in 1979, was convened by the World Meteorological Organization (WMO) to discuss applications of climate to socio-economic development. The conference drew interest of physical and social scientist as well as planners. The conference noted an increasing trend in concentration of carbon dioxide in the atmosphere. This observation stimulated interest among scientists particularly regarding implications of this trend. The conference agreed to review the status of the world climate as well as applications of climate in socio-economic development within ten years.

Aware of the increasing evidence of climate change and its impacts on socio-economic development, WMO and the United Nations Environment Programme (UNEP established the Intergovernmental Panel on Climate Change (IPCC) in 1988 to assess, available scientific information on Climate Change, its environmental and Socio-economic impacts and advise governments on possible course of action.

The Second World Climate Conference held in November 1990, was a unique scientific conference, which drew interest of scientists, planners and politicians (at both ministerial and heads of states level). The objective of the conference was to create awareness through case studies on economic benefits of climate information and to assess the current knowledge of global issues of climate change, greenhouse gas emissions and policy implications. The Ministerial Declaration, noting the huge risk posed by potential climate change, called upon the United Nations to immediately take action to protect the global atmosphere. In December 1990 at its 45^{th} session the General Assembly established the Intergovernmental Negotiating Committee (INC). The INC met many times and on 9^{th} of May 1992 it adopted the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC was opened for signature at the Earth Summit held in Rio de Janeiro, Brazil in June 1992.

IPCC in its “Second and Third Assessment Reports” concluded that there is discernible evidence that human activities are influencing the global climate system through human activities such as combustion of fossil fuels, deforestation, land-use and land-use change. Concentrations of GHGs such as Carbon dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_20), Nitrogen Oxides (NO_X), sulphur dioxide (SO_2) and Non-Methane Volatile Organic Compounds (NMVOC) have continued to accumulate in the atmosphere resulting in global warming. It is the global warming, which has caused climate change. Climate change manifests itself through increased frequency and intensity of extreme weather events such as droughts, floods, sea level rise and heat waves. IPCC predicts that average global temperature will increase in

the range of 1.4 to 5.8 degrees centigrade while global mean sea level will rise in the range of 0.09 to 0.88m over the period 1990 to 2100. Global averaged precipitation is projected to increase during the same period though at regional scales there will be alternative scenarios of increase and decrease in precipitation.
Uganda, a least developed country and therefore one of the most vulnerable countries to the adverse effects of climate change, has committed herself in the spirit of global cooperation to actively participate in the climate change process. She signed and ratified the UNFCCC on 13th June 1992 and 8th September 1993 respectively.

1.2 The Objective of the UNFCCC

The ultimate objective of the UNFCCC is to achieve stabilisation of green house gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a timeframe sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

1.3 Impacts of Adverse Effects of Climate Change

Although there are some positive elements of climate change such as increased precipitation in some areas of the world and warmer temperatures in mid and high latitudes the adverse effects of climate change by far outweighs the positive elements of climate change. All countries are vulnerable to adverse effects of climate change, however, the poorer countries, particularly the least developed countries, are more vulnerable because of their low adaptive capacity. Impact of adverse effects of climate change include the following:-

- Food insecurity arising from frequent and intense occurrences of droughts and floods;
- Outbreak of diseases such as malaria, dengue fever, water borne diseases (such as cholera, dysentery) associated with floods and respiratory diseases associated with droughts;
- Reduction in agricultural production as a result of floods and droughts;
- Heavy rainfalls which can accelerate land degradation;
- Damage to communication infrastructure by floods;
- Heat waves in hot climates;
- Scarcity of water for both human consumption and production, particularly in drought prone areas and;
- Increased ethnic conflicts due to scarcity of resources.

1.4 Impacts of Adverse Effects of Climate Change on Uganda

Although droughts and floods have occurred in Uganda in the past, the last few decades have seen an increase in the frequency and intensity of these extreme weather events with serious socio-economic consequences. The El Nino of 1997/98 is one of such event.

Despite the difficulty to quantify the damage caused by climate change events, the El Nino of 1997/98 inflicted heavy losses. The El Nino of 1997/98, probably the most severe swept bridges (many towns were cut off from commercial centre causing heavy losses in goods and services), crops were destroyed, outbreak of water borne diseases such as cholera and other flood-related diseases. The impacts during the El Nino of 1997-98 included the following:-

- An estimated 525 people died and over 11,000 were hospitalised and treated for cholera triggered by the El Nino induced floods and land slides;
- An estimated 1,000 people were reported to have died in flood related accidents;
- About 150,000 people were displaced from their homes;
- Damage to trunk and rural roads infrastructure was estimated at US 400 million;
- In Kapchorwa district about 300 hectares of wheat were destroyed;
- Tea estates were flooded making tea picking difficult;
- Coffee exports dropped by 60% between October and November (disrupted transport system);
- Infiltration of water resources and flooding of some pumping stations (submerging of pumping stations).

Monetary value of the losses in the agricultural sector and inaccessible markets were not estimated. The total cost could run into hundreds of millions of US dollars.

Uganda's economy is dependent on exploitation of its natural resources, which are sensitive to climate variability and climate change. Climate variability and climate change have a large negative impact on Uganda's socio-economic development. Adaptation to adverse effects of climate change is therefore of great importance to Uganda.

1.5 National Communication

Articles 4 paragraph 1 (a) and (b) and 12 commit all parties to the UNFCCC to prepare and submit an inventory of GHGs, mitigation options of GHG emissions, an assessment of its vulnerability to adverse effects of climate change and adaptation options to the Conference of the Parties through the UNFCCC Secretariat. Uganda is therefore complying with its commitments under these articles. National communication also is a channel of providing information to the COP on actions taken or envisaged to be taken to address climate change. Developing countries may also provide information of action plans for implementation of the UNFCCC in their countries and financial assistance they may need to carry out such activities.

The preparation of Uganda’s initial communication was coordinated by the Department of Meteorology, which is the technical climate change focal point. Key stakeholders were involved in the actual preparation of the national communication. The Draft Initial Report is discussed at both technical and policy level prior to its submission to the UNFCCC Secretariat. Uganda as a least developed country, will be

preparing a national adaptation programme of action and therefore no attempt has been made to prepare a national action plan for implementing the UNFCCC.

1.6 The National Communications Process

The National communications process started with Uganda's signing and ratification of the UNFCCC. Following ratification, the country carried out a inventory of sources and sinks of green house gases in 1993 and was updated in 1966 which was followed by a vulnerability and adaptation to climate change assessment. In both cases the following key sector/ministries participated: -

- Ministry of Agriculture, Animal Industry and Fisheries;
- Ministry of Energy and mineral development;
- Department of Forestry;
- Makerere University, Kampala and;
- Ministry of Water Lands and Environment
- Ministry of Tourism Trade and Industry.
- Selected NGOs

The input from these sectors was an important contribution to preparation of the national communication. The draft initial report was discussed at several stakeholder workshops, which culminated into the National Policy Makers' Workshop. It is fair to say, therefore, that this process was enriched by a wide cross section of stakeholders.

CHAPTER 2

NATIONAL CIRCUMSTANCES

2. Background

2.1 Geography

Uganda is a land-locked country located in the eastern part of Africa within the Great Lakes region. In the north Uganda shares borders with Sudan, in the east with Kenya, in the west with the Democratic Republic of Congo and in the south with Tanzania and Rwanda as shown in Figure 1.

Uganda occupies 241,038 square kilometres, of which open water and swamps constitute 43,941 square kilometres and land area, excluding open water and swamps; constitutes 197,097 square kilometres. Table 2.1 and Figure 2.1 show the landuse coverage of Uganda.

Table 2.1: Land use and coverage

	Area in KM^2	As percentage of total area
Open water	36,909.2	15.28
Wetlands	30,105	13.00
Farm land	83,931	35.03
Tropical high forests	8,846.7	3.66
Rest	81,246.1	33.71
Total	241,038	100.00

Source: - State of the Environment report, 2000/01

Relief: Most parts of Uganda lie at an average height of 1,200 metres above sea level. The minimum altitude is 620 meters (within the Albert Nile) above sea level and the maximum altitude is 5110 meters (Mt. Rwenzori Peak). Uganda has four main mountain ranges namely Rwenzori in the west, Elgon in the East, Mufumbiro in the Southwest and Moroto in the Northeast.

Water (Major Rivers and Lakes): Uganda is well endowed with fresh water resources though the distribution is more concentrated in the central and South-western regions. River Nile, the longest river in Africa, has its sources at Lake Victoria, which is also, the largest lake in Africa. Other rivers include Aswa, Kagera and Tonga. The lakes include Victoria located in the South-east, Albert, George and Edward in the west and Kyoga in the centre.

Over 40% of Uganda's population derives considerable economic benefits from Lake Victoria in the form of fishing, water supply, transport, hydro-energy and tourism, among others. Furthermore, Lake Victoria, as well as the other lakes in the country, are sensitive to climate change and climate variability. During the floods of 1960 – 1962, for example, the levels of Lakes Victoria, Kyoga and Albert rose considerably and economic activities along the shores were disrupted. In 1997 the El Nino rains caused over flooding on the shores of Lake Kyoga leading to submergence of land that culminated into disruption of economic activities and losses of lives and property. Degradation of river banks and lake shores is causing silting.

Vegetation: The Ugandan vegetation is mainly composed of Savanna grassland, bushland and tropical high forests. While Uganda's land reserves hold considerable potential for agricultural development, tourism and water/energy resources development they can easily be degraded due to either uncontrolled and poor of land-use practices or climatic change. The most fragile ecosystems in Uganda are the highlands and the dry lands comprising the cattle corridor (rangelands). The main environmental problems in Uganda and a potential forcing to various climate change scenarios include Land degradation, recurrent droughts and floods, deforestation, soil erosion, overgrazing and over-cultivation. In recent times, the frequency of extreme weather events has increased leading to more severe drought and flood impacts.

2.2 Climate

Uganda experiences moderate climatic conditions throughout the year and its location across the equator gives it two rain seasons in a year although these two seasons merge into one long rain season as you move away from the equator. The first rain season ranges from March to June, while the second one ranges from August to October. The rainfall level ranges from 750 to 2000 mm per year.

Despite the general favourable climatic conditions, in recent years Uganda has experienced frequent and severe droughts in most parts of the country, though the incidences have been more pronounced in the western and north eastern parts of the country especially during the year 2001. In the Western region, the prolonged period of drought caused decline in animal stocks and crop production. Farmers were forced to slaughter and sell their animals in order to reduce the management burden and to meet the high costs of food prices. This long drought had its toll mainly on Mbarara, which is the main source of milk, meat and matoke (plantains) for western and central regions. A similar situation was experienced in Karamoja in the north-eastern part of the country, which further escalated into unrest/conflict caused by the Karamojong raids on their neighbours, as they search for pasture. These two areas were particularly affected because of the nature of their nomadic way of cattle keeping whereby number of animals is preferred to quality.

As a result of climate variability/climate change also emerged climate- related economic losses. With failures in agricultural production global inflation-adjusted losses tends to rise in order of magnitude and the GDP rate of growth consequently dropped. The performance in the export sector and foreign exchange earning also declined.

Rainfall: In Uganda, rainfall is the most sensitive climate variable that affects social and economic activities. The wettest districts are located within the lake basin areas and include the districts of Kalangala, Kampala, and part of Masaka, Mpigi, Mukono, Jinja and Bugiri. The western and northern districts occasionally experience long droughts, which are becoming more frequent.. The eastern region including Pallisa, Mbale, Kapchorwa, Kumi, Soroti, Tororo, Busia and Bugiri receive moderate rainfall. The average long term annual rainfall for Uganda is 1318 mm derived from the centres as shown in table 2.2 below.

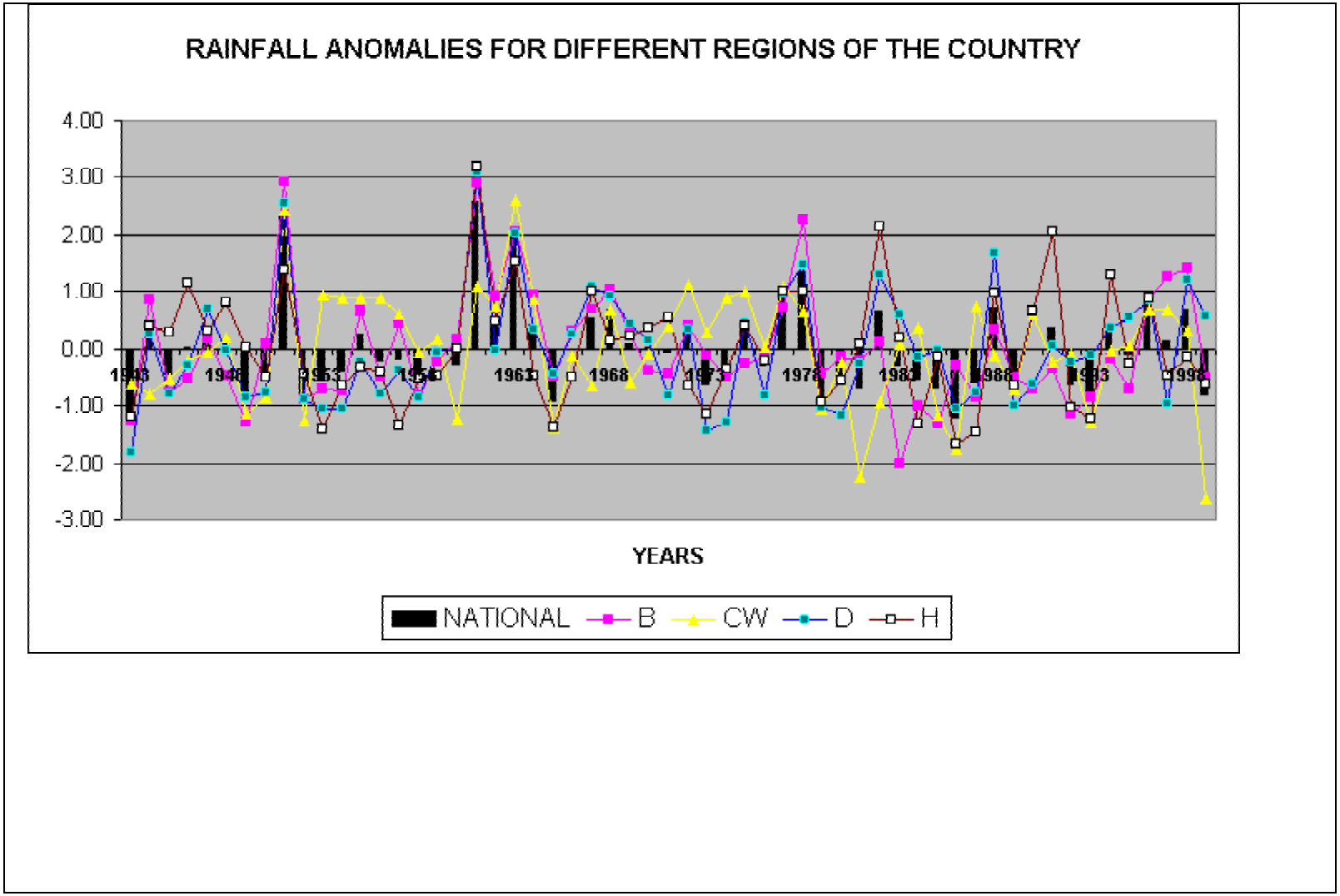
Table 2.2: Average long-term (1960 – 1990) annual Rainfall patterns in Uganda by regions and centres in millimetres (mm)

Region	Districts	Rainfall
EAST		**1365**
	Jinja	1321
	Tororo	1462
	Soroti	1312
	Moroto	745
WEST		**1043**
	Mbarara	905
	Kabale	994
	Kasese	970
	Masindi	1304
NORTH		**1464**
	Gulu	1555
	Lira	1430
	Arua	1406
CENTRE		**1400**
	Kampala	1180
	Entebbe	1619
Average for all regions		**1318**

Sources: Uganda Bureau of Statistics (Statistics Abstract 2000)

Rainfall Variability and Trend: The year-to-year variation of rainfall over different zones is shown in figures 2.2. It is expressed in terms of normalised rainfall anomaly. This analysis of rainfall variability does not show any significant trends in rainfall. On the other hand there is clear evidence of an increased frequency of droughts in the later years. This is demonstrated further by the records (shown in table 2.3) of regional dry and wet years between 1943 and 1999. The records show increasing variability in most regions of Uganda other than the central region.

Figure 2.2: Rainfall anomalies for different regions of Uganda



B = CENTRAL REGION
CW = SOUTH WESTERN REGION
D = SOUTH EASTERN REGION
H = CENTRAL NORTHERN REGION
Source: - Data provided by the Department of Meteorology, Uganda

Table 2. 3: Records of regional dry and wet years between 1943 to 1999

Years	South western	Central	Eastern	Central northern
1943		D	VD	D
1946				W
1949	D	D		
1951	VW	VW	VW	W
1952	D			
1953			D	D
1954			D	
1957				D
1961	W	VW	VW	VW
1963	VW	VW	VW	W
1965	D			D
1967			W	W
1972	W			
1973			VD	D
1974			D	
1975	W			
1977	W		W	W
1978		VW	W	W
1979	D		D	
1980			D	
1981	VD			
1982			W	VW
1983		VD		
1984		D		D
1985	D	VD		
1986	VD		D	VD
1987				VD
1988			VW	
1989			D	
1991				VW
1992		D		D
1993	D			D
1994				W
1997		W	D	
1998		W	W	
1999	VD			
Summary				
D	6	4	8	9
VD	3	2	2	2
W	4	2	5	7
VD	2	4	4	3

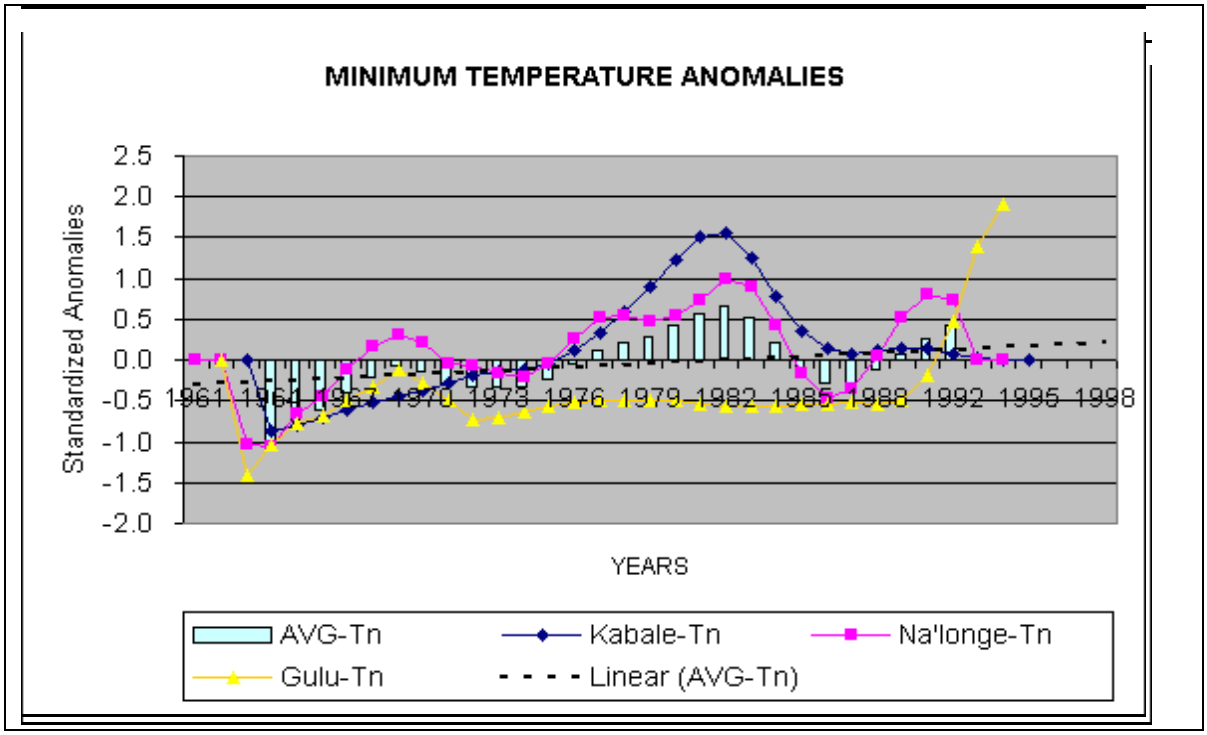
Key:				
	D	Dry	W	Wet
	VD	Very dry	VW	Very wet
		Normal		

Source: State of the Environment Report 2000/01

Temperature: Uganda experiences moderate temperatures throughout the year. The mean daily temperature is 28^0C. Extreme temperatures as low as 4^oC are experienced in Kabale, which is located in the western highlands. However, temperatures below 0^0C are experienced on the higher mountain ranges of Rwenzori and Elgon. Rwenzori has a permanent ice cap, which is vulnerable to global warming. Highest temperatures of over 30^0C are experienced in Gulu, Kitgum and Moroto in the north and North Eastern part of the country.

Temperature Variability and Trend: The year-to-year variation in annual mean, maximum and minimum temperatures over selected stations in Uganda are shown in figure 2.3.

Figure 2.3: Maximum and minimum Temperature Anomalies over selected regions of Uganda



Source: - Data provided by the Department of Meteorology - Uganda

This analysis shows a sustained warming particularly over southern parts of Uganda. The fastest warming regions are in the Southwest of the country where the rate is of the order of 0.3^{o}C per decade. The minimum temperature is rising faster than the maximum temperature.

2.3 Population

There exists interdependence between population size, structure and growth rate on the one hand and climate on the other. In Uganda, population pressure has often led to changes in landuse practices. This has the potential to contribute to both climate change and climate variability. The impacts of adverse effects of climate change are severe on densely populated areas.

Uganda's high population density and growth rate inflict pressure on the natural resources and the environment, consequently causing adverse effects on climate. Population pressure has often led to deforestation, land degradation and decline in agricultural production. This has the potential to influence both climate change and climate variability.

Since 1948 the Ugandan population has been doubling every 25 years. Between 1969 and 1991 Uganda's population grew at an average of 2.6 percent per annum. In the last inter census period of 1980 to 1991 the average annual population growth rate dropped to 2.5% from 2.7% between 1969 and 1980. Currently, it is estimated at 3.0%

Uganda's population was estimated to have reached 22.2 million people by June 2000 (A census was carried out in September 2002 but the results were not yet released at the time of this report). The population census of 1991 revealed a population of 16.7 million persons, an increase of 6,036,000 over the 1980-2001 inter census period. The 1959 – 1980 inter-census period saw an increase of 6,099,000 persons.

The population density of Uganda at the 1991 census was 85 people per square kilometre (table 2.4 below). This level is much higher than that of her neighbours in East Africa. The urban population of Uganda according to 1991 census was 1.9 million people representing 11.3 percent of the total population. This marked an increase over time from 4.2 percent in 1959 and 7.4 percent in 1980. The high rate of urbanisation during 1980-1991 was partly attributed to migration as a result of insurgency in the districts. Selected population indicators are shown in table 2.4.

Table 2.4: **Population size, density, growth rates and sex**

Regions & Districts	**Total population**		**Land**	**Population Density**		**Growth Rates**	
	Area Sq km	1980 (000s)	1991 Sq km	1980-1991 persons per Sq. km	1969-1991 persons per Sq. km	1980 (%)	1991 (%)
Central	3582.4	4843.6	37489	96	129	2.7	2.8
Eastern	3237.4	4128.5	27957	116	148	2.2	2.3
Northern	2424.2	3152	82099	30	38	2.4	2.4
Western	3392.1	4547.7	49551	88	92	2.7	2.9
Uganda	**12,636.2**	**16,672**	**197,096**	**64**	**85**	**2.5**	**2.6**

Source: Uganda Bureau of Statistics

Uganda has a high fertility rate. The level of fertility has been consistently high (over 7 children per woman). The total fertility rate by 1991 census was estimated at 7.1 percent, though the estimate of 1995 reflected a slightly lower rate of 6.9 children per woman.

2.5 Poverty and inequality trends

The measurement of poverty still remains a global challenge for social scientists. Therefore indicators of poverty vary with different institutions. In Uganda poverty is measured using the absolute poverty line based on consumption expenditure as a proxy for income. The absolute poverty line refers to the monetary cost of affording the basic food or non-food requirements of life. The poverty line therefore is the total cost of obtaining both the 3000-calorie food requirements based on typical diet of an absolutely poor person and the non-food essential requirements such as, clothing, health and education. The 3000 calories is a recommendation of the World Health Organisation as the basic daily requirement for persons aged 18-30 years and engaged in moderate work.

By 1992, 56 percent of the Ugandan population was living below the absolute poverty line. By the year 2000 this proportion had decreased to 35 percent.

Between 1997 and 2000 the average real consumption per capita in Uganda grew by 22 percent. These results were derived from a representative sample of household survey, 2000. The benefits of this growth was not distributed equally as the consumption was largest for the richest 10 percent of the population, whose consumption increased by 20 percent while that of the poorest group increased by mere 8 percent during this period. In the urban areas consumption increased by 42 percent and by 15 percent in the rural areas.

Over the same period (1997 – 2000) the reduction in rural poverty was evenly spread except for 3 percent of the population who are engaged in fishing and livestock. The fishing industry was affected by the ban on fish exports to the European Union market while livestock was affected by drought that affected production and ultimately lowering milk yields.

Regional comparisons of incidence of poverty reveals that poverty continues to be more concentrated in the North and the East of the country. This is mostly as a result of the persistent civil strife in those areas. There are 2.1 million poor people in the East while there are 2.7 million in the North. The Eastern region has experienced a sharp fall in the incidence of consumption poverty. Over 700,000 people have been lifted out of poverty between 1997 and 2000 as a result of security prevalence in most of the districts. On the other hand poverty in the north, where there is persistent insecurity, has increased by 8 percent leaving two thirds of the population living below the poverty line.

2.6 The economy

After experiencing a significant decline in economic growth and social development between the 1970s and 1980s, Uganda embarked on a programme to restructure the economy to enable the country restore economic stability and regain growth. These efforts were rendered futile because of the civil unrest that intensified during 1983/84. During 1987, with the support from the World Bank, the International Monetary Fund and the Development Partners another a comprehensive Structural Adjustment Programme was developed and its implementation was started. For the period 1995/96 to 1999/00 financial years, thanks to this programme, Uganda's economy grew at an average of 6 percent per annum. The highest growth rate of 7.8 percent was experienced in 1995/96 Financial Year. Real Per Capita GDP rose from about US$ 150 to US$ 165 over the same period. But the preliminary GDP estimates show a drop from 7.4 per cent in 1998/99 to 5.1 percent in 1999/00 mainly due to severe draught that affected agriculture production in Western Uganda.

The good economic performance was attributed to appropriate macroeconomic policies, which included prudent and tight fiscal discipline. Inflation was brought down from double digits in 1991 to single digits in 1995. Low Inflation has mainly been attributed to

government's commitment to refrain from central bank borrowing and limiting spending within the available resources. Table 2.5 below shows the GDP and GDP per capita performances as well as inflation rates.

Table 2.5: GDP at factor cost at constant (1997 prices) and GDP Per capita performances fiscal years 1997/98-2001/02:

	1997/98	1998/99	1999/00	2000/01	2001/02
Total GDP (Mill. Shs)	6,868,176	7,351,612	7,753,391	8,217,603	8,675,677
GDP Growth rates	5.1	7.0	5.5	6.0	5.6
Inflation rates	7.1	0.2	5.9	4.5	3.5
Percapita GDP (Shs.)	334,299	348,765	358,721	371,300	383,659

Source: Uganda Bureau of Statistics

The performance of Uganda's terms of trade has been relatively poor. By the end of Fiscal Year (FY) 2000/2001 Uganda's terms of trade had declined by over 30% over the past 2 years while oil prices rose by as much as 81% on annual basis and the farm gate prices of coffee declined by more than 50%. Due to decline in the terms of trade, growth in the private incomes, domestic consumption and private investment dramatically dropped. Uganda's export earnings fell by 194 million US Dollars over the past 2 years as a result of decline in world prices and the exchange rate, having depreciated by 22%. Despite this problem the economy grew by 5% in 2000/01.

Revenue: Uganda's Domestic revenue performance has exhibited tremendous improvement from about Shs.12 billion in 1990/91 to about Shs.1100 billion in the FY 2000/01. Overall revenue which includes non-tax revenue was 11.5% of GDP in 2000/01 down from 11.7% in 1999/2000. Net tax revenue (excluding taxes on government purchases and tax refunds) for the FY 2000/01 was estimated at Shs.1069, billion below the budget levels by Shs. 42.6 billion representing a 3.8% shortfall.

The total annual tax revenue increased from about Shs. 623 billion in 1995/96 FY to about Shs. 988 billion during the FY 1999/00. The major contributor to tax revenue has been the Indirect Taxes, contributing about 83 percent on the average. Income tax revenue contributes about 15 percent of the tax revenue. The main sources of tax revenue include Income tax, Indirect tax, Customs and Excise duties, VAT and Non-tax revenue. Revenue and its sources is shown in Table 2.6.

Table 2.6: Revenue and its sources including government Expenditure in billions of shillings

	1996/97	1997/98	1998/99	1999/2000	2000/01
Income Tax	102.4	124.8	170.0	182.0	214.5
Indirect Tax	614.8	696.9	799.8	827.1	884.5
Customs Duty	264.8	262.1	277.9	286.9	336.8
Excise Duty	102.1	116.4	130.9	132.0	123.4
Sales Tax, CTL & VAT	219.8	266.7	328.4	359.3	378.1
Total Tax Revenue	717.2	821.8	969.8	1009.1	1098.1
Non-tax Revenue	25.5	52.4	62.5	48.7	N/A
Grants	310.7	397.7	406.9	600.6	883.9
Recurrent Expenditure	658.2	722.9	863.8	957.4	1143.5
Development Expenditure	442.0	494.5	635.1	814.3	1001.4

Source: 2000 Statistical Abstract

Budget deficit: In Uganda the recurrent expenditure is wholly funded by locally generated revenue while a bigger part of the development expenditure is funded through grants or borrowing from development partners. During the FY 1999/2000 the overall budget deficit including grants narrowed from 3% of GDP to a projected 1.6% in 2000/01. The narrowing deficit was mainly attributed to higher import support grants than anticipated.

On the other hand the deficit excluding grants widened from 9.9% of GDP in 1999/00 to 10.9% in 2000/01, mainly reflecting increased externally funded development expenditure. The deficit is funded by a highly consessional loan borrowed from external sources. For instance net external borrowing was Shs. 344.4 billion in 2000/01 compared to Shs. 131.8 billion in 1999/00. This was more than sufficient to finance the deficit and allowed government to save about Shs. 45 billion with the banking system.

2.7 Sectoral Contribution to GDP

Different sectors contribute differently to both the economy and to the GDP. The relative contributions are shown in Table 2.7 below.

Agricultural Sector: Agriculture is the backbone of Uganda's economy. It constitutes about 42% of GDP, over 90% of export earnings and employs about 81% of the labour force. Agricultural performance fluctuates with changes in weather conditions and is adversely affected by rudimentary means of production and poor market and storage infrastructure.

The contribution of agriculture to total GDP has decreased from 45.7 percent in 1995/96 to 41.5 percent in 1999/00. The decline in agricultural contribution to GDP does not imply a decrease in agricultural production of other sectors to the GDP performance. The major factors to increased production in the agricultural sectors are good rains and the availability of export market for such crops as maize, Sesame and Soya beans especially to neighbouring countries. The state of the climate would have a significant effect on agricultural production in Uganda.

During the financial year 2000/01, the agricultural sector performed well and achieved a real growth of 4.9%. Its entire sector except the cash crop sub-sector experienced positive growth. There has been impressive performance in the monetary food crop and forestry production, which registered real growth rates of 7.8%. Cash crop production experienced a decline of 1.1%.

Food crop production (plantains, sweet potatoes, maize and cassava etc.) increased in 2000/01 as a result of stable rainfall and normal rainfall regime compared to the drought in the previous year. Overall, cash crop production declined as a result of poor performance in the coffee and tobacco sub-sectors. For instance, coffee deliveries dropped from 222,220 tones in 1998/99 to 179,799 tonnes in 2000/2001. The decline was caused to a greater extent by coffee wilt and prolonged drought.

Table 2.7: GDP at Factor cost at constant 1991 prices and percentage contributions

Sector	1995/96	1996/97	1997/98	1998/99	1999/00
Total GDP	2,852,756	2,982,180	3,143,090	3,375,940	3,546,662
Agriculture	45.7%	44.2%	42.7%	42.5%	41.5%
Mining and Quarrying	0.4%	0.6%	0.7%	0.7%	0.7%
Manufacturing	7.9%	8.6%	9.3%	9.7%	10.0%
Electricity and water	0.9%	1.0%	1.0%	1.0%	1.1%
Construction	7.5%	7.7%	7.9%	7.9%	8.1%
Wholesale, retail, Hotels & Restaurants	14.8%	14.6%	14.7%	14.9%	14.9%
Transport and Communication	4.7%	5.0%	5.2%	5.2%	5.4%
Community services	11.8%	11.9%	12.0%	11.7%	11.6%
Rent and owner-occupied dwellings	6.2%	6.4%	6.5%	6.5%	6.6%
Total GDP %	100%	100%	100%	100%	100%

Source: Uganda Bureau of Statistics

Sugar production experienced an increase from 59,459 tonnes produced during the same period in 1999/00 to 70,006 tonnes in 2000/01. Cotton production declined from 117,000 bales in 1999/00 to about 100,000 bales during 2000/01. The decline in cotton production is attributed to disincentives in the low world prices and the high level of inputs and cost of labour. Since 1999 there has been improvement in tea production. Production of green leaf increased from 136,271 tonnes in 1999/2000 to 139,508 tonnes in 2000/01. The increased tea production stems from increased rehabilitation of the estates and improved production.

On the other hand, tobacco production was devastated by prolonged drought in West Nile that affected the production of flue-cured tobacco.

The livestock sub-sector is estimated to have grown by 3.6% in 2000/01.

Fish production: Fish is a major source of food and foreign exchange earnings in Uganda. The Uganda fish is in high demand in the European and Middle Eastern Markets. The fisheries sub-sector has undergone a tremendous setback since March 1999 as a result of the ban on exports to the European Union market that lasted 18 months. The ban caused a loss of US$ 30 million of exports. When the ban was lifted in 2001, export recovered and was estimate at US$ 27.83 million in 2000/01. Fish production was estimated to have increased by 73% in 2000/01.

Forestry: Forest is of high economic importance due to its household uses. The energy sector is characterised by a heavy dependence on bio-mass resources, which provide more than 90 percent of the national energy needs Uganda's forest industry has undergone changes attributed to population pressure. Bio-mass is the dominant energy resource for households and small scale industries like lime, brick and tile making and a number of agro-based industries like tea, tobacco and fishing. The two major natural forest reserves, Budongo in the West and Mabira in the centre have experienced over exploitation due to increased demand for timber and fuel wood. Some portions of the forest reserves, including government owned ones, have been exhausted by farmers and replaced with crops. The 7.8% growth rate in the forest industry represents the efforts of the private sector and individuals to plant trees as a source of timber and fuel.

Production or consumption of forests' raw material poses a big threat to environment and climate. The total wood production rose from 20.4 metric tonnes in 1995 to 23.9 metric tonnes in1999. This growth reflects demand for these products in construction, and fuel supply accruing to population pressure.

Mining and quarrying: Uganda is endowed with mineral deposits some of which. are currently being exploited and others are still under studies to determine the viability of their exploitation. The main minerals include clay, phosphates, limestone, asbestoes, cobalt and to a certain extent gold. Clay mining and limestone production has been boosted by the constantly growing building industry. Mining industry in 1999/00 grew by 5% over the previous year.

Manufacturing: The manufacturing sector is characterised by processing of agricultural produce (agro-processing) such as coffee, tea, cotton, tobacco and sugar cane. The sector grew by an average of 18.7 percent over the period 1995/96 to 1999/00. The contribution of the sector to GDP increased from 7.9 percent in 1995/96 to 10 percent in 1999/00. There is a direct link between production in agricultural sector and manufacturing sector.

Transport and Communication: Road transport is the major transport mode among others that include; rail, water, air and non-motorised transport. Road transport constitutes over 80% of the transport sector. The transport sub-sector policy aims at promoting efficient and effective transport services as a means of providing effective support to increased agricultural and industrial production, trade, tourism, social and administrative services. An efficient transport sector plays a crucial role in the enhancement of Governments' strategy of poverty reduction and economic integration of the economy. The policies in the roads sub-sector are geared towards providing an optimum and sustainable road network that will effectively and safely satisfy a growing traffic demand while meeting environmental and road safety requirements.

The growth rate in road transport in 1999/2000 was 5% and in 2000/01 was 5.5%. Considerable efforts and investment has gone into the rehabilitation of Uganda's transport sector over the past decade.

Road is by far the dominant transport mode in Uganda in terms of scale of infrastructure and volume of freight and people movements. Road infrastructure comprises of classified (main) roads, district roads, urban roads as well as community access roads. The community access roads is estimated at 30,000 km long, but there is little information on its accessibility to motor vehicles. Table 2.8 shows the road infrastructure in Uganda.

Table 2.8: The Road Network in Uganda

TYPE	DISTANCE (KM)	% PAVED
Classified roads	9,458	25.0
District roads	22,300	0
Urban roads	2,800	45.0
Sub-total	34,558	
Community access roads	30,000	

Source: Updated 10 Year Road Sector Development Programme Vol. 2

Tourism: Uganda has a high potential for tourism, which has not been exploited due to weak infrastructure and management capacity. Within the relatively stable period from 1962 - 1971, the industry experienced a 34% annual growth rate, making tourism Uganda's third largest foreign exchange earner after coffee and cotton. During the years of instability (1972 - 1978), the industry registered 13.8% decline per annum. Since the mid-1980s, however, the tourism industry picked up and the peak growth rate was achieved in 1995 at 53% per annum (SOER 1996)[1].

The tourist profile is dominated by the business tourist category (32%) followed by holiday tourists (20%) and visiting friends (14%). The tourism facilities, which could be vulnerable to climate change, includes ten national parks, 29 wildlife reserves, sanctuaries and communal wildlife areas (covering 56,000 sq. km) and gazatted forests covering 14,900 Sq. km. The tourism industry is vulnerable to climate change because climate change impacts on the game and their movement as well as other bio-diversity species. Moreover a good climate attracts the inflow of tourists.

2.8 Systematic Observations

Under Article IV of the UNFCCC, Parties are committed to among others "…… *co-operate in research, systematic observations and development of data archives related to the climate system* ……." Uganda continues to fulfil this commitment in spite of a series of constraints related to her limited capacity and lack of resources.

[1] ***State of the Environment Report, 1996 National Environment Management Authority.***

Climate, Atmospheric and Hydrological Monitoring: The responsibility to monitor climate in Uganda lies with the Department of Meteorology in the Ministry of Water, Lands and Environment. Currently, Uganda operates a network of stations, which include synoptic stations, climatological stations, upper air stations and rainfall stations.

Table 2.9 gives the number and type of stations operated in the country for monitoring weather and climate.

Table 2.9: Network of Climate Monitoring Stations in Uganda

NO	STATION TYPE	OPERATIONAL STATIONS (NO)	OPTIMUM STATIONS (NO)
1	Synoptic station	7	15
2	Hydrological stations	6	18
3	Agrometeorological Stations	5	14
4	Other climate stations	10	N/A
5	Rainfall Stations	112	500
6	Upper Air Stations	1	2
7	Radar Station	1	2

Source: Uganda Department of Meteorology

At synoptic stations, meteorological parameters are observed on hourly basis and disseminated world wide through the Global Telecommunications System (GTS) for use in weather and climate prediction. At climatological stations (agro-meteorological, Hydro-meteorological and other climate stations) observations are made twice a day and returns are submitted to Department of Meteorology Headquarters in Kampala. Historically the number of rainfall stations was large (about 1000) but had reduced to just over 100 by the 1990s. Some rainfall records are reasonably long with Entebbe and Kabale stations starting in 1906 and 1908 respectively.

The existing network of climate monitoring stations in Uganda is far from adequate. The management of the climatological, hydrological and other databases relevant to climate change also needs strengthening. Hydrological monitoring in Uganda is carried out by the Directorate of Water Development also based in the Ministry of Water, Lands and Environment.

Climate Databases: The WMO supported the development and maintenance of climate computing system (CLICOM) for use by small National Meteorological/Hydrological services for processing their climate data. Uganda is using CLICOM for processing its climate date. Although most of the rainfall data has been digitised the bulk of the other

climate parameters remain in manuscript format. The hydrological database is maintained in the Directorate of Water Development.

Research: The body responsible for directing research in the country is the Uganda National Council for Science and Technology (UNCST). UNCST is responsible for the overall policy guidance on scientific research and its co-ordination. However, line institutions, including the Department of Meteorology are responsible for research in their specific fields. The Department of Meteorology has carried out research in the following areas:

- El Nino and Southern Oscillation Studies.
- Climate change studies including the:

  - Inventory of GHGs;
  - Vulnerability and adaptation assessments;
  - Policy implications of implementing the UNFCCC;
  - Identification of candidate projects for the Clean Development Mechanism (CDM).

- Temperature and rainfall trends.
- Hydroclimatic studies.
- Rainfall variability.

2.9 Biodiversity

Uganda's position astride the equator coupled with its wide range of altitude and climate conditions makes it rich in biodiversity. Africa has a number of distinct *biogeographic* regions; or *phytochoria*; and Uganda is located in an area where several of them meet. There are seven major bio-geographic regions in Uganda (White 1983)[i]. Uganda is in a privileged position because of its hypothetical Pleistocene forest *refugium* of the Eastern Democratic Republic of Congo, known as the Albertine Rift area of Regional Endemism (National Biodiversity Unit, 1992)[ii]. Uganda benefits from her extensive biodiversity in terms of tourism, variety of foods and crops, forestry and biofuels, and medicinal plants, among others.

Most of Uganda's Bio-diversity can be found in Natural Forests, but a considerable amount is found in open waters, wetlands, and dry/moist savannah. The range of Uganda's ecosystem biodiversity includes the following:

a) Natural Ecosystems:

- Forests – high altitude moorland and heath, high altitude forests, medium altitude forests, savanna Mosaics, and woodland savanna.
- Woodlands - Combretaceious and vitex (Butyrospermum) woodlands.
- Savannah- Composed of thickets, and dominate the drier areas of the country.
- Wetlands - areas with impeded drainage, swamp forests, papyrus, and grass swamps.
- Aquatic – five major lakes, 160 minor lakes, and an extensive river system.

b) Modified Ecosystems

- Agro-systems - including sugar cane, tea and coffee plantations and agropastoral system.
- Forest plantations - of indigenous and exotic species.
- Urban systems - of various urban centres.
- Irrigation schemes - such as Kibimba, Doho and Olweny rice schemes and Mubuku irrigation scheme.

The country's biodiversity hotspots include:

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- Mgahinga Gorilla National Park and Bwindi Impenetrable National Park - the mountain gorilla (*Gorilla Berengei*) and regionally and globally endemic species.
- Rwenzori Mountain National Park - bay duker (*Ceplahophus Leucogaster*)
- Sango Bay wetlands and Forest ecosystem - bio-diversity of global significance.
- Kibaale National Park - globally and regionally endemic species.
- Dry mountains of Karamoja (Napak, Morungole, Kadam, Timu and Moroto) - regional and global endemics.
- Lake Victoria - cichlid and Nile Perch species (alien species invasion)
- Papyrus swamps of Lakes Edward, George and Bunyonyi - There occurs the endemic papyrus (C*hloropeta Gracilirostis);*
- Mount Elgon National Park.

Uganda's bio-diversity such as wild life is vulnerable to adverse effects of climate change especially prolonged droughts, floods and rapid change in climate parameters.

In Uganda wildlife occur in both protected areas and on private ungazetted public lands. There are four types of wildlife protected areas classification according to the degree of protection as shown in Table 1.10 below:

Table 2.10: Classification of Wildlife Protected Areas in Uganda

TYPE OF PROTECTED AREA	NUMBER OF AREAS	TOTAL AREA SQUARE KM	PERCENTAGE OF COUNTRY
National parks	10	11,555	4.6
Wildlife reserves	10	8,764	3.6
Wildlife sanctuaries	7	850	0.35
Community wildlife areas	13	27,600	11.4

Source: State of the Environment Report (2000/01)

2.10 Energy

The energy sector plays a critical role in the development of Uganda's economy. The sector is predominantly dependent on wood fuel, which accounts for up to 93% of the countries total energy consumption. The other sources of energy in Uganda are petroleum and hydroelectricity accounting for 5% and 1.5% respectively. Uganda has one of the lowest per capita energy consumption in the world estimated at 0.26 TOE with commercial energy consumption accounting for about 10% of the total energy consumption.

Energy Resources and Potential: Uganda is endowed with renewable energy resources. These include bio-mass supplies, hydropower potential (over 2000 MW), solar and bio-mass residues from agricultural production. The available or installed capacity is shown in table 2.11 below.

Table 2.11: Potential and available/installed Energy Resources

RESOURCES	AVAILABLE OR INSTALLED	POTENTIAL
Woody Biomass (,000 tons, air dry)	275,928	477,170
Hydropower capacity	320 MW[iii]	2,000 MW
Petroleum (cubic metres)	500,000	N/A
Geothermal energy	Nil	450 MW
Industrial bio-mass residues (mostly baggasse)	2.5 MW	15 MW

Source: Ministry of Energy and Mineral Development

In addition there is abundant solar energy throughout the country. By 2001, about ten thousand solar home systems had been installed in the country.

2.11 Energy Production and Consumption

Biomass Resources: Biomass energy in Uganda consists of woody biomass, charcoal and crop residues. Woody biomass (fuelwood) is the main source of energy for cooking. By 1992, the total consumption of firewood was estimated at 11,025 kilotons - for the rural population. The charcoal consumption for the urban population was estimated at 282 kilotons during the same period. Sugar industries use bagasse to fire boilers and a total of 174 kilotons was burnt in the same period.

Hydropower Resources: The total installed hydropower capacity currently stands at 280 WM; with

- Nalubaale Power station - 180 MW
- Kiira Power station - 120 MW; and
- Small Hydropower Stations - 20 MW

By the year 2004, Kira power station will have been upgraded to 200 MW bringing the total to 400 MW.

Petroleum Resources: Uganda imports all her petroleum products through either Mombasa, Kenya or Dar-es-salaam, Tanzania. The market share is dominated by the motor spirit, which was 42.4% in 1992, followed by auto diesel, 33.5% and Kerosene 11.7% in the same period. The least used petroleum products are Liquid Petroleum Gas (LPG). In 1996, motor spirit was 43% followed by auto-diesel at 29.8% and kerosene at 11.0%. All petroleum products used in the country are imported, although there are efforts to explore for oil in the Western Rift valley.

Figure 2.4 shows the annual sales of petroleum products, which is equivalent to the annual consumption between 1970 and 1999.

This figure is not available in electronic format

Figure 2.4: Consumption of Petroleum Products, 1970 – 1999

Source: Ministry of Energy and Mineral Development

2.12 Projected Energy Utilisation

Planned hydropower generation: The largest potential for hydropower generation is located along the White Nile River. The table 13 below gives the installed capacity, the projected/installed capacity and the maximum potential in MW.

Table 2.12: Installed Capacity and Maximum Hydropower Potential.

SITE	CURRENT INSTALLED CAPACITY (MW)	PLANNED CAPACITY (MW)	MAXIMUM POTENTIAL (MW)
Owen Falls (Nalubale)	180	180	180
Kiira (Owen Falls)	120	200	200
Bujagali Site	-	250	320
Kalagala	-	350	450
Kamdini (Karuma)	-	150	180
Ayago (South)	-	-	234
Ayago (North)	-	-	304
Murchison Falls*	-	-	642
Non-Nile sites	16.3	35	N/A

Source: Ministry of Energy and Mineral Development

Murchison falls has been declared a UNESCO heritage site and will not be available for hydropower production.

2.13 Transport and Energy

The transport sector is the major consumer of fossil fuels. It is also the single most important import commodity responsible for the high-energy import bills.
Over 75% of the petroleum fuels are used in the transport sector. The demand forecast for petroleum products indicates an average growth rate of 7.5% per year with diesel demand at 8.4% and petrol at 6.5% per year.

Motor Vehicle Fleet: The transport fleet is dominated by private motor vehicles, mini buses of rather low efficiency and virtually no mass transit transport in the capital city of Kampala. Over 60% of the motor vehicle fleet operate within Kampala City. It is estimated that there are approximately 200,000 vehicles (2000/2001 F/Y) in the country with a potential of additional 10,000 vehicles per year. Table 2.13 below demonstrates this trend.

Table 2.13: ESTIMATED NUMBER OF VEHICLES ON THE ROAD 10991 - 2002

YEAR	TRUCKS	P/UPS & 4WDS	BUSES	M/BUSES S/WAGON	CARS	M/CYCLES	AG/TRACTORS	OTHERS	TOTAL	% CHANGE
1991	7224	13000	342	4680	17804	5226	988	838	**50,102**	
1992	7397	13791	382	5283	18998	6213	1222	981	**54,267**	**8.31**
1993	7554	15035	401	6489	20464	7646	1331	1080	**60,000**	**10.6**
1994	7957	17776	464	8809	24208	12142	1541	1150	**74,047**	**23.4**
1995	8531	22039	591	11158	28941	21988	1785	1179	**96,212**	**29.9**
1996	9189	27365	617	13261	35361	36994	2043	1386	**126,216**	**31.2**
1997	9850	33120	625	13400	42000	48000	2100	1400	**150,495**	**19.2**
1998	11451	37199	686	15143	46930	61044	2289	1424	**176,166**	**17.1**
1999	12801	41365	770	15272	48392	63769	2427	1448	**186,244**	**5.7**
2000	13,240	42,443	800	15,523	49,016	64,305	2,334	1,444	**189,105**	**1.5**
2001	14,441	45,161	845	17,148	53, 105	66,984	2,317	1,520	**201,522**	**6.6**
2002**	15,842	48,711	895	19,173	58,298	70,762	2,323	1,618	**217,622**	**8.0**

Note: figures for 2002** are based on 2002** projections for New Vehicle Registration

Source: Ministry of Works, Housing and Communication (MoWHC) National Transport DataBase (NTDB)

Traffic Congestion: Traffic congestion in Uganda is not pronounced except in Kampala City where it has been estimated that 10% of all vehicle kilometres are undertaken in conditions of severe congestion with average speeds of 15 km/h. The total incremental consumption of fuel arising out of this congestion was estimated to be equivalent to 5.5 million US dollars per annum.

Within Kampala City, the Average Daily Traffic (ADT) count is much in excess of the estimated ADT at the design of Kampala roads. Traffic flow volumes of ADT for 1988 and 1996 in Kampala City show a major increase as shown in Table 2.4.

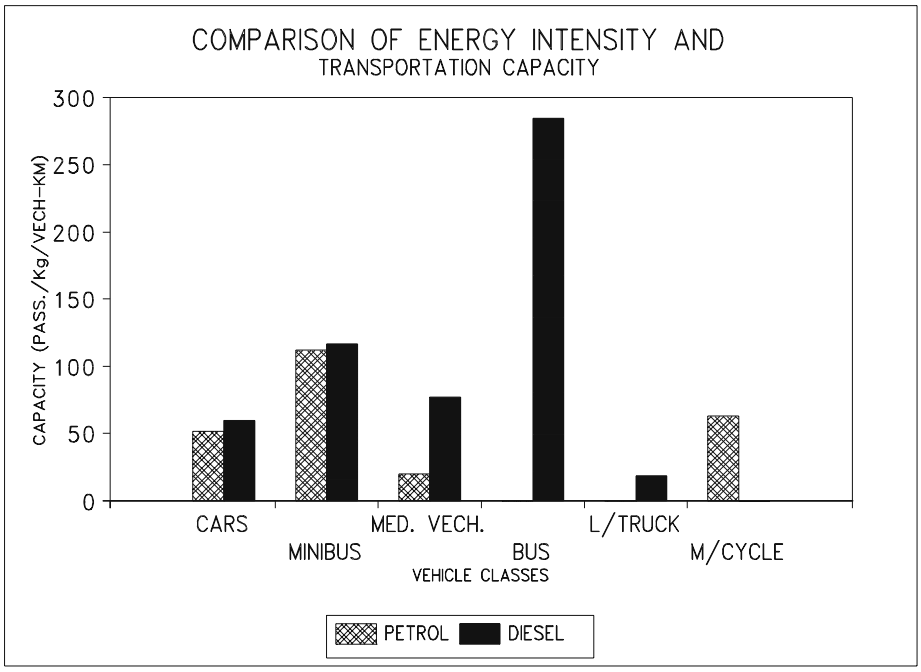
Table 2.14: Summary of Traffic Flow Volumes for selected Kampala streets

STREET NAME	**DESIGN ADT**	**COUNTED ADT**	
		JANUARY 1988	**AUGUST 1996**
Nkrumah Road	1000	6612	8889
Nasser	1000	6503	9742
Lugogo Bypass	2000	3139	5269

Source: Adopted from B.M. Kiggundu (1996).

Energy Consumption intensity per vehicle class: A study of the GHGs in the transport sector estimated the energy consumption intensity of motor vehicles on Uganda's roads. It was found that the large buses have the highest number of passengers per kilogramme of fuel per vehicle kilometre travelled as shown in Figure 2.5. Motorcycles, which are increasingly being used for public transport, are worse than minibuses/mini-vans.

Figure 2.5: Comparison of Uganda.



Source: Magezi, 1998[iv]

Air Transport: Air transport plays an important role in Uganda's economic development. This is so because Uganda is a land-locked country. Energy consumption in the aviation industry is represented by the sales of aviation fuel, albeit most of it is consumed by international flights.

The statistics from Civil Aviation Authority (CAA) Annual Statistical Report 2000 indicate that both passenger and cargo traffic grew fast, although the annual growth rates were somewhat erratic. The highest passenger traffic growth of 32.7% was registered in 1995. Indeed, in the period between 1991 and 2000 the international passenger traffic increased nearly three times. During the same period, the overall average growth rate per annum was 13.3% for aircraft movements, 13.1% for passenger and 22.8% for cargo. Cargo exports increased faster than imports. The average annual growth rate for exports more than doubled than for imports at an average of 32% per annum for exports against 13.8% per annum for imports.

These growth rates compare favourably with the overall rate of growth of air traffic in the world as a whole and also on the African Continent. The world average in 1985-1996 was 6.7% (ICAO Statistical Report.). The international passenger traffic handled by African airlines during the same period increased only by 3.5% per annum on average.

2.14: Non Motorised Transport

Pedal bicycle transport, walking and head loading are predominant means of rural transport and travel. Nationally, bicycle passenger transport locally known as ***boda-boda*** has picked up in all towns including Kampala (Jimmy Combe, 1995)[v]. Kampala City is putting priority on improving access for pedestrians and non-motorised vehicles.

CHAPTER 3

NATIONAL INVENTORY OF GREENHOUSE GASES AND MITIGATION OPTIONS[vi]

3.1 NATIONAL INVENTORY OF GREENHOUSE GASES

The UNFCCC aims at stabilizing concentration of greenhouse gases in the atmosphere and commits Parties to take measures to mitigate GHG emissions, in accordance with the principle of common but differentiated responsibility and taking into account their national priorities and aspirations. Inventories of GHGs provide means of monitoring reduction of GHGs by Parties and are therefore important components of national communications. The IPCC has developed guidelines for computation of GHGs (by Parties) to enable their comparison. To ensure that Uganda's emissions inventory is comparable to those of other UNFCCC signatory countries the inventory presented here were calculated using methodologies consistent with those recommended in the GHG inventory reference manual produced by the IPCC. This inventory used 1994 as the base year.

The emission categories covered in this inventory are energy, industrial processes, agriculture, solvents, landuse change and forestry as well as waste. The gases addressed from these sectors are: Carbon dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_20), Nitrogen Oxides (NO_X), sulphur dioxide (SO_2) and Non-Methane Volatile Organic Compounds (NMVOC).

Methodology: The GHG emissions by sources and removals by sinks were calculated using the IPCC-1995 guidelines for National Greenhouse Gas Inventories by category apart from GHG inventory on Agriculture methodology was used. Default emission

factors were used in most cases. Details of the methodology and data sources are in Annex II.

Key Assumptions: In order to carry out the inventory of emissions and removals a number of assumptions included the following were made:

- Conversion and emission Factors: There were no country specific values. Default values were used as provided by the IPCC.
- In calculating CO_2 emissions in the energy sector, it was assumed that 99% of the carbon was oxidised.
- All petroleum sales represent petroleum consumption in Uganda.
- Emissions from bio-fuels are included in the total inventory.

3.2 Analysis and Results

Apart from emissions from bio-fuels, other emissions can be described as minimal. This is due to the fact that Uganda has a very low level of commercial energy consumption. There is, however, indication of a systematic reduction in the CO_2 sink due to continued deforestation. A summary of the salient issues and findings is as follows:

Emissions from fossil fuels: Fossil fuels consumed in Uganda are all imported petroleum products. The bulk of Gasoline and gas oil is consumed in the transport sector, which is the main contributor to GHG emissions. Using the bottom-up methodology in estimating the CO_2 emissions from petroleum products, an estimated total of 708.61 Giga grammes of CO_2 were emitted from a total carbon content of 195.07 Giga grammes. This figure excludes 105.5 Giga grammes of CO_2, which was an emission due to jet fuel. Most jet fuel is used on international aircraft and is considered as bunker fuel.

In adopting a top-down approach, estimates were made for a number of end-use devices. Both stationary and mobile end-use devices were considered and were based on the following:

- Thermal power-generation,
- Road mobile and off-road Transport and agricultural tractors,
- Motor boats,
- Locomotives and
- Marine vessels.

Regarding estimates from fuel oil, only 35% of the imported residual fuel oil could be accounted for. The total emissions in Giga grammes for CO_2, CH_4, CO, and N_2O are respectively 21.94, 0.0053,0.00378 and 0.053 Giga grammes. In addition emissions from thermal generators for CO_2, CH_4, CO, N_2O and NO_X respectively were 73.3, 0.01, 0.51,

0.0019 and 1.01 Giga grammes. These are from a total of 259,902 metric tons of petroleum fuel.

Estimation from mobile sources was done using the basic IPCC methodology. The main mobile sources are from the transport sector. Motor vehicles were grouped according to their weight and fuel type. Tables 3.1 and 3.2 attached below give the detailed emission for motor vehicles by class and fuel type for the year 1994. On the other hand, the non-road transport included marine vessels, locomotives, motorboats and local flight aircraft. Emissions estimates from the top-down approach (end-device sector activity approach) were comparable to the estimates arrived at from the primary bottom up methodology for both Gasoline and Gas oil.

Table 3.1: GHG Emissions for road and Agricultural Vehicles using gasoil (Diesel)

Trans-port Class	**Total Distance Travelled (Km)**	**Energy Consumed (Gj)**	**Emission Factors (G/M)**						**Greenhouse Gas Emissions (Gg)**					
			N_2O	**METHANE**	**NMVOC**	**CO**	**NOX**	**CO_2**	**NOX**	**METHANE**	**NMVOC**	**CO**	N_2O	CO_2
Car	215.37	9,331.9	140	1	73	150	1.9	73,300	0.0013	0.0000	0.0007	0.0014	0.0000	0.6840
Pickup	5,464.23	236,765.1	170	0	100	190	1.9	73,300	0.0403	0.0000	0.0237	0.0450	0.0004	17.3549
4Wheel Drive	2,201.26	95,380.5	170	0	100	190	1.9	73,300	0.0162	0.0000	0.0095	0.0181	0.0002	6.9914
Minibus	4,291.17	185,479.9	170	0	100	190	1.9	73,300	0.0316	0.0000	0.0186	0.0353	0.0004	13.6323
Medium Bus	8,932.98	387,065.8	170	0	100	190	1.9	73,300	0.0658	0.0000	0.0387	0.0735	0.0007	28.3719
Bus	4,324.95	187,400.2	1010	10	180	510	1.9	73,300	0.1893	0.0019	0.0337	0.0955	0.0004	13.7364
24xle Truck	31,859.49	1,380,471.6	1010	10	180	510	1.9	73,300	1.3943	0.0138	0.2485	0.7040	0.00026	101.1886
3Axle Truck	9,513.00	412,198.3	1010	10	180	510	1.9	73,300	0.4163	0.0041	0.0742	0.2102	0.0008	30.2141
Truck Trailer	3,173.32	137,499.9	1010	10	180	510	1.9	73,300	0.1389	0.0014	0.0247	0.0701		10.0787
Articulated Trucks	3,751.58	162,556.0	1010	10	180	510	1.9	73,300	0.1642	0.0016	0.0293	0.0829		11.9154
Agric. Tractor	308,19	13,354.0	1010	10	180	510	1.9	73,300	0.0135	0.0001	0.0024	0.0068		0.0788

Others	1,058.74	45,918.5	1010	10	180	510	1.9	73,300	0.0464	0.0005	0.0083	0.0234		3.3658
Total	75,113.09	3,253,421.7	1010	71	1733	4480	22.8	879,600	2.5181	0.0234	0.5123	1.3662		237.6123

Source: Ministry of Natural Resources, 1996

Table 3.2**: Emissions from Road Vehicles using Diesel**

Ghg Emissions For Road Transport And Agricultural Vehicles Using Gasoline														
Transport Class	**Fuel Consumed (Litres)**	**Energy Consumed (Gj)**	**Emission Factors (G/MJ)**						**Greenhouse Gas Emissions (Gg)**					
			N_2 0	**METHANE**	**NMVOC**	**CO**	**NO_X**	**CO_2**	**NO_X**	**METHANE**	**NMVOC**	**CO**	**N_20**	**CO_2**
Car <1300Kg	215.37	9,331.9	390	31.4	1140	7330	0.9	69,300	0.215	0.0173	0.628	4.041	0.000496	38.205
Car 1300-1900kg	5,464.23	236,765.1	390	31.4	1140	7330	0.9	69,300	0.213	0.0172	0.624	4.013	0.000490	37.939
Car > 1900kg	2,201.26	95,380.5	410	26.9	1320	6890	0.9	69,300	0.054	0.0035	0.150	4.906	0.000120	9.119
Pickup	4,291.17	185,479.9	410	26.9	1320	6890	0.9	69,300	0.420	0.0275	1.353	7.062	0.000920	71.028
4 Wheel Drive	8,932.98	387,065.8	410	26.9	1320	6890	0.9	69,300	0.122	0.0080	0.393	2.056	0.000270	20.683
Minibus	4,324.95	187,400.2	410	26.9	1320	6890	0.9	69,300	0.391	0.0260	1.260	6.577	0.000860	66.151
24xle Motorcycle	31,859.49	1,380,471.6	410	26.9	1320	6890	0.9	69,300	0.315	0.0010	0.049	0.257	0.000030	2.585
TOTALS	9,513.00	412,198.3							1.73	0.1005	4.457	28.912	0.003186	245.71

Source: Ministry of Natural Resources, 1996

Emissions from Biomass fuels: Wood-fuel is the main energy source for domestic and some commercial activities. In 1990, the total firewood consumption was estimated at 11,025 KT while charcoal consumption was estimated at 282.39 KT. It should be pointed out that there has never

been real nation-wide determination of both firewood and charcoal consumption. Estimates are based on samples taken around a few urban centres. The carbon released during the conversion of wood to charcoal was estimated at 377.63 KT using a conversion factor of 6.6.

In estimating emissions from bio-fuels, national figures for the carbon content, nitrogen content, C/N and N/C ratios were experimentally determined. Using these conversion factors, the total CO_2 emission from wood-fuel, charcoal, and from wood to charcoal respectively was 11,605.42 KT, 773.67 KT and 1,384.64 KT. Smaller amounts of emissions from bagasse were estimated at about 76.28 KT. The emission data is provided in the minimum data tables parts 1 to 3 (Tables 3.3 to 3.5).

Table 3.3: MINIMUM DATA TABLES 1 ENERGY: 1A Energy Fuel Combustion Activities (part 1)

SOURCE AND SINK CATEGORIES	**ACTIVITY DATA**	**EMISSIONS ESTIMATES**						**AGGREGATE EMISSION FACTORS**					
Sector Specific Data (Units)	**A Apparent Consumption (PJ)**	**B Gg of full mass of pollutant**						**Kg (Pollutant)/GJ C**					
								C = B / A					
		CO_2	**CH_4**	**N_2O**	**$N0_X$**	**CO**	**NMOC**	**CO_2**	**CH_4**	**N2O**	**$N0_X$**	**CO**	**MNOC**
1 A Fuel Combustion activities													
Oil	9.921083	708.2					N/A	71.38					N/A
Gas	0.006576	0.4					N/A	60.82					N/A
Coal		N/A	N/A				N/A						
Biomass	125.539	13763	74.52	4.704	22.81	822.93	N/A	109.6	0.594	0.037	0.182	6.56	
Other (specify)													

Source: Ministry of Natural Resources, 1996

Table 3.4: MINIMUM DATA TABLES 1 ENERGY: 1 A Energy Fuel Combustion Activities (part 2)

SOURCE AND SINK CATEGORIES	**ACTIVITY DATA**	**EMISSIONS ESTIMATES**						**AGGREGATE EMISSION FACTORS**					
Sector Specific Data (Units)	**A Apparent Consumption (PJ)**	**B Gg of full mass of pollutant**						**C Kg (Pollutant)/GJ C = B / A**					
		CO	**CH4**	**N2O**	**NOx**	**CO**	**NMOC**	**CO2**	**CH4**	**N2O**	**Nox**	**CO**	**MNOC**
1 A 3 Transport													
Oil	7.092173	507.1	0.126	0.554	3.95	27.27	4.99	71.50	0.017	11.042	0.0076	3.845	0.703
Coal	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Other (specify)													
1 A 4													
Commercial/Institutional													
Oil	1.18972479	63.00						53.00					
Gas													
Biomass													
Other (specify)													
1 A 5 Residential													
Oil	1.5987385	113.7						71.14					
Gas	0.006576	0.40						60.80					
Biomass													

Other (specify)													

Source: Ministry of Natural Resources, 1996

Table 3.5: MINIMUM DATA TABLES 1 ENERGY: 1A Energy Fuel Combustion Activities (part 3)

SOURCE AND SINK CATEGORIES	**ACTIVITY DATA**	**EMISSIONS ESTIMATES**						**AGGREGATE EMISSION FACTORS**					
Sector Specific Data (Units)	**A Apparent Consumption (PJ)**	**B Gg of full mass of pollutant**						**C Kg (Pollutant)/GJ C = B / A**					
		CO	**CH4**	**N2O**	**NOx**	**CO**	**NMOC**	**CO2**	**CH4**	**N2O**	**Nox**	**CO**	**MNOC**
1 A 3 Transport													
Oil	.013354	0.978	0.000	0.013	0.00	0.006	0.002	73.29	0.007	1.01	0.00	0.509	0.179
Coal	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Biomass	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Other (specify)													

Source: Ministry of Natural Resources, 1996

Industrial processes and solvents: Only three industrial processes were considered due to Uganda's narrow industrial base. These are cement, lime and foam production. From cement, a total of 15.4 Gg of CO_2 was emitted while lime and foam emitted 28.0 and 0.1 Gg of CO_2 respectively.

Three types of solvents were considered in the study. These are paint, perchloroethylene, and carbon tetrachloride which emitted 0.935 Gg, 0.057 Gg and under 0.001 Gg per year respectively.

Agriculture and Savannah burning: Emissions were estimated from livestock, livestock manure, rice production, fertiliser use and burning of agricultural wastes. Regarding fertiliser use, the OECD methodology to calculate N_2O emission was used together with OECD emission co-efficient. The variation in total emission was very high varying between 0.24 Tonnes to 105.42 tones.

Land-use Change and Forestry (LUCF): Land-use changes used in the study were linked with agricultural cultivation, livestock grazing, and various types of forest clearance and managed forests (sinks and removals). A summary of the inventory in this sector is given in Table 3.6.

Table 3.6: Summary of Emissions and removals in the land-use sector in Gg.

NO	SOURCE AND SINK CATEGORY	CO_2	CH_4	N_2O	NO_X	CO	NMVOC
	Sub-Total Net Emission	8,122	5.98	0.01	0.32	1.72	-
1	Forest clearing and onsite Burning of cleared forests	2,835.0	1.97	0.01	0.32	1.72	-
2	Grassland Conversion	6,641	4.01	-	-	-	-
3	Managed Forests	-1,354	-	-	-	-	-

Source: - Data from the Department of Forestry Uganda.

In this estimate, it was assumed that all fuel wood comes from government-managed forests, which is not the case. In addition the study does not include removals by the other forests like agro-forests, hedges, and private forests.

3.3 Greenhouse Gas Emissions and Removals

The key GHG is CO_2. It is found that agricultural activities are the biggest contributor to all the other GHG emissions including methane, Nitrousoxide, Carbon-monoxide, and Nitrogen oxides. Agriculture does not contribute to emissions of Non-Methane Volatile Organic Compounds (NMVOC). The energy sectors is the major contributor of NMVOC which contributes 4.9956 out of the total 5.9876 Gg of NMVOC. The details of the emissions are in the summary report for National Green House Gas inventories (Part I) shown as Table 3.7.

The summary report for the national GHG inventory shows fairly high GHG emissions. These are reflected in biomass burned for energy, agricultural waste burning, savannah burning and grassland conversion.

SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (PART 1) IN Gg

Table 3.7: Summary Report for National Greenhouse Gas Inventories (Part 1)

No.	GREENHOUSE GAS SOURCE AND SINK CATEGORY	CO2 (Gg)	CH4 (Gg)	N2O (Gg)	NOX	CO	NMVOC
	Total (Net) National Emission						
1	All Energy (Fuel Combustion + Fugitive)						
	A Fuel Combustion	* 708.610					
	Energy & Transformation including	--	--	--	--	--	--
	Industry (SIC)	--	0.207	0.053	--	--	--
	Transport	507.150	0.126	0.540	3.950	27.270	4.990
	Commercial/Institutional	63.000	--	--	--	--	--
	Residential	114.140	--	--	--	--	--
	Agriculture/Forestry	0.979	0.001	0.014	0.000	0.006	0.002
	Other (UEB Generators)	1.483	0.001	0.000	0.021	0.010	0.004
	Biomass Burned for Energy	13,763.000	74.520	4.704	22.810	822.930	--
	B Fugitive Fuel Emission						
	Oil Natural Gas Systems						
	Coal Mining						
2	Industrial Processes	--	--	--	--	--	--
	A Iron and Steel	--	--	--	--	--	--
	B Non-Ferrous Metals						
	C Inorganic Chemicals						
	D Organic Chemicals						
	E non-metallic Mineral Products	43,4300.000					
	F Other (Foam)	0.070					
3	Solvent Use						
	A Paint Application	--	--	--	--	--	0.935
	B Degreasing and Dry Cleaning						0.057

	C Chemical Products Manufacture/Processing	--	--	--	--	--	--
	D Other	--	--	--	--	--	--
4	Agriculture						
	A Enteric Fermentation	--	197,400		--	--	--
	B Animal Wastes	--	7.050	--	--	--	--
	C Rice Cultivation	--	23.536	--	--	--	--
	D Agriculture Soils (Fertiliser Use)			0.002			
	E Agricultural Waste Burning	# 264.500	1.780	0.380	8.540	37.050	--
	F Savannah Burning	# 72,130.000	960.000	40.000	1,165.000	16,830.000	--
5	Lands Use Change and Forestry						
	A Forest clearing & On-Site Burning of Cleared Forest	2,834.750	1.971	0.014	0.319	17.243	--
	B Grassland conversion	6,641.900	4.015	--	--	--	--
	C Abandonment of Managed Lands	--	--	--	--	--	--
	D Managed (Forests Removals)	-1,354.000	--	--	--	--	--
6	Waste						
	A Landfills	--	2.926	--	--	--	--
	B Waste water	--	--	--	--	--	--
	C Other (Pit Latrines)	--	1.600	--	--	--	--

* - Total emission
\# - Part of the natural cycle

Source: Ministry of Natural Resources, 1996

3.4 MITIGATION OPTIONS AND MEASURES[vii]

The major reason for carrying out mitigation measures in the climate change sub-sector is to reduce the total amount of GHG emissions. Despite its low GHG emissions, Uganda, to the extent possible, should join the international community in mitigating GHG emissions. High priority should be given to those mitigation options that bring direct socio-economic benefits. Furthermore, mitigation measures should be in line with the national policy on poverty eradication, and sustainable development.

In that case, identified mitigation options are those which could lead to among others:

- Minimisation of losses in production;
- Improvement in production and utilisation efficiency;
- Improvement of health due to reduction in pollution levels; and
- Creation of additional opportunities for creation of wealth..

In view of the foregoing, Uganda has put emphasis on mitigation options that are part of the no-regrets measures as outlined above. The Uganda Enabling Project and the East African power study carried out a GHG mitigation assessment in the energy sector as outlined below.

Petrol/Ethanol Blending: This mitigation option was considered for Uganda. It was proposed that ethanol from the sugar processing industry may be blended at a level of 15% for all petrol by the year 2020 (ethanol blended with petrol up to 20% does not require petrol engine modification). Currently, however, the estimated cost of ethanol production in Uganda is still far beyond that for equivalent amounts of petrol.

Elimination of Residual/fuel oil in Industry: Fuel oil has been used mostly in agro-based industries such as tea and sugar processing plants. Fuel wood, which is cheaper and considered as a renewable energy resource is now preferred to fuel oil and or residual oil. With increased rural electrification, more rural based agro industries will change from fuel oil to hydro electricity.

Hydro and photovoltaic based mitigation options: Uganda still has undeveloped hydroelectric resources mostly along the Nile River. Studies have proposed the development and implementation of an enhanced rural electrification programme to improve the electrification coverage from the current 1% to 10% by the year 2012. This strategy is to be combined with grid extension, and development of small-scale hydropower in areas remote from the National grid as well as the use of solar photovoltaic systems.

For reduction of GHG in the rest of East Africa, a hydropower export strategy under a East African power study has been proposed. Studies on the following sites have been concluded.

Kalagala Hydropower site: This site has an estimated potential of 450MW. It has been earmarked for potential mitigation options for East Africa and will aim at replacing thermal plant within East Africa.

Karuma Hydropower Site: This site has an estimated potential of 180MW. It is to be built, owned and operated as a run of the river scheme by NORPAK Power Ltd. This plant will also aim at replacing a thermal plant in the East African least cost generation plan.

Bujagali Power Project: This is a 250MW power project. AES Nile Power is developing it as an Independent Power Producer (IPP).

Murchison Falls Site: This site has the highest potential at 642MW, however it has been gazetted as an UNESCO World Heritage Site, because of its unique environmental and touristic appeal. It is located in a National Game Park. Although it has potential, no foreseeable development is envisaged.

Other Sites: There are many other sites, which are candidates for potential Hydropower sites and could be developed to boost the energy mitigation options.

Other Renewable Sources: The Rural Electrification Strategy and Plan Covering the Period 2001 to 2010 incorporates the use of solar and wind energy. Already over 10,000 solar units had been installed in homes by the year 2001. Government commissioned the Uganda Alternative Energy Resource Assessment and Utilisation Study. This will assist Government to formulate a flexible least cost Alternative Energy Resources Development Programme (AERDP) that can be swiftly adapted to changing conditions including adaptation to climate change. The AERDP covers a 15-year period (2005 - 2020).

3.4.1 Transportation Sector

Considering that traffic congestion in the capital city of Kampala leads to an incremental fuel consumption of approximately 10 to 15% (Rendal Palmer and Tritton 1994[viii]), the first mitigation option is aimed at reducing traffic congestion on all roads in Kampala. Measures include the following:-

Motor vehicle road transport: Vehicles with lower energy consumption intensity with respect to transportation capacity should be encouraged. This will call for the replacement of mini-buses with buses/coaches (mass transit), and improved awareness on transport, road use, and mass transit benefits

Road Networks and Maintenance: Particularly for the urban centres, changes have been proposed with respect to:

- National and the Greater Kampala Transportation Master Plans;
- Engineering design of roads where one-way streets and by-pass roads can reduce traffic congestion,
- Provision of adequate parking and improvement on drainage. Kampala City Council is already undertaking a Kampala Drainage Master Plan.
- Installation of traffic signals/lights as well as other road furniture.

Non Motorised Transport (NMT): Dedicated NMT lanes have been proposed. In addition it has been proposed that some urban road sections be closed to motorised traffic.

Regulatory Measures: The regulatory measures, which have been proposed, include the following:-

- Introduction of suitable taxation measures to limit fuel consumption.
- Creating incentives for procurement of efficient and mass transit vehicles.
- Ensuring compliance with vehicle emissions standards;
- Increase regional co-operation in transport policy formulation and fuel taxation measures.

3.4.2 Forestry Sector

The major mitigation option in this sector is through enhancement of sinks for CO_2. To this effect, Uganda has put in place a Forest Action Plan whose goal is to increase forest cover and ensure sustainable management of the forest estate. To do this, a number of innovative economic instruments have or are being applied. These include:-

- Sharing of revenue schemes between Government Institutions and Communities surrounding forest reserves and wildlife protected areas.
- Revision of royalty rates by Forestry Department Managers to encourage better utilisation of wood products;
- Encourage private sector participation in afforestation and reforestation through access to gazetted degraded forest reserves.

3.4.3 Agriculture and Livestock

Mitigation measures, which have been proposed under this sector, include the following:

- Improved feeding of livestock to reduce methane emissions;
- Discouragement of Savannah and trash burning. The trash should instead be used to control soil erosion;
- Improvement of livestock breeds followed by appropriate pasture management practices;
- Effective utilisation of animal waste (e.g. in production of manure and biogas);
- Promotion of organic farming and minimisation of chemical fertiliser usage;
- Encourage farmers to grow more of upland rice as opposed to paddy rice;
- Increased awareness.

CHAPTER 4

4.0 VULNERABILITY AND ADAPTATION

4.1 Introduction

All countries, rich and poor are vulnerable to adverse effects of climate change but the degree of impacts varies from country to country depending on its capacity to cope with disasters. IPCC findings indicate that the poorer countries will suffer disproportionately despite their little contribution to climate change. Article 4 paragraph 1(a) commits parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, to put in place measures to mitigate GHG emissions and reduce impacts of climate change.

Climate change will have far reaching consequences for Uganda for various reasons such as weak institutional capacity, lack of skills in disaster management, lack of equipment for disaster management, limited financial resources and above all an economy, which depends entirely on exploitation of its natural resources. Uganda's economy is totally dependent on climate and therefore vulnerable to adverse effects of climate change. Adaptation to adverse effects of climate change is therefore of particular importance.

A limited preliminary vulnerability and adaptation assessment was done under the US Climate Change Country Study Programme (1996). The study covered agriculture (crop and livestock), water resources and forestry sectors. No attempts were made to carry out an integrated vulnerability assessment, which would have given a better picture of the magnitude of potential impacts of adverse effects of climate change. There is therefore need for a more detailed and integrated study.

The following key sectors are vulnerable to adverse impacts of climate change:

- Agriculture;
- Water Resources;
- Forestry;
- Natural ecosystems and Wild Life;
- Health;
- Energy;
- Transport and;
- Local Governance

4.2 Vulnerability

4.2.1 Climate Change Scenarios

Vulnerability assessment was done based on climate scenarios derived from General Circulation Models (GCMs) listed below.

- The Canadian Climate Centre Model (CCCM),
- The Geophysical Fluid Dynamics Laboratory's Model (GFDs) and

- The United Kingdom Meteorological Office - 1989 Model (UK 89).

Climate variables were used as inputs and simulations were run to provide baseline scenario and future climate scenarios were generated by doubling concentrations of CO_2 in the atmosphere by the year 2100.

The model results showed significant variation amongst themselves and also within the different regions of Uganda. Tables 4.1 and 4.2 show the adjustment statistics for doubling of CO_2 as compared to the current CO_2 as generated by different GCMs, for central areas (Entebbe) and northern areas (Lira) of Uganda respectively.

Table 4.1: Adjustment Statistics of Doubling CO_2: Entebbe

MONTH	**CCCM**		**GFDs**		**UK 89**	
	TEMP ^{o}C	**Precipitation Ratio**	**TEMP ^{o}C**	**Precipitation Ratio**	**TEMP ^{o}C**	**Precipitation Ratio**
Jan	2.56	1.09	2.51	1.13	2.36	0.70
Feb	2.41	1.27	2.61	1.00	4.32	0.82
Mar	2.11	0.93	2.28	1.48	4.70	0.75
Apr	2.26	1.08	2.18	1.02	3.78	1.20
May	2,27	0.87	2.48	1.10	2.96	1.57
Jun	2.12	0.72	2.98	1.07	3.02	1.51
Jul	2.02	0.65	3.58	1.26	4.03	0.80
Aug	2.23	0.85	3.37	1.09	4.08	1.00
Sept	2.40	0.86	2.58	1.24	3.55	1.32
Oct	2.38	1.02	2.57	1.19	3.33	1.20
Nov	2.47	1.07	2.76	1.18	2.87	1.26
Dec	2.51	10.4	2.57	1.23	2.76	1.37
Annual	2.31	0.976	2.71	1.16	3.48	1.13

Source: Source: Department of Meteorology Vulnerability study.

Table 4.2: Adjustment Statistics of Doubling CO_2: Lira

MONTH	CCCM		GFDs		UK 89	
	TEMP ^oC	PRECIPITATION RATIO	TEMP ^oC	PRECIPITATION RATIO	TEMP ^oC	PRECIPITATION RATIO
Jan	2.75	1.14	2.51	1.07	1.39	0.53
Feb	2.63	1.41	2.52	1.15	3.93	0.77
Mar	1.97	0.94	1.87	1.40	4.69	0.51
Apr	2.37	1.42	2.00	1.04	4.19	1.06
May	2.20	0.90	2.19	1.22	3.65	1.28
Jun	2.19	0.89	2.24	1.15	3.13	1.64
Jul	2.02	0.82	3,38	1.15	3.48	0.85
Aug	2.16	0.97	3.01	1.17	4.08	0.86
Sept	2.38	0.93	2.41	1.11	3.82	1.30
Oct	2.40	0.99	2.49	1.28	3.36	1.42
Nov	2.69	1.16	2.73	1.24	2.82	1.46
Dec	2.71	0.95	2.53	1.19	2.62	1.49
Annual	2.37	0.996	2.53	1.17	3.48	1.09

Source: Department of Meteorology Vulnerability study.

These results show that all the models used predicted an increase in the temperatures of between 2 and 4^{o}C. There is variation in the precipitation results. The CCCM model gives an overall decrease in rainfall while the other two models gave a slight increase in rainfall.

4.2.2 Vulnerability of Socio-economic Sector

Uganda's economy is particularly vulnerable to climate variability and climate change, because of its reliance on exploitation of natural resources with agricultural sector being a major contributor. Over 80% of the population derives their livelihood either directly or indirectly from agricultural-related activities. Agriculture performance in Uganda fluctuates with changes in climate. Consequently, GDP growth and inflation rates often correspond with performance of rainfall seasons.

Uganda's population size according to mid- 2000 estimate stood at 22.2 million with average annual growth rate of about 3%, which is higher than 2.6% and 1.7% for Sub-Sahara Africa and low-income countries respectively. This high population growth rate coupled with high level of poverty make it difficult for Uganda to cope with impacts of adverse effects of climate change. Increased population inflicts pressure on forests and wetlands, which may result into deforestation and wetland degradation. These activities will contribute to GHG emissions. As a poor country Uganda cannot adequately finance adaptation measures that would enable it minimise the impacts of adverse effects of climate change.

The factors, which contribute to Uganda's low capacity to cope with impacts of adverse effects of climate change, include the following:

- Low level of income reflected in per capita income (about US $ 300) and revenue/GDP ratio of about 11.3%[ix].
- Heavy dependency on rain-fed agriculture
- Weak and inadequate infrastructure (weak buildings, seasonal roads);
- Inadequate supply of clean water and sanitation facilities;
- Inadequate provision of health and medical services.

Consequently climate change is likely to impact on socio-economic development of Uganda in the following ways:

Macroeconomic Stability

Poor climate conditions reduce Uganda's agricultural sector performance, which constitutes up to about 40% of GDP. This results into higher food prices, lower domestic revenues and widening of the current account deficit due to lower export earnings. The overall likely impact is an increase in inflation related to an expansion in the fiscal deficit, increase external indebtedness and a depreciation of the exchange rate.

Health

- Inadequate provision of medical/health personnel and services;
- Inadequate nutrition (2226 daily calorie intake per person compared to 2663 average for developing countries), which may result into malnutrition[x];
- Inadequate or contaminated water supply;
- Heavy rainfall, triggering water-borne diseases such as malaria, cholera, dysentery; and
- Increased frequency of thunderstorms and high humidity leading to respiratory and cardio-vascular diseases.

Energy and Transport

- Weak road infrastructure;
- Weak and undeveloped energy sector; and
- Reliance on fossil fuels and wood fuel for domestic use.

4.2.3 The Agricultural Sector

Vulnerability assessment was done using maize. Maize was analyzed using the CERES - maize model. The selected site for the study was Namulonge Agricultural and Animal Research Institute ((00o 31'N, 32o 38'E) at an altitude of 1128.8m above MSL.

The results from the model, shown in Table 4.3 below, are considerably lower than the mean observed values for Namulonge. There is need to calibrate the model to

make it appropriate to local conditions. Therefore the model was not used for the assessment. However, the Study was carried out based on empirical knowledge.

Table 4.3: Model Results on Environmental and Stress Factors for Maize at Namulonge

	Tmax Range	**Tmin Range**	**Kg/Ha Yields**	**Lengths of Season in days**
Model Result	12^oC - 17^oC	8^oC - 12^oC	29	310
Namulonge Actual	26^oC - 30^oC	14^oC - 17^oC	4000 – 6000	120

Source: Department of Meteorology Vulnerability study.

Crop vulnerability to climate variability and change is dependent on ecological zone. There is high uncertainty in onset and cessation of rainfall seasons. This coupled with high evaporation rates, particularly in northern Uganda, affects agricultural production.

4.2.4 Grassland/Livestock Sector

Productivity of Uganda's grasslands and livestock is dependent on climate and will therefore be affected by climate variability and climate change. The major grassland areas, concentrated in the cattle corridor, are the home for about 41% of the human and 60% of the cattle population. It is estimated that 56.9% of Uganda's total area is potential for feeding ruminant livestock (MWL&E, 1996)[xi]. The World Bank Assessment put pastures at 54% (1993) as shown in figure 4.1.

Figure 4.1: Land-use Pattern as at 1993 Showing the Extent of Pastures/Grassland

This figure is not available in electronic format

Source: World Bank (1993)

The livestock population is dominated by cattle most of which is found within the cattle corridor. The cattle corridor is an area of lower rainfall and has increasingly become prone to frequent droughts leading to depletion of both pastures and water resources.
Sheep and goats are also important, although these are not predominantly in the cattle-grazing corridor. Figure 4.2 shows the trends in livestock numbers (in millions).

Figure 4.2: Trends in Livestock Numbers (million) 1972 – 1997

This figure is not available in electronic format

Source: Ministry of Finance Planning and Economic Development (1997)

Using the Simulation of Production and Utilization of Rangelands (SPUR2) model which incorporates the Colorado Beef Cattle Production Model (CBCPM) a vulnerability and adaptation assessment was carried out. The vulnerability assessment used the following different plant species, which are prevalent in the grasslands:

- Warm (dry) season grass - *Hyparrhenia rufa;*
- Cool (wet) season grass - *Setaria sphaceleta;*
- Warm (dry) season forbe - *Tripscum laxum;*
- Cool (wet) season forbe - *Pennisetum purpurum; and*
- Shrub - *Acacia hockii.*

Further consideration of potential vulnerability of high yielding dairy cattle was considered. This was done in montane zones, which are rich in high yielding dairy cattle. In the montane zones, such as Kabale (south-western highlands), an increase in mean temperatures is likely to lead to heat stress among the exotic diary cattle. High yielding cows are susceptible to heat stress compared to the low yielding ones such as the traditional cattle found in the cattle corridor. Effects of heat stress on cattle include the following:-

- Elevated body temperature and respiration rates;
- Decreased feed in-take, lactogenic hormone production, and milk yield;
- Increased weight loss;
- Decrease in reproduction efficiency;
- Reduced Calf weight; and
- A host of other pathological effects.

An increase in temperature is therefore most likely to reduce total optimum area where high yielding dairy cattle can be economically reared. This increases vulnerability of this sector.

In areas where the models simulate increased precipitation, an increased peak standing crop (biomass above ground) is expected. For doubled CO_2 it has been demonstrated that a growth of 0 -10% may occur in the tropical pasture grasses (Warrick et al, 1986)[xii]. In the rangelands where cattle keepers are mostly nomadic, replenishment of soil organic matter is not adequate. Higher temperatures will cause an increase in the rate of nutrient in-take by the pastures while reducing their maturity period. This may result into reduced soil fertility.

4.2.5 The Forestry Sector

Forestry makes a substantial contribution to Uganda's economic development. It is estimated that forestry contributed about 6% to the national GDP in 1997. The forestry sector creates significant employment opportunities now estimated at an equivalent of about one million jobs (SOER, 2000/2001[xiii]). As a result of this observation, vulnerability of the forest sector translates directly to socio-economic impacts.

In assessing vulnerability, the forest cover was simulated using the Holdrige Life Zone Classification model. This model produced the following Holdridge life zones:

- Sub-tropical thorn Woodland;
- Tropical thorn woodland;
- Tropical dry forest;
- Tropical very dry forest;
- Subtropical moist forest;
- Warm temperature moist forest;
- Subtropical dry forest; and
- Lakes and rivers.

The simulation shows marked differences between simulated Holdridge life zones and the actual land-use/land cover classifications. The vulnerability assessment could not be continued using this model.

The major conclusion is that the models require calibration and modification in order to fit Ugandan conditions. For the time being, vulnerability assessment should be based on analogue periods and historical experiences of droughts and floods.

4.2.6 Water Resources Sector

Up to 15% of Uganda's total area is covered by water, 80% of which is accounted for by Lake Victoria. The distribution of water resources is not even such that large parts of Uganda (especially to the North East) are partly semi-arid. These areas do face severe water shortages particularly during drought periods. In many parts therefore, the cyclic and increasingly frequent periods of drought have had an adverse effect on both the quantity and quality of water resources. The temporal and spatial distribution of water resources is such that there will continue to be competition for water in the dry areas during the drought periods particularly in those areas where the streams are not perennial.

Sparse information is available on frequently flooded areas. Nevertheless, problems of flooding from flashy mountain streams on Mt. Elgon and Mt. Rwenzori have been frequently reported. Reported incidences include the flooding of the lower valleys in Kilembe stretching to Kasese airfield by the river Nyamwamba (from the Rwenzori mountains) and flooding of lower Mbale areas by the river Manafwa (from Mt. Elgon). Heavy rains have led to numerous landslides in the mountainous regions to western and eastern Uganda. Other areas experiencing frequent flooding include Kampala City mostly due to changed landuse activities. Another problem associated

with flooding and heavy rainfall is severe erosion. In Uganda soil erosion accounts for over 80% of the total cost of environmental degradation conservatively estimated at 4% - 12% of the Gross National Product (GNP) (Slade and Weitz, 1991)[xiv].

The problems of flooding, droughts, soil erosion and siltation are expected to become more frequent and more severe with the impending climate change. This was a major incentive (justification) for carrying out a vulnerability and adaptation assessment.

The three GCMs predicted a 10 - 20% increase in run-off under future climate change scenarios. As a consequence, results of the hydrological vulnerability assessment using the three river basins generally indicated a 10% - 20% increase in run-off for most of the country. However, this may not be the case with the semi-arid areas where the run-off may instead reduce. It was not possible to justify this reduction due to lack of sufficient data in the catchment of the semi-arid zone.

Future projections of urban and rural water supply indicated that the aggregate water supply at the national level would be adequate to meet the demand. However, this does not take into account the spatial and temporal distribution of the water, which is important for household and community socio-economic activities and production. It is further anticipated that water demand may not be met in the semi-arid regions of Northeast and Southwest areas; where shortages are occuring especially during droughts.

4.3 Assessment of Adaptation Options

Limited vulnerability assessment of a few sectors (agriculture, water resources and forestry) was done, however the model outputs differ significantly from observed values. Nonetheless recent occurrences of droughts and floods clearly give some magnitude of impacts of climate change. The adaptation options proposed in the subsequent sections are based on empirical and indigenous knowledge built over time. There is need for a comprehensive and integrated vulnerability assessment, particularly for subsequent national communications to support long-term adaptation plans.

The Conference of the Parties (COP) at its seventh session adopted National Adaptation Programmes of Action (NAPA) as an additional channel of communicating urgent and immediately adaptation interventions required to minimize impacts of adverse effects of climate change. The preparation of NAPA will involve key stakeholders and consultations with local governments and communities to collect information and indigenous methodologies used to adapt to climate variability. The adaptation options listed in the subsequent sections are therefore preliminary in nature.

4.3.1 Agricultural Sector

Although PMA was not explicitly developed as an adaptation instrument it contains significant adaptation elements such as development of drought resistant cultivars and provision of water for production. A number of strategies have been suggested during the assessment of adaptation options. Table 4.4 shows adaptation options for crops.

Tables 4.4: Adaptation Options for Crops

Adaptation Options	**Changes in Practice**	**Government Action**
Irrigation	• Develop capacity to tap water for irrigation; • Apply weather and climate information; • Encourage water harvesting; • Sensitise people to optimise water usage.	• Develop initial irrigation infrastructure; • Construct water reservoirs; • Create incentives for water harvesting; • Re-enforce implementation of the Water Statute (1995).
Diversification of crops	• Introduce drought resistant crops; • Remove cultural barriers; • Diversify crops grown in the locality.	• Promote development and production of drought resistant varieties; • Strengthen capacity of research institutions.
Improved farming methods	• Popularise mulching to conserve soil and water; • Improvement of management and agricultural practices; • Training.	• Strengthen extension services.
Processing and Storage facilities	• Engage in food processing; • Improve food storage technologies.	• Create incentives for food processing industry; • Stimulate market for agricultural products.

4.3.2 Grassland and Livestock

About 60% of the livestock is reared within the cattle corridor. This high density has resulted into degraded rangelands, which are vulnerable to adverse effects of climate change. In the cattle corridor, pastoralism is currently considered as one of the efficient ways of utilising their rangelands. Table 4.5 shows adaptation options to adverse effects of climate change.

Tables 4.5: Adaptation Options for Livestock

Adaptation Options	**Changes in Practice**	**Government Action**
Reduction of animal population	• Sale of animals; • Meat processing plants; • Removal cultural barriers; • Diversification of economic activities for herdsmen; • Introduce high yielding breed; and • Use weather and climate information	• Create market and incentives; • Encourage diversification of economic activities
Improve pastures and rangeland management	• Create paddocks to reduce soil degradation; • Supplement animal food with crop residue during droughts; • Improve management of rangelands by planting shrubs and drought resistant pastures; • Reduce bush burning; • Use weather and climate information.	• Promote research on rangeland management; and • Re-enforce implementation of relevant policies and legislation.
Reduce silting of river banks and lake shores	• Reduce run-off into rivers and lakes through increase of vegetation cover along lake shores and river banks.	• Re-enforce implementation of Water Statue (1995); • Enforcement of regulations on river banks, lake shores and wetlands (2000).
Water harvesting	• Construct permanent houses; • Harvest rain water and run-offs during wet season and preserve for dry periods;	• Create incentives for poor people to build permanent iron-roofed houses.

4.3.3 The forestry Sector

Uganda has developed a Forestry Action Plan. In this plan, the key adaptation strategies are linked to afforestation, reforestation, conservation and protection of the existing forest estate. Table 4.6 shows adaptation options.

Table 4.6: Adaptation Options for Forestry Sector

Adaptation Options	**Changes in Practice**	**Government Action**
Develop drought resistant species	• Planting of drought resistant species; and • Remove cultural barriers for new species.	• Encourage research into drought resistant species; • Promote sensitization; and • Promote use of products of new species.
Improve management of forests	• Control outbreaks of wild fires; and • Remove dead trees from forest reserves to reduce on outbreaks of wild fires	• Re-enforce implementation of Forestry Statue and regulations; • Incentives for private sector participation.
Research into new pests and diseases	• Use appropriate pesticides to control new pests and diseases.	• Promote research
Preservation of indigenous species	• Collect and preserve indigenous seedlings.	• Support collection and preservation of indigenous species.

4.3.4 **Water Resources Sector**

The water resources sector offers a number of opportunities for adaptation to climate change. Adaptation measures will call for improved water management systems throughout the country. Table 4.7 gives a list of some adaptation options.

Tables 4.7: Adaptation Options for Water Sector

Adaptation Options	**Practice Changes**	**Government Action**
Water Conservation	• Recycling of waste water (water re-use); • Reduction in water demand through efficient use; • Minimise water leakages and waste; and • Encourage water harvesting and storage at all levels.	• Strict implementation of the Water Statute.
Pollution Control	• Improve sanitation; • Strict waste management; and • Use of better soil conservation methods to minimize erosion.	• Routine water quality monitoring; and • Re-enforcement of the polluter pays principle.
Construction and maintenance of storage structures	• Development of new dam sites; and • Limit settlement in potential dam sites for easy vacation when necessary.	• Restriction on development in potential dam sites.
Water harvesting	• Construct permanent houses; and • Harvest rain water and run-offs during wet season and preserve for dry periods;	• Encourage building of permanent houses; • Create incentives for poor people to build iron-roofed houses.
River Basin Planning	• Conjunctive use of surface and ground water.	• Emphasize integrated river basin management.
Wetlands and catchment protection	• Ensure that wetlands are well protected and an optimal level of forestry cover is maintained within the catchment areas.	• Re-enforcement of both Wetland and forestry policies.
Use of ground water	• Increase the number of boreholes in areas where ground water resources exist (where water is safe)	• Re-enforce implementation of the water action plan

CHAPTER 5

NATIONAL POLICIES AND MEASURES

5.0 Introduction

Having signed and ratified the UNFCCC, Uganda requires putting in place the relevant policies and measures which can effectively implement the convention. At the same time the country needs to be careful so as not to divert from her preferred developmental path. This means that the chosen policies and measures will necessarily be required to contribute to the long-term strategic framework for national development. Such measures must certify the national criterion compliant with poverty eradication.

Through a countrywide consultation process, Uganda came up with an overall Vision for the first quarter of the 21st century known as the VISION 2025. Although Vision 2025 did not have the UNFCCC as its major driving force, many of the envisaged activities under vision 2025 are relevant to the implementation of the UNFCCC in particular and agenda 21 in general. The broad objectives of Vision 2025 are well covered under Uganda's Poverty Eradication Action Plan (PEAP) and under the Plan for the Modernisation of Agriculture (PMA) among many other action plans in the environment and Natural resources sectors. Briefly Uganda's vision may be described as follows: -

Vision 2025: - Uganda's Vision 2025 constitutes a strategic framework for national development in the long-term. The major areas for vision 2025 are import substitution, sectoral linkages and export lead growth. The main aspiration for Uganda is to have a science and technology driven country by the year 2025. The focal elements of this aspiration include the following:

- A highly productive and modernised agricultural sector;
- Widely distributed, technological proficient, innovative and competitive industries;
- Maximum utilisation of information technology;
- Expanded research capacity;
- An adequate well trained number of scientists and technologists in all fields of production and other human activities;

Poverty Eradication Action Plan (PEAP): - Poverty Eradication Action Plan (PEAP) is Uganda's Comprehensive Development framework, which has guided the formulation of government policies since 1997. Under PEAP Uganda is being transformed into a modern economy in which agents of all sectors can participate in economic growth. The government envisages that poor people can benefit from economic growth only if the following conditions are met under PEAP:

- Implementation of structural transformation, including Modernisation of Agriculture and the development of industries which build on the demand and supply linkages from agriculture;

- Ensuring the participation of the poor in growth, both by expanding smallholder agriculture and employment in industry and services including rural non-farm enterprises; and
- Achievement of sustainable economic growth.

Uganda believes that once the above mentioned conditions are met, the poor may be able to benefit through increased incomes from wage employment and from improved services delivered by the state and the community. Economic growth must therefore involve small farmers, must encourage the expansion of labour intensive activities and hence involve a stance of economic openness. Moreover, extra fiscal resources generated must be targeted on the delivery of direct poverty-reducing services.

The Poverty Eradication Plan programme operates on the basis of following four pillars: -

- Fast and sustainable economic growth and structural transformation;
- Good governance and security;
- Increased ability of the poor to raise their incomes; and
- improved quality of life of the poor.

The government gives priority support to activities and programmes that have direct and positive implications to the 4 pillars of PEAP. For any project to be included in the government development programme for financial or material support it must address poverty eradication directly. This criterion also applies to Environmental and climate change related projects and programmes. Implementation of the UNFCCC and the Kyoto Protocol must conform to this criterion.

Plan for Modernisation of Agriculture (PMA): - As indicated in the earlier sections, agriculture presents a great opportunity for poverty eradication because it employs over 80 of the labour force, and because agricultural growth can be accelerated substantially by the uptake of modern farming techniques. From the poor household's perspective, improving their livelihoods means transforming agriculture by enhancing their capital assets(including natural, physical, financial, human and social assets).

PMA is a holistic, strategic framework for eradication of poverty through multi-sectoral intervention enabling the people to improve their livelihoods in a sustainable manner. It is an outcome-focussed set of principles upon which sectoral and inter-sectoral policies and investment plans can be developed at both central and local government levels.

The PMA is part of the government's broader strategy of poverty eradication contained in the Poverty Eradication Action Plan (PEAP). It is perceived that modernising agriculture will contribute to increasing incomes of the poor by raising farm productivity, increasing the share of agricultural production that is marketed, and creating on-farm and off-farm employment. The poverty focus of the PMA is based on poor people's perspectives that are contained in various poverty studies in Uganda.

The objectives of the PMA are to:

- Increase incomes and improve the quality of life of the poor subsistence farmers;
- Improve household food security;
- Provide gainful employment; and
- Promote sustainable use and management of natural resources.

These objectives will be met through maintenance of prudent macroeconomic and sectoral policies, undertaking institutional reforms and adjustments and implementation of the identified priority interventions.

Uganda is in the process of developing a number of specific policies for the agricultural sector. The key policy areas will include:

- Agricultural research;
- Agricultural Advisory services;
- Farm power and agricultural mechanisation;
- Dairy sub-sector;
- Beef sub-sector; and
- Fisheries sub-sector.

With respect to food security, Uganda has considered several options. These options include:

- Extensive irrigation;
- Publicly held grain resources; and
- Compulsory retention of reserve of designated food crops by farmers; and
- Improved productivity through intensive agriculture.

5.1 Relevant Policies to UNFCCC

Apart from targeted activities such as the proposed creation of the National Climate Change Secretariat, a number of relevant policy guidelines and objectives related to climate and climate change have been highlighted in various policy documents. The major goal of these policies is to achieve poverty reduction through environmentally sustainable development as described in the following sections.

5.1.1 Population Policy[xv]

The Population Policy for Uganda was developed in 1994 with overall goal to influence the future demographic trends and patterns in desirable directions in order to improve the quality of life and standard of living of the people.

This policy is for the encouragement of sustainable development through, the harmonisation of population growth with the country's natural resources such as water, land, forests and climate. This is being done through:

- Expansion of the Primary Health Care (PHC) especially maternal and child care;
- Promotion of a comprehensive family planning delivery system;
- Education and awareness inter alia family size, health and welfare;
- Integration environmental concerns into population and development issues.

Among the many strategies highlighted in the population policy, the strategy on environment aims at:

- Increasing awareness about impact of population change on the environment;
- Reviewing, enacting and enforcing laws relating to forest conservation, game parks, wildlife, and environmental management in general; and encouraging afforestation programmes;
- Promoting proper waste management in both urban and rural areas;
- Promoting research in use of alternative sources of energy and energy saving devices.

5.1.2 Health Policy[xvi]

The Health Policy and Sector Strategic Plan were developed within the context of the provisions of the Constitution of the Republic of Uganda (1995) and the Local Government Act (1997), which decentralised governance and service delivery. The Health Policy further derives guidance from the National Health Sector Reform Programme and the Poverty Eradication Action Plan (PEAP).

The overall policy goal is the attainment of a good standard of health by all the people in Uganda, in order to promote a healthy and productive life. To achieve the goal, the principles of PHC, equitable distribution of health services, good quality health care, efficiency and inter-sectoral co-operation between different health related sectors and authorities are being followed.

The objective is to reduce mortality, morbidity and fertility, and the disparities therein ensuring access to the Minimum Health Care Package and clinical services to all its population, with emphasis on the poor, women and children. The Minimum Health Care Package include prevention and control of measures through improved case management, vector control and personal protection from insect bites at the community and household levels, selective chemoprophylaxis, intensified surveillance to help prevent and better manage epidemics, and monitoring the efficacy of existing anti-malarial drugs.

Over 75% of the life years lost due to premature death were due to 10 preventable diseases, perinatal and maternal conditions (20.4%), malaria (15.4%), acute lower respiratory tract infections (10.5%), AIDS (9.1%) and diarrhoea (8.4%) together account for 60% of the total national death burden (Ministry of Health, 1995[xvii]). Others at the top of the list include tuberculosis, malnutrition (with 38% of under 5s stunted, 25% underweight for age and 5% wasted), Trauma/accidents and measles.

Uganda is committed to addressing the increasing burden of disease resulting from poor environmental health by particularly placing greater emphasis on rural areas where the population has low access to safe water and poor latrine coverage. Key

components of the minimum health package, which are directly relevant to the UNFCCC, include: - Malaria Prevention and Control, Integrated Management of Childhood Illness, Public Health Interventions, Health Education and Epidemics, Environmental Health and Disaster Prevention.

5.1.3. Disaster Management[xviii] and Preparedness Policy

Uganda has put in place a comprehensive policy that details an arrangement for the effective and practical management of disasters. The overall policy goal is to promote, in relation to disasters, prevention, preparedness, mitigation, response and recovery to be implemented in a manner that integrates disaster management with development planning. The policy objectives aim at: -

- Land use planning to minimise degradation;
- Conservation of the environment through rational exploitation of the related resources;
- Gender integration
- Education, Training and public awareness;
- Public participation in disaster management;
- Water resources conservation

5.1.4 Forestry Policy (2001)[xix]

The current trend in Uganda has been one of loss of forest cover and degradation of the remaining forest resource base. For this reason, there has been a need to plan a new direction for forestry development in Uganda. The new policy (2001) sets out the goal and objectives.

The Policy Goal of the Uganda Forestry Policy (2001) is to establish an integrated forest sector that achieves sustainable increases in the economic, social and environmental benefits from forests and trees by all the people of Uganda, especially the poor and vulnerable.

The policy document sets out specific policy statements as follows:

- The Permanent Forest Estate (PRE) under government trusteeship will be protected and managed sustainably;
- The development and sustainable management of natural forests on private land will be promoted;
- Profitable and productive forest plantation business will be promoted;
- A modern, competitive, efficient and well-regulated wood and non-wood processing industry will be promoted in the private sector;
- Collaborative partnerships with rural communities will be developed for sustainable management of forests;
- Tree growing on farms will be promoted in all farming systems, and innovative mechanisms for the delivery of forestry extension and advisory services will be developed;
- Uganda's forest biodiversity will be conserved and managed in support of local and national socio-economic development and international obligations;

- Watershed protection forests will be established, rehabilitated and conserved;
- Urban forestry will be promoted;
- The government will support sustainable forest sector development through appropriate education, training and research;
- Innovative mechanisms for the supply of high quality tree seed and improved planting stock will be developed;

Every specific policy statement seeks to meet a certain objective. The Objectives are stated as follows:

- To afforest all bare areas of the PFE and increase forestry on private lands;
- To maintain the current national levels of forests on private land;
- To encourage private investment in commercial forest plantations and develop fuel wood, timber and carbon storage plantations in different areas of the country, concentrating fuel-wood priorities in peri-urban areas;
- To encourage private investment in the processing industry, control illegal practices, monitor best practice, measure environmental and social impacts and collect dues;
- To promote the sharing of benefits from improved forest management, increase stakeholder participation, encourage collective responsibility and equity and also improve the livelihoods of forest-dependant communities;
- To boost land productivity, increase farm incomes, alleviate pressures on natural forests and improve food security;
- To safeguard biodiversity in both government and private forests, improve agricultural biodiversity through farm forestry initiatives and meet and implement its obligations under international agreements;
- To protect watersheds;
- TO improve the livelihoods and well-being of urban people through supporting urban forestry and improving the urban landscape and environment;
- To increase awareness and understanding of the role of forests and trees in Uganda's national economy and local livelihoods and the crucial environmental services they provide;
- To supply high quality tree seeds and improve planting stock to meet the needs of all small-scale farmers and large-scale commercial tree growers;

5.1.5 Environment Policy

The National Environment Management Policy[xx] promotes the use of economic instruments, public participation and environment information and education. The overall policy goal is "sustainable social and economic development which maintains or enhances environmental quality and resource productivity on a long term basis, that meets the need of the present generations without compromising the ability of future generations to meet their own needs".

It recognises Environmental Education (EE) is an essential component of sustainable development and environmental management. In order to achieve increased awareness and understanding among all people of the need for sustainable environmental management, a guiding principle is that EE should be integrated into curricula.

5.1.6 National Water Policy

The National Water Policy of 1995[xxi] sets out water supply and sanitation polices as well as sustainable provision of accessible clean safe water and hygienic sanitation. The policy promotes a new integrated approach to manage the water resources in ways that are sustainable and most beneficial to the people of Uganda. It is implemented in accordance with the Water Action Plan (1995), which lays emphasis on sustainable management of Uganda's water resources.

The overall policy objective for the Water Resources Management is: to manage and develop the water resources of Uganda in an integrated and sustainable manner so as to secure and provide water of adequate quantity and quality for all social and economic needs of the present and future generations with full participation of all stakeholders.

5.1.7 Energy Policy

The main policy goal in the energy sector is "to meet the energy needs of Uganda's population for social and economic development in an environmentally sustainable manner". The broad policy objectives include the following:

- To establish the availability, potential and demand of the various energy resources in the country;
- To increase access to modern affordable and reliable energy services as a contribution to poverty eradication;
- To improve energy governance and administration;
- To stimulate economic development; and
- To manage energy-related environmental impacts.

To meet some of the objectives, Government shall employ the following strategies:

- Promote the use of alternative sources of energy and technologies, which are environmentally friendly.
- Work towards the establishment and acceptance of broad targets for the reduction of energy-related emissions that are harmful to the environment and energy users.
- Promote efficient utilisation of energy resources
- Promotion of private sector participation in the development of both conventional and renewable energy resources.

5.1.8 Waste Management

The policy issues relevant to waste management are addressed through the existing National Environment Policy framework, which provides information for appropriate methods and technologies to be provided to stakeholders. This is further strengthen by the Action plan for Municipal Solid Waste Management and National Environment (Waste Management) Regulations (1999[xxii]).

5.1.9 National Wetlands Policy (1995)

The overall goal of the policy is to promote the conservation of Uganda's wetlands in order to sustain their ecological and socio-economic functions for the present and future well being of the people. The objectives of the policy are:

- Establish the principles by which wetland resources can be optimally used, and their productivity can be maintained into the future;
- End existing unsustainable exploitative practices in wetlands to avert the decline in their productivity;
- Maintain a biological diversity in wetlands either in the natural community of plants and animals or in the multiplicity of agricultural activity;
- Maintain the functions and values derived from wetland resources throughout Uganda;

5.1.10 Climate Monitoring

The Department of Meteorology is the institution mandated to implement policies related to climate and climate change. The policy goal in this sector is "to maintain a well developed weather and climate monitoring system that provides necessary information and advisories to support sustainable socio economic development. In the light of the UNFCCC, there are proposals to put in place a National Climate Change Secretariat. The major function of the Secretariat is to coordinate implement of the UNFCCC and the Kyoto Protocol.

5.2 Implementation Strategy for the UNFCCC and the Kyoto Protocol

Currently, the Department of Meteorology (DoM) is the focal point for the UNFCCC. Considering the cross cutting nature of climate change issues, no single sector or institution can independently handle all the aspects of climate change. Noting the increasing responsibility it has become necessary to expand the focal point into a National Climate Change Secretariat through a well-harmonized legal framework. Following a number of workshops and studies a two-pronged approach to address climate change issues was adopted: establishment of a legal framework and a National Climate Change Secretariat and development of measurers to address mitigation of GHGs and impacts of adverse effects of climate change. The preparation of NAPA constitutes a short-term means for addressing impacts of adverse effects of climate change. Short term measures to address impacts of adverse effects of climate change will be addressed within the framework of NAPA.

5.2.1 **Functions of the Secretariat**

The main functions of the Secretariat includes:

- Formulation and reviews of policies and programmes for implementation of the UNFCCC and the Kyoto Protocol.
- Negotiation of purchase agreements of Clean Development Mechanism (CDM) projects.
- Raise the level of awareness at the national level regarding the UNFCCC and Kyoto protocol.
- Checking, verifying CDM baseline calculations and developing CDM operational guidelines for the approval of projects.
- Co-ordinate the implementation of the UNFCCC and the Kyoto Protocol
- Maintaining a register of CDM projects and keeping track of Certified Emission Reduction Units (CERs).
- Identify capacity building needs and mobilise resources to address them.

5.2.2 Measures to address climate change

Implementation of the UNFCCC requires the involvement of stakeholders at all levels. At the national level, as evidenced by the sectoral polices in the previous section, coordination, collaboration and cooperation with government, private and NGO institutions is critical. Indeed this has already been done. Proposed measures to address climate change, particularly adaptation, should also take into account inputs from the local communities. In order to develop effective measures to implement the Convention, the following should be taken into account:-

- Capacity development;
- Strengthening climate and climate change monitoring; and
- Development of Adaptation Action Plan.
- Apply participatory and consultative approach
- Establish legal and institutional framework

5.2.2.1 Capacity Development

A preliminary capacity building needs assessment has been carried out. A more detailed capacity needs self assessment is due to be done with support from the Global Environment Facility. This assessment will cover the main multilateral environment agreements. The preliminary capacity building needs assessment revealed the following:

- Inadequate human resources capacity for the enhancement of environmental management systems and integration of climate change issues into the legislation process;
- Weak institutional framework for implementing the UNFCCC;
- Weak coordination, collaboration and cooperation mechanism;
- Lack of implementation action plan for the UNFCCC;
- Inadequate climate change skills;

- Lack of technical capacity to adapt new and appropriate technologies for abatement of GHGs and reduction of impacts of adverse effects of climate change;
- Low level of awareness on climate change issues; and
- Insufficient information on the existing indigenous adaptation knowledge/options.

5.2.2.2 **Climate and Climate Change Monitoring**

Weather and climate information is required to support adaptation activities as well as long-term monitoring of climate change. A good network of climate and hydrological station network is therefore critical for provision of accurate and timely weather and climate information for adaptation activities, including early warning systems. An effective early warming system will require a robust and adequate hydrological and climate-monitoring network.

The climate and hydrological monitoring network is inadequate. Most of the climate data is still in manuscript form, which makes it difficult to provide timely climate information for specific sector in any part of the country. It is, therefore, important that the national meteorological and hydrological services should be strengthened. This should be done through improving:

- The surface and upper air climate observation;
- Hydrological observations networks, including the hydrometeorological observation of inland lakes;
- Communication systems for efficient climate data collection and exchange;
- The data archiving and processing system to ensure the availability of quality data for climate monitoring and operations and research;
- Capacity for climate data management systems through the training of personnel in data monitoring and processing; and
- Selection of appropriate models.

Improvements in data collection, processing and archiving will enhance Uganda's capacity to develop early warming systems. In addition Uganda would be better placed to respond to current and future challenges in the fields of weather forecasting, climate prediction, climate change and related environmental issues.

5.2.2.3 **Development of Long-term Adaptation Action Plan**

Although Uganda will be developing a NAPA, there is need to develop a long-term adaptation plan. The long-term adaptation plan should take into account the vulnerability of various sectors of the economy. The adaptation plan should therefore be consistent and should re-enforce existing principles and sectoral plans. The following could guide the development of the adaptation action plan:

- Strengthening of the early warning information capacity, especially for food security and short-term climate prediction;
- Incorporation of climate change and variability information and projections into long-term development plans;
- Carrying out an inventory of existing practices and methods used to adapt to extreme climate events; and
- Participatory and consultative approach.

5.3 Policy Gaps and Constraints

Although a number of environmental policies have been put in place, these policies were not designed to address climate change issues. In many ways climate change is downplayed and is thought of in the face of disaster. Lack of awareness is a major factor in this marginalization of climate and climate change.

5.3.1 Land-use Planning

Currently, Uganda does not have a comprehensive national land-use policy. As a result, inappropriate land-use activities are contributing to serious environmental degradation. Uganda will need assistance to develop national and local land-use plans to help guide land-use decisions in an environmentally – sound, economically sustainable and socially acceptable manner. Such land-use plans should take account of climate change issues like sources and sinks of greenhouse gases.

5.3.2 Capacity Building

While Uganda has an enabling environmental laws, these laws have not fully taken into account climate change issues. This weakens implementation of the UNFCCC. Uganda, like many developing countries, is experiencing serious capacity problems. Capacity building needs have been identified in a preliminary survey but implementation of the identified proposals are hampered by lack of financial and technical assistance.

CHAPTER 6

EDUCATION, TRAINING AND PUBLIC AWARENESS

6. Background

Uganda committed itself to reduce illiteracy levels through the introduction of Universal Primary Education and Functional Adult Literacy Programme. High literacy levels will enable dissemination and assimilation of development information. This lays a foundation for disseminating environmental, including climate change, information.

Effective implementation of the Convention depends on the level of awareness of the population at the various levels of society. Public awareness must therefore be an integral component of national programmes to address climate change and its adverse effects. Public awareness alone is not sufficient; education and training must also be carried out to complement public awareness. Incorporation of climate change issues into the education system will ensure that young generations are well informed about climate change and its adverse effects. Existing training programmes do not include climate change. It is therefore necessary that training and research institutions include climate change issues into their programmes.

6.1 Activities Undertaken

Public awareness, like capacity building, is a continuous process, which requires substantial efforts (financial, technical and human). Although there has not been an explicit public awareness programme Uganda has taken advantage of climate change meetings and workshops to invite the media to cover these events with objective of raising the level of awareness of the public. The following meetings and workshops were organised in the last two years:-

- Inception Workshop for Enabling Uganda Project;
- Clean Development Mechanism (CDM) capacity building workshops;
- Least developed countries meeting: development of guidelines for preparation of national adaptation programmes of action;
- African Climate Change Negotiators meeting; and
- CDM Investors' forum;

The frequent occurrences of floods and droughts within and outside Uganda have helped to increase the level of awareness of climate change and its adverse effects among the Ugandan community. This is attributed to both the local and international media for the coverage of these events. However, the level of awareness is still limited

6.2 Planned Activities and Constraints

Integration of climate change into the education curriculum is the best approach and indeed a cost effective method of raising the level of awareness of the youth. However, there is need to ensure that the education curricula is not overburdened with

additional issues. Careful planning is required in addition to assessing what can be absorbed by the education curricula. The following main activities would be undertaken:-

- Dialogue with Ministry of Education and detailed discussion with the Curriculum Development Centre;
- Assessment of what can be incorporated in the education curriculum;
- Training of teachers at the various levels; and
- Development of educational materials.

Climate change is a crosscutting and complex issue. There is acute shortage of expertise in this area. The lack of climate change expertise is compounded by the fact that climate change would need to be fused into many sectors if not all. While training institutions have started addressing lack of skills in the environment sector climate change is not one of those where programmes have been developed. In addition climate change skills alone have limited market, there is therefore need to develop multi-sectoral training programmes. In addition to incorporation of climate change into the education curriculum and training programmes, there is need to develop and implement awareness programme. Lack of financial and technical assistance remains the main barrier to education, training and public awareness.

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ANNEX I

Box 1: List of the relevant environmental laws/Conventions of Importance to Uganda signed after Stockholm, 1992.

- Convention concerning the Protection of the World Cultural and Natural Heritage (1972)
- Convention on the International Trade in Endangered Species of Wild Fauna and Flora – CITES (1973)
- Convention on the Conservation of Migratory Species of Wild Animals (1979)
- Vienna Convention for the Protection of the Ozone Layer (1985)
- Montreal Protocol on Substances that Deplete the Ozone Layer (1987)
- Convention concerning Safety in the Use of Asbestos (1986)
- Basal Convention on the Trans-boundary Movements of Hazardous Wastes and their Disposal
- Convention on Biological Diversity – CBD (1992)
- United Nations Frame Work Convention on Climate Change – UNFCCC (1992)
- United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and or Desertification, Particularly in Africa – CCD (1994)
- The Kyoto Protocol to the Climate Change Convention

ANNEX II

5.2 Methodology

The GHG emissions by sources and removals by sinks were calculated using the IPCC-1995 guidelines for National Greenhouse Gas Inventories by category.

Energy: Emissions were inventoried using the bottom up methodology as detailed under the GHG inventory reference manual produced by the IPCC. For comparison, a top down methodology was employed starting from the end use devices. Apart from specific emission factors for bio-fuels, which were nationally determined, IPCC default emission factors were used for the fossil based fuels.

Industrial Processes: On account of Uganda's narrow industrial base, only a few industries were considered. As before, IPCC guidelines were employed to estimate the emissions. The key industries were cement, lime and foam industries.

Solvents: The inventory considered paints, perchloroethylene and carbon tetrachloride. The available data was not segregated which meant that IPCC guidelines could not be employed. Nevertheless, default emission factors were used to estimate the emissions from solvents.

Agriculture: The IPCC/OECD Methodology was used to calculate GHG emissions from livestock, paddy rice cultivation, fertiliser application, burning of both agricultural resides and savannah.

Forestry and Land use change: GHG emissions were based on the various types of forests, growing stock, deforestation and harvesting rates, shifting cultivation and on managed and unmanaged forests. IPCC guidelines were followed to estimate the emissions and removals.

Waste/Garbage/Sewage: Because the municipal solid wastes in Uganda were not land filled, it was not possible to use some of the IPCC Methodologies suggested. The method suggested by Orlich (1990) for developing countries was used. An empirical model based on landfill recovery at 50% of the average methane recovery determined for the USA was employed.

4.3 Data Sources

All raw data used in the estimation of GHG emissions were obtained from local sources by sector as follows:

Energy: Data on annual sales of petroleum products was obtained from the Department of Energy, Ministry of Natural Resources; on mobile sources was obtained from the Ministry of Transport and the Uganda Civil Aviation Authority; on rail and marine transport from both the Uganda Railways and the Department Fisheries; on thermal power generation from the Uganda Electricity Board, and on Bio-mass combustion from the Department of Forestry and sugar processing plants.

Industrial Processes: Data on cement was obtained from the two cement processing plants and for lime from the lime plants at Hima, Equator and NEC lime. Data on Foam Mattresses was obtained from the three Foam processing industries (i.e. Vitaform, Uganda foam and NEC Foam).

Solvents: Data on paint was collected from the budget survey reports as well as from the paint production factories.

Agriculture and Savannah Burning: Data was obtained from the results of the National Census of Agriculture and Livestock (1990 - 1991). Data on burning of agricultural crop wastes was obtained from crop production figures of the Department of Agriculture.

Land-use Change and Forestry: Data was obtained from woody biomass growing stock as obtained from the National Bio-mass study.

Wastes: Data was obtained from City and Municipal Records as well as the 1991 housing and population census summaries on the use of toilets

LIST OF ACRONYMS

ADT	:	Average Daily Traffic Count
AERDP	:	Alternative Energy Resources Development Programme
C/N	:	Carbon/Nitrogen Content Ratio
CAA	:	Civil Aviation Authority
CBCPM	:	Colorado Beef Cattle Production Model
CBD	:	Convention on Biological Diversity
CC	:	Climate Change
CCCM	:	Canadian Climate Centre Model
CDM	:	Clean Development Mechanism
CERs	:	Certified Emission Reduction Units.
CH_4	:	Methane
CLCOM	:	Climate Computing System
CO	:	Carbon Monoxide
CO^2	:	Carbon Dioxide
COP	:	Conference of the Parties
FEWS	:	Famine Early Warming System
FY	:	Fiscal Year
GCM	:	General Circulation Model
GDP	:	Gross Domestic Product
GEF	:	Global Environmental Facility
GFD	:	Geophysical Fluid Dynamics Laboratory's Model
Gg	:	Giga Grames
GHG	:	Greenhouse Gas
Gj	:	Giga Joules
GNP	:	Gross National Product
GTS	:	Global Telecommunications System
IPCC	:	Intergovernmental Panel on Climate Change
IPP	:	Independent Power Producer
Kg	:	Kilogramme
KT	:	KiloTon
LDC	:	Least developed Country
LEWS	:	Livestock Early Warming System
LPG	:	Liquid Petroleum Gas
LUCF	:	Landuse Change and Forestry
MSL	:	Mean Sea Level
MW	:	Mega Watts
MWL&E	:	Ministry of Water, Lands and Environment
N_20	:	Nitrogen Oxide
NMT	:	Non-Motorised Transport
NMVOC	:	Non Methane Volatile Organic Compounds
NO_X	:	Nitrous Oxides
OECD	:	Organization for Economic Co-operation and Development
PMA	:	Plan for the Modernisation of Agriculture
REAP	:	Poverty Eradication Action Plan?
SO_2	:	Sulphur Dioxide
SOER	:	State of the environment Report

SPUR	:	Simulation of Production and Utilisation of Rangelands
UK	:	United Kingdom
UNCED	:	United Nations Conference on Environment and Development
UNEP	:	United Nations Environment Programme
UNESCO	:	United Nations Educational Social and Children Organisation?
UNFCCC	:	United Nations Framework Convention on Climate Change
V&A	:	Vulnerability and Adaptation
VAT	:	Value Added Tax
WMO	**:**	**World Meteorological Organisation**