

Forward

The increasing concentration of the so called greenhouse gases (i.e CO₂, CH₄, N₂O, O₃) in the atmosphere as a result of human activities and its possible consequence of global warming and climate change has become an international issue since the 1980's.

Some of the adverse impacts of global warming and climate change are Sea level raising, desertification, frequent occurrence of extreme weather events such as drought and flood, lose of biodiversity, expansion of infection disease such as malaria, degradation of ecosystems and reduction in food production and fresh water supply.

To collaborate in mitigating the potential treat of climate change, governments signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 in Reo at the Earth Summit. The Convention which came into force in march 1994, was signed after extensive negotiations among governments. Ethiopia not only signed the convention, it has also ratified it in April 1994.

The objective of the Convention is to stabilize the concentration of GHGs in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

Developing national inventories of sources and sinks of GHGs, impact assessment and preparation of climate change adaptation measures are some of the commitments which apply to all parties under the convention.

Although Ethiopia's current emission of greenhouse gases is negligible as compared to that of the developed countries, it is likely that the country will be affected negatively by global warming and climate change. Therefore conducting research on vulnerability and adaptation assessments to climate change is highly important for the country's long term development planning. It was in this sprit and as a party to the Climate Change Convention that we participated in the U.S countries study program to carry out GHG emission inventory, Vulnerability, Adaptation and Mitigation assessments.

It should be noted that this type of research work is of its first kind in Ethiopia and results found should be viewed as preliminary. However, the results and experience gained in the project will serve as a basis to under take future work in climate change issues.

There is no doubt that much remains to be done. It is hoped that an indepth and comprehensive study in climate change will be embarked on as grants are made available both locally and internationally. In this regard there is an urgent need to establish a national climate committee that will coordinate and oversee climate change activities in the country.

I would like to take this opportunity to thank the U.S government for providing financial and technical support and local Ministries and experts who co-operated in carrying out the project. The ministries include the Ministry of Agriculture (Agriculture Development Department, Grassland & Livestock and fisheries Development Department and Forestry Research center), Ministry of water resources (Department of Hydrology) and Ministry of Mines and Energy (Ethiopian Energy Research Center). Last but not least I would like to extend my gratitude to the staffs of NMSA who directly or indirectly contributed for the completion of the project and in particular to the Climate Change and Air pollution Studies Team members for their hard work in coordinating and facilitating the project activities.

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Agency

Acronyms

| | |
|-------------|--|
| CBCPM | Colorado Beef Cattle Production Model |
| CC | Climate Change |
| CCCM | Canadian Climate Change Model |
| DOE | Department of Energy of the United States of America |
| DSSAT | Decision Support System for Agro-technology Transfer |
| EEA | Ethiopian Energy Authority |
| EESRC | Ethiopian Energy Studies & Research Center |
| FCCC | Framework Convention on Climate Change |
| FRC | Forestry Research Center |
| GCMS | General Circulation Models |
| GDP | Gross Domestic Production |
| GFD3 | Geophysical Fluid Dynamics Laboratory model-R30 |
| GFDL | Geophysical Fluid Dynamics Laboratory |
| GFDL - TRAN | Geophysical Fluid Dynamics Laboratory Transient model |
| GFDL - R30 | Geophysical Fluid Dynamics Laboratory Model Wave No.30 |
| GFO1 | Geophysical Fluid Dynamics Laboratory Model at 1% per year Transient Increment |
| GHG | Greenhouse Gases |
| GISS | Goddard Institute for Space Science |
| IIASA | International Institute for Applied System Analysis |
| ILCA | International Livestock Center for Africa |
| ILRI | International Livestock Research Institute |
| IPCC | Intergovernmental Panel on Climate Change |
| ITCZ | Intertropical Convergence Zone |
| LPG | Liquid Petroleum Gas |
| MOA | Ministry of Agriculture |
| MOWR | Ministry of Water Resources |
| NMSA | National Meteorological Services Agency |
| SPUR | Simulation of Production & Utilization of Rangelands |
| UK89 | United Kingdom Meteorological Office model-1989 |
| UKMO - 89 | United Kingdom Meteorological Office model-1989 |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WAPCOS | Water & Power Consultancy Services (India Limited |
| WatBal | Water Balance |
| WMO | World Meteorological Organization |

Ethiopian Climate Change Country Study Project

General

A Cooperative Agreement was signed in May 1993 between the Ministry Mines and Energy of the Government of Ethiopia and Department of Energy of the US government to carry out the Climate Change Country Study Project. The project was divided into two Phases. Phase I of the project which included Inventory of greenhouse gases was implemented by Ethiopian Energy Research Center (formerly Ethiopian Energy Authority) of the Ministry of Mines and Energy and Phase II tasked with Vulnerability, Adaptation and Mitigation Assessments was implemented by the National meteorological Services Agency in collaboration with the departments of Agricultural Development, Fisheries and Livestock Development, Water Resources Development, Forestry Research Center and Ethiopian Energy Research Center. The economic sectors included in the Vulnerability and adaptation assessment were crops, grassland/livestock, forestry and water resources. Mitigation assessment to climate change was carried out for the grassland/livestock and Energy sector. It was also planned to carry out mitigation assessment in the forestry sector but this wasn't done as the forestry expert responsible for the task left for long term training.

The Study Coordinators for the Phase I and II of the Project were Mr. Omar Mohammed Getta, Xgeneral Manager of EESRC (formerly EEA) and Mr. Tesfaye Haile, General Manager of the National Meteorological Services Agency, respectively. The Project Officer from the US government side was Mr. Arthur Horowitz. The technical team that carried out the project was composed of the following experts:

| Name and Profession | Sector involved | Affiliation |
|--|---|-------------|
| Ademe Mekonnen, Meteorologist Kinfe H. Mariam, Meteorologist | Baseline & Climate Change | NMSA |
| Abebe Tadege, Agrometeorologist Ibrahim Mohammed, Agronomist | Crops | NMSA MOA |
| Dr. Wondwessen Asfaw, Veterinarian Abaye Tedla, Senior Livestock expert | Grassland/ Livestock (V & A and mitigation) | MOA |
| Negash Mammo, Forester | Forestry | FRC |

| | | |
|---|------------------------|--------------|
| Kinfe H.Mariam, Meteorologist Tamiru Worku, Hydrogeologist | Water Resources | NMSA MOWR |
| Assres W.Giorgis, Precision Engineer Tensaye Ayele, Economist Yisehak seboka, Chemist Iyasu Cheroka, Geologist Afewerk Atnafu, Elec. engineer | GHG Emission Inventory | EESRC |
| Assres W.Giorgis, Precision Engineer | Energy Mitigation | EESRC |

A grant of the amount US\$ 109,300 was made available for the project from the US Government through the Department of Energy out of which 30% and 70% were allocated for phase I and phase II respectively. Ethiopian Government has made comparable contributions by covering the salaries and per diems of the experts involved, providing office facilities with mains, and transport facilities.

Technical documents and analytical tools (software) such as DSSAT3 for V&A assessment in crops, WatBal & CLIRUN for V&A assessment in water resources, SPUR2 for V&A in grassland/livestock, Holdridge & Forest Gap Model for V&A assessment in forestry, Century for mitigation assessment in grassland/livestock, MARKAL MACRO for mitigation assessment in energy sector, COPATH for mitigation assessment in the forestry sector and GCMs of various modeling centers were acquired for the project from the US Country Studies Management Team.

Hands on training on some of the analytical tools for the project team members were provided abroad. Local training were also provided on GCMs, Century and MARKAL MACRO.

Hardware and equipment that were acquired through the phas II part of the project include two computers, one printer, one photocopier, and one overhead projector with screen.

Two local workshops, one in August, 1995 and the second in March 1996 were held to introduce results found in each sector for participants from various Government and non-government institutions.

Country Profile

Ethiopia is found in northeastern Africa lying between 3.5⁰N-15⁰N latitude and 33⁰-48⁰E longitude (Fig 1). It has an area of about 1.1 million square Kms. About one third of this land area is comprised of a hilly and mountainous plateau between 1500 and 3500 meters asl. The highland is surrounded by arid and semiarid lowland plains (<1500 meters asl). The highland is also divided by the southwest-

northeast oriented Rift valley (extension of the Great African Rift Valley).

The climate of the country is mainly controlled by the seasonal migration of the Intertropical Convergence Zone (ITCZ) and associated atmospheric circulation as well as by its complex topography. It has a diversified climate ranging from semiarid desert type in the lowlands to humid and warm (temperate) type in the southwest. Mean annual rainfall distribution has maxima (>2000 mm) over the Southwestern highlands and minima (<300 mm) over the Southeastern & Northeastern lowlands. Mean annual temperature ranges < 15 °C over the highlands to > 25 °C in the lowlands. Although season length varies across the country, one can generally identify three seasons, namely;

Bega :- dry season (October- January)

Belg :- short rainy season (February- May)

Kiremt:- long rainy season (June- September)

The current (1996) population of the country is estimated at 54.9 million and is estimated to grow at the rate of about 3% per annum. Most of the population (>80%) live in rural areas.

Although its current productivity is low due to backward practices, agriculture (including livestock) is the most important sector of the national economy and the main source of livelihood for 85% of the population. It is the source of 90% of the export earnings and 40-50% of the GDP. Food crops, industrial crops, export crops (e.g. coffee), livestock and livestock products are the main components of Ethiopian agriculture. Subsistence mixed farming (cultivation and livestock rearing) and nomadic pastoralism are widely practiced in the highlands and lowlands respectively.

In 1993 cropped land (annuals and perennials) was estimated to cover about 15% (17 million hectares) of the country but the extent of potentially arable land is much more than this figure. A very large proportion of cropped land is covered by the five main cereals (Teff - an indigenous cereal crop, Maize, Barley, Wheat and Sorghum).

The livestock population in Ethiopia that reaches about 70 million heads is the largest in Africa and the 10th in the world. It constitutes a large component of the Ethiopian agricultural sector and is well integrated with the farming

systems found in the highlands and provide the sole means of subsistence for the nomadic pastoralist in the lowlands.