THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

MINISTRY OF WATER RESOURCES

NATIONAL METEOROLOGICAL AGENCY

CLIMATE CHANGE NATIONAL ADAPTATION PROGRAMME OF ACTION (NAPA) OF ETHIOPIA

JUNE 2007

ADDIS ABABA

ETHIOPIA

UNDP

Global Environment Facility

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
MINISTRY OF WATER RESOURCES
NATIONAL METEOROLOGICAL AGENCY

CLIMATE CHANGE NATIONAL ADAPTATION PROGRAMME OF ACTION (NAPA) OF ETHIOPIA

Editor: Abebe Tadege

This report is the output of a project entitled "Preparation of National Adaptation Programme of Action for Ethiopia" that was supported by the GEF through the UNDP.

JUNE 2007
ADDIS ABABA
ETHIOPIA

For further information, please contact:

NATIONAL METEOROLOGICAL AGENCY (NMA)
P.O.BOX 1090
ADDIS ABABA, ETHIOPIA
Tel: (251) 11 661 5779
Fax: (251) 11 662 5292
E-mail: nmsa@ethionet.et

Cover page:

The pictures shown on the cover page represent some of the coping mechanisms of farmers and pastoralists to climate extremes such as drought in Ethiopia.

NATIONAL ADAPTATION PROGRAMME OF ACTION (NAPA) PREPARATION TEAM

NAPA Project Steering Committee Members

Name	Institution	Role
		Chairman
Mr Kidane Asefa	Director General and Focal Point for UNFCCC National Meteorological Agency (NMA)	
Mr Asres Wolde Giorgis	Director General Rural Energy Development and Promotion Center	Member
Mr Deksyos Tarekegn	Head, Hydrology Department Ministry of Water Resources	Member
Dr. Mohammed Oumer	Associate Prof, Department of Earth Science, Addis Ababa University	Member
Dr. Bateno Kabeto	Head, Crop Development Department Ministry of Agriculture and Rural Development	Member
Mr Mitiku Abebe	Team Leader, Christian Relief and Development Ass. (CRDA)	Member
Mr Getachew Abate	Disaster Prevention and Preparedness Agency	Member
Mr Abebe Mekuriaw	Head, Department of Mines, Water and Energy, Ethiopian Science and Technology Agency	Member
Mr Berihun Gebremedhin	Head, Ecosystem Conservation Department, Institute of Biodiversity Conservation and Research	Member
Dr. Kidane Georgis	Director, Dry land Research Directorate Ethiopian Agricultural Research Institute	Member
Miss Aynalem Meshesha	Senior Expert, Ministry of Finance and Economic Development	Member
Mr Abebe Tadege	Head, Meteorological Research and Studies Department, NMA	Member and Secretary
Dr. Abebe Yeshanew	Team Leader, Climate Change and Air pollution Studies, NMA	Informant
Mr Million Bekele	National UN Volunteer (NMA)	Informant

Project Management Unit with in the National Meteorological Agency (NMA)

Mr Abebe Tadege	National Project Coordinator
Dr. Abebe Yeshanew	Assistant National Project Coordinator
Mr Million Bekele	National UN Volunteer
Mr Habtu G/Yohannes	Team member
Mrs Aklile Assefa	Team member
Mrs Kidist Endashaw	Project Accountant
Mrs Sada Abdulwasie	Project Secretary

NAPA Technical Report Preparation Team

B and M Development Consultants PLC

TABLE OF CONTENTS

	Page
Foreword	vi
Acknowledgement	viii
List of Acronyms	ix
List of Tables	ix
List of Figures	x
Executive Summary	1
Chapter 1 Introduction and Setting	14
1.1 Country profile	14
1.2 Environmental problems/stresses	16
1.3 The need for NAPA	17
Chapter 2 Framework for Adaptation Programme	19
2.1 Introduction	19
2.1.1 The climate of Ethiopia	19
2.2 Current climate variability and observed trends	20
2.2.1 Rainfall variability and trend	20
2.2.2 Temperature variability and trend	21
2.3 Projected climate change over Ethiopia	22
2.4 Impacts of current climate variability	25
2.4.1 Droughts and floods	25
2.5 Impacts of projected climate change	29
2.5.1 Causes of vulnerability to climate conditions in Ethiopia	29
2.5.2 Coping mechanisms to climate variability	29
2.5.3 Adverse effects of climate change	30
2.6 NAPA and its relationship to Ethiopia's development goals	31
2.7 Rational for developing the NAPA and its objectives	36
2.8 Potential barriers for implementation of NAPA	36
Chapter 3. Identification of Key Adaptation Needs	38
3.1 Introduction	38
3.2 Review of on-going and planned project initiatives	38
3.3 Adaptation options as proposed in the Initial National Communication of Ethiopia to the UNFCCC	40
3.4 Adaptation options proposed by the regional consultative workshops	42
3.5 Adaptation options which have synergy with Multi-lateral Environmental Agreements (MEAs)	43
3.6 Summary of potential climate change adaptation options	44
Chapter 4. Criteria for Selecting Priority Projects/Activities	46
Chapter 5. List of Priority Projects/Activities	48
5.1 Introduction	48

5.2 Steps in ranking of adaptation projects---------- 50
5.3 Ranking project options based on standardized weighted average scores---------- 52
5.4 Summary of the outcomes and recommendations---------- 53
5.4.1 Brief summary of the outcomes---------- 53
5.4.2 Recommendations---------- 53

Chapter 6. NAPA Preparation Process---------- 61

6.1 Institutional arrangements---------- 61
6.2 Synthesis of information---------- 62
6.3 Stakeholders consultation---------- 62
6.4 Mechanisms of endorsement---------- 62

Reference ---------- 66

Annex I Profile of Priority Adaptation Activities/Projects---------- 68

FOREWORD

There are now strong evidences, which show that the earth's climate is changing mainly as a result of the increasing concentration of greenhouse gases in the atmosphere that are emitted from various human activities. According to the recent Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. IPCC has also concluded that more climate change is on the way resulting from past, current, and future greenhouse gas emissions with its potential adverse impacts on socio-economic development of nations.

Developing countries in general and least developed countries like Ethiopia in particular are more vulnerable to the adverse impacts of climate variability and change. This is due to their low adaptive capacity and high sensitivity of their socio-economic systems to climate variability and change. Sensitivity and adaptive capacity also vary between sectors and geographic locations, time and social, economic and environmental considerations within a country.

Current climate variability is already imposing a significant challenge to Ethiopia by affecting food security, water and energy supply, poverty reduction and sustainable development efforts, as well as by causing natural resource degradation and natural disasters. For example the impacts of past droughts such as that of the 1972/73, 1984 and 2002/03 are still fresh in the memories of many Ethiopians. Floods in 2006 caused substantial human life and property loss in many parts of the country. These challenges are likely to be exacerbated by anthropogenic climate change. In this context, planning and implementing climate change adaptation polices, measures and strategies in Ethiopia will be necessary.

Adaptation is recognized as a critical response to the impacts of climate change, because current agreements to limit emissions, even if implemented, will not stabilize atmospheric concentrations of greenhouse gases and climate change. Adaptation can reduce present and future losses from climate variability and change. It is neither a one-off intervention nor a stand-alone activity. It is rather a process that needs to be incorporated in the overall development planning, including the design and implementation of projects and programs across relevant sectors.

Article 4.9 of the United Nations Framework Convention on Climate Change (UNFCCC) calls for addressing the specific needs and special situations of the least developed countries. In line with this the Seventh Session of the Conference of Parties (COP 7) established instruments and mechanisms for supporting adaptation, including the establishment of three new funds namely the Special Climate Change Fund, the Least Developed Countries Fund and the Adaptation Fund.

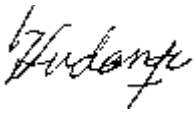
The Federal Democratic Republic of Ethiopia has already put in place policies, strategies and programs that enhance the adaptive capacity and reduce the vulnerability of the country to climate variability and change. Such programs include Plan for Accelerated and Sustainable Development to End Poverty (PASDEP), Environmental Policy of Ethiopia, Agriculture and Rural Development Policy and Strategy, etc. Improved economic growth has been registered in the country over the past four years as a result of these policies, strategies and programs. However, the country needs financial and technological support and capacity building to fully implement theses policies and strategies.

The Ethiopian NAPA preparation process has followed the steps and guiding principles outlined in the NAPA Annotated Guidelines. Through stakeholder consultations and expert assessments regarding the identification of who is vulnerable and to what, there was a general consensus that ecologically arid, semi-arid and dry sub-humid parts of the country are the most vulnerable to drought. Sectoraly, agriculture is the most vulnerable to climate variability and change. In terms of livelihoods, small scale rain-fed subsistence farmers and pastoralists are the most vulnerable.

Through the NAPA process, twenty priority project ideas are identified that address immediate climate change adaptation needs of the country. These projects broadly focus in the areas of human and institutional capacity building, improving natural resource management, enhancing irrigation agriculture and water harvesting, strengthening early warning systems and awareness raising.

The preparation and submission of the NAPA report of Ethiopia to the UNFCCC is a step forward in the long-term challenge of implementing the commitments of the Convention. It is with great pleasure for Ethiopia, to submit this document to the UNFCCC and look forward for the follow up implementation of the priority projects.

On behave of the Government of Ethiopia; we would like to thank the Global Environmental Facility and UNDP for their financial support.



Asfaw Dingamo
Minister
Ministry of Water Resources

Kidane Asefa
Director General of the National Meteorological Agency
and National Focal Point to the UNFCCC

ACKNOWLEDGNMENT

The preparation of this report involved a number of people and institutions. The NAPA project was coordinated by the National Meteorological Agency (NMA) in collaboration with government agencies, non-governmental organizations and academic institutions. Members of the project steering committee are listed on page iii. NMA would like to acknowledge the members of the steering committee for their contributions towards the success of the NAPA project implementation. NMA also wishes to extend special thanks for the multi-disciplinary experts of B and M Development Consultants PLC that prepared technical reports which were used as the basis for preparing the NAPA document.

Special thanks go to the Global Environmental Facility (GEF) and UNDP for financing the project. Thanks also go to the various stakeholders who made invaluable contributions to the improvement of the document.

Due credit is given to members of the technical committee drawn from the various departments of NMA. Particularly, we would like to acknowledge Mr Kinfe H/Mariam and Mr Henock Hailu for their review and useful comments on the report.

Our appreciation also goes to the project management team members; namely, Mr. Abebe Tadege, Dr. Abebe Yeshanew, Mr. Million Bekele, Mr. Habtu G/Yohannes, Mrs Aklile Assefa, Mrs. Kidist Endashaw and Mrs Sada Abdulwasie for their relentless efforts to carry out the day to day activities of the Project.

Kidane Asefa
Director General of National Meteorological Agency
and National Focal Point to the UNFCCC

ACRONYMS

CBO	Community Based Organization
CO_2	Carbon dioxide
COP	Conference of the Parties
CRDA	Christian Relief and Development Agency
EIAR	Ethiopian Institute of Agricultural Research
FDRE	Federal Democratic Republic of Ethiopia
GDP	Gross Domestic Product
GEF	Global Environmental Facility
IBC	Institute of Biodiversity Conservation
ITCZ	Inter Tropical Convergence Zone
Km	Kilo Meter
LDC	Least Developed Country
MCA	Multi-Criteria Analysis
MEAs	Multi-lateral Environmental Agreements
MOFED	Ministry of Finance and Economic Development
NAPA	National Adaptation Program of Action
NGO	Non-Governmental Organization
NMA	National Meteorological Agency
NTFP	Non Timber Forest Products
PASDEP	Plan for Accelerated and Sustainable Development to End Poverty
SC	Steering Committee
SNNPRS	Southern Nations, Nationalities and Peoples Regional State
UNCBD	United Nations Convention on Biodiversity Conservation
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
UNV	United Nations Volunteers
USD	United Sates Dollar

LIST OF TABLES

		Page
Table 1:	Description of criteria and their weights	9
Table 2:	List of projects prioritized using Multi-Criteria Assessment (MCA)	10
Table.2.1:	Chronology of El Niño and Drought/Famine in Ethiopia	27
Table 2.2:	Summary of impact/vulnerability assessment for the selected sectors	29
Table 2.3	Policy/ Program-wise summary of relevant climate change adaptation options	32
Table 2.4	Complementarities among selected policies/programs/strategies and climatic change adaptation options and other MEAs	35
Table 3.1	The list of reviewed projects by sector/ areas of relevance	39
Table 3.1	Adaptation options as proposed in the Initial National Communication of Ethiopia to the UNFCCC	40
Table 3.3	Summary of potential adaptation options proposed by the regional consultative workshops	42
Table 4.1	Description of criteria and their weight	47
Table 5.1	Description of criteria and their weights and values	50
Table 5.2:	Evaluation criteria and scores assigned to each project option	55
Table 5.3:	Standardized simple scores and ranking based on average scores for the 37 project options	57
Table 5.4:	List of projects prioritized using Multi-Criteria Assessment (MCA)	60

LIST OF FIGURES

		Page
Figure 1	Year- to- year variability of annual minimum temperature over Ethiopia expressed in temperature	2
Figure 2	Year-to-year variability of annual rainfall and trend over Ethiopia expressed in normalized deviation.	2
Figure 3	Composite (average of 19 GCMs) change in temperature (^{o}C) relative to 1961-1990 normal for A1B emission scenario.	3
Figure 4	Composite (average of 19 GCMs) percentage change (%) in rainfall relative to 1961-1990 normal for A1B emission scenario.	3
Figure 1.1	Location map of Ethiopia	14
Figure 2.1	Mean annual rainfall and temperature distribution over Ethiopia (source NMA, 2001).	19
Figure 2.2	Year-to-year variability of annual rainfall and trend over Ethiopia expressed in normalized deviation.	20
Figure 2.3	Year-to-year variability of annual minimum Temperature over Ethiopia expressed in temperature difference.	20
Figure 2.4	Composite (average of 19 GCMs) change in temperature (^{o}C) relative to 1961-1990 normal for A1B emission scenario.	23
Figure 2.5	Composite (average of 19 GCMs) percentage change (%) in rainfall relative to 1961-1990 normal for A1B emission scenario.	23
Figure 2.6	Drought probability map of Ethiopia	26
Figure 2.7	Impact of climate related hazards in Africa	26
Figure 2.8	Flood in the city of Dridawa (eastern Ethiopia) in August 2006	26

Executive Summary

1. Introduction and Setting

Ethiopia is found in the Horn of Africa covering an area of about 1.2 million square kilometers. It is a mountainous country with a rich diversity in climate, biodiversity, ethnicity and culture. Its climate varies from hot and arid to cold and humid types. The country is also endowed with rich water resources compared to most African countries. These natural resource bases are yet to be developed sustainably for the socio-economic development of the country.

Though the economic reform made after the political change in 1991 brought significant improvements in the economy, Ethiopia is still one of the least developed countries (LDCs) in the World. This development status makes the country more vulnerable to climate variability and change. The key socio-economic indicators of the country for the year 1997 EC (2004/2005 G.C) are provided in Table 1 (MoFED, 2006). These indictors are very low compared to most countries of the world.

In recent years environment has become a key issue in Ethiopia. The main environmental problems in the country include land degradation, soil erosion, deforestation, loss of biodiversity, desertification, recurrent drought, flood and water and air pollution. The National Adaptation Programme of Action (NAPA) is a mechanism within the UNFCCC, designed to help the Least Developed Countries (LDCs) including Ethiopia to identify their priority adaptation needs to climate change and to communicate these needs to the Conference of Parties (COP) of the UNFCCC and other concerned bodies.

2. Framework for Adaptation Programme

Current climate variability and observed trends

Mean annual minimum temperature and annual rainfall variability and trend observed over the country in the period 1951-2006 are shown in Figures 1 and 2, respectively. Annual minimum temperature is expressed in terms of temperature differences from the mean and averaged for 40 stations. Figure 1 clearly reveals that there has been a warming trend in the annual minimum temperature over the past 55 years. It has been increasing by about 0.37 ^{0}C every ten years. The country has also experienced both dry and wet years over the same period as depicted in Figure 2. The trend analysis of annual rainfall shows that rainfall remained more or less constant when averaged over the whole country (Figure 2).

Table 1: Key Socio-economic indictors for Ethiopia (Source MoFED, 2006)

	Indicators	**1997 EC (2004/05 GC)**
1.	**Demography**	
	Total population (in millions)	73
	Population growth rate (average rate of recent years in %)	2.73
	Fertility rate (2004/05)	5.4
	Infant mortality rate per 1,000	77
	Urban population (%)	16
	Rural population (%)	84
	Population density (per/km2)	66
	Life expectancy at birth	48
2.	**Education**	
	Gross Primary Enrollment (1 to 8) (%)	79.8
	Literacy rate (%)	37.9
	Ratio of girls to boys (in primary school)	0.84
3.	**Health**	
	Primary health services coverage (%)	70
	Infant mortality rate	77/1,000
	Under-five mortality rate	123/1,000
	Maternal mortality rate	871/100,000
4.	**Water**	
	Access to clean water- Rural (within distance of 1.5 km) (%)	35
	Access to clean water- Urban (within distance of 0.5 km) (%)	80
	Cumulative farm land developed with irrigation (ha)	62,057
5.	**Infrastructure**	
	Average Time taken to all-weather road (hours)	5.0
	Road density (km/1,000 km2)	33.2
	Population with access to electricity (%)	16
	Irrigated land out of the total irrigable land (%)	5
6.	**Economy**	
	GDP at constant prices in thousand Birr	78,488,114
	GNI per capita in USD for 2006	180*
	GNI per capita in USD for 2006 in terms of purchasing power parity	1190*
	Share of agriculture & allied activities in GDP (%)	46
	Share of industry in GDP (%)	14
	Share of services in GDP (%)	40
	GDP growth rate (%)	10.6
	Growth rate of agricultural value added (%)	13.4
	Growth rate of industry (%)	8.1
	Growth rate of services (%)	8.4
7.	**Agriculture**	
	Major crops production (million tons)	16.7
	Meat production (1,000 metric tons)	566

* source: World Development Report of the World Bank, 2008

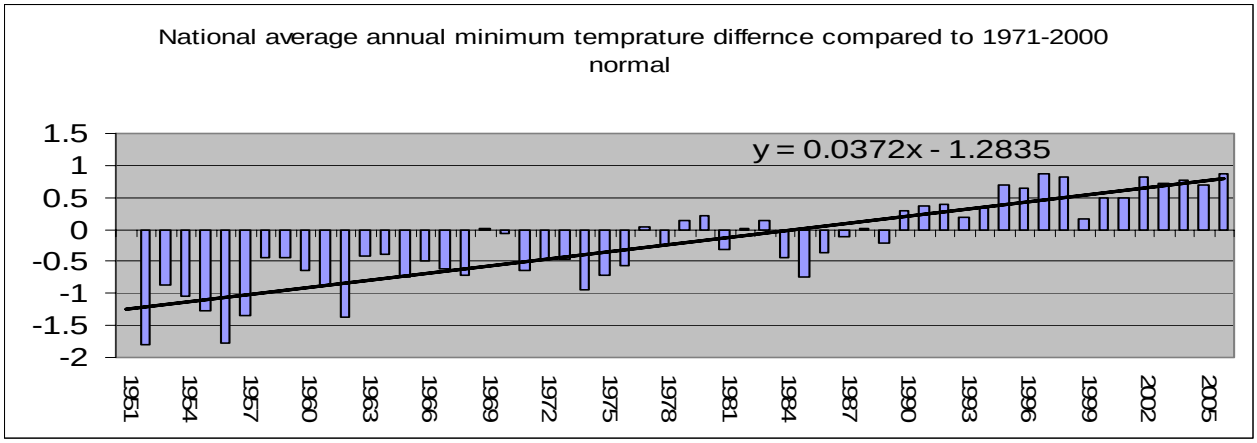


Figure 1: Year to Year Variability of Annual minimum Temperature over Ethiopia expressed in temperature.

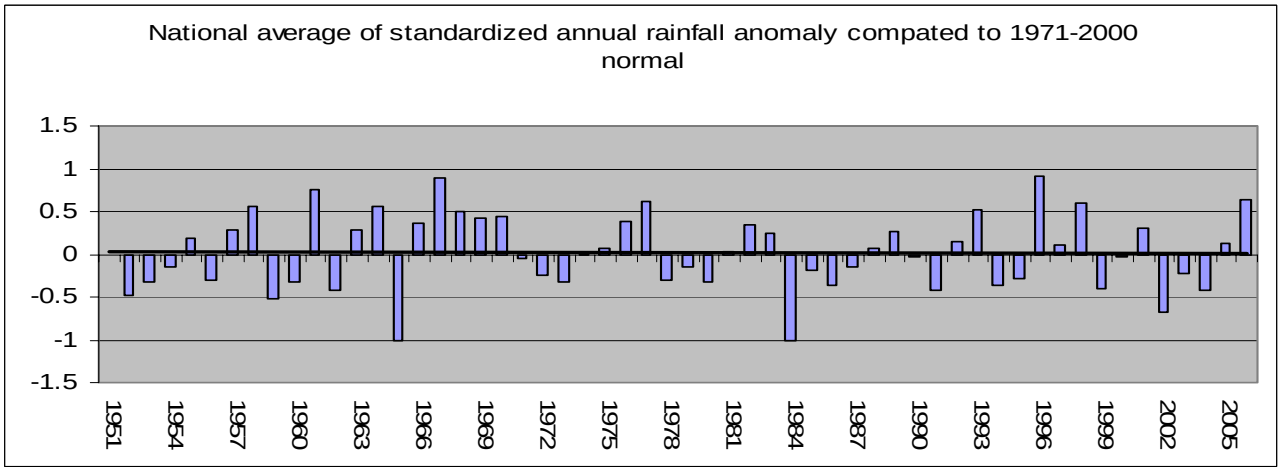


Figure 2: Year to Year Variability of Annual Rainfall and trend over Ethiopia expressed in Normalized Deviation.

Projected climate change over Ethiopia

Climate projections for Ethiopia have been generated using the software MAGICC/SCENGEN (Model for the Assessment of Greenhouse-gas Induced Climate Change)/ (Regional and global Climate SCENario GENerator) coupled model (Version 4.1) for three periods centered around the years 2030, 2050 and 2080. For the IPCC mid-range (A1B) emission scenario, the mean annual temperature will increase in the range of 0.9 -1.1 °C by 2030, in the range of 1.7 - 2.1 °C by 2050 and in the range of 2.7-3.4 °C by 2080 over Ethiopia (Figure 3) compared to the 1961-1990 normal. A small increase in annual precipitation is also expected over the country (Figure 4).

2030 **2050** **2080**

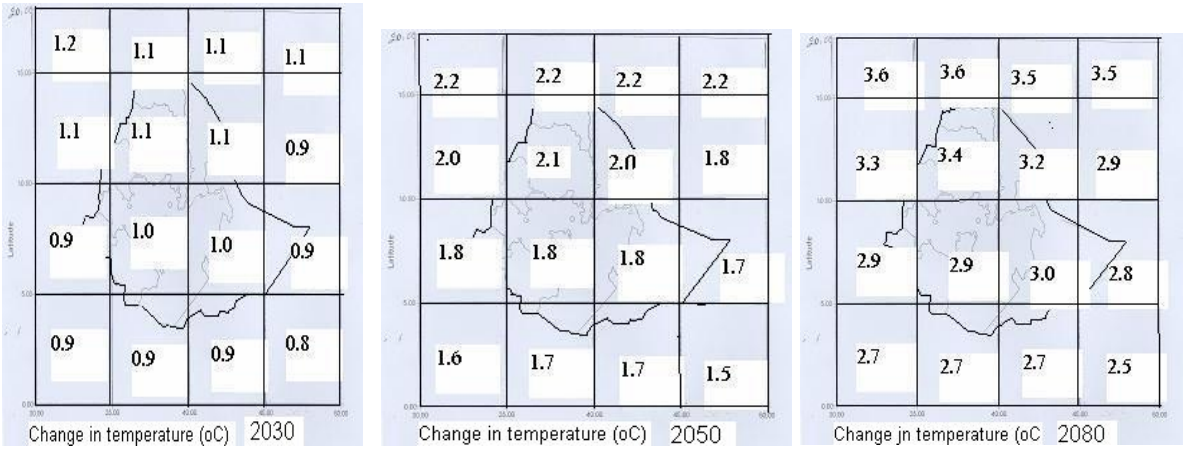


Figure 3: Composite (average of 19 GCMs) change in temperature (^{o}C) relative to 1961-1990 normal for A1B emission scenario.

2030 **2050** **2080**

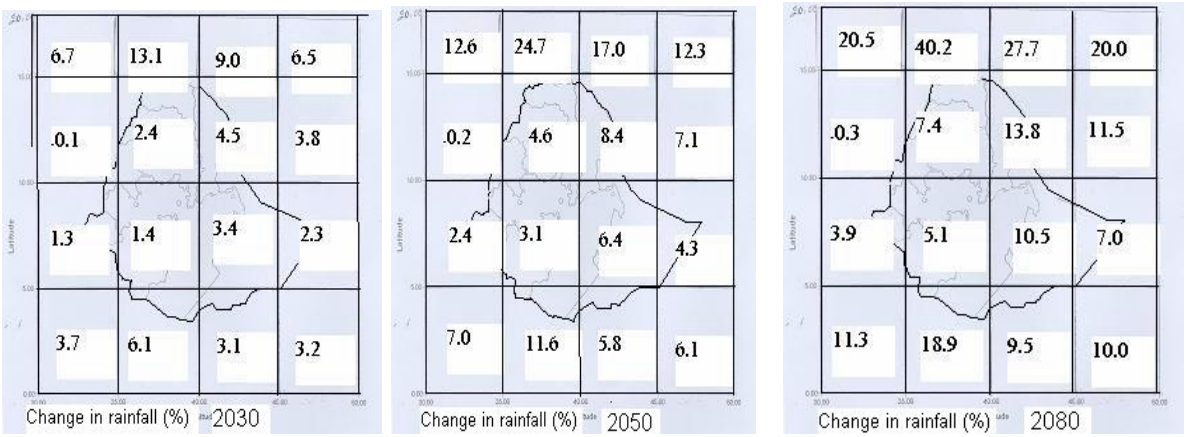


Figure 4: Composite (average of 19 GCMs) percentage change (%) in rainfall relative to 1961-1990 normal for A1B emission scenario.

Impacts of current climate variability

Climate related hazards in Ethiopia include drought, floods, heavy rains, strong winds, frost, heat waves (high temperatures), etc. Though the historical social and economic impacts of all of these hazards are not systematically well documented, the impacts of the most important ones; namely droughts and floods are discussed.

Ethiopia is highly vulnerable to drought. Drought is the single most important climate related natural hazard impacting the country from time to time. Drought occurs anywhere in the world but its damage is not as severe as in Africa in general and in Ethiopia in particular. Recurrent drought events in the past have resulted in huge loss of life and property as well as migration of people.

The other climate related hazard that affects Ethiopia from time to time is flood. Major floods which caused loss of life and property occurred in different parts of the country in 1988, 1993, 1994, 1995, 1996 and 2006.

Causes of Vulnerability to Climate Conditions in Ethiopia

Causes for vulnerability of Ethiopia to climate variability and change include very high dependence on rain fed agriculture which is very sensitive to climate variability and change, under-development of water resources, low health service coverage, high population growth rate, low economic development level, low adaptive capacity, inadequate road infrastructure in drought prone areas, weak institutions, lack of awareness, etc.

Vulnerability assessment based on existing information and rapid assessments carried out under NAPA has indicated that the most vulnerable sectors to climate variability and change are Agriculture, Water and Human health. In terms of livelihood approach smallholder rain-fed farmers and pastoralists are found to be the most vulnerable. The arid, semiarid and the dry sub-humid parts of the country are affected most by drought.

Coping mechanisms to climate variability

Traditional and contemporary coping mechanisms to climate variability and extremes in Ethiopia include changes in cropping and planting practices, reduction of consumption levels, collection of wild foods, use of inter-household transfers and loans, increased petty commodity production, temporary and permanent migration in search of employment, grain storage, sale of assets such as livestock and agricultural tools, mortgaging of land, credit from merchants and money lenders, use of early warning system, food appeal/aid, etc.

Adverse effects of Climate Change

Climate change is expected to have adverse ecological, social and economic impacts. Quantitative climate change impact assessments made so far on various socio-economic sectors are limited in the country. However, effort was made to compile information on climate change impacts from various sources such as the Initial National Communications of Ethiopia to the UNFCCC, the IPCC reports and other sources. Impact and vulnerability assessments in priority sectors were undertaken as part of the process of developing the Initial National Communications of Ethiopia to the UNFCCC.

NAPA and its relationship to Ethiopia's development goals

There are already a number of existing national policy initiatives, sectoral policies, programs and strategies that may directly or indirectly address climate change adaptation. Accordingly, the most relevant policy and program documents that have relevance for climate change adaptation include Plan for Accelerated and Sustainable Development to end Poverty (PASDEP), Environmental policy of Ethiopia, Agriculture and Rural Development Policy and Strategy, Water resources Management Policy, Health Sector Development Policy and Program, National Policy on Disaster Prevention and Preparedness, National Policy on Biodiversity Conservation and Research, Science and Technology Policy, Population Policy and National Agricultural Research Policy and Strategy.

Rational for developing the NAPA and its Objectives

The Conference of the Parties to the UNFCCC at its Seventh Session (COP 7 of the UNFCCC) decided that the least developed countries including Ethiopia be provided with support to address urgent and immediate needs and concerns related to adaptation to the adverse effects of Climate Change. The Rationale for NAPA rests on the low adaptive capacity of LDCs including Ethiopia, which renders them in need of immediate and urgent support to start adapting to current and projected adverse effects of climate change.

Potential barriers for implementation of NAPA

As discussed earlier, most of the national initiatives - action plans, policy/ program and project initiatives are synergistic for climate change adaptation. Thus, the implementation of the existing national initiatives is of central importance for climate change adaptation. However, potential

barriers and adjustments need to be dealt with in order to optimise climate change adaptation gains from the ongoing national initiatives, and to ensure a coordinated effort towards successful implementation of environmental initiatives as well as the strategies and action plans of the Rio-Conventions.

Some of the major barriers for adaptation gains from the on-going national initiatives include:

- Lack of strong coordination mechanism both at the federal and regional levels;
- Inadequacy of cross-sectoral links of ministries and line departments;
- Lack of linking elements such as cross sectoral federal committees;
- Lack of elaborated links of federal and regional sector offices involved in environment and development;
- Lack of capacity, i.e., absence of a center or an institution for research and development (R & D) on climate change adaptation;
- Lack of efficient outreach mechanism on environment to local communities;
- Oversight of long-term environmental impacts of short-term economic benefits;
- Economic challenge, i.e., limited finance for environment;
- Low level of awareness for environment;
- Low level of public literacy;
- High level of poverty;
- Inadequate capacity to exchange information among NMSA and NAPA project and or action plans implementers:

3. Identification of Key Adaptation Needs

Based on the review of adaptation options identified under MEA synergy assessments, ongoing programs and development project initiatives, the INC and the outcomes of the two national and the eight regional consultative workshops conducted by the NMA, the following 37 potential adaptation options were proposed (identified) for further prioritization and ranking and inclusion in the NAPA to address immediate adaptation needs. These adaptation options identified are either proposed by the synergy assessment report, the INC or the consultative workshops, or otherwise.

1. Promoting drought/crop insurance program in Ethiopia
2. Realizing food security through multi-purpose large-scale water development project in Genale–Dawa Basin
3. Community Based Development and Commercialization of Non-timber Forest Products (Gum Arabic, Myrrah and Frank Incense)
4. Community Based Rehabilitation of Degraded Eco-Systems in Selected Parts of Ethiopia
5. Propagation and Commercial Scale Cultivation of Wild Essential Oil Crops
6. Establishment of Centre for Propagation and Commercialization of Traditional Herbal Medicinal Plants
7. Establishment of Acacia Woodland Nature Reserve in the Ethiopian Rift Valley System
8. Community Based Carbon Sequestration Project in the Rift Valley System of Ethiopia
9. Range Shift Cultivation of Selected Cash Crops in Drought Prone Areas
10. Establishment of National R&D Center for Climate Change
11. Development of an Incentive Scheme for Farmers (Hill-farming communities) to Reforest Hill Areas in the Northern Parts of Ethiopia
12. Participatory Approach to Rehabilitate Degraded Hills/Ecosystem in Northern Ethiopia
13. Institutional Re enforcement for Bio-diversity Conservation
14. Establishment of National Environmental Education Program
15. Reforestation for Fuel in the Highlands of Ethiopia
16. Regional Capacity Building for Monitoring and Inventorying of Biodiversity
17. Establishment of Potato-centered Small-sized Cottages
18. Reclamation of Bush Encroached Rangelands
19. Promotion of Legume-based Agroforestry Systems and Home-garden Agriculture
20. Development of New and Rehabilitation (upgrading) of the existing watering sites in Pastoral Areas
21. Aquaculture Development for Efficient Harvest of Commercial *Spirulina* Species in the Lakes of the Ethiopian Rift Valley System
22. Reorganization of drought Affected Communities
23. Stall feeding promotion and free range grazing restriction in selected regional states of Ethiopia
24. Promotion of on farm and homestead forestry and agroforestry practices in arid, semi-arid and dry-sub humid parts of Ethiopia
25. Undertake soil and water conservation practices for improved land husbandry in Afar, Somali and Gambella regional states and Diredawa city administration
26. Develop community seed bank and food storage facilities in Amhara, SNNPRS, Tigray, Oromia.
27. Capacity building for small scale irrigation planning and development in Afar, Gambella, Somali and SNNPRS.

28. Community based sustainable utilization and management of wet lands in selected wet lands in Ethiopia
29. Strengthening/enhancing drought and flood early warning systems in Ethiopia
30. Capacity building for climate change adaptation in Ethiopia at federal as well as regional levels
31. Public awareness program on climate change in Ethiopia at national as well as regional levels
32. Enhancing the use of water for agricultural purpose on small farms in arid and semi arid parts of Ethiopia
33. Community capacity building to initiate and implement environmental health program and or projects in the national regional states
34. Commercial level uses of some indigenous, wild edible fruits in selected arid and semi arid areas of Ethiopia
35. Malaria containment program (MCP) in selected areas of Ethiopia
36. Institutional development; enhancement of research and development capacity of the national dry land research centers in Somali, Gambella, Benishangul-gumuz, low lands of Oromia, Amhara, Tigray, Afar and SNNPR.
37. Improving/enhancing the range land resources management practices in the pastoral areas of Ethiopia

4. Criteria for Selecting Priority Projects/Activities

In order to match the resource requirement of potential adaptation projects with available resources, it is of paramount importance to devise evaluation criteria so as to produce prioritized set of projects. The criteria used in prioritizing adaptation options were based on the generic criteria as proposed by the Least Developed Countries Expert Group (LEG) and outlined in the Annotated Guidelines for the preparation of NAPAs, as well as those generated through national and regional stakeholder consultations. These criteria are further examined in relation to national priorities and their advantages in climate risk avoidance, in poverty reduction, ensuring complementarities and promoting synergies with national and sectoral development plans, and other MEAs. The National Steering Committee members established by NMA endorsed the criteria proposed before the prioritization process started. The criteria are:

- Impact on economic growth of the poor (poverty reduction potential);
- Complementarities with national and sectoral plans;
- Climate change risk (Losses avoided by poor People);
- Synergy with action plans under Multi-lateral Environmental Agreements (MEAs);
- Cost Effectiveness;

Once the criteria were defined, the next step was to determine the importance of the criteria and assign corresponding weights to them. Although, all the identified criteria are relevant for prioritizing adaptation projects, the study has assumed that their level of importance would be different.

Accordingly greater importance (weight) was given to level of risk (0.3 out of 1) followed by poverty reduction potential and cost effectiveness each receiving a weight of 0.2 followed by complementarities and synergy each receiving a weight of 0.15 (Table 2). The Evaluation Criteria Assessment Study indicated the need for complementing the outcomes of the study with consultation outcomes to further rationalize the weight attached to each criterion.

Table 2: Description of Criteria and their weight

Criteria	*Weights*
Level of Climate Change Risk (Loss Avoided by Poor People)	0.30
Poverty reduction potential (Impact on poor peoples' Income Growth)	0.20
Cost effectiveness	0.20
Complementarities with national and sectoral plans, policies & strategies, and other MEAs	0.15
Synergy with national plans including action plans under MEAs	0.15

5. List of Priority Projects/Activities

Identifying high priority adaptation projects is the ultimate goal of the whole NAPA preparation process. The purpose of ranking and prioritization is to select high priority adaptation projects that are aimed at addressing immediate needs of adaptation to climate change. Analysis was carried out making use of Multi-Criteria Analysis (MCA). This involves assigning appropriate scores to each criterion across all project options followed by standardizing the scores for each criterion across project concepts. The next step has been to rank the project options based on average cores (simple averages followed by weighted scores). Altogether; six stages of analysis were carried out in the process of selecting high priority adaptation projects. This constitutes three broader phases: ranking based on simple standardized scores, ranking based on weighted scores, and the conduct of sensitivity analysis. The sensitivity analysis is indicative of the robustness of the ranks given and the criteria as weights change. The outcomes of the third stage ranking followed by the three stages of sensitivity analysis are the basis for the final selection of the top 20 high-ranking priority projects (Table 3). These projects broadly focus in the areas of human and institutional capacity building, improving natural resource management through community participation, enhancing irrigation agriculture and water harvesting, strengthening early warning systems and awareness rising. The profiles of the selected projects are provided in Annex I.

Table 3: List of projects prioritized using Multi-Criteria Assessment (MCA)

	Title of Project	Average standard score	Rank	Estimated project implantation cost (Million USD)	Estimated project design cost (Million USD)
1	Promoting drought/crop insurance program in Ethiopia	1.00	1	8	0.1
2	Strengthening/enhancing drought and flood early warning systems in Ethiopia	1.00	2	10	0.1
3	Development of small scale irrigation and water harvesting schemes in arid, semi-arid, and dry sub-humid areas of Ethiopia	0.99	3	30	0.5
4	Improving/enhancing rangeland resource management practices in the pastoral areas of Ethiopia	0.95	4	2	0.05
5	Community based sustainable utilization and management of wet lands in selected parts of Ethiopia	0.95	5	2	0.05
6	Capacity building program for climate change adaptation in Ethiopia	0.85	6	3	0.1
7	Realizing food security through multi-purpose large-scale water development project in Genale–Dawa Basin	0.80	7	700	2
8	Community Based Carbon Sequestration Project in the Rift Valley System of Ethiopia	0.78	8	1	0.05
9	Establishment of national research and development (R&D) center for climate change	0.78	9	2	0.2
10	Strengthening malaria containment program(MCP) in selected areas of Ethiopia	0.78	10	6	0.5
11	Promotion of on farm and homestead forestry and agro-forestry practices in arid, semi-arid and dry-sub humid parts of Ethiopia	0.76	11	5	0.1
		Total cost		**770**	**3.75**

6. NAPA Preparation Process

The NAPA preparation process followed the guidelines prepared by the LDC expert groups.

Institutional Arrangements

The National Adaptation Program of Action for Ethiopia was initiated and coordinated by the National Meteorological Agency. A project Steering Committee with representatives from the following stakeholder institutions was established. The role of the steering committee was to provide overall guidance and oversight for the project.

- Ministry of Water Resources
- Ministry of Agriculture and Rural Development
- Ministry of Finance and Economic Development
- Disaster Prevention and Preparedness Agency
- Ethiopian Science and Technology Agency
- National Meteorological Agency
- Addis Ababa University
- Institute of Biodiversity Conservation and Research
- Ethiopian Rural Energy Promotion and Development Center
- CRDA representing NGOs

A Project Management Team consisting of a project coordinator, assistant project coordinator, secretary, accountant, technical coordinator, and data processor was established within NMA to implement the day to day activities of the project. A National UNV was also employed to assist the project management team. Use was made of national experts as consultants to prepare various technical reports that were used as input to the preparation of NAPA.

Synthesis of information

Assessments conducted by national consultants to feed in to the formulation of high priority adaptation options (project profiles) for the NAPA include synthesis of available information on vulnerability, synergy assessment reports and development of criteria for prioritization of projects.

Stakeholder consultation

The preparation of NAPA followed a participatory process involving stakeholders. It was prepared by a multidisciplinary team and the approach was complementary, building on existing plans and programs including national action plans under the United Nations Convention to Combat Desertification, National Biodiversity Strategies and Action Plans and the Convention on Biological Diversity, and national sectoral policies.

Considering the circumstances under which the required participation of stakeholders could be best achieved in the NAPA process, the so called "participatory workshop technique" was used for consultation to elicit information from the grass root population to inform the process of prioritization and selection of adaptation options. In this regard two national and eight regional workshops were conducted involving about 500 participants with various expertises. The purpose of the consultations was to create awareness about climate change issues and to solicit inputs on vulnerability and adaptation options as well as criterias for prioritizing adaptation projects. Some pictures of the consultation workshops are shown on pages 63-65 of this document.

Mechanisms of Endorsement

The draft final NAPA report was discussed in a national workshop organized on 29 January 2007. The document was improved by incorporating comments and suggestions made during the national workshop. The Steering Committee reviewed and recommended approval of the NAPA document. Finally, the document was officially approved and signed by the Minister of Water Resources.

Chapter 1
Introduction and Setting

1.1 Country Profile

Ethiopia is found in the horn of Africa covering an area of about 1.2 million square kilometers (Figure 1.1). It is a mountainous country with a rich diversity in climate, biological resources, ethnicity and culture. Its climate varies from hot and arid to cold and humid types. The country is also endowed with rich water resources compared to most African countries.

The fundamental economic development objetive of Ethiopia is to build a free market economic system in the country which will enable the economy develop rapidly and the country extricate itself from depenedence on food aid and poor people to be the main beneficiaries from economic growth. The rural-based development strategy derived from the Agriculture-Development–Led Industrialization (ADLI) strategy initiated in 1994 emphasizes the need to develop the agriculture sector to fuel the growth of other sectors of the economy as well as for assuring food security.

Though the economic reform made after the political change in 1991 brought improvement in the economy, Ethiopia is still one of the least developed countries (LDC) in the World. This development status makes the country more vulnerable to climate variability and change. The main socio-economic indicators of the country for the year 1997 EC (2004/2005 G.C) are provided in Table 1.1.

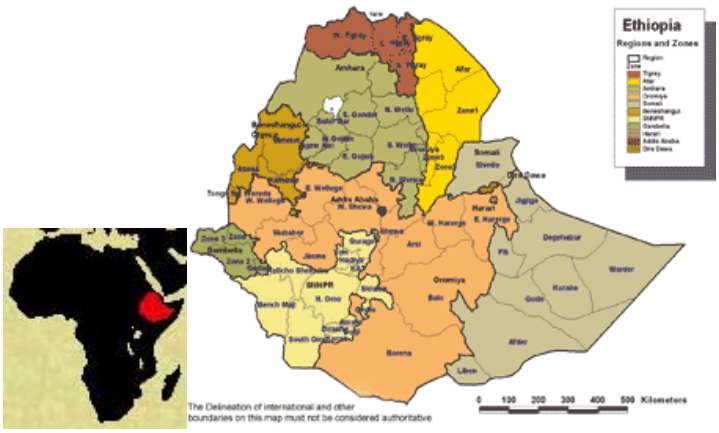


Figure 1.1: Location Map of Ethiopia

Table 1.1: Key Socio-economic indictors for Ethiopia (Source MoFED, 2006)

	Indicators	**1997 EC (2004/05 GC)**
1.	**Demography**	
	Total population (in millions)	73
	Population growth rate (average rate of recent years in %)	2.73
	Fertility rate (2004/05)	5.4
	Infant mortality rate per 1,000	77
	Urban population (%)	16
	Rural population (%)	84
	Population density (per/km2)	66
	Life expectancy at birth	48
2.	**Education**	
	Gross Primary Enrollment (1 to 8) (%)	79.8
	Literacy rate (%)	37.9
	Ratio of girls to boys (in primary school)	0.84
3.	**Health**	
	Primary health services coverage (%)	70
	Infant mortality rate	77/1,000
	Under-five mortality rate	123/1,000
	Maternal mortality rate	871/100,000
4.	**Water**	
	Access to clean water- Rural (within distance of 1.5 km) (%)	35
	Access to clean water- Urban (within distance of 0.5 km) (%)	80
	Cumulative farm land developed with irrigation (ha)	62,057
5.	**Infrastructure**	
	Average Time taken to all-weather road (hours)	5.0
	Road density (km/1,000 km2)	33.2
	Population with access to electricity (%)	16
	Irrigated land out of the total irrigable land (%)	5
6.	**Economy**	
	GDP at constant prices in thousand Birr	78,488,114
	GNI per capita in USD for 2006	180*
	GNI per capita in USD for 2006 in terms of purchasing power parity	1190*
	Share of agriculture & allied activities in GDP (%)	46
	Share of industry in GDP (%)	14
	Share of services in GDP (%)	40
	GDP growth rate (%)	10.6
	Growth rate of agricultural value added (%)	13.4
	Growth rate of industry (%)	8.1
	Growth rate of services (%)	8.4
7.	**Agriculture**	
	Major crops production (million tons)	16.7
	Meat production (1,000 metric tons)	566

* source: World Development Report of the World Bank, 2008

1.2 Environmental Problems/Stresses

In recent years, environment has become a key issue in Ethiopia. The main environmental problems in the country include land degradation, soil erosion, deforestation, loss of biodiversity, desertification, recurrent drought, flood and water and air pollution.

A large part of the country is dry sub-humid, semi-arid and arid, which is prone to desertification and drought. The country has also fragile highland ecosystems that are currently under stress due to population pressure and associated socio-economic practices. Ethiopia's history is associated, more often than not, with major natural and man-made hazards that have been affecting the population from time to time. Drought and famine, flood, malaria, land degradation, livestock disease, insect pests and earthquakes have been the main sources of risk and vulnerability in most parts of the country. Especially, recurrent drought, famine and, recently, flood are the main problems that affects millions of people in the country almost every year. While the causes of most disasters are climate related, the deterioration of the natural environment due to unchecked human activities and poverty has further exacerbated the situation.

The expansion of agriculture usually takes place at the expense of the natural vegetation, particularly forests, woodlands and other wildlife resources, leading to loss of both flora and fauna, and ultimately, destruction of habitats as a whole. Some wild relatives of cultivated crops are also threatened by such habitat destruction. The rate of deforestation due to mainly agricultural expansion and fuel wood gathering is remarkably high. This process has immense impacts on bio-diversity and ultimately leads to desertification.

The Government of Ethiopia is making efforts to address these adverse conditions and has designed coping mechanisms. In fact some of these efforts have brought about strategies that have induced changes in the attitude of the affected local communities. Some strategic measures include the development and implementation of national environmental initiatives, as well as policy/ program and project initiatives that directly and/or indirectly address climate change and adaptation mechanisms. These initiatives could be capitalized for mitigating the undesirable consequences of climate related hazards.

The Environmental Policy of Ethiopia, an umbrella policy composed of 10 sectoral and 10 cross-sectoral environmental policies, has been formulated and approved by the government in 1997 to promote sustainable socio-economic development through sound management and rational use of natural resources and the environment. The Policy includes implementation issues like institutional coordination, legislative framework and monitoring, evaluation and review provisions. The Policy also emphasizes the need for environmental sustainability to be recognized in other policies and strategies as a key prerequisite.

Climate Change and Air Pollution is among the ten sectoral environmental policies. The overall objectives of this policy are to:

- promote climate monitoring programs as the country is sensitive to changes in climate,
- recognize that a firm and demonstrable commitment to the principle of containing climate change, and
- foster use of hydro, geothermal and solar energy so as to minimize emission of greenhouse gases (GHGs).

The country needs to further formulate and implement specfic policies, strategies and action plans related to climate change. The preparation of NAPA is therefore expected to contribute towards this end.

1.3 The Need for NAPA

Ethiopia is one of the developing countries, which are more vulnerable to climate variability and change. Low level of socio-economic development, inadequate infrastructure, lack of institutional capacity and a higher dependency on natural resources base make the country more vulnerable to climatic factors including climate variability and extreme climate events.

The National Adaptation Programme of Action (NAPA) is a mechanism within the UNFCCC, designed to help the Least Developed Countries (LDCs) including Ethiopia to identify their priority adaptation needs to climate change and to communicate these needs to the Conference of Parties (COP) of the UNFCCC and other concerned bodies. It is multi-disciplinary and complementary to existing plans and programmes such as the national action plan to combat desertification, national

biodiversity strategies and PASDEP. Involvement of stakeholders was an integral part of the preparation process for assessing impacts, vulnerabilities, and in identifying adaptation options.

The process involved a wide consultation with various stakeholders including government institutions, academia, NGOs and sectoral experts in eight regional states. Synthesizing available information from already existing sources on the vulnerabilities of three major socio-economic sectors (agriculture, water and human health), as well an assessment of: synergies between adaptation and

- Multi-lateral environmental agreements (MEAs);
- Policy/ programme initiatives; and
- Project initiatives

were the key elements of the NAPA preparation process.

The purpose of the NAPA document for Ethiopia is therefore to identify immediate and urgent adaptation activities that address current and anticipated adverse effects of climate change including extreme climate events. It provides a flexible framework to guide the coordination and implementation of adaptation initiatives in the country through a participatory approach; building synergies with other relevant environmental and related programs and projects.

Chapter 2

Framework for the Adaptation Programme

2.1 Introduction

Climate is a key natural resource on which the others depend. It influences food production, water and energy availability. It sets the stage for the establishment of habitats, affects the pace of primary productivity, and influences species density and distribution.

Climate, whether manifested as extreme events or persistent conditions, is experienced first as a physical phenomenon. Temperature, wind and rain all affect the biophysical environment. When extreme events such as droughts and floods occur, people suffer injuries, incur loses, habitats are destroyed and the built environment is damaged. Socio-economic systems are therefore sensitive to the frequency, intensity and persistence of these conditions, as well as potential changes in long-term trends.

2.1.1 The Climate of Ethiopia

Climate is often described by the statistical interpretation of precipitation and temperature data recorded over a long period of time for a given region or location. Mean annual rainfall distribution over the country is characterized by large spatial variation which ranges from about 2000 mm over some pocket areas in the Southwest to less than 250 mm over the Afar and Ogaden low lands as shown in Figure 2. 1 (NMSA, 1996, NMSA 2001).

Rainfall during a year occurs in different seasons. Unlike most of the tropics where two seasons are common (one wet season and one dry season), three seasons are known in Ethiopia, namely Bega (dry season) which extends from October-January, Belg (short rain season) which extends from (February-May), and Kiremt (long rain season) which extends from June-September.

Temperatures are also very much modified by the varied altitude of the country. In general, the country experiences mild temperatures for its tropical latitude because of topography. Mean annual temperature distribution over the country varies from about 10^0C over the highlands of northwest, central and southeast to about 35^0C over north-eastern lowlands (Figure 2.1).

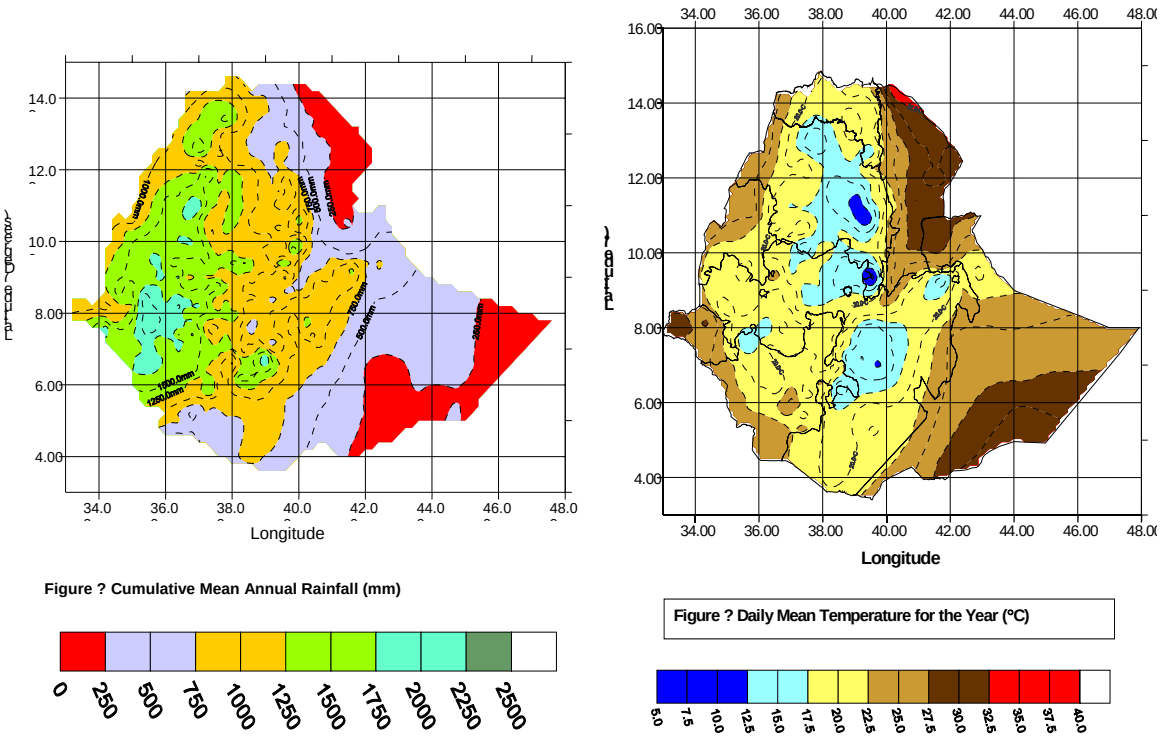


Figure 2.1 : Mean Annual Rainfall and Temperature Distribution over Ethiopia (source NMA, 2001).

2.2 Current Climate Variability and Observed Trends

2.2.1 Rainfall Variability and Trend

Baseline climate was developed using historical data of temperature and precipitation from 1971- 2000 for selected stations. Figure 2.2 shows the year-to-year variation of rainfall over the country expressed in terms of normalized rainfall anomaly averaged for 42, stations. As it can be seen from the figures, the country has experienced both dry and wet years over the last fifty five 55 years. Years like 1952, 1959, 1965, 1972, 1973, 1978, 1984, 1991, 1994, 1999 and 2002 were dry while 1958, 1961, 1964, 1967, 1968, 1977, 1993, 1996, 1998 and 2006 were wet years (Figure 2.2). Studies made at NMA have shown that there is a link between ElNino and LaNina Phenomena and Ethiopian rainfall (Haile, T., 1988, Korecha, D., and Barnston, A.G, 2007, Gissila, T. etal, 2004).

The trend analysis of annual rainfall shows that rainfall remained more or less constant when averaged over the whole country (Fig 2.2).

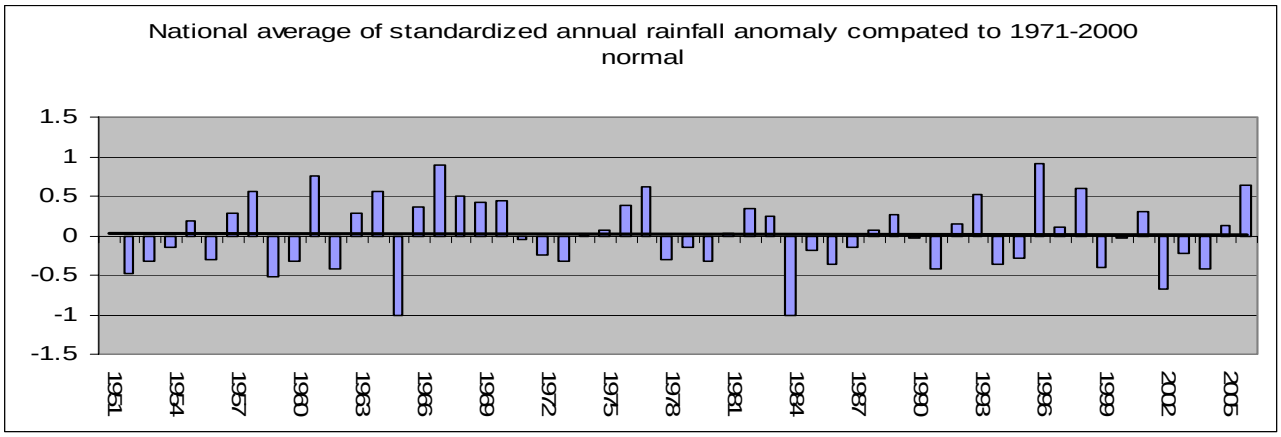


Figure 2.2: Year to Year Variability of Annual Rainfall and trend over Ethiopia expressed in Normalized Deviation.

2.2.2 Temperature Variability and Trend

The year to year variation of annual minimum temperatures expressed in terms of temperature differences from the mean and averaged over 40 stations is shown in Figure 3. As it can be seen from the Figure, the country has experienced both warm and cool years over the last 55 years. However, the recent years are the warmest compared to the early years. Figure 2.3 clearly reveals that there has been a warming trend in the annual minimum temperature over the past 55 years. It has been increasing by about 0.37 ^{0}C every ten years.

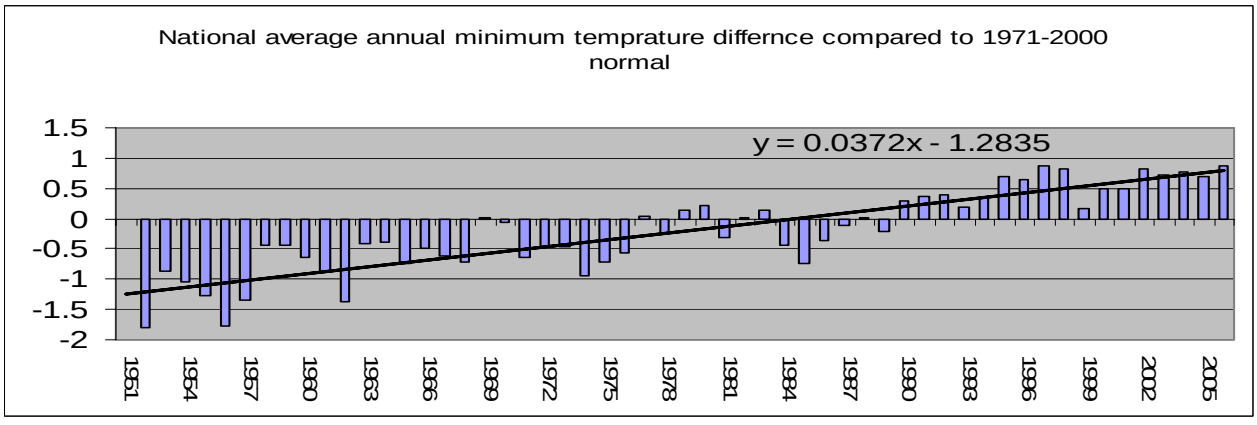


Figure 2.3: Year to Year Variability of Annual minimum Temperature over Ethiopia expressed in temperature difference.

2.3 Projected Climate Change over Ethiopia

It is widely recognized that global warming associated with increased concentration of greenhouse gases in the atmosphere will have local implications. There are three approaches for projecting future climate scenario for a particular area. These approaches are:

- Incremental (arbitrary) scenarios;
- Temporal /spatial/paleo-climatic analog scenarios; and,
- Model-based climate scenarios (GCMs).

The most widely used method for obtaining information on possible future climate change is to use coupled Atmosphere-Ocean General Circulation Models (AOGCMs).

Future climate change cannot be adequately predicted without a sound understanding of the future expectation of the emission and concentration of GHGs in the atmosphere, which will depend on socio-economic trends including population and economic growth, technological changes, energy demand, fuel mix, etc. IPCC (2001) have developed a set of six emission scenarios that can be used for climate changes studies. These are known as SRES scenarios (A1FI, A1T, A1B, A2, B1, B2). The "A" scenarios have more of an emphasis on economic growth while the "B" scenarios emphasis on environmental protection. The "1" scenarios assume more globalization while the "2" scenarios assume more regionalization. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (A1B) (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end use technologies). It should be noted that a scenario is not a *forecast* but a coherent, internally consistent, and plausible description of a possible future state of the world (IPCC 2001).

Climate projections for Ethiopia have been generated using the software MAGICC/SCENGEN (Model for the Assessment of Greenhouse-gas Induced Climate Change)/ (Regional and global

Climate SCENario GENerator) coupled model (Version 4.1) for three periods centered around the years 2030, 2050 and 2080.

The MAGICC module consists of a suite of coupled gas-cycle, climate and ice-melt models integrated into a single software package that determines changes in greenhouse-gas concentrations, global-mean surface air temperature and sea-level resulting from anthropogenic emissions of greenhouse gases and aerosols. The SCENGEN module comprises a simple database that contains the results of a large number (19) of GCM experiments, as well as observed global and regional climate datasets. MAGICC gives projections of global-mean temperature and sea level change due to melting ice and thermal expansion of water in global reservoirs, while SCENGEN gives projections of future climate/climate change on a 5° latitude by 5° longitude grid. MAGICC has two types of emissions scenarios: A "no policy scenario", with very high emissions based on supposedly intensive use of fossil fuels due to rapid economic growth, and a "policy scenario", with lower greenhouse-gas emissions assuming a gradual change to alternative energy sources as fossil fuels become scarcer. A policy emission scenario of lower greenhouse-gas emissions assuming a gradual change to alternative energy sources as fossil fuels become scarcer, was applied.

For this report, we use A1B-AIM as a reference or a "no policy scenario" and B2-MES was used as a policy scenario. Nineteen GCMs were used to supply the SCENGEN data. The temperature and rainfall change scenarios generated are composites (averages) of these 19 GCMs.

For the IPCC mid-range (A1B) emission scenario, the mean annual temperature will increase in the range of 0.9 -1.1 °C by 2030, in the range of 1.7 - 2.1 °C by 2050 and in the range of 2.7-3.4 °C by 2080 over Ethiopia (Figure 2.4) compared to the 1961-1990 normal. A small increase in annual precipitation is expected over the country (Figure 2.5). It should be noted here that the results shown are for a mid range emission scenario. Changes in climate need to be looked into for the lowest and highest emission scenarios as well when assessing impacts.

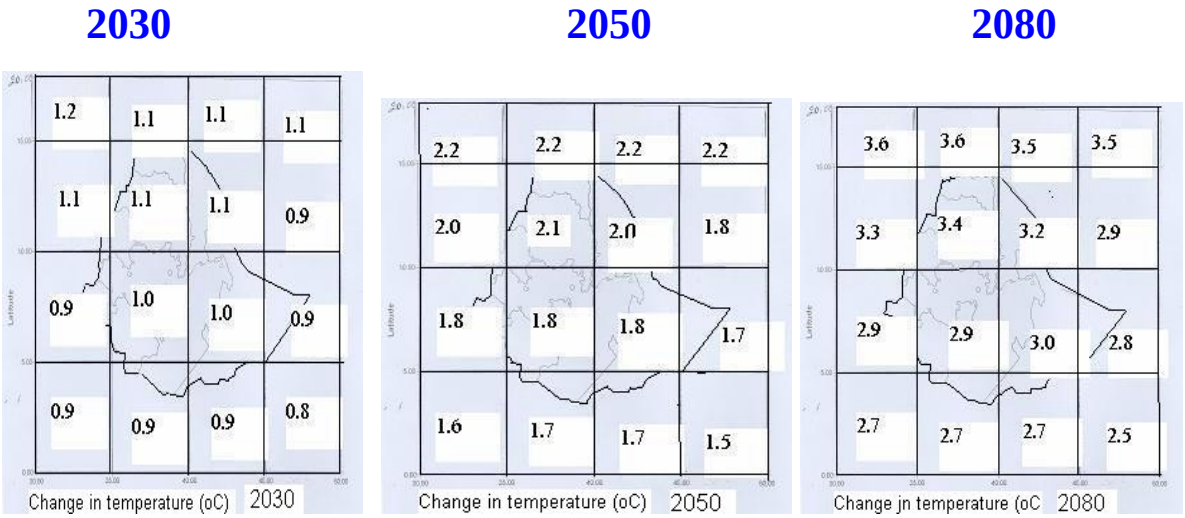


Figure 2.4: Composite (average of 19 GCMs) change in temperature (^{o}C) relative to 1961-1990 normal for A1B emission scenario.

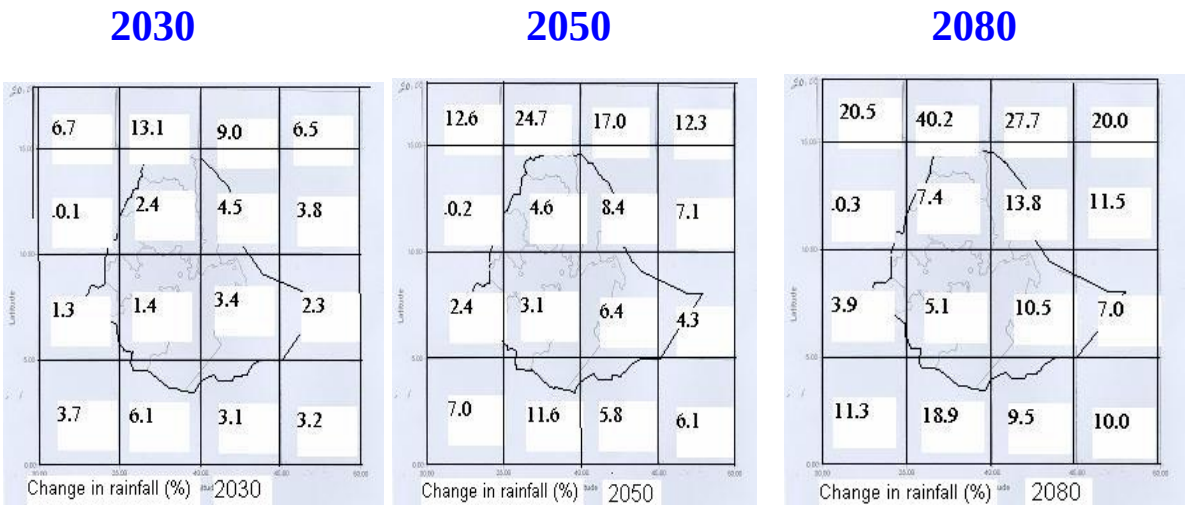


Figure 2.5: Composite (average of 19 GCMs) percentage change (%) in rainfall relative to 1961-1990 normal for A1B emission scenario.

2.4 Impacts of Current Climate Variability

Climate related hazards in Ethiopia include drought, floods, heavy rains, strong winds, frost, heat waves (high temperatures), lightning, etc. Though the historical social and economic impacts of all of these hazards are not systematically well documented, the impacts of the most important ones; namely, droughts and floods are discussed.

Understanding how social systems respond to climate change and variability requires knowledge of how they are affected by those conditions today and how they might respond in the future if those conditions change. Historical analogs give us some insight into climate changes and corresponding social responses.

The major adverse impacts of climate variability in Ethiopia 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;
- . Land degradation due to heavy rainfall;
- Damage to communication, road and other infrastructure by floods;

2.4.1 Droughts and Floods

Ethiopia is highly vulnerable to drought. As depicted in the drought probability map in Figure 2.6, most of the country is prone to drought (NMSA, 1996, Degefu, W., 1987). Drought is the single most important climate related natural hazard impacting the country from time to time. Drought occurs anywhere in the world but its damage is not as severe as in Africa in general and in Ethiopia in particular (Fig 2.7) due to low adaptive capacity. Recurrent drought events in the past have resulted in huge loss of life and property as well as migration of people (Table 2.1).

The other climate related hazards that affect Ethiopia from time to time are flash and seasonal river floods. Areas in the Afar Region along the Awash River, in the Somali Region along the Wabi

Shebele River and in the Gambela Region along the Baro-Akobo River, in the Southern Region along the Oomo-Gibe River, Bahirdar Zuria and Fogera areas along the Abbay River in the Amhara Region are prone to seasonal river floods (Endalkchew, B, *etal,* 2004).

Major floods which caused loss of life and property occurred in different parts of the country in 1988, 1993, 1994, 1995, 1996 and 2006. For example in the 2006 main rainy season (June-September), flood caused the following disasters (NMA, 2006):

- More than 250 people died, about 250 people were unaccounted for and more than 10,000 people became homeless. Due to the Diredawa. Flood.
- More than 364 people died, and more than 6000 people were displaced due to flooding of about 14 villages in South Omo.
- More than 16,000 people were displaced in West Shewa.
- Similar situations also occurred over Afar, Western Tigray, Gambella Zuria and the low lying areas of Lake Tana.

In terms of loss in property and livestock

- The DPPA estimate is about 199,000 critically affected people due to the flood in the country.
- More than 900 livestock drowned over South Omo. 2700 heads of cattle and 760 traditional silos were washed away (WFP).
- About 10,000 livestock were encircled by river floods in Afar.
- Over Diredawa, the loss in property is estimated in the order of tenth of millions of dollars.

Other impacts of flood include human health such as spread of Acute Water Borne Diarrhea (AWD) and malaria outbreak, impacts on the country's infrastructure and damages to field crops.

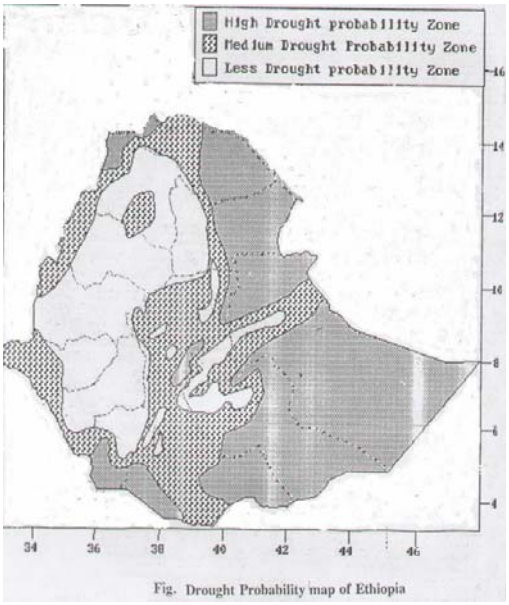
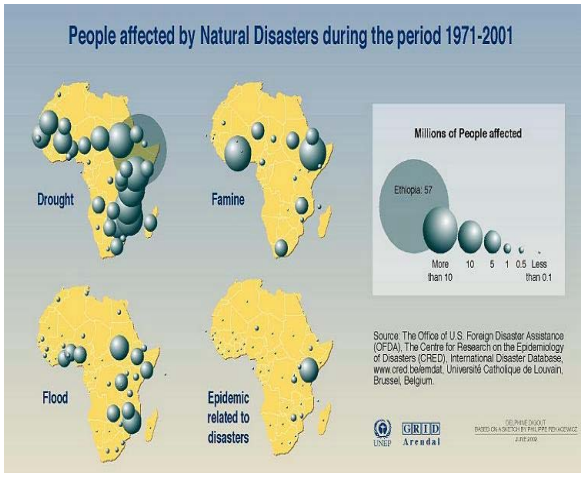


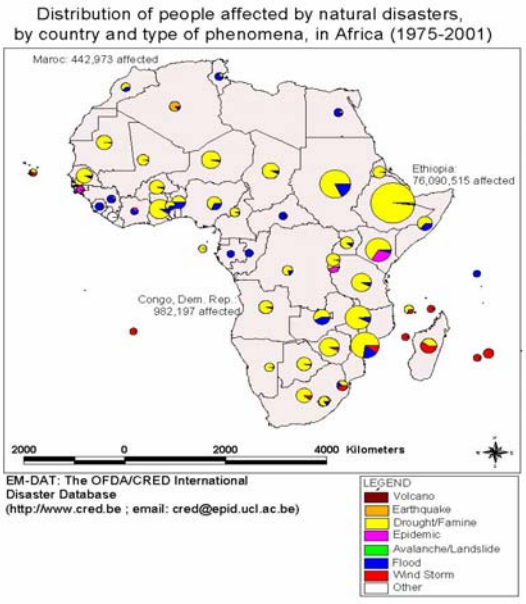
Figure 2.6: Drought probability map of Ethiopia

3. Current impacts of climate variability

Flood in Dridawa in August 2006 due to the overflow of the Dechatu River

Fig 2.8 Flood in the city of Dridawa (eastern Ethiopia) in August 2006





"There is emerging evidence that some social and economic systems have been affected by the recent increasing frequency of floods and droughts in some areas", IPCC TAR.

Figure 2.7: Impact of climate related hazards in Africa

Table 2.1: Chronology of El Niño and Drought/Famine in Ethiopia

El Niño Years	Drought/Famine	Regions affected	Impact on human life and property
1539-41	1543-1562	Hararghe	
1618-19	1618	Northern Ethiopia	
1828	1828-29	Shewa	
1864	1864-66	Tigray and Gondar	
1874	1876-78	Tigray and Afar	
1880	1880	Tigray and Gondar	
1887-89	1888-1892	Ethiopia	
1899-1900	1899-1900	Ethiopia	
1911-1912	1913-1914	Northern Ethiopia	
1918-19	1920-1922	Ethiopia	
1930-32	1932-1934	Ethiopia	
1953	1953	Tigray and Wollo	
1957-1958	1957-1958	Tigray and Wollo	
1965	1964-1966	Tigray and Wollo	About 1.5 million people affected
1972-1973	1973-1974	Tigray and Wollo	About 200,000 people and 30% of livestock dead
	1978-79	Southern Ethiopia	1.4 million
	1982	Northern Ethiopia	2 million People affected
1982-1983	1983-1984	Ethiopia	8 million affected One million dead and Many livestock lost
1986-87	1987-1988	Ethiopia	7 million people affected
1991-92	1990-1992	North, Eastern, Southeastern Ethiopia	About 0.5 million people affected
1993	1993-94	Tigray and Wollo	7.6 People affected
2000		Ethiopia	About 10.5 million people affected
2002/2003	2002/2003		About 13 million people were in need of food assistance

Sources: Quinn and Neal (1987); Degefu (1987); Nicholls (1993); Webb and Braun (1994) and others

2.5 Impacts of Projected Climate Change

2.5.1 Causes of Vulnerability to Climate Conditions in Ethiopia

The concept of vulnerability is a very complex one. Causes for vulnerability of Ethiopia to climate variability and change include very high dependence on rain fed agriculture which is very sensitive to climate variability and change, under-development of water resources, low health service coverage, high population growth rate, low economic development level, low adaptive capacity, inadequate road infrastructure in drought prone areas, weak institutions, lack of awareness, etc.

Vulnerability assessment based on existing information and rapid assessments carried out under NAPA has indicated that the most vulnerable sectors to climate variability and change are agriculture, water and human health. In terms of livelihood approach, smallholder rain-fed farmers and pastoralists are found to be the most vulnerable. The arid, semiarid and the dry sub-humid parts of the country are affected most by drought.

2.5.2 Coping Mechanisms to Climate Variability

Experience with how society copes with current climate variability and extreme events provides a valuable foundation for longer-term adaptation, as it offers familiarity with climate and its socio-economic impacts. Decision support tools and methods that are used for addressing today's challenges could also be used under a changing climate. In this regard strengthening capacity in terms of developing methods, tools, institutions and individuals to produce, disseminate and apply climate information is highly essential.

Traditional and contemporary coping mechanisms to climate variability and extreme in Ethiopia include changes in cropping and planting practices, reduction of consumption levels, collection of wild foods, use of inter-household transfers and loans, increased petty commodity production, temporary and permanent migration in search of employment, grain storage, sale of assets such as livestock and agricultural tools, mortgaging of land, credit from merchants and money lenders, use of early warning system, food appeal/aid, etc.

2.5.3 Adverse Effects of Climate Change

Climate change is expected to have adverse ecological, social and economic impacts. Quantitative climate change impact assessments made so far on various socio-economic sectors are limited in the country. However, effort was made to compile information on climate change impacts from various sources such as the Initial National Communications of Ethiopia to the UNFCCC, the IPCC reports and other sources. Impact and vulnerability assessments in priority sectors were undertaken as part of the process of developing the Initial National Communications of Ethiopia to the UNFCCC. A summary of the results is given in Table 2.2.

There was also a general observation from the regional consultative meeting that temperature has increased over the country and recurrent drought and flood are the most severe problems that affected millions of the country's population almost every year. This perception of change in temperature and in the frequency of drought could be linked to a changing climate. Climate change may also impact the land resources of the country by exacerbating desertification and its consequences.

Table 2.2 Summary of impact/Vulnerability Assessment for the selected sectors (Source: NMSA 2001)

Sectors	**Potential Impacts**
Agriculture	• Shortening of maturity period and decrease in crop yield
Grass land and Livestock	• Change in livestock feed availability • Effects of climate change on animal health, growth and reproduction • Impacts on forage crops quality and quantity • Change in distribution of diseases • Changes in decomposition rate • Change in income and prices • Contracting pastoral zones in many parts of the country
Forests	• Expansion of tropical dry forests and the disappearance of lower montane wet forests**;** • Expansion of desertification
Water Resources	• Decrease in river run-off • Decrease in energy production

	• Flood and drought impacts
Human Health	• Expansion of malaria to highland areas
Wild life	• Shift in physiological responses of individual organisms • Shift in species distribution from one to the next • Shift in biomes over decades/centuries • Shifts in genetic makeup of population • Loss of key wetland stopover and breeding sites for threatened bird species; and in general endemic and threatened species of flora and fauna are front line victims

2.6 NAPA and its Relationship to Ethiopia's Development Goals

There are already a number of existing national policy initiatives, sectoral policies, programs and strategies that may directly or indirectly address climate change adaptation. Accordingly, the most important policy and program documents that have relevance to climate change adaptation include Plan for Accelerated and Sustainable Development to end Poverty (PASDEP), Environmental Policy of Ethiopia, Agriculture and Rural Development Policy and Strategy, Water Resources Management Policy, Health Sector Development Policy and Program, National Policy on Disaster Prevention and Preparedness, National Policy on Biodiversity Conservation and Research, Science and Technology Policy, Population Policy and National Agricultural Research Policy and Strategy.

The Government of Ethiopia has set a number of national socioeconomic goals. These goals are:

- Eradication of poverty through accelerated growth mainly centered on rural areas;
- Stimulating food production and overall economic growth through Agricultural Development-Led Industrialization (ADLI);
- Rehabilitation of the Environment;
- Capacity Building for good governance both at federal and regional levels;
- Development of basic health services and primary education;
- Containing the AIDS pandemic, using all possible approaches;
- Consolidating peace and participatory democracy;

- Enhancing the process of decentralization and building the capacity of each region;
- Providing a conducive environment for a vibrant private sector;
- Integrating gender into all development activities;

The priorities of the national policies, sector strategies and programmes of the government are primarily targeted at promoting rural and agricultural development and poverty reduction. As a result, climate change and adaptation issues are often treated indirectly in sector specific policies and programmes since climate impacts are considered as a sub-component of the overall development goal particularly in relation to natural resources and environmental protection. Moreover, climate change and adaptation issues are crosscutting issues like poverty, which should be addressed in a holistic approach through ensuring the participation of all the relevant sectors.

From the policy perspective, the ultimate goal is to reduce climate change impacts through development programmes and projects that contribute towards the alleviation of the worsening natural resource depletion and environmental deterioration. Therefore, programmes that address climate change impacts (drought, famine, etc), vulnerability and adaptation measures should be treated as an integral component of the overall development programmes that involve all the relevant sectors through short and long-term programmes particularly in the areas of natural resource management, utilization, development and conservation.

Thus, considering the nature of the subject (climate change) as a crosscutting issue, it will be useful to incorporate some of the climate change/adaptation interventions into the on-going national programmes like poverty reduction as a sub-component. In addition to poverty reduction programmes, climate change and adaptation issues could be addressed along with two other national programmes; namely, food security and disaster prevention and management. In general, crosscutting issues like poverty, food security and others are aspects that should be considered when planning interventions that address climate change and adaptation.

The extent of complementarities of the reviewed policies, programmes and strategies among climate change adaptation options and or MEAs has been assessed as summarized in Table 2.4.

Table 2.3 Policy/ Program-Wise Summary of Relevant Climate Change Adaptation Options

Policy/ Program	Potential adaptation option
PASDEP: improving air quality	• Developing a federal strategy, standards and law to improve urban air quality • Developing a national strategy to enhance coping mechanisms regarding the adverse impacts of climate change • Launching environmentally sound investment and other programs that foster cleaner development mechanisms, including emissions trading
PASDEP: food security & productive safety net	• Further expanding the quality and quantity of agricultural packages and other interventions • Expand the size of water harvesting and small – scale irrigation • Use various water harvesting technologies and familiarize farmers with effective and efficient water utilization methods • Capacity building, training & awareness creation of the community
Environmental policy of Ethiopia: Natural resource & environment	• Establish environmental forums to promote environmental education through Information, Education & communication (IEC) networking to introduce environmental protection, environmental health care, etc • Awareness creation programs about the effects of GHGs emission, effects on climate change & natural environment • Natural resources conservation & development projects (tree planting, soil conservation, protection of water resources & introduce appropriate water harvesting techniques, etc) • Establish & build national capacity to undertake climate monitoring programs • Introduce better adaptation mechanisms
Agriculture & rural development: Crop	• Introduce programs/projects that promote improved farming practices, drought resistant & early maturing crop varieties & supply inputs that increase crop yield & productivity • Improved land management, moisture & soil conservation & flood control method in both the high & lowland areas • Develop improved water use (water harvesting, small – scale irrigation, etc) in drought prone areas to alleviate rain shortages that cause crop failure • Improve farmers' knowledge about proper use of weather information in carrying out agricultural activities to avoid risks of climate change. • Introduce off – farm activities to increase alternative household income sources
Agriculture & rural development: Livestock	• Promote improved/productive animal breeds to reduce herd size & the pressure on land • Introduce/promote improved fodder crops and pasture management & the conservation & use of hay • Introduce agro – forestry system to plant multi purpose trees that could be used to produce feed, conserve soil & produce fruits for human consumption • Create awareness about natural resource management, conservation and rational use & environmental protection • Promote and implement natural resource (soil, water, forestry, etc) development & conservation programs & projects • Develop drinking water sources for human and animals in pastoral areas

Water resources policies & strategies:	• Conduct water resources assessment studies (inventory of water quality and quantity, surface and underground water in time and space to develop proper use of available water resources • Introduce improved methods of water conservation, storage and rational use • Construction of small check dams and rainwater harvesting schemes to meet water supply for domestic and irrigation use • Undertake soil conservation measures that help to reduce soil erosion & siltation and also protect the pollution of water sources • Implement watershed management and water conservation programs & projects that promote local community participation • Introduce methods to tackle & prevent flood protection, disaster prevention actions; and maintenance of flood control structures • Manage and tackle droughts as well as the associated slow on-set diseases
Health policy and program:	• Implement programs that help to prevent and control communicable diseases like malaria through community participation • Organize and implement community – based health education programs to create the awareness & develop the knowledge about personal hygiene & environmental health management • Develop & introduce surveillance system, introduce methods of health prevention & vector control for health workers and the community • Provide training programs to build the manpower capacity to improve the provision of health extension services at local level • Support health research & community health services through the supply of drags and help the development of health facilities & infrastructure
Energy policy:	• Initiate & develop projects that promote the use of alternative and or non-wood energy sources (e.g. bio-gas, fuel saving stoves, etc) • Increase awareness about the effect of pollution on the environment through IEC with focus on energy utilization and environmental education • Enforce laws & regulations to protect and prevent pollutions and ensure utilization of local factories that are environmentally friendly.

Table 2.4 Complementarities among Selected Policies/Programs/Strategies and Climatic Change Adaptation Options and Other MEAs

Selected Policies & Programs	Relevancy/complementarities	Remark
- Most policies, strategies & programs	Promoting sustainable development, sustainable use of Biological diversity & reducing climate related vulnerabilities are the common objectives	Achieving sustainable development in sectors affected by drought is among areas of emphasis for UNCCD while sustainable use of Biological diversity is among areas emphasis for UNCBD
- EPE, - Biodiversity Conservation policy, - Agriculture policy	Strength & resilience ecosystems thereby help to reduce the economic and social vulnerability of local people in the country	Both the EPE & the UNFCCC aim at ensuring sustainable economic development through the mitigation of adverse climate change impacts.
-Rural & Agriculture Policy, - Safety Net, - PASDEP/FSS	Focus on rehabilitation & reclamation of degraded land, reforestation, the conservation, management & protection of natural resources	Community - based participatory projects/activities to ensure food self sufficiency, increase farm production & reduce vulnerability through the transfer of income, household asset building, public works to develop natural resources base & productivity
- PASDEP, - EPE, - Biodiversity Conservation Policy, - NARP	Encourage activities that reduce poverty/improve livelihoods and simultaneously conserve, which protect the ecosystem	Projects that introduce & propagate plants that have high commercial value to improve income/livelihoods through benefit sharing arrangements involving local communities using indigenous or exotic plants herbal medicinal plants & plants used to extract essential oils are the potential areas
- Rural & Agriculture Policy, - PASDEP, - Safety Net, - FSS	Drought resistant plants & crop species easily adaptable to areas with moisture stress & interventions to rehabilitate & maintain biodiversity of dry land & fragile ecosystem have complementarities with MEAs	Poverty alleviation & improving livelihoods are among the strategies of PASDEP & the agricultural policy. The shift/diversification of crops & selection of drought resistant crops/ varieties are also the strategies to attain food – self-sufficiency & improve household livelihoods in drought prone areas with high climate variability.
- EPE, - PASDEP	UN Conventions & other MEAs that emphasis environmental information network & capacity building as well as the need to create awareness about the impacts of climate change & coping mechanism are in conformity with policies/strategies/program particularly the EPE	Promoting projects that target capacity building to ameliorate the impacts of climate change on livelihoods and national economy. Mainly information network on climate & biodiversity; environmental forums & institutional capacity building, etc are among projects that help to develop national capacity building & NAPA.

2.7 Rational for Developing the NAPA and its Objectives

The Conference of the Parties to the UNFCCC at its Seventh Session (COP 7 of the UNFCCC) decided that the least developed countries including Ethiopia get support to address urgent and immediate needs and concerns related to adaptation to the adverse effects of climate change.

The rationale for NAPA rests on the low adaptive capacity of LDCs which renders them in need of immediate and urgent support to start adapting to current and projected adverse effects of climate change.

The NAPA document has been developed to enable Ethiopia address her urgent and immediate adaptation needs caused by climate change and extreme weather events. It aims at: -

- Identifying a list of priority activities
- Formulating priority adaptation options
- Building capacity
- Raising public awareness on the urgency to adapt to the adverse effects of extreme weather events

2.8 Potential Barriers for Implementation of NAPA

As discussed earlier, many of the national initiatives - action plans, policies/strategies, programmes and project initiatives are synergistic with climate change adaptation. Thus, the implementation of the existing national initiatives is of central importance for climate change adaptation. However, potential barriers and adjustments need to be dealt in order to optimise climate change adaptation gains from the ongoing national initiatives, and to ensure a coordinated effort towards successful implementation of environmental initiatives, strategies and action plans of the Rio-Conventions. Some of the major barriers for adaptation gains from the on-going national initiatives include:

- Lack of strong coordination mechanism both at the federal and regional levels to maximize climate change adaptation gains from the on going and planned national initiatives – action plans, policies/ programmes and projects;

- Inadequacy of cross-sectoral links of the ministries and line departments,
- Lack of elaborated links of federal and regional sector offices as well as cross sectoral federal committees involved in environmental and developmental issues;
- Lack of capacity;
- Lack of efficient outreach mechanism on environment to local communities;
- Oversight of long-term environmental impacts of short-term economic benefits;
- Economic challenge, i.e., limited finance for environment;
- Low level of awareness about the environment;
- Low level of public literacy;
- High level of poverty;
- Inadequate capacity on information exchange among NMA and NAPA project and/or action plan implementers:

The following recommendations are suggested in order to maximize climate change adaptation gains from the existing or planned national initiatives:

- The focal institution and the key climate change relevant project implementers should be well connected with efficient information and networking system;
- Key climate change adaptation relevant project implementers should be well acquainted and familiar with objectives of the NAPA;
- Strengthen the focal institution with the required infrastructure, facilities and manpower; and
- Mainstream climate change adaptation options into relevant policy/ programmes - agriculture, health and water programmes indicated in the PASDEP;

Chapter 3

Identification of Key Adaptation Needs

3.1 Introduction

The vulnerability of Ethiopia to current climate variability and change as well as the cause of vulnerability was highlighted in Chapter 2. Vulnerability can be reduced though enhancing adaptive capacity and or reducing sensitivity/exposure to climate related hazards. In this chapter, effort is made to identify adaptation options that could reduce the vulnerability of the country to climate variability and change.

A wide range of adaptation options that are thought to reduce vulnerability to climate variability and change in Ethiopia were compiled and reviewed mainly from the following sources:

- On-going and planned projects
- Initial National Communication of Ethiopia to the UNFCCC
- Two national and eight regional consultation workshops
- Synergy with multi-lateral environmental agreement assessment reports

3.2 Review of on-going and planned Project Initiatives

A range of on-going and or planned projects related to agriculture, water and human health sectors have been reviewed for their relevance to climate change adaptation. Accordingly, the projects that may have relevance to adaptation are listed in Table 3.1. The focus of the reviewed projects is in the areas of soil and water conservation, fertility improvement, flood control, income generation, institutional strengthening and capacity building, improving animal genotype and health, etc. Some of the projects contained community-oriented components and or activities that offer success stories. For example Adama Woreda participatory rural land rehabilitation and forty-two community-based organizations working on sustainable agriculture in Tigray National Regional State are examples of community-based projects with success stories that are relevant for climate change adaptation.

Table 3.1 Reviewed Projects by Sectors/ Areas of Relevance

No	Title of the project	Areas of focus
1	Managing Envixonmental Resources to Enable Transition to more sustainable livelihoods	Soil and water conservation; Water resources development; income generating activities; capacity building
2	Sustainable Development and Ecological Land Management with Farmers in Tigray	Compost making, capacity building, water resources development; multipurpose tree planting program; soil and water conservation; institutional strengthening local community;
3	Mareka -Gena and Alaje Woreda Food Security Program	Small scale irrigation development; soil conservation;
4	Agriculture sector support project	Small scale irrigation development; crop development and marketing; capacity building and institutional strengthening
5	National Capacity Needs self Assessment for Global Environmental Management	Capacity building at individual, systemic and institutional levels for the synergistic implementation of the RIO Conventions
6	Environment and Sustainable Dry lands Management	Implement the priorities of NAP
7	Country Partnership Program for Sustainable Land Management	Integrated land and water management; Protect and restore ecosystem functions in agriculture land scope; land monitoring system development
8	Sustainable Utilization of Natural resources for improved food security	Water shed management; increase productivity of Agriculture land and increase use of water and biomass resources
9	Ethiopian Home Garden Potentation of Practices of biodiversity conservation	Capacity building of the community through enhancing income
10	The Nile Trans boundary Environment Project of the Nile Basin Initiative	Capacity building and institutional strengthening; local level approaches to land and water conservation; wetland and bio diversity conservation; water quality monitoring; improve capacities for monitoring and management of water quality
11	Removing Barriers to Invasive Plant Management in Africa	Biodiversity conservation; Monitoring and reporting systems development; Capacity building and institutional strengthening;
12	Emergency Drought Recovery Project	Provide income supplements; protect private assets of the affected; Rehabilitate or creation of communal assets using communally labor of the affected population;
13	National Livestock Development Project	Improve animal genotype and better disease parasite control through upgrading of local breeds of cattle through artificial and natural mating and animal health care; promotion of grazing management through forage legumes production
14	Food Security Project	Asset and income increasing funds for income and asset building activities; strengthening institutional strengthening;
15	Site Action Plan for the Conservation of and Sustainable Use of Zeway Lakes Biodiversity	Integrated Watershed management
16	Site Action Plan for the Conservation of and Sustainable Use of Awassa Lakes Biodiversity	Integrated Watershed Management; wetlands rehabilitation; evaluation and control of chemical pollution of the lake from domestic and industrial effluents;
17	Awash river Basin Flood Control and Watershed Management	Flood control and integrated watershed management
18	Special Country Program II – Irrigation and water management	Capacity building for improvement and expansion of existing traditional and development of new irrigation scheme to improve food security and income
19	Humera and Walkayta irrigation development study and design construction project	Reduce erosion problem; reduce flooding problem on the community; create employment opportunity

20	National Five-Year Strategic Plan For Malaria Prevention and Control in Ethiopia	
21	Adama Woreda Participatory Rural Land Rehabilitation (by World Vision)	Water Pond construction, Area closure, gully re-vegetation
22	Sida Amhara Rural Development Program (by CIDA)	Economic Diversification, food security
23	Bonga Integrated Participatory Forest Management and Reproductive Health Project (by Farm Africa)	Capacity development of the community in forest management
24	Chilimo Participatory Forest Management Project (by Farm Africa)	Capacity development of the community in forest management
25	Borana Collaborative Forest Management Project (by Farm Africa)	Livelihood improvement and strengthening the traditional organizations
26	Rehabilitation and Development programs in Amhara (by ORDA)	Food security through natural and human resource development; Water resources development; Capacity development and community empowerment
27	Food security Program (by Action AID)	build their resilience to disaster through investment in health, water, education, environmental protection, and off-farm activities,etc

3.3 Adaptation Options as Proposed in the Initial National Communication of Ethiopia to the UNFCCC

Table 3.2 Adaptation Options as Proposed in the Initial National Communication (INC)

Sectors	**Proposed adaptation options**
Agriculture: Crop	• Enhancing erosion control • Improve and changing management practices and techniques such as planting date, seedling rate, fertilizer application rate, etc • Engagement in obtaining food from other sources and income generating activities in times of crises • Proper use of climate information for land use planning and early warning systems, etc • Grow crops which requires less water
Agriculture: Grassland & livestock (highlands)	• Selection of crops and cropping systems that maximize biomass production and therefore, CO_2 and N_2 fixation • Improve animal genotype and better disease parasite control to take advantage of the improved management • Use of multi purpose cattle that work and provide milk and meat and also breed to provide suitable draught animas, in addition to supplying fuel and fertilizer from their excreta
Agriculture: Grassland & livestock (lowlands/ rangelands)	• Introduce mixed farming system, where appropriate • De-stocking of livestock on a regular basis • Promote lifestyle choices of pastoralists through access to education and local urban development • Conservation and utilization of hay from natural pastures • Promotion of grazing management schemes • Integrated approach for pastoral development • Rehabilitation of bush encroached areas • Promote traditional range conservation and management systems • Use of local legume forage including Acacia fruits and leaves, • Promotion of irrigation for agricultural development • Establish community gene banks specially for drought and diseases resistant land races

Agriculture: crop, livestock & rangeland (relevant crosscutting adaptation options)	• Capacity building and institutional strengthening of the local community • Community empowerment for improved agricultural production and natural resources conservation • Restrict free range grazing and promotion of stall feeding • Water resources development • Control and management of Invasive Alien Species (IAS) • Introduction of various agro forestry systems in the existing farming systems • Promotion of renewable energy sources to minimize the use of agricultural residues for house hold energy rather than using it as soil conditioner to enhance soil fertility and there by agricultural productivity and production • Conservation of Agro biodiversity resources • Establishment of fodder factory
Water resources	• Allocation of water supply through market based systems • Conservation of water and use of river basin planning and coordination • Flood control • Combating drought • Construction of reservoirs for hydropower, irrigation, water supply, flood control over and /or multipurpose uses and establishment of flood forecasting and drought monitoring system have been identified as high effective climate adaptation options in the Abay Basin (FNRC, 2001) • Improve the under ground water resources potential and management • Promotion of water resources saving techniques in drought and climate change vulnerable areas • Introduction of Fish Ponds; establishing, legalization and regulation of fish resource exploitation • Introduction of water quality monitoring systems • Building upon the existing traditional irrigation systems by the local communities/Water resource users through capacity building • Integrate and implement climate adaptation options in the River basin master plan studies • Introduce wise use and management of wetlands to improve among others recharging capacity of underground water • Undertake study on the possible future demand for water by considering future development plans from the rift valley lakes and establish a system to control the amount of water to be abstracted from the lakes • Introduce drip irrigation system • Introduction of integrated watershed management for the management of the vegetation cover and abatement of erosion and siltation of water bodies • Regulation and prevention of discharged of domestic and industrial organic wastes as well as toxic chemical pollutants that cause hazards from entering into water bodies

Human health	• Establish and strengthen surveillance system • Promote integrated vector control approach • Improve ecosystem management, which are sensitive to malaria invasion • Strengthening research in the health sector • Educating the public about malaria and its control and encourage the use of malaria bed nests • Encouraging utilization of climate and meteorological information in the planning of malaria control • Developing effective malaria drugs • Establish climate and health awareness, training and research programs • Establish climate and health data base for analysis of climate and health information and make available for village communities • Establish early warning surveillance system program that will enable communities to adapt to potential out breaks of diseases • Avail the required capacity for the realization of National Five year Strategic Plan for malaria Prevention and Control

3.4 Adaptation Options Proposed by the Regional Consultative Workshops

As part of the Ethiopian NAPA preparation, the National Meteorological Agency (NMA), based on a pre-designed consultation methodology, had conducted consultation workshops in eight Regions, which resulted in a set of climate change potential adaptation options for agriculture, water resources and human health sectors. A summary of the adaptation options that were proposed by the workshops in at least three or more of the Regions where the workshops were conducted is provided in Table 3.3.

Table 3.3 Summary of potential adaptation options proposed by the regional consultative workshops

Sectors	**Proposed adaptation options**
Agriculture	• Promoting drought/crop insurance program in Ethiopia • Irrigation scheme development, promotion of irrigation agriculture • Feed conservation, forage development, rotation grazing and changing of the traditional feeding practices • Crop diversification, promotion of crop types that offer comparative advantage (cash crops) • Research on stress/ drought resistant & early maturing crops • Improve agricultural productivity through improved inputs, adapting improved farm technologies, improved animal health service, strengthened disease & pest control mechanism
Water Resources	• Water harvesting, improved water use efficiency, spring & wells development, river diversion • Water sector strategic policy development • Development of a water dam on Genale-Dawa river for integrated development

Human Health	• Improved health services & health facilities, provision of medicines, use of mosquito nets, health extension, environmental and personal hygiene & sanitation • Research on the tradition coping mechanism of climatic hazards, dissemination of endogenous knowledge and encourage efficient & traditional medication
Cross-sectoral	• Improved early warning system • Proper utilization of meteorological information at all levels • Integrated watershed management & practices • Improve access to potable water and water harvesting • Forestry, agro forstory, participatory forest management, strengthen natural resources conservation & management practices • Awareness creation, educating people, investors & policy makers on climate change at all levels • Capacity building at all levels • Diversify income generating activities, improve market access infrastructure and socio-economic environment • Proper land use policy, resettlement • Improve inter-institutional linkages, NMA, research & other development partners; capacity building; planning applicable policies & strategies • Family planning (mainstreaming into agriculture sector)

3.5 Adaptation Options which have Synergy with Multi-lateral Environmental Agreements (MEAs)

The intrinsic nature of climate change, desertification and biodiversity leads to potential synergy for climate change adaptation. National consultants carried out an assessment of synergy between climate change adaptation and multi-lateral environmental agreements especially with desertification and biodiversity which Ethiopia is a signatory. Adaptation options, which could have synergy with other MEAs, are listed below. These projects satisfy multiple objectives as required by NAPA, i.e., they increase national carbon pool, decelerate land degradation and ameliorate climate change.

- Community-based development and commercialization of Non-timber forest products (gum Arabic, myrrh and frank incense);
- Community-based rehabilitation of degraded ecosystem in selected parts of Ethiopia for carbon sequestration and trading;
- Propagation and commercial scale cultivation of wild essential oil crops;
- Establishment of centre for propagation and commercialization of traditional herbal medicinal plants
- Establishment of a*cacia* woodland nature reserve in the Ethiopian Rift Valley System
- Range shift cultivation of selected cash crops at drought-prone areas
- Establishment of national R & D centre for Rio-Conventions

- Development of an incentive scheme for farmers (hill-farming communities) to reforest degraded hill areas in the northern parts of Ethiopia;
- Participatory approach to rehabilitate degraded hills/ecosystem in northern Ethiopia;
- Institutional Reinforcement for Biodiversity Conservation
- Establishment of National Environment Education Program
- Reforestation for Fuel in the Highlands of Ethiopia
- Regional Capacity Building for Monitoring and Inventorying of Biodiversity
- Establishment of Potato-Centered Small-Sized Cottages
- Reclamation of Bush Encroached Rangelands
- Promotion of Legume-Based Agro-Forestry Systems and Home-Garden Agriculture;
- Development of New and Rehabilitation (upgrading) of the existing watering sites in Pastoral Areas
- Aquaculture Development for Efficient Harvest of Commercial *Spirulina* Species in the Lakes of the Ethiopian Rift Valley System
- Reorganization of drought affected community

3.6 Summary of Potential Climate Change Adaptation Options

Based on the review of adaptation options identified under MEA synergy assessments, ongoing programs and development project initiatives, the INC and the outcomes of the regional consultative workshops conducted by the NMA, the following 37 potential adaptation options were proposed (identified) for further prioritization and ranking and inclusion in the NAPA to address immediate adaptation needs. These adaptation options identified are either proposed by the synergy assessment report, the INC or the regional consultative workshops, or otherwise.

1. Promoting drought/crop insurance program in Ethiopia
2. Realizing food security through multi-purpose large-scale water development project in Genale–Dawa Basin
3. Community Based Development and Commercialization of Non-timber Forest Products (Gum Arabic, Myrrah and Frank Incense)
4. Community Based Rehabilitation of Degraded Eco-Systems in Selected Parts of Ethiopia
5. Propagation and Commercial Scale Cultivation of Wild Essential Oil Crops
6. Establishment of Centre for Propagation and Commercialization of Traditional Herbal Medicinal Plants
7. Establishment of Acacia Woodland Nature Reserve in the Ethiopian Rift Valley System
8. Community Based Carbon Sequestration Project in the Rift Valley System of Ethiopia
9. Range Shift Cultivation of Selected Cash Crops int Drought Prone Areas
10. Establishment of National R&D Center for Climate Change

11. Development of an Incentive Scheme for Farmers (Hill-farming communities) to Reforest Hill Areasin the Northern Parts of Ethiopia
12. Participatory Approach to Rehabilitate Degraded Hills/Ecosystem in Northern Ethiopia
13. Institutional Re enforcement for Bio-diversity Conservation
14. Establishment of National Environmental Education Program
15. Reforestation for Fuel in the Highlands of Ethiopia
16. Regional Capacity Building for Monitoring and Inventorying of Biodiversity
17. Establishment of Potato-centered Small-sized Cottages
18. Reclamation of Bush Encroached Rangelands
19. Promotion of Legume-based Agroforestry Systems and Home-garden Agriculture
20. Development of New and Rehabilitation (upgrading) of the existing watering sites in Pastoral Areas
21. Aquaculture Development for Efficient Harvest of Commercial *Spirulina* Species in the Lakes of the Ethiopian Rift Valley System
22. Reorganization of drought Affected Communities
23. Stall feeding promotion and free range grazing restriction in selected regional states of Ethiopia
24. Promotion of on farm and homestead forestry and agroforestry practices in arid, semi-arid and dry-sub humid parts of Ethiopia
25. Undertake soil and water conservation practices for improved land husbandry in Afar, Somali and Gambella regional states and Diredawa city administration
26. Develop community seed bank and food storage facilities in Amhara, SNNPRS, Tigray, Oromia.
27. Capacity building for small scale irrigation planning and development in Afar, Gambella, Somali and SNNPRS.
28. Community based sustainable utilization and management of wet lands in selected wet lands in Ethiopia
29. Strengthening/enhancing drought and flood early warning systems in Ethiopia
30. Capacity building for climate change adaptation in Ethiopia at all levels mainly federal as well as regional levels
31. Public awareness program on climate change in Ethiopia at national as well as regional levels
32. Enhancing the use of water for agricultural purpose on small farms in arid and semi arid parts of Ethiopia
33. Community capacity building to initiate and implement environmental health program and or projects in the national regional states
34. Commercial level uses of some indigenous, wild edible fruits in selected arid and semi arid areas of Ethiopia
35. Malaria containment program (MCP) in selected areas of Ethiopia-Gambella, Ethiopian rift valley, Somali.
36. Institutional development; enhancement of research and development capacity of the national dry land research centers in Somali, Gambella, Benishangul-gumuz, low lands of Oromia, Amhara, Tigray, Afar and SNNPR.
37. Improving/enhancing the range land resources management practices in the pastoral areas of Ethiopia

Chapter 4

Criteria for Selecting Priority Projects/Activities

In order to match the resource requirement of potential adaptation projects with available resources, it is of paramount importance to devise evaluation criteria so as to produce prioritized set of projects.

The criteria selected for prioritizing adaptation options were based on the generic criteria as proposed by the Least Developed Countries Expert Group (LEG) and outlined in the Annotated Guidelines for the preparation of NAPAs, as well as those generated through national and regional stakeholder consultations. As the NAPA is intended to build upon and be integrated with existing national development plans such as poverty reduction strategies, sustainable development strategies, national conservation strategies, etc, the criteria selected were further examined in relation to national priorities and their advantages in climate risk avoidance, in poverty reduction, ensuring complementarities and promoting synergies with national and sectoral development plans, and other MEAs. The National Climate Change Steering Committee members established by NMA endorsed the criteria proposed before the prioritization process started. The criteria selected were:

- Impact on economic growth of the poor (poverty reduction potential);
- Complementarities with national and sectoral plans;
- Climate change risk (Losses avoided by poor People);
- Synergy with action plans under Multi-lateral Environmental Agreements (MEAs);
- Cost Effectiveness;

Once the criteria were defined, the next step was to determine the importance of the criteria and assign corresponding weights to them. Although, all the identified criteria are relevant to prioritize adaptation projects, the study has assumed that their level of importance is different.

Accordingly, greater importance (weight) was given to level of risk (0.3 out of 1.0) followed by poverty reduction potential and cost effectiveness each attached a weight of 0.2 followed by complementarities and synergy each given a weight of 0.15. The Evaluation Criteria Assessment

Study indicated the need for complementing the outcomes of the study with consultation outcomes to further rationalize the weight attached to each criterion.

Table 4.1: Description of Criteria and their weight

Criteria	*Weights*
Level of Climate Change Risk (Loss Avoided by Poor People)	0.30
Poverty reduction potential (Impact on poor peoples' Income Growth)	0.20
Cost effectiveness	0.20
Complementarities with national and sectoral plans, policies & strategies, and other MEAs	0.15
Synergy with national plans including action plans under MEAs	0.15

Chapter 5

List of Priority Projects/Activities

5.1 Introduction

Identifying high priority adaptation project profiles is the ultimate goal of the whole NAPA preparation process. The purpose of ranking and prioritization is to select high priority adaptation projects that are aimed at addressing immediate needs of adaptation to climate change.

The ranking of projects is an exercise undertaken to systematically evaluate potential climate change adaptation projects and prioritize them for inclusion in NAPA. This process involves identification of a set of country-driven criteria that reflect national development objectives and priorities, defining of scales and weights, and ranking of criteria (UNFCCC/LEG, 2002).

Thirty seven (37) potential adaptation projects were identified in Chapter Three through vulnerability assessments and consultation processes. All of these projects may be important by their own right to address the country's concerns with regard to adaptation to the adverse effects of climate change in the key vulnerable sectors of agriculture, water, health, etc. However, all the identified projects cannot be considered for implementation at the same time mainly due to shortage of financial resource and /or capacity limitations. In an attempt to match the resource requirement of these projects with the availability, we need to have evaluation methods and criteria to be applied to a long list of potential adaptation projects in order to select a prioritized set of projects.

The evaluation methods and criteria would have the following benefits among others:

- Enable the choice of projects that address the country's most urgent and immediate adaptation needs,
- Maximize their chances of acceptability and obtaining funding from Global Environmental Facility(GEF) and other donors,
- Facilitate the selection of worthwhile projects, thus helping to save time, money, and effort, and
- Increase the likelihood that projects will continue to reap sustainable benefits and contribute to poverty reduction.

There are a number of methods that can be used for the prioritization and selection of projects. The most commonly used methods include the following.

- Cost Benefit Analysis (CBA)
- Cost-Effectiveness Analysis (CEA), and
- Multi-Criteria Analysis (MCA).

Multi-Criteria Analysis (MCA): In the social and environmental fields in general and in the climate adaptation fields in particular, projects usually involve variables that cannot be fully handled by financial and economic analysis. Some considerations may be quantifiable but difficult to value while others may only be amenable to qualitative assessments. In cases when benefits cannot be quantified and valued, the MCA appears to be appropriate for evaluating proposed projects. The MCA is a method of analysis that considers separately a variety of different criteria for assessing a project and then attempts to define the trade offs between the criteria in order to decide on the best course of action. Preferably, the analysis would also show various alternatives for comparison.

One of the alternatives could be 'without the project'. The MCA has constituents of objectives, alternative measures/options/interventions, criteria, scores, and weights. Defining objectives and formulating different options under MCA is the same as in CBA or CEA. The difference lies in the selection of criteria and determining their weights where the MCA involves subjective elements.

The limitations of MCA are also its strengths. It introduces considerations that might be left out of the CBA or the CEA, but in doing so, it introduces strong value judgments. It is probably quite useful for investigating alternative ways of achieving a particular objective and for looking at projects with multiple objectives. The MCA is not very good at comparing completely different projects with each other because the applicability of particular criteria will vary from one situation to another. It can be used in conjunction with the CBA to cover the aspects of the project that are sometimes difficult for CBA to deal with and it can be used on its own for projects where the CBA or CEA are not readily applicable.

Given the fact that the MCA includes CBA and CEA, and because it permits the use of non-monetary and qualitative variables and indicators resulting from complete lack of data, the MCA has been chosen for use in the prioritization and selection of adaptation projects in this study.

5.2 Steps in Ranking of Adaptation Projects

The weighted criteria selected in Chapter 4 were used for prioritizing the 35 projects identified in Chapter 3 and the steps are discussed below.

Assigning Values/scores to Each Criterion

Once the criteria were weighted as was done in chapter 4, the next step was to assign values/scores for each criteria. The scores were quantitative or qualitative or binary (such as ‘’yes’’ or “no” or even “+” “–“) depending on the nature of the criteria. Either way, for the purpose of MCA analysis, the scores need to be described in number. For instance, “yes” and “+” could be assigned a value of 1 and “no” and “–“a value of 0.

The criterion entitled “Impact on Economic Growth of Poor People/Poverty Reduction Potential” was assigned score values between 1 to 5 percent depending on judgments the researcher has developed after going through each of the project options identified and assessed its relevance against the criterion. The other criterion, Environmental Risk (Loss Avoided per capita by poor people), was assigned the least value of 50 and the highest value of 500.The third criterion, complementarities with national programs, was assigned scores on a 1 to 5 scale while the fourth criterion, synergies with MEAs, was assigned values on a 0 to 4 scale. The scores for the cost effectiveness range from 0.3 to 700 USD depending on the estimated project costs (Table 5.1).

Table 5.1: Description of Criteria and their weights and values

Criteria	*Weights*	*Range of Values for Each Criteria*	*Remark*
Level of Climate Change Risk (Loss Avoided by Poor People)	0.30	$50 to $500	USD Per Capita Per Person Per Year
Poverty reduction potential (Impact on poor peoples' Income Growth)	0.20	1 to 5	Percent per year
Cost effectiveness	0.20	0.3 to 700	Million USD as provided in from the profile of each Project
Complementarities with national and sectoral plans, policies & strategies, and other MEAs	0.15	1 to 5	Just a scale "1" representing least complementarities and "5" highest complementarities
Synergy with national plans including action plans under MEAs	0.15	0 to 4	Just a scale 0 representing no synergy and 4 the highest synergy

Each project option had to be assigned scores across each criterion. Accordingly, each of the 37 project options was assigned scores across the five criteria (Table 5.2).

Standardized Scores

Once each option was assigned with its respective score, the scores need to be standardized for each criterion so that they could easily be aggregated horizontally for each project option for the purpose of ranking project options.

As can be seen from Table 5.2, all the different criteria are not expressed in the same unit of measurement. Some are expressed in absolute values, but not necessarily in the same units (costs, rates, etc), others are assigned just scores. For instance, Impact on Economic Growth of Poor people is expressed in percentage while Cost Effectiveness is measured in Million USD per project option. The MEA Synergies criterion is assigned a score in the 0 to 4 scales while the Complementarities criterion is assigned a score on a 1 to 5 scale. The criterion Environmental Risk/Loss Avoided by Poor People is expressed in USD Per Capita.

To be able to compare the different Criteria, the values must now be standardized; that is, expressed in one common unit, according to one common scale. This would enable add the values of each criterion horizontally for a given project option to be able to establish a single aggregated standardized value while ranking them. The average standardized aggregated value will be the basis for ranking and finally for selection of project options.

The standardization was carried out by plotting each value of the criterion on an axis (linear interpolation) ranging from 0 to 1. Higher values correspond to advantages, while lower values correspond to disadvantages. The standardization for all criteria save that of Cost Effectiveness is taken as the ratio of two differences: the difference between the actual value of the project option under consideration and the project with the least value in the numerator and the difference between the project with the highest value and the one with the least value in the denominator. Accordingly, the standardized value of a project with the highest score is 1.0 while the standardized value of the project with the least value is 0.

In the case of Cost Effectiveness Criterion, the project with the highest cost is considered to be the least advantageous and by contrast the project with the least cost is most advantageous. In this case, the "Inverse Scoring" technique has been applied in the standardization of criterion scores for each project option. This measure is again the ratio of two differences: the difference between the cost of the project with the highest value and the actual cost of the project under consideration in the numerator and the difference between the project with the highest value and the project with the least value in the denominator. According to this technique, a project with least cost will have the highest standardized score. Naturally standardized values should fall in between 0 and 1 inclusive. Accordingly, the standardization process is undertaken for all project options under each criterion, yielding the results in Table 5.3.

5.3 Ranking Project Options Based on Standardized Weighted Average Scores

As shown in Table 5.3, every score for each criterion has been expressed in the same standardized unit (on a 0 to 1 scale). This allows the average scores to be calculated. This can be done in two ways: by attaching equal importance (simple average of the standardized scores of each criterion for a given project option) or by attaching different weights to each criterion for a given project option. The ranking in Table 5.3 is based on standardized simple average scores, adding each of the five standardized scores for a given project option and dividing the total by 5 for each of the 37 project options listed. This is a preliminary step in the ranking process. In the strict sense of ranking, it should be done based on weighted average standardized scores, the weights are the relative weights of each criterion as given by the Criteria Assessment in chapter 4.

First, second and third stage ranking was also carried out by taking a weighted average of the standardized scores for each project option in an iterative way. Further ranking and sensitivity analysis was also done to see the impact of weightage given to each criterion. The final outcome of the analysis gave 11 projects listed in Table 5.4. The prioritized projects can be categorized into sectoral development projects, community based natural resource management projects and cross cutting projects.

5.4 Summary of the Outcomes & Recommendations

5.4.1 Brief Summary of the Outcomes

The selection process of high priority adaptation projects listed in Table 5.4 followed the NAPA guidelines and procedures. The criteria developed by the Evaluation Criteria Assessment Team and the prioritized project concepts from the Synergy Assessment Team are the starting points in the selection of project profiles. Accordingly, the prioritization commenced with 37 project options with a total cost of about 874 million USD as estimated by the Synergy Assessment Team. The pertinence of these projects in respect of synergies and relevance to the three Rio Conventions has been well examined and articulated by the Synergy Assessment Team.

The task of Multi-Criteria Analysis (MCA) involves assigning appropriate scores to each criterion across all project options followed by standardizing the scores for each criterion across project concepts. The next step was to rank the project options based on average scores (simple averages followed by weighted scores). Altogether; six stages of analysis were carried out in the process of selecting the high priority adaptation projects. This constitutes three broader phases: ranking based on simple standardized scores, ranking based on weighted scores, and the conduct of sensitivity analysis. The sensitivity analysis is indicative of the robustness of the ranks as weights given to the criteria change. The outcomes of the third stage ranking followed by the three stages of sensitivity analysis were the basis for the final selection of the top 11 high-ranking priority projects. The profiles of selected projects have been outlined in Annex I.

Most of the projects are in line with government programs articulated in the PASDEP consistent with directions and strategies the Government is pursuing in areas of Environment and Natural Resource Conservation and Management. Ethiopia's environmental problems are mainly related to land/soil degradation and deforestation. The total estimated cost of selected high priority projects with out the project design cost is about 770 million USD (see Table 5.4).

5.4.2 Recommendations

General: Given that projects selected through the NAPA process should as a matter of priority be activities supporting target groups, particularly those vulnerable from economic and climatic perspective to respond to their urgent and immediate needs, this is just the beginning in the process of concretizing high priority adaptation projects. The outcomes reported here may need to be further rationalized and concretized through more structured stakeholder consultations.

On the Evaluation Criteria: As has been already noted, the selection process more than any thing else hinges on the criteria identified and the weights attached to each criterion. The first obvious question is: Have we been exhaustive enough in identifying and quantifying the criteria used? Could some of the criteria be unbundled? In this regard, efforts have been made for each criterion/set of criteria to reflect the cross-cutting nature of environmental risks in general and climate change risks in particular. The criteria have been designed in such a way that it enables to pick out projects that are pertinent to address immediate adaptation needs to cope with various environmental hazards including climate change risks. In that sense the criteria have been rendered comprehensive and holistic in the process. But one should not still fall at the mercy of analytical frameworks of the type used in ranking and selecting these project options. One may need to go back and see the projects that have been dropped in the selection process as long as there is good intuitive judgment for a second thought. But it is still recommended that this be done in consultation with experts in the area and more importantly through consultation with the very beneficiaries on the ground.

Another related point is the **weights assigned to each criterion**. The issue of assigning weights has been discussed at length during and following the consultation workshop. The three round sensitivity analysis also provided some degree of confidence in this regard.

Threshold Level of Average Weighted Score: To arrive at a limited number of high priority adaptation Project options, projects were dropped at each stage on the basis of standardized weighted average scores. Threshold average scores were assigned based on subjective judgment.

Table 5.2: Evaluation Criteria and Scores Assigned to Each Project Option

	Project Titles	Criteria				
		Impact on Economic Growth of the Poor (%)	Complementarities with National and Sectoral Plans (0 to 5 scale)	Losses Avoided by Poor People in USD (Units Per Capita Per Year)	Synergies Scale 0 to 4	Cost Effectiveness Million USD
1	Promoting drought/crop insurance program in Ethiopia	5	5	500	4	8
2	Realizing food security through multi-purpose large-scale water development project in Genale–Dawa Basin	5	5	500	4	700
3	Community Based Development and Commercialization of Non-timber Forest Products (Gum Arabic, Myrrah and Frank Incense)	5	3	300	2	5
4	Community Based Rehabilitation of Degraded Eco-Systems in Selected Parts of Ethiopia	3	3	300	4	1
5	Propagation and Commercial Scale Cultivation of Wild Essential Oil Crops	3	4	300	3	5
6	Establishment of Centre for Propagation and Commercialization of Traditional Herbal Medicinal Plants	3	4	250	3	5
7	Establishment of Acacia Woodland Nature Reserve in the Ethiopian Rift Valley System	2	3	300	3	5.5
8	Community Based Carbon Sequestration Project in the Rift Valley System of Ethiopia	4	4	350	3	1
9	Range Shift Cultivation of Selected Cash Crops in Drought Prone Areas	4	4	300	2	0.6
10	Establishment of National R&D Center for Rio-Convention	3	4	350	4	2
11	Development of an Incentive Scheme for Farmers (Hill-farming communities) to Reforest Hill Areas in the Northern Parts of Ethiopia	4	2	250	3	5
12	Participatory Approach to Rehabilitate Degraded Hills/Ecosystem in Northern Ethiopia	2	4	150	2	0.5
13	Institutional Re enforcement for Bio-diversity Conservation	1	5	300	1	4
14	Establishment of National Environmental Education Program	1	2	100	2	0.3
15	Reforestation for Fuel in the Highlands of Ethiopia	3	3	200	2	7
16	Regional Capacity Building for Monitoring and Inventorying of Biodiversity	1	5	400	2	8
17	Establishment of Potato-centered Small-sized Cottages	3	2	200	2	10
18	Reclamation of Bush Encroached Rangelands	4	4	300	1	4
19	Promotion of Legume-based Agroforestry Systems and Home-garden Agriculture	3	4	350	1	0.5
20	Development of New and Rehabilitation (upgrading) of the existing watering sites in Pastoral Areas	3	5	200	1	3
21	Aquaculture Development for Efficient Harvest of Commercial *Spirulina* Species in the Lakes of the Ethiopian Rift Valley System	1	1	200	0	2.5
22	Reorganization of drought Affected Communities	1	1	100	0	8

	Project Titles	Criteria				
		Impact on Economic Growth of the Poor (%)	**Complementarities with National and Sectoral Plans (0 to 5 scale)**	**Losses Avoided by Poor People in USD (Units Per Capita Per Year)**	**Synergies Scale 0 to 4**	**Cost Effectiveness Million USD**
23	Stall feeding promotion and free range grazing restriction in selected regional states of Ethiopia	3	3	400	3	0.6
24	Promotion of on farm and homestead forestry and agro-forestry practices in arid, semi-arid and dry-sub humid parts of Ethiopia	4	4	300	3	5
25	Undertake soil and water conservation practices for improved land husbandry in Afar, Somali and Gambela regional states and Diredawa city administrations	3	3	300	3	7
26	Development of community seed bank and food storage facilities in Amhara, SNNPRS, Tigray, Oromia.	2	4	400	3	0.72
27	Capacity building for small scale irrigation planning and development in Aid, Smi-arid and Dry sub-humid areas of Ethiopia.	4	3	300	3	0.5
28	Community based sustainable utilization and management of wet lands in selected parts of Ethiopia	4	5	500	4	1
29	Strengthening/enhancing drought and flood early warning systems in Ethiopia national level	5	5	500	4	10
30	Capacity building needs for climate change adaptation in Ethiopia mainly at federal as well as regional levels	4	5	400	3	3
31	Public awareness program on climate change in Ethiopia at national as well as regions levels	2	4	300	0	1
32	Development of small scale irrigation and water harvesting schemes in arid, semi-arid, and dry sub-humid areas of Ethiopia	5	5	500	4	30
33	Community capacity building to initiate and implement environmental health program and or projects in the national regional states	2	3	300	2	3
34	Commercial level uses of some indigenous, wild edible fruits in selected arid and semi arid areas of Ethiopia	3	4	300	2	8
35	Strengthening Malaria containment program (MCP) in selected areas of Ethiopia-Gambell, Ethiopian rift valley, Somali.	2	5	350	4	6
36	Institutional development; enhancement of research and development capacity of the national dry land research centers in Ethiopia	1	3	100	3	10
37	Improving/enhancing the range land resources management practices in the pastoral areas of Ethiopia	5	5	400	4	2

Table 5.3: Standardized Simple Scores and ranking based on Average Scores for the 37 Project Options

		Criteria					MCA	
	Project Titles	**Impact on Economic Growth of the Poor (%)**	**Complementarities with National and Sectoral Plans (0 to 5 scale)**	**Losses Avoided by Poor People Units Per Capita Per Year**	**Synergies Scale 0 to 4**	**Cost Effectiveness Million USD**	**Average Score**	**Rank**
1	Promoting drought/crop insurance program in Ethiopia	1.0	1.0	1.00	1.0	0.99	1.00	1
2	Realizing food security through multi-purpose large-scale water development project in Genale–Dawa Basin	1.0	1	1.00	1	0.00	0.80	7
3	Community Based Development and Commercialization of Non-timber Forest Products (Gum Arabic, Myrrah and Frank Incense)	1.0	0.5	0.56	0.5	0.99	0.71	15
4	Community Based Rehabilitation of Degraded Eco-System in Selected Parts of Ethiopia for Carbon Sequestration and Trading	0.5	0.5	0.56	1	1.00	0.71	14
5	Propagation and Commercial Scale Cultivation of Wild Essential Oil Crops	0.5	0.75	0.56	0.75	0.99	0.71	15
6	Establishment of Centre for Propagation and Commercialization of Traditional Herbal Medicinal Plants	0.5	0.75	0.44	0.75	0.99	0.69	19
7	Establishment of Acacia Woodland Nature Reserve in the Ethiopian Rift Valley System	0.3	0.5	0.56	0.75	0.99	0.61	27
8	Community Based Carbon Sequensation Project in the Rift Valley System of Ethiopia	0.8	0.75	0.67	0.75	1.00	0.78	8
9	Range Shift Cultivation of Selected Cash Crops in Drought Prone Areas	0.8	0.75	0.56	0.5	1.00	0.71	12
10	Establishment of National R&D Center for Rio-Convention	0.5	0.75	0.67	1	1.00	0.78	9
11	Development of an Incentive Scheme for Farmers (Hill-farming communities) to Reforest Hill Areas in the Northern Parts of Ethiopia	0.8	0.25	0.44	0.75	0.99	0.64	24
12	Participatory Approach to Rehabilitate Degraded Hills/Ecosystem in Northern Ethiopia	0.3	0.75	0.22	0.5	1.00	0.54	30
13	Institutional re-enforcement for Bio-diversity Conservation	0.0	1	0.56	0.25	0.99	0.56	29
14	Establishment of National Environmental Education Program	0.0	0.25	0.11	0.5	1.00	0.37	34
15	Reforestation for Fuel in the Highlands of Ethiopia	0.5	0.5	0.33	0.5	0.99	0.56	28
16	Regional Capacity Building for Monitoring and Inventorying of Biodiversity	0.0	1	0.78	0.5	0.99	0.65	23
17	Establishment of Potato-centered Small-sized Cottages	0.5	0.25	0.33	0.5	0.99	0.51	31
18	Reclamation of Bush Encroached Rangelands	0.8	0.75	0.56	0.25	0.99	0.66	20
19	Promotion of Legume-based Agro-forestry Systems and Home-garden Agriculture	0.5	0.75	0.67	0.25	1.00	0.63	25

		Criteria					MCA	
	Project Titles	**Impact on Economic Growth of the Poor (%)**	**Complementarities with National and Sectoral Plans (0 to 5 scale)**	**Losses Avoided by Poor People Units Per Capita Per Year**	**Synergies Scale 0 to 4**	**Cost Effectiveness Million USD**	**Average Score**	**Rank**
20	Development of New and Rehabilitation(upgrading) of the existing watering sites in Pastoral Areas	0.5	1	0.33	0.25	1.00	0.62	26
21	Aquaculture Development for Efficient Harvest of Commercial *Spirulina* Species in the Lakes of the Ethiopian Rift Valley System	0.0	0	0.33	0	1.00	0.27	35
22	Reorganization of drought Affected Communities	0.0	0	0.11	0	0.99	0.22	36
23	Stall feeding promotion and free range grazing restriction in selected regional states of Ethiopia	0.5	0.5	0.78	0.75	1.00	0.71	18
24	Promotion of on farm and homestead forestry and agro-forestry practices in arid, semi-arid and dry-sub humid parts of Ethiopia	0.8	0.75	0.56	0.75	0.99	0.76	11
25	Undertake soil and water conservation practices for improved land husbandry in Afar, Somali and Gambela regional states and Diredawa city administrations	0.5	0.5	0.56	0.75	0.99	0.66	21
26	Development of community seed bank and food storage facilities in Amhara, SNNPRS,Tigray, Oromia.	0.3	0.75	0.78	0.75	1.00	0.71	17
27	Capacity building for small scale irrigation planning and development in Aid, Smi-arid and Dry sub-humid areas of Ethiopia.	0.8	0.5	0.56	0.75	1.00	0.71	13
28	Community based sustainable utilization and management of wet lands in selected parts of Ethiopia	0.8	1	1.00	1	1.00	0.95	5
29	Strengthening/enhancing drought and flood early warning systems in Ethiopia national level	1.0	1	1.00	1	0.99	1.00	2
30	Capacity building needs for climate change adaptation in Ethiopia at all levels mainly federal as well as regional levels.	0.8	1	0.78	0.75	1.00	0.85	6
31	Public awareness program on climate change in Ethiopia national as well as regions at all levels	0.3	0.75	0.56	0	1.00	0.51	32
32	Development of small scale irrigation and water harvesting schemes in arid, semi-arid, and dry sub-humid areas of Ethiopia	1.0	1	1.00	1	0.96	0.99	3
33	Community capacity building to initiate and implement environmental health program and or projects in the national regional states of Afar, Gambella, Oromia (Borena), Somali and SNNPR.	0.3	0.5	0.56	0.5	1.00	0.56	16
34	Commercial level uses of some indigenous, wild edible fruits	0.5	0.75	0.56	0.5	0.99	0.66	22

		Criteria					MCA	
	Project Titles	**Impact on Economic Growth of the Poor (%)**	**Complementarities with National and Sectoral Plans (0 to 5 scale)**	**Losses Avoided by Poor People Units Per Capita Per Year**	**Synergies Scale 0 to 4**	**Cost Effectiveness Million USD**	**Average Score**	**Rank**
	in selected arid and semi arid areas of Ethiopia (Somali, lowlands of Oromia, Tigray and Amhara)							
35	Malaria containment program (MCP) in selected areas of Ethiopia	0.3	1	0.67	1	0.99	0.78	10
36	Institutional development and/or enhancement of research and development capacity of the national dry land research centers.	0.0	0.5	0.11	0.75	0.99	0.47	33
37	Improving/enhancing the range land resources management practices in the pastoral areas of Ethiopia	1.0	1	0.78	1	1.00	0.95	4

Table 5.4: List of projects prioritized using Multi-Criteria Assessment (MCA)

	Title of Project	Average standard score	Rank	Estimated cost (Million USD)	Estimated project design cost (Million USD)
1	Promoting drought/crop insurance program in Ethiopia	1.00	1	8	0.1
2	Strengthening/enhancing drought and flood early warning systems in Ethiopia	1.00	2	10	0.1
3	Development of small scale irrigation and water harvesting schemes in arid, semi-arid, and dry sub-humid areas of Ethiopia	0.99	3	30	0.5
4	Improving/enhancing rangeland resource management practices in the pastoral areas of Ethiopia	0.95	4	2	0.05
5	Community based sustainable utilization and management of wet lands in selected parts of Ethiopia	0.95	5	2	0.05
6	Capacity building program for climate change adaptation in Ethiopia	0.85	6	3	0.1
7	Realizing food security through multi-purpose large-scale water development project in Genale–Dawa Basin	0.80	7	700	2
8	Community Based Carbon Sequestration Project in the Rift Valley System of Ethiopia	0.78	8	1	0.05
9	Establishment of national research and development (R&D) center for climate change	0.78	9	2	0.2
10	Strengthening malaria containment program(MCP) in selected areas of Ethiopia	0.78	10	6	0.5
11	Promotion of on farm and homestead forestry and agro-forestry practices in arid, semi-arid and dry-sub humid parts of Ethiopia	0.76	11	5	0.1
		Total cost		770	3.75

Chapter 6

NAPA Preparation Process

The NAPA preparation process in Ethiopia has followed the annotated guidelines prepared by the LDC Expert Group (LEG). According to the guidelines the steps for preparing NAPA's include building NAPA team, synthesizing available information, conducting stakeholder consultation, synergy assessment, identification of adaptation options, development and evaluation of criteria, prioritizing adaptation projects and development of project profiles (UNFCCC/LEG, 2002).

6.1 Institutional Arrangement

The National Adaptation Program of Action for Ethiopia was initiated and coordinated by the National Meteorological Agency. A project Steering Committee with representatives from the following stockholder institutions has been established. The role of the steering committee is to provide overall guidance and oversight for the project.

- Ministry of Water Resources
- Ministry of Agriculture and Rural Development
- Ministry of Finance and Economic Development
- Disaster Prevention and Preparedness Agency
- Ethiopian Science and Technology Agency
- National Meteorological Agency
- Addis Ababa University
- Institute of Biodiversity Conservation and Research
- Ethiopian Rural Energy Promotion and Development Center
- CRDA representing NGOs

A Project Management Team consisting of a project coordinator, assistant project coordinator, secretary, accountant, technical coordinator, and data processor was established with in NMA to implement the day to day activities of the project. A National UNV was also employed to assist the project management team. Use was made of national experts as consultants to prepare various technical reports that were used as input to the preparation of NAPA.

6.2 Synthesis of Information

Assessments conducted by national consultants to feed in to the formulation of high priority adaptation options (project profiles) for the NAPA include synthesis of available information on vulnerability, synergy assessment and development of criteria for prioritization of projects.

6.3 Stakeholder Consultation

The preparation of NAPA was guided by a participatory process involving stakeholders, a multidisciplinary and complementary approach building on existing plans and programs including national action plans under the United Nations Convention to Combat Desertification, National Biodiversity Strategies and Action Plans and the Convention on Biological Diversity, and national sectoral policies.

Considering the circumstances under which the required participation of stakeholders could be best achieved in the NAPA process, the so called "participatory workshop technique" was used for consultation to elicit information from the grass root population to inform the process of prioritization and selection of adaptation options. In this regard 2 national and 8 regional workshops were conducted involving about 500 participants with various expertise. The purpose of the consultations was to create awareness about climate change issues and to solicit input on vulnerability and adaptation assessments. Some pictures of the consultation workshops are shown on pages 63, 64 and 65.

6.4 Mechanisms of Endorsement

The draft final NAPA report was discussed in a national workshop organized on January 29, 2007. The document was improved by incorporating comments and suggestions made during the national workshop. The Steering Committee reviewed and approved the NAPA document. The NAPA document was officially approved and signed by the Minister of Water Resources.

First national consultation workshop with stakeholders on Climate Change Technology Needs Assessment and NAPA

Consultative and stakeholders workshop in Benishangul-Gumuz Regional State- Asossa

Consultative and stakeholders workshop in Tigray Regional State- Mekele



Consultative and stakeholders workshop in Southern National and Nationalities Peoples' Regional State-


Consultative and stakeholders workshop in Oromiya Regional State- Adama


Consultative and stakeholders workshop in Amhara Regional State- Bahirdar

Final national consultation workshop with stakeholders on NAPA in Addis Ababa

7. Reference

1. Degefu, W., 1987: Some aspects of meteorological drought in Ethiopia. In M. H. Glantz (Ed.), *Drought and Hunger in Africa*. Cambridge: Cambridge University Press
2. *Endalkachew, B, etal, 2004*: *Generation and Application of Climate Information, Products and Services for Disaster Preparedness and Sustainable Development in Ethiopia, Addis Ababa, Ethiopia*
3. Gissila, T., E. Black, D.I.F. Grimes and J.M.Slingo, 2004: Seasonal forecasting of the Ethiopian Summer rains. Int. J. Climatol., **24**, 1345-1358.
4. Haile, T., 1988: Causes and Characteristics of Drought in Ethiopia. *Ethiopian Journal of Agricultural Sciences.* **10**, 85 – 97
5. Intergovernmental Panel on Climate Change (IPCC), 2007: Climate Change 2007. Synthesis Report. Cambridge University Press. Cambridge.
6. Intergovernmental Panel on Climate Change (IPCC). 2001: Climate Change 2001, Synthesis Report. Cambridge University Press. Cambridge.
7. Intergovernmental Panel on Climate Change (IPCC), 1995: Climate Change 1995, Synthesis Report. Cambridge University Press, Cambridge
8. Korecha, D., and Barnston, A.G, 2007: Predictability of June-September Rainfall in Ethiopia. Monthly weather review, **135**, 629-649.
9. Ministry of Finance and Economic Development (MoFED), 2006, Ethiopia: Building on Progress, A Plan for Accelerated and Sustained Development to End Poverty (PASDEP), (2005/06-2009/10) Volume I: Main Text, Addis Ababa, Ethiopia
10. Ministry of Finance and Economic Development (MoFED), 2002: Sustainable development and Poverty Reduction Program. Addis Ababa, Ethiopia.
11. Nicholls, N., 1993: What are the potential contributions of El Niño - Southern Oscillation research to Early Warning of potential acute Food-deficit situations. In M. H. Glantz (Ed.), *Workshop on Usable Science: Food Security, Early Warning and El Niño,* Budapest, Hungary, Boulder: NCAR, 169-177
12. National Meteorology Agency (NMA), 2007: Final Report on Synergy between Adaptation and Multi-lateral Environmental Agreements prepared by B and M Development Consultants for NMA. Addis Ababa, Ethiopia
13. National Meteorology Agency (NMA), 2007: Final Report on Synergy between Adaptation and Policy /Program Initiatives prepared by B and M Development Consultants for NMA. Addis Ababa, Ethiopia
14. National Meteorology Agency (NMA), 2007: Final Report on Synergy between Adaptation and Project Initiatives prepared by B and M Development Consultants for NMA. Addis Ababa, Ethiopia
15. National Meteorology Agency (NMA), 2007: Final Summary Report on Synergy Assessment prepared by B and M Development Consultants for NMA. Addis Ababa, Ethiopia
16. National Meteorology Agency (NMA), 2007: Final Report on Evaluation Criteria for Identifying High Priority Adaptation Activities prepared by B and M Development Consultants for NMA. Addis Ababa, Ethiopia
17. National Meteorology Agency (NMA), 2006. Agro-meteorology bulletin, Addis Ababa, Ethiopia
18. National Meteorological Services Agency (NMSA), 2001. Initial National Communication of Ethiopia to the UNFCCC. Addis Ababa, Ethiopia

19. National Meteorological Services Agency (NMSA), 1996: Climatic and Agro-Climatic Resources of Ethiopia. Meteorological Research Report Series, Vol.1.No.1, 1-37. Addis Ababa, Ethiopia

20. UNDP, 2005: Adaptation Policy Framework (APF)

21. UNFCCC/LEG, 2002: Annotated Guidelines for the Preparation of National Adaptation programmes of action. Bonn, Least Developed Countries Expert Group

22. Webb, P. and J. von Braun, 1994: Famine and Food Security in Ethiopia: Lessons for Africa. *Chichester: John Wiley & Sons*

Annex I

Profile of Priority Adaptation Activities/Projects

The proposed project concepts summarized below are meant for further development and implementation.

I	***Project Title***	**Promoting drought/crop insurance program in Ethiopia**
	Rationale/justification *in relation to climate change, including sectors concerned*	Ethiopia is highly vulnerable to drought.. Drought is the single most important climate related natural hazard impacting the country from time to time. Ethiopian economy depends on rain-fed agriculture. 85% of the population livelihood is contingent upon this sector. But, climate extremes shackle the livelihood and economy of the country as it is closely linked to recurrent drought. Cases in points are the 1965, 1976, 1979, 1982, 1984, 1987, 1990-1992, 1997, 2002/3 droughts that resulted in poor crop production and economy. The 2002/3 drought affected 14, 000 peoples livelihood, particularly farmers. Drought insurances will minimize these shocks. The recurrent drought occurrences and population affected time series data reveal that population affected increases abruptly with time. To partially reverse this statistics and sustain the farmers' livelihood in the drought prone areas, drought insurance is one of the solutions. It will as well ease the impacts from climate change shocks. Poor farmers face highly uncertain risks with a lot to loose. Because of their high risk they don't have access to credit. Weather insurance opens up the possibility to credit. Insurance is one way of weather risk coping mechanism. It is a risk management tool.
	Description	
	Objectives	• Contribute to risk-management system to protect the livelihoods of Ethiopian farmers vulnerable to recurrent drought risk and • Demonstrate the feasibility of establishing contingency funding for an effective aid response in drought years.
	Activities	Undertake assessment of needs and current situation Undertake consultation with stakeholders Build capacity for insurance design Acquisition of facilities Short and long term training of personnel on climate change issues Preparation of full project proposal

	Short-term outputs	Drought Indices and insurance design developed Increased number of farmers insured for drought Capacity building and training of key actors Studies, research and assessments of various aspects of weather/drought insurance
	Potential long-term outcomes	Enhanced coping mechanism and adaptive capacity to drought impacts
	Implementation	
	Institutional arrangement	Ministry of Agriculture and Rural Development will lead the coordination of the project. Other stakeholder institutions include the National Meteorological Agency, Disaster Prevention and Preparedness Agency, National/ international insurance company
	Risks and barriers	Lack of finance, lack of technical capacity
	Evaluation and monitoring	A project steering committee composed of representatives from stockholders will oversee the project. Regular progress reports will be submitted to all concerned bodies by the lead institution and field visits will be conducted as appropriate. Evaluation of the project will be carried out by independent technical experts.
	Estimated (indicative and tentative) project cost	Full project implementation: USD 8 million Project design: USD 100,000

II	***Project Title***	**STRENGTHENING/ENHANCING DROUGHT AND FLOOD EARLY WARNING SYSTEMS IN ETHIOPIA**
	Rationale/justification *in relation to climate change, including sectors concerned*	According to the recent IPCC Fourth Assessment Report extreme weather and climate events are likely to increase in frequency and intensity under a changing climate. The report also concluded that the impacts of these events would be severe on developing countries like Ethiopia. Extreme weather and climate events can be monitored and predicted with current technologies such as numerical weather prediction, climate models, satellites and radars. The National Meteorological services in Ethiopia, however, do not have adequate capacity to provide accurate and timely user specific weather and climate forecast. The current capacity to provide accurate and timely weather and climate forecasts in Ethiopia is limited due to lack of facilities, skilled manpower and technologies. Metrological station networks are not adequate. Communication, satellite and radar facilities that can support generating weather and climate information are lacking In line with enhancement of meteorological services delivery, there is need to improve physical infrastructure (observation stations, telecommunications, data processing) and climate applications. In order to keep abreast with the rapid and ever changing new technologies especially technologies for advanced meteorological services, there is need to adopt human resource development strategies in information technology.
	Description	
	Objectives	To establish improved drought and flood early warning system in Ethiopia through improved weather and climate monitoring and predication.
	Activities	• Assess existing early warning systems and identify gaps in the country Improvements of monitoring and prediction facilities: • Improvement of observational network • Upgrading telecommunication network through modern technologies. • Improvement of data processing systems and automation of date quality control, analysis and archival ▪ Development of skilled human resource: • Improvement of observational network; • Specialized training in Numerical weather prediction(NWP), climate modelling; information technology, meteorological equipment and instrument maintenance

	Short-term outputs	• Improved observational network and telecommunications and data processing facilities; • Adequately trained human resource at National Meteorological Agency (NMA); • Improved dissemination techniques; and • Accurate and timely weather and climate forecasts
	Potential long-term outcomes	Impacts of extreme weather and climate events on life and property minimized
	Implementation	
	Institutional arrangement	National Meteorological Agency will lead the coordination of the project.
	Risks and barriers	Lack of finance, lack of technical capacity
	Evaluation and monitoring	A project steering committee composed of representatives from stockholders will oversee the project. Regular progress reports will be submitted to all concerned bodies by the lead institution and field visits will be conducted. as appropriate. Evaluation of the project will be carried out by independent technical experts.
	Estimated (indicative and tentative) project cost	Full project implementation: USD 10 million Project design: USD 100,000

III	***Project Title***	**DEVELOPMENT OF SMALL SCALE IRRIGATION AND WATER HARVESING SCHEMES IN ARID, SEMI-ARID, AND DRY SUB-HUMID AREAS OF ETHIOPIA**
	Rationale/justification *in relation to climate change, including sectors concerned*	Dependency on seasonal rains has not only kept crop production and productivity very low but also made agriculture a risky business. Arid, semi-arid, and dry sub-humid areas of the country experience very high seasonal and inter annual rainfall variability affecting crop production and food security. Ethiopia is rich in its water resources and sometimes called the water tower of East Africa. However, the country is constrained; among others by lack of capacity to sustain and ably utilize its water resources. The total irrigable land under irrigation currently averages 4 to 5 percent. Large and Small scale irrigation development is mentioned as one of the priorities of NAP and the Initial National Communication Report for UNFCCC has also suggested as one of the climate change adaptation options for the agriculture sector. Water harvesting could be a valuable tool in increasing crop production, supplying water for humans and livestock.
	Description	
	Objectives	• To increase water accessibility for agricultural production and enhance food security as well as to minimize impacts of drought hazards • Enhance socio-economic growth and alleviate poverty • To increase domestic water supply and livestock through water harvesting • To develop arable production with runoff farming/ rain water harvesting • To rehabilitate existing traditional irrigation and improve water application practices; • To increases capacity of farmers and key actors to utilize water for agricultural production
	Activities	Assessment and inventory of existing situation Study, design and implementation Identification of suitable sites for water harvesting, small scale irrigation dams and boreholes Construction/development of dams, boreholes and ponds Develop improved field canals and on-farm works Prepare land for irrigation Develop river diversion schemes using gravity or pump supply for small scale irrigation schemes Organization of workshops for training of communities and professionals in water management

	Short-term outputs	Small scale irrigation dams and boreholes developed at selected sites Increased irrigated land (Development of 30,000 hectares of small scale irrigation scheme) Increased agricultural production through better productivity Increased capacity of communities and professionals in small scale irrigation management
	Potential long-term outcomes	Improved food and energy security, water supply and economic development
	Implementation	
	Institutional arrangement	Ministry of Agriculture and Rural development will lead the coordination of the project. Ministry of Water resources, Bureau of Agriculture and Rural development, Water Users Associations, farmers and private investors are the main stakeholders
	Risks and barriers	lack of finance, lack of technical capacity, unavailability of suitable sites
	Evaluation and monitoring	A project steering committee composed of representatives from stockholders will oversee the project. Regular progress reports will be submitted to all concerned bodies by the lead institution and field visits will be conducted. as appropriate. Evaluation of the project will be carried out by independent technical experts.
	Estimated (indicative and tentative) project cost	Full project implementation: USD 30 million Project design: USD 500,000

IV	***Project Title***	**IMPROVING/ENHANCING THE RANGELAND RESOURCES MANAGEMENT PRACTICES IN THE PASTORAL AREAS OF ETHIOPIA**
	Rationale/justification *in relation to climate change, including sectors concerned*	The rangeland resources of the country are deteriorating, thus threatening the very livelihoods of the vast majority mainly the pastoral community. The major reasons for the decline in the resources bases include, among others: overgrazing, decline of the traditional mode of managing the rangeland resources, bush encroachment, introduction of Invasive Alien Species, expansion of development endeavors, population pressure, etc. These phenomena have been exacerbated by climatic change/variability and the spread of desertification. This project is believed to contribute to efforts aimed at reversing the degradation of the rangeland resources, which has been one of the main concerns in those National Regional States especially the lowlands where the pastoral communities inhabit.
	Description	
	Objectives	To improve the current status of rangeland resources degradation by taking one woreda (district) from pastoralist areas as a pilot site from each National Regional States.
	Activities	• Assessment of the socio-economic conditions of the pilot woredas; • Introduction of fodder development initiatives such as site specific suitable fodder trees and shrubs planting program; • Undertake controlling measures on bush encroachment problems; • Measures to control of Invasive Alien Species such as *Prosopis Juliflora,* for instance, in Afar National Regional state; • Document and undertake promotional activities on the indigenous rangeland resources management practices using various awareness raising approaches/ means such as media; and • Undertake adaptive research
	Short-term outputs	Improved rangeland management practices piloted in selected site
	Potential long-term outcomes	Improved productivity and sustainable use of rangelands

	Implementation	
	Institutional arrangement	Ministry of Agriculture and Rural Development (MoRAD) will lead the coordination of the project.
	Risks and barriers	Lack of finance, lack of technical capacity
	Evaluation and monitoring	A project steering committee composed of representatives from stockholders will oversee the project. Regular progress reports will be submitted to all concerned bodies by the lead institution and field visits will be conducted as appropriate. Evaluation of the project will be carried out by independent technical experts.
	Estimated (indicative and tentative) project cost	Full project implementation: USD 2 million Project design: USD 50,000

V	***Project Title***	**COMMUNITY BASED SUSTAINABLE UTILIZATION AND MANAGEMENT OF WET LANDS IN SELECTED PARTS OF ETHIOPIA**
	Rationale/justification *in relation to climate change, including sectors concerned*	Wetlands are among the world's most important assets, providing the basis for human survival and development, and contribute to global biodiversity. Among their significant functions, they reduce the greenhouse effect (through their capacity for sequestrating and retaining carbon); stabilize microclimates; provide tourism/recreation and water transport opportunities; retain and purify agrochemicals, toxicants and sediments; minimize natural disasters such as drought and floods; recharge ground water; and contribute to the hydrological characteristics of aquatic ecosystems. They also generate various products such as water supply, fisheries, wildlife, forest and agricultural resources. The above paragraphs explicitly show the significance of protecting the wetlands ecosystems for climate change adaptation, biodiversity conservation and combating desertification and mitigate the effects of drought.
	Description	
	Objectives	To conserve and wisely use the selected wetlands to promote the adaptation capacity of the rural community for climate shocks
	Activities	Detail assessment of current situation Undertake consultation with stakeholders Create awareness and training of personnel Identification of potential and target areas Preparation of full project proposal
	Short-term outputs	Selected wetlands situated in arid semiarid and dry sub-humid parts of the country are sustainably managed
	Potential long-term outcomes	Sustainable utilization of wetland in Ethiopia
	Implementation	
	Institutional arrangement	Ministry of Water Resources will lead the coordination of the project. The main stakeholders include Regional Environmental Protection Agencies; Bureaus of Agriculture and Rural development; Community Based Organizations; Local NGOs, farmers, pastoralists and local administrations.
	Risks and barriers	Lack of finance, lack of technical capacity
	Evaluation and monitoring	A project steering committee composed of representatives from stockholders will oversee the project. Regular progress reports will be submitted to all concerned bodies by the lead institution and field visits will be conducted. as appropriate. Evaluation of the project will be carried out by independent technical experts.
	Estimated (indicative and tentative) project cost	Full project implementation: USD 2 million Project design: USD 50,000

VI	***Project Title***	**CAPACITY BUILDING NEEDS FOR CLIMATE CHANGE ADAPTATION IN ETHIOPIA**
	Rationale/justification *in relation to climate change, including sectors concerned*	Currently there are a number of constraints for planning and implementing climate change adaptation. These constraints include: • Inadequacy of skilled manpower on climate change issues; • Weak institutional set up and coordination on climate change; • Inadequate facilities; • Lack of specific policies on climate change adaptation; and • Inadequate research Available studies and research conducted so far on vulnerability and adaptation specific to Ethiopian case are scanty due to lack of capacity. Adequate knowledge and information has to be generated to develop adaptation polices for the country. Strengthening research in the field is essential. Skilled human resources development on climate change issues is of a primary importance and needs to be given due attention. Unless the country has adequate number of cadres that can spearhead climate change issues, implementation of adaptation will be slow.
	Description	
	Objectives	• To develop capacity that enables to plan and implement adaptation to climate change in the country; and • To develop capacity that enables to conduct research, promote documentation and information on climate change
	Activities	Capacity building in terms of development of skilled human resource, infrastructure and facilities including institutional strengthening is a prerequisite for planning and implementing adaptation to climate change. Specific human resource capacity needs required includes short and long term training including specialization at higher levels (such as MSc, PhD levels) in the areas of: • Climate change vulnerability and adaptation assessment for sectors of Agriculture, water resources, human health, biodiversity/ecosystems; • Climate modeling, climate analysis and prediction; • Environmental economics, environmental management; • Policy analysis and appraisal focused on climate change; • Sustainable agriculture; • Irrigation agriculture; • Integrated water resource management; • Natural resource management; and

		• Land use planning Specific needs in terms of infrastructure and facilities/institutions include: • Vulnerability and adaptation assessment tools such as DSSAT, WEAP; • Information and research data base, (global, regional, national, local); • Statistical and GIS Packages such as SYSTAT, ARCGIS, IDRSI; • Climate data base management systems; • Integrated assessment tools, economic models; • Climate analysis tools and Climate prediction tools (regional climate models such as Magic/Sengen, Precis, downscaling methods); • Risk assessment tools; • High speed connectivity and high capacity/speed computers; and • Upgrading the current research department to a national center on climate research
	Short-term outputs	• Adequate number of trained manpower to undertake adaptation planning and implementation; and • Adequate facilities and analytical tools and institutional setup put in place
	Potential long-term outcomes	The country will be in a better position to meet its obligations and exploit opportunities under the Climate Convention.
	Implementation	
	Institutional arrangement	National Meteorological Agency will lead the coordination of the project Disaster Prevention and Preparedness Agency, Ministry of Capacity Building and Higher Learning Institutions. departments, academic and research institutions, and NGOs
	Risks and barriers	Lack of finance, lack of technical capacity, legal/institutional
	Evaluation and monitoring	A project steering committee composed of representatives from stockholders will oversee the project. Regular progress reports will be submitted to all concerned bodies by the lead institution and field visits will be conducted. as appropriate. Evaluation of the project will be carried out by independent technical experts.
	Estimated (indicative and tentative) project cost	Full project implementation: USD 3 million Project design: USD 100,000

VII	***Project Title***	**Realizing food security through multi-purpose large-scale water development project in Genale–Dawa Basin**
	Rationale/justification *in relation to climate change, including sectors concerned*	The mainstay of Ethiopian economy is subsistent and rain-fed agriculture. 85% of the population is engaged in farming. Compounding the problem, drought and flood dictates our lives. The largest part of the country is under semi-arid and arid ecology. According to the recent Human Development Resource, incidence of poverty is considered to be one of the highest in the world with 55% of the population below the poverty line –in some regions, as high as 85%. Food is unsecured and health problems are prevalent. Climate change makes this situation more serious. It is therefore imperative to opt to multipurpose large-scale irrigation project ameliorate the impacts of recurrent drought in the country. Towards this end, an integrated developmental project to develop the adaptive capacity of drought prone population within Genale - Dawa River Basin (in southern part of Ethiopia) is proposed. It is in this Basin that the higher percentage of people under poverty line. Infrastructures such as electricity, water supply, health are absent. The region is known with subsistence farming and pastoralal livelihood facing frequent drought and rainfall declining abruptly. More than 91% of the population in the Basin lives in rural areas, where accessibility of basic needs hardly any. The Basin is a highland –lowland system with a risk of natural resource degradation, particularly water and land, due to a rapid increase in the demand of water and high variability. The multi-purpose project entails large-scale irrigation, food security (large-scale agriculture of food and cash crops), rural water supply (drinking) and sanitation, water supply for livestock and hydro-power generation. The Basin has an area of 168,000 km2, annual flow of 6.10 billons cubic meter of annual flow and 406,000 ha of irrigable land, optimal for this type of project.
	Description	
	Objectives	● To contribute to the reduction of poverty, improvement of the welfare of the rural populations and sustainable natural resources management towards viable sustainable development in the basin. ● To improve the living standard and general socio-economic well being of people ● To realize food self-sufficiency and food security of

		population in the Basin. ● To extend water supply and sanitation coverage to large segments of the society ● To access electric energy from the hydropower for multi-use ● To increase the availability of water for livestock, crop irrigation, aquaculture, energy , rural industry and domestic use
	Activities	Assessment and review of existing master plans and works on Genale–Dawa river basin Feasibility studies Construction of dams Training of personal on irrigation development and management
	Short-term outputs	Increased availability of water for livestock, crop irrigation, aquaculture, rural industry and domestic use Dams constructed Irrigated land Increased agricultural production Hydro power generated Capacity built in irrigation management
	Potential long-term outcomes	Improved livelihood with minimum impact of climate variability and change with easy access to drinking water, water for livestock, electricity, reliable food production and cash crops towards food security
	Implementation	
	Institutional arrangement	Ministry of Water Resources will be the lead institution to coordinate the project
	Risks and barriers	Lack of finance, lack of technical capacity, environmental impact, legal/institutional
	Evaluation and monitoring	A project steering committee composed of representatives from stockholders will oversee the project. Regular progress reports will be submitted to all concerned bodies and field visits will be conducted as appropriate. Evaluation of the project will be carried out by independent technical experts.
	Estimated (indicative and tentative) project cost	Full project implementation: USD 700 million Project design: USD 2 million

VIII	***Project Title***	**COMMUNITY BASED CARBON SEQUESTRATION IN THE RIFT VALLEY SYSTEM OF ETHIOPIA**
	Rationale/justification *in relation to climate change, including sectors concerned*	The Ethiopian Rift Valley system is endowed with immense natural resources of high values. It embodies a chain of Ethiopian famous lakes packed with various resources of commercial importance such as fishery and highly nutritious algal group (Spirulina species). The project will focus on community carbon budget forestry to rehabilitate the Acacia woodland. It should be realized that accelerated degradation of Acacia woodland in the rift valley system does also trigger losses of both soil and terrestrial biodiversity.
	Description	
	Objectives	• Establishment of nursery sites for the propagations of indigenous *Acacia* species • Enrichment plantations of *Acacia* woodland • To trade Carbon • To establish incentive schemes
	Activities	Assessment of current situation Undertake consultation with stakeholders Create awareness and training of personnel Identification of potential and target areas Preparation of full project proposal
	Short-term outputs	Community based carbon sequestration projects piloted in selected sites in the rift valley
	Potential long-term outcomes	Improved livelihoods through clean development mechanisms (carbon trading); restored ecosystem and permanent in-situ carbon fixation
	Implementation	
	Institutional arrangement	Environmental Protection Authority will be the lead agency for coordinating the project
	Risks and barriers	Lack of finance, lack of technical capacity, legal/institutional
	Evaluation and monitoring	A project steering committee composed of representatives from stockholders will oversee the project. Regular progress reports will be submitted to all concerned bodies by the lead institution and field visits will be conducted as appropriate. Evaluation of the project will be carried out by independent technical experts.
	Estimated (indicative and tentative) project cost	Full project implementation: USD 1 million Project design: USD 50,000

IX	***Project Title***	**ESTABLISHMENT OF NATIONAL CLIMATE RESEARCH CENTER**
	Rationale/justification *in relation to climate change, including sectors concerned*	Climate is a key natural resource on which the others depend. It influences food production, water and energy availability. It sets the stage for the establishment of habitats, affects the pace of primary productivity, and influences species density and distribution. At the moment there is no dedicated institution which carries out research and studies on the issues of climate change and variability in the country.
	Description	
	Objectives	To establish a national climate center which can provide information and policy advice for government through research and studies.
	Activities	Assessment of needs and current situation Undertake consultation with stakeholders Acquisition of facilities Short and long term training of personnel on climate change issues Preparation of full project proposal
	Short-term outputs	Establishment of well equipped centre for climate change research centre Trained human capital that can undertake research and studies on climate change
	Potential long-term outcomes	The Centre will help the country to pursue sustainable development that contributes for the protection of the earth's climate. The establishment of the center will also enhance the adaptive capacity of the country for climate related risks.
	Implementation	
	Institutional arrangement	National Meteorological Agency will lead the coordination of the project.
	Risks and barriers	Lack of finance, lack of technical capacity, legal/institutional
	Evaluation and monitoring	A project steering committee composed of representatives from stockholders will oversee the project. Regular progress reports will be submitted to all concerned bodies by the lead institution and field visits will be conducted as appropriate. Evaluation of the project will be carried out by independent technical experts.
	Estimated (indicative and tentative) project cost	Full project implementation: USD 3 million Project design: USD 200,000

X	***Project Title***	**STREANGTHINING MALARIA CONTAINMENT PROGRAMS IN SELECTED AREAS OF ETHIOPIA**
	Rationale/justification *in relation to climate change, including sectors concerned*	One of the potential adverse impacts of climate change is range expansion of vector-borne diseases such as malaria. It is now a common practice in Ethiopia to witness malaria infections in places, which were safe hitherto. Although eradication of malaria may be a long way to pursue, containment could be viewed as the best alternative at this juncture. To further pursue this goal, the proposed project combined direct assistances for the local community with the development of traditional knowledge for the treatment of this disease.
	Description	
	Objectives	To contain and reduce the infection rate of malaria in selected parts of Ethiopia.
	Activities	• Assessment of current situation • Undertake consultation with stakeholders • Identification of potential and target areas • Distribution of mosquito nets to local people; • Upgrading and maintaining high level of environmental standards of streams, ponds and other water bodies close to settlements; • Conduct scheduled training programs involving experts and local development agents; and • Up-scaling traditional health practices in connection to treatment of malaria • Preparation of full project proposal
	Short-term outputs	Malaria containment programs strengthened in selected malaria prone areas (districts)
	Potential long-term outcomes	Impact of malaria on mortality and morbidity minimized
	Implementation	
	Institutional arrangement	Ministry of Health will be the lead in coordinating the project
	Risks and barriers	Lack of finance, lack of technical capacity, legal/institutional
	Evaluation and monitoring	A project steering committee composed of representatives from stockholders will oversee the project. Regular progress reports will be submitted to all concerned bodies by the lead institution and field visits will be conducted as appropriate. Evaluation of the project will be carried out by independent technical experts.
	Estimated (indicative and tentative) project cost	Full project implementation: USD 6 million Project design: USD 500,000

XI	***Project Title***	**PROMOTION OF ON FARM AND HOMESTEAD FORESTRY AND AGRO-FORESTRY IN ARID, SEMI-ARID AND DRY-SUB HUMID PARTS OF ETHIOPIA**
	Rationale/justification *in relation to climate change, including sectors concerned*	Decline in farmlands productivity and production as one of the manifestations of land degradation is caused mainly due to loss in soil fertility .The decline in soil fertility in turn is mainly caused by removing or not planting the trees, notably, the indigenous trees which are important for nitrogen fixation. In order to promote the fertility and productivity of the farmlands, one of the feasible intervention areas is the introduction of on-farm and homestead forestry practices. Legume-based agro-forestry also serves multiple purposes such as fixing nitrogen (increased crop production) and enhances carbon pool and counter balance desertification. Pods and leaves can be used as fodder for livestock. Vegetation cover increment on farmlands enhances carbon sequestration, and climate mitigation. Moreover, intensification of agricultural practices is one of the priorities in the National Action Plan to combat desertification Convention in Ethiopia.
	Description	
	Objectives	• To build the capacity of the farmers for improved soil management through the promotion of awareness, raising or availing indigenous and multi- purpose trees and provision of technical advice on the indigenous trees seedling production and planting • To promote legume-based agro-forestry • To promote the growing of fruit trees
	Activities	Detail assessment of current situation Undertake consultation with stakeholders Create awareness Identification of potential and target areas Establishment of tree nurseries Training of farmers and agricultural extension workers Preparation of full project proposal
	Short-term outputs	A number of nursery sites for fruit trees, fodder and legumes identified Farm and homestead forestry and agro-forestry practiced in selected pilot districts Capacity building and key actors trained

	Potential long-term outcomes	Sustainable Fodder production; improved soil fertility, increased food security
	Implementation	
	Institutional arrangement	Ministry of Agriculture and Rural Development (MoRAD) will lead the coordination of the project.
	Risks and barriers	Lack of finance, lack of technical capacity, legal/institutional
	Evaluation and monitoring	A project steering committee composed of representatives from stockholders will oversee the project. Regular progress reports will be submitted to all concerned bodies by the lead institution and field visits will be conducted. as appropriate. Evaluation of the project will be carried out by independent technical experts.
	Estimated (indicative and tentative) project cost	Full project implementation: USD 5 million Project design: USD 100,000