GOVERNMENT OF THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

INSTITUTE OF BIODIVERSITY CONSERVATION

NATIONAL BIODIVERSITY STRATEGY AND ACTION PLAN

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Ethiopia

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ACRONYMS

AAU ..... Addis Ababa University
AHRI ..... Armaeur Hansen Research Institute
AUA ..... Alemaya University of Agriculture
CBO ..... Community Based Organisation
CCD ..... Convention to Combat Desertification
CSA ..... Central Statistics Authority
CSE ..... Conservation Strategy of Ethiopia
EARO ..... Ethiopian Agricultural Research Organisation
ECA ..... Ethiopian Customs Authority
EHNRI ..... Ethiopian Health and Nutrition Research Institute
EIA ..... Environmental Impact Assessment
FCCC ..... Framework Convention for Climate Change
GMO ..... Genetically Modified Organism
NEQS ..... National Environmental Quality Systems
EDRI ..... Ethiopian Development Research Institute
EMA ..... Ethiopian Mapping Authority
EPA ..... Environmental Protection Authority
ESTC ..... Ethiopian Science and Technology Commission
ETC ..... Ethiopian Tourism Commission
EVDSA ..... Ethiopian Valleys Development Studies Authority
EWCO ..... Ethiopian Wildlife Conservation Organisation
EWDCD ..... Ethiopian Wildlife Development and Protection Department
FAO ..... Food and Agricultural Organisation
GEF ..... Global Environmental Facility
GIS ..... Geographical Information System
HLI ..... Higher Learning Institutions
IBC ..... Institute of Biodiversity Conservation
ILRI ..... International Livestock Research Institute
IUCN ..... World Conservation Union
LMO ..... Living Modified Organism
MOARD ..... Ministry of Agriculture and Rural Development
MOCB ..... Ministry of Capacity Building
MOE ..... Ministry of Education
MOFA ..... Ministry of Foreign Affairs
MOFED ..... Ministry of Finance and Economic Development
MOI ..... Ministry of Information
MOJ ..... Ministry of Justice
MOWR ..... Ministry of Water Resources
NBSAP ..... National Biodiversity Strategy and Action Plan
NGO ..... Non-Governmental Organisations
REPA ..... Regional Environmental Protection Authority
SEA ..... Standard Environmental Assessment
UNDP ..... United Nations Development Programme

Foreword

The life support system on which our livelihoods depend are being degraded, and biodiversity is the principal component of this system. On top of the profound ethical and aesthetical implications, it is clear that the loss of biodiversity has serious economic and social costs. The genes, species, ecosystems and human knowledge that are being lost represent a living reservoir of options available for preventing, adapting and managing local and global changes. To this end, we have to align our endeavours towards sustainable conservation and development.

Ethiopia is a country of great natural and cultural biodiversity. These assets must be valued, conserved and developed in order to bring benefits to all. If we are to conserve these resources, we must learn more about them and our interactions with ecosystems.

This National Biodiversity Strategy and Action Plan (NBSAP) is a useful document providing analyses of the state of biodiversity and the environment at large over the past decades, the root causes of biodiversity loss and the adverse consequences against social and economic developments. These consequences are presented both in terms of impacts on ecosystems and vulnerability of human populations to droughts, floods, diseases, pests, etc. The NBSAP brings out the multidimensional challenges and opportunities that biodiversity conservation provides not only to citizens but to the world community at large

The links between loss of biodiversity and critical issues such as poverty, population growth, sustainable development, land use, HIV/AIDS, culture, gender, socio-economics, environment, biotechnology, among others, are explored and appropriate intervention measures identified. The NBSAP assessment followed UNEP's guide document to developing a biodiversity strategy from a sustainable development perspective, millennium development goals and the UNDP's role fact sheet. It builds on sound data produced by relevant professionals from vital stocktaking documents with inputs from all stakeholders to identify priority issues. Building on the analyses of the past, NBSAP outlines a series of policy approaches that lead to different useful outcomes over the next 15 years. The NBSAP is, therefore, a vital strategic document that should guide biodiversity and its ecosystem conservation, sustainable development and utilisation undertakings in the country.

I hope this strategy will inspire all stakeholders in their endeavours for conservation and sustainable use of biodiversity in Ethiopia.

Addisu Legesse
Deputy Prime Minister, and
Minister of Agriculture and Rural Development

NOTE FROM THE DIRECTOR GENERAL

In a world increasingly dominated by a mega modeling, complex global trading and consumer trends, it is easy to forget the economic, social and environmental values of plants, animals and ecosystems. Humans variably appreciate biodiversity, since different cultures and people from different walks of life perceive and value biodiversity in different ways as a consequence of their distinct heritages and experiences. #

Article 6 of the Convention on Biological Diversity (CBD) demands the preparation of National Biodiversity Strategy and Action Plan (NBSAP) by each signatory country. As a party to the Convention and in fulfillment of its obligation, Ethiopia has prepared its NBSAP document. This document defines the current status of, pressures on, options for, and priority action to ensure the conservation, sustainable use, and equitable share of benefits accrued from the use of biological diversity of Ethiopia. It serves as a roadmap for supporting the environmental component on Ethiopia's journey to sustainable development.

NBSAP has gone through many processes including establishing of the Steering Committee and Planning Team, training of members of the Planning Team, and stocktaking of the Ethiopia’s biodiversity and noting related important issues from other biodiversity strategies and action plans of many developing countries.

The NBSAP has one principal message to all concerned individuals, groups or organizations/institutions – ‘let us join hands and work together, and resolve to weave the life-sustaining mechanisms of all diverse groups into a resilient fabric that will conserve and ensure sustainable productivity of life systems’.

Girma Balcha (Ph.D.)
Director General, IBC
Addis Ababa, Ethiopia

PREFACE

The NBSAP process was developed with funding from GEF-UNDP. A Project Steering Committee of principal stakeholders was established to provide overall direction and policy guidance to the NBSAP process. The Steering Committee identified and selected an NBSAP Planning Team of 60 members expertise from all over the country on the basis of their biodiversity and planning expertise. Planning Team members represented the varied sectors, institutions and biodiversity resource users. The Planning Team was the principal technical organ of the NBSAP process. A secretariat office for the project was established at the Institute of Biodiversity Conservation (IBC) and a National Project Coordinator was assigned. The National Project Co-ordinator was responsible for day-to-day co-ordination of the project activities and served as chairman of the Planning Team.

The principal achievements of the NBSAP process have been the following:

- Training of members of the Planning Team (PT) by an international consultant on the required contents of an NBSAP and on participatory methodologies for NBSAP preparation;
- Another training was given to the PT by local consultants in the area of remote sensing for natural resources management and the use of geographical information systems for natural resources management;
- The PT established steps and procedures to be followed for developing the overall strategy and action plan document and produced a stocktaking checklist;
- An exhaustive list of sources of secondary information/data was prepared. The list included ministries, institutions, universities, research organisations NGOs, international organisations, UN organs, individuals, etc;
- The PT was organised into 14 sub-teams that undertook a stocktaking and inventory of the following thematic area: legal, institutional and biotechnology/biosafety issues; ecosystems; remote sensing and geographical information systems; domestic, wild and aquatic animals; field crops, forage, horticultural crops, medicinal plants, forest and essential oil bearing plants; microbial genetic resources (viruses, bacteria, fungi, protozoa and algae); biodiversity information systems and socio-economics and indigenous knowledge. All the information gathered have been compiled, synthesised and produced in a standard written form;
- The outcome of the stocktaking activity of each sub-team was reviewed by the Planning Team and revised accordingly;
- Three high level experts reviewed each document, the revised documents were presented in the 1st national workshop and were further enriched by additional suggestions and comments from this forum;
- Next, the documents were presented at regional workshops held at different autonomous regions. The participation of local communities in the regional workshops was significant. This has helped to integrate the concerns of the autonomous regional governments and to further strengthen the documents;
- The 14 chapters produced from the stocktaking and inventory of information have been compiled and served as the basic resource documents for subsequent

activities in the preparation of the NBSAP;

- Local senior ecologist and economist consultants were contracted and prepared a synthesis of the root causes of biodiversity loss working from the stocktaking documents;
- Two high level international consultants, one expert in biodiversity and another environmental economist, were hired and prepared a 'Strategy Options' document using the 14 stocktaking documents and the root cause analysis;
- Two high level local prepared the first draft document of the Ethiopian National Biodiversity Strategy and Action Plan;
- This draft document was presented in the 2nd national workshop, and all the feedback and inputs were integrated into the document;
- A high level international consultant was hired to enrich the document to international standard and undertake language editing;
- Finally, the final version of the document is printed in the present form.

The efforts of all the parties that contributed to the development of the NBSAP are greatly appreciated. In particular I wish to thank the Steering Committee, IBC management, UNDP, GEF, MoFED, EPA and the international and local consultants who worked on the NBSAP. Special thanks are due to the members of the Planning Team who prepared the basic resource documents.

Fassil Kebebew (Ph.D.)
National Project Coordinator, NBSAP Project

EXECUTIVE SUMMARY

With its dramatic geological history, broad latitudinal spread and immense altitudinal range, Ethiopia spans a remarkable number of the world's broad ecological regions.

These range from the depressions in the Afar (115 m below sea level) to the spectacular mountaintops of Ras Dashen in the north and the Bale Mountains in the southeast. This variety of habitats also supports a rich variety of different species, which contributes to the overall biological diversity (or "biodiversity") of the country.

Ethiopia has some of the world's rarest animals and plants but these are now in danger of disappearing forever due to overuse and loss of natural habitat. While people are without doubt a most valuable resource in Ethiopia, uncontrolled population growth puts ever-increasing pressures on the country's natural resource base. Inadequate economic policies have deepened poverty/widened inequalities and forced rural people and others to exploit biodiversity at rates that are no longer sustainable. As a result, processes such as deforestation, overgrazing, soil erosion, and desertification have become major threats to the remaining biodiversity in Ethiopia. Ethiopia is believed to have had extensive vegetation/forest cover; that has dwindled to less than 3% at the present time. The continuing loss of this forest habitat with its associated fauna and flora will have serious implications for the nation's other natural and agro-ecosystems. Just as more and more people may be part of the problem, they must also be part of the solutions. The key to protecting the biological heritage of Ethiopia lies in the involvement of local people and in the support provided by competent institutions for the conservation and sustainable use of biodiversity. The Government of Ethiopia recognised the importance of these measures in the preparation of the Conservation Strategy of Ethiopia (1997) and in becoming a signatory to in 1992, and ratifying the Convention on Biological Diversity (CBD) in 1994.

The current Ethiopian Biodiversity Strategy and Action Plan (EBSAP) will address interlinked issues comprising biodiversity protection and management for food security (poverty reduction), health and livelihood improvement of the Ethiopian population especially the rural communities (farmers and pastoralists) whose survival depends on the use of natural resources. In parallel it is the first attempt to meet the planning requirements of the Convention as well as the national biodiversity conservation needs. It tries to roll into one of the three sequential processes called for under the Convention (the country study, national strategy, and action plan). As such it provides a brief assessment of the status and trend of the nation's biodiversity (Chapter 2), outlines strategic goals and objectives (Chapter 3), and identifies a plan of action that outlines co-ordination arrangements and implementation measures (Chapters 4, 5, and 6). Preparation of the NBSAP has been carried out under an agreement between the Government of Ethiopia and the United Nations Development Programme (UNDP) under the Global Environment Facility (GEF) Trust Fund.

The process leading up to preparation of the NBSAP has involved broad participation from governments, local communities, academia and civil society through national and

regional-level consultative workshops to develop and review the draft document.

Background information required for the formulation of the present Biodiversity Strategy and Action Plan has been compiled by national experts on sectoral and cross-cutting issues on the following topics: Ecosystems of Ethiopia; Forest Biodiversity; Medicinal Plants; Biodiversity in Essential Oil Bearing Plants; Field Crops Biodiversity; Pasture and Forage Biodiversity; Horticultural Crop Biodiversity; Terrestrial Wild Animals and Protected Areas; Aquatic Animals Diversity; Domestic Animal Biodiversity; Microbial Biodiversity; Information, Traditional Knowlegde and Socioeconomics; GIS and Remote Sensing; Policy, Legal and Institutional Issues, and Biotechnology and Biosafety issues; Root Cause Analysis for Biodiversity loss and Option Analysis.

The goal of the Ethiopian Biodiversity Strategy and Action Plan has been formulated as "*Effective systems are established that ensure the conservation and sustainable use of Ethiopia's biodiversity, that provide for the equitable sharing of the costs and benefits arising therefrom, and that contribute to the well-being and security of the nation.*" Ethiopia's biodiversity conservation priorities are found in the four Strategic Objectives:

1. Representative examples of Ethiopia's remaining ecosystems are conserved through a network of effectively managed protected areas.
2. By 2020, all remaining natural ecosystems outside of the protected areas are under sustainable use management.
3. The costs and benefits on biodiversity conservation are equitably shared through a range of public, private, community/CBO and NGO partnerships for PA management and for sustainable use and marketing of biodiversity.
4. The rich agro-biodiversity of Ethiopia is effectively conserved through a mix of *in situ* and *ex situ* programs.

The Strategic Objectives are then followed by a much longer list of Specific Objectives. Each Specific Objective will be achieved through a set of individual Actions. A timeframe and performance indicator is defined for each Action and institutional responsibilities are proposed.

Overall responsibility for implementation of the NBSAP at the federal level will be that of the Institute of Biodiversity Conservation (IBC) under the umbrella of the Ministry of Agriculture and Rural Development. The Ministry in collaboration with IBC shall establish a Federal Biodiversity Steering Committee composed of relevant institutions. The Plan proposes establishing a Biodiversity Secretariat within the regional bureaus of the Ministry of Agriculture and Rural Development using existing resources to co-ordinate NBSAP implementation and foster linkages between, and within, different sectors affecting biodiversity. The Regional Secretariats would report to a Federal Biodiversity Steering Committee and receive technical support from a broad-based, re-notified Biodiversity Working Group. Since most implementation measures will take place at the regional level, the Plan also proposes Regional Steering Committees to be constituted (or merged with those created under Regional Conservation Strategies).

Finally, the Plan provides an implementation schedule of proposed actions to prioritise those that could be implemented immediately and at low cost following government

endorsement of the first Biodiversity Strategy and Action Plan for Ethiopia. In addition the adoption and implementation of the NBSAP would benefit Ethiopia by attracting international collaboration (bilateral and multilateral) for its effort to conserve and sustainable use of its biological resources.

The action plan calls on the Federal Government of Ethiopia to find ways and means to achieve the following: a) develop an effectively managed protected areas network that covers the full range of ecosystems; b) bring the natural areas outside of the PA network under sustainable use; c) strengthen the policy framework for biodiversity conservation; d) develop effective legislation for biodiversity conservation; e) build capacity in research and training; undertake public education and awareness raising; g) develop environmental impact assessment in support of biodiversity conservation; h) develop policies and laws to regulate access to genetic resources and to ensure equitable sharing of benefits; i) ensure effective exchange of information; j) develop the financial resources needed; k) build biotechnology capacity and enhance technology transfer.

CHAPTER ONE

INTRODUCTION

1.1 WHAT IS BIODIVERSITY?

Biological diversity or "biodiversity" has been defined by the Convention on Biological Diversity (CBD) as: "the variability among living organisms from all sources including *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems". In short, biodiversity refers to the variety of life on earth. This variety provides the building blocks to adapt to changing environmental conditions in the future.

1.2 BIODIVERSITY AND ITS SIGNIFICANCE

Richness of species in an area indicates the total biodiversity of that particular area. All species display genetic variation among individuals and populations. Genetic variation brings natural selection and adaptability to changes in the environment, which ultimately ensures species survival. Genetic diversity in domestic species and their wild relatives enables researchers to develop improved varieties of animals and plants for human needs. Diversity in wild plant species is potentially a major medicinal resource, and it is insurance for further food security. It should also be noted that species that might not have known direct economic value today may turnout to be economically important in the future.

Biodiversity provides free of charge services worth hundreds of billions of Ethiopian Birr every year that are crucial to the well being of Ethiopia's society. These services include clean water, pure air, soil formation and protection, pollination, crop pest control, and the provision of foods, fuel, fibres and drugs. As elsewhere, these services are not widely recognised, nor are they properly valued in economic, or even social terms. Reduction in biodiversity affects these ecosystem services. The sustainability of ecosystems depends to a large extent on the buffering capacity provided by having a rich and healthy diversity of genes, species and habitats. Losing biodiversity is like losing the life support systems that we, and other species, so desperately depend upon.

The conservation of biodiversity is fundamental to achieving sustainable development. It provides flexibility and options for our current (and future) use of natural resources. Almost 85% of the population in Ethiopia live in rural areas, and a large part of this population depends directly or indirectly on natural resources. Conservation of biodiversity is crucial to the sustainability of sectors as diverse as energy, agriculture, forestry, fisheries, wildlife, industry, health, tourism, commerce, irrigation and power. Ethiopia's development in the future will continue to depend on the foundation provided by living resources and conserving biodiversity.

1.3 THE CONVENTION ON BIOLOGICAL DIVERSITY (CBD)

155 parties at the Earth Summit held in Rio de Janeiro signed the Convention on Biological Diversity (CBD) in 1992. This signalled the intention of the world community at large to forming a global alliance to protect habitats, species, and genes, to shift to sustainable modes of resource use, and to make the necessary policy, economic and managerial adjustments to guarantee that the benefits to be gained from the use of components of biological diversity is equitably shared across local, regional, and global societies. Ethiopia signed the CBD in 1993 and ratified it in May 1994 (Proc. 98/1994). The number of parties that have ratified the convention has now reached 187.

Having agreed to conserve biodiversity, foster the sustainable use of forests, fisheries, agriculture and other resources, transfer related technologies, and share in financial investments, Ethiopia is confronted with the question: how can the nation determine what steps to take? Article 6 of the Convention calls for parties to:

- develop national strategies, plans or programmes, or adapt existing plans;
- to address the provisions of the Convention and to integrate biodiversity work into sectoral and cross-sectoral plans, programmes and policies.

The preparation of conservation and development strategies and action plans is not new to Ethiopia. Ethiopia has had a well-established procedure for the preparation of Five Year Plans and Annual Development Plans in the past; a similar mechanism is in place at present as well - Peace, Democracy and Development- that is translated into action on yearly based on annual budget lines. Ethiopia has a National Conservation Strategy (EPA, 1997) and put in place an Environmental Policy in 1997. Regional States have formulated their own 'Regional Conservation Strategies', including Tigray, Afar, Amhara, Oromia, Somali, Southern Nations, Nationalities and Peoples, Gambella and Benshangul-Gumuz Regional States.

There are also a number of sectoral plans for biological resources such as the 1994 Forestry Proclamation (Proc. No.94/1994). Ethiopia has been involved in many aspects of biodiversity conservation including national park planning, *in-situ* and *ex situ* conservation of biodiversity. However, Ethiopia has not yet approached biodiversity planning and implementation in the comprehensive, integrated manner required by the Convention.

Three processes used in sequence have been recommended for adoption in the Convention: country studies (biodiversity assessment), national strategies (developing goals and operational objectives), and action plans (identifying actions and implementation measures). All three are components of a larger and quite flexible process that can help countries build on existing institutions, programmes, investments, and capabilities. This process is cyclical. It leads countries to periodically assess their biota and capacity, identify an evolving set of priorities and actions for responding to new opportunities, and prepare different reports to government, society and the Convention on their findings and conclusions. The process is multi-sectoral, involving a wide range of government ministries, private resource-using industries, and civil society. And finally, it

is adaptive. It is revised and reformulated as new information is obtained, and the results of previous activities and investments are continually assessed.

1.4 A BIODIVERSITY STRATEGY AND ACTION PLAN FOR ETHIOPIA

The process leading up to preparation of the NBSAP has three steps: stocktaking and inventory of information, root cause and option analysis and formulation of NBSAP. In the processes, there was broad participation from governments, academia and civil society through national and regional-level consultative workshops to develop and review the draft document.

Background information required for the formulation for the present Biodiversity Strategy and Action Plan has been compiled by national experts on sectoral and cross-cutting issues on the following topics: Ecosystems of Ethiopia; Forest Biodiversity; Medicinal Plants; Biodiversity in Essential Oil Bearing Plants; Field Crops Biodiversity; Pasture and Forage Genetic Resources; Horticultural Crop Biodiversity; Terrestrial Wild Animals and Protected Areas; Aquatic Animals Diversity; Domestic Animal Biodiversity; Microbial Biodiversity; Information, Indigenous Knowledge and Socioeconomics; GIS and Remote Sensing; Policy, Legal and Institutional Issues, and Biotechnology and Biosafety issues; Root Cause Analysis for Biodiversity loss and Option Analysis.

The NBSAP is a first attempt to meet the planning requirements of the Convention. It will contribute to achieving the millennium development goals, poverty reduction and fosters grass-root (farmers/ pastoralists) participation. It provides a brief assessment of the current status and threat of the nation's biodiversity (Chapter 2), outlines principles, goals, strategic objectives, specific objectives and proposals for action (Chapter 3); co-ordinating biodiversity conservation efforts (chapter 4); implementation measures (Chapter 5) and monitoring and evaluation of the implementation process (Chapters 6).

Preparation of the NBSAP has been carried out under an agreement between the Government of Ethiopia and the United Nations Development Programme (UNDP) under the Global Environment Facility (GEF) Trust Fund. The Institute of Biodiversity Conservation (IBC) of Ethiopia was selected as the lead agency in collaboration with the UNDP to implement formulation of Ethiopia's NBSAP.

While the NBSAP necessarily covers much of the same ground covered by the Conservation Strategy of Ethiopia (CSE) and the Regional Conservation Strategies (RCSs), it is more focused on biodiversity and therefore provides a new and important perspective. Biodiversity conservation in Ethiopia will be better served, at least initially, by a distinctive and focused action plan. Such a plan can promote awareness; unleash political will, and funding.

1.5 THE SOCIO-ECONOMIC ENVIRONMENT

Ethiopia is one of the poorest countries of the world, as indicated by income (GNP per capita of $100.00), with large proportion of the population living on less than a $1 a day. The country faces considerable problems, with indicators on its social development being amongst the lowest in the world. The life expectancy at birth is about 43 years, the adult literacy rate of 36.3%, the combined education enrolment ratio of 26% and GNP per capita all scoring considerably lower than the average of the world's least developed countries. Ethiopia suffers from chronic food insecurity. Among other factors, a combination of frequent drought and low levels of on-farm investment persistently undermine the productivity of the agricultural sector. In addition, Ethiopia's low health status, high population growth, and low literacy rates further deplete human productivity and exert a heavy burden on the state to increase delivery for health, education and other social services (www.dfid.gov.uk, October 2001)

The government has reaffirmed repeatedly its commitment to poverty reduction and indeed most of its macro and sectoral policies reflect this. The broad outline of the government strategy for reducing poverty in Ethiopia as described in the Poverty Reduction Strategy document comprises the following elements: an a agriculture-development led industrialisation (ADLI), continuing implementing economic reforms, decentralisation and capacity building (FDRE 2002). However, the relationship between poverty reduction strategy, the policy matrix and the list of targets/indicators is not clearly put in the document. Moreover, some key elements are not properly addressed in the document. For example no adequate emphasis is given to conservation of biodiversity resources and its linkages to poverty reduction effort in the country.

Projections suggest that the locus of poverty will continue to remain in rural, agricultural areas for the foreseeable future. In addition, economic growth on the non-farm sectors depends in large part on a vibrant and prosperous agricultural sector. Practical solutions to rural poverty must therefore focus on increasing income and productivity of the rural poor through smallholder-focused agricultural growth and sustainable utilisation of resources available therein. For these reasons, policymakers, donor agencies, research institutions, and the development community at large are actively searching for new and more effective agricultural development strategies as a key pillar in the struggle against poverty. NBSAP comprise an important input to this search for solution.

CHAPTER TWO

BIODIVERSITY IN ETHIOPIA - A REVIEW

The following documents prepared by IBC were consulted as background materials in the preparation of the NPSAP: Fassil Kebebew et al. 2003 for Field Crops Biodiversity; Degelo Sendabo and Tekle Welde-Gerima for GIS and Remote Sensing; Getahun Mulat et al, 2003 for Pasture and Forage Genetic Resources; Mesfin Bayou et al. 2003 for Policy, Legal and Institutional Issues, and Biotechnology and Biosafety issues; Million

Tadesse et al. 2003 for Domestic Animal Biodiversity; Mohammed Abdi et al. 2003 for Terrestrial Wild Animals and Protected Areas; Tadele Gemechu et al. for Information Indigenous/traditional knowledge and Socioeconomics; Tadele Worku and Bekele Eshetu. 2003 for Biodiversity in Essential Oil Bearing Plants; Taye Bekele et al. 2003 for Forest Biodiversity; Tesfaye Awas et al. 2003 for Ecosystems of Ethiopia; Tesema Tanto et al. 2003 for Medicinal Plants; Zeleke W/Tenssay et al. 2003 for Microbial Biodiversity; Zenebe Tadesse and Seyoum Mengistou 2003 for Aquatic Animals Diversity; Zenebe Woldu et al. for Horticultural Crop Biodiversity. In addition documents on the Root Cause Analysis (Getahun Tafesse and Shibru Tedla, 2003) and Option Analysis (Muramira and Wood, 2003)

2.1 CURRENT STATUS AND THREATS

2.1.1 Physiography

Ethiopia is located between 3º and 15ºN latitude and 33º and 48ºE longitude and covers a land surface (including water bodies) area of 1,127,127 km². The country is currently divided into nine regional states and two city administrations (Fig. 1). It is a country of great geographical and climatic diversity, which has given rise to many and varied ecological systems.

The rainfall pattern in Ethiopia is influenced by two rain-bearing wind systems, one bringing the monsoonal wind systems from the South Atlantic and the Indian Ocean and the winds from the Arabian Sea. The two wind systems alternate, causing different rainfall regimes in different parts of the country.

Although much of the interior of Ethiopia is dominated by highland plateau, these are interrupted by deep gorges and twelve major valleys formed by large rivers and their tributaries. The annual runoff amounts to 122.19 billion cubic meters of which 74% goes into the rivers that flow into the Sudan, Egypt, Somalia and Kenya (Annex 1. Table 1). There are 18 natural and artificial lakes with a total surface area of about 7500 km^2 in Ethiopia. Seven of the eight major natural lakes are found in the Rift Valley (Annex 1, Table 7).

Ethiopia's soil units comprise different soil types (Annex 1. Table 2), most, of which have relatively good agricultural potential.

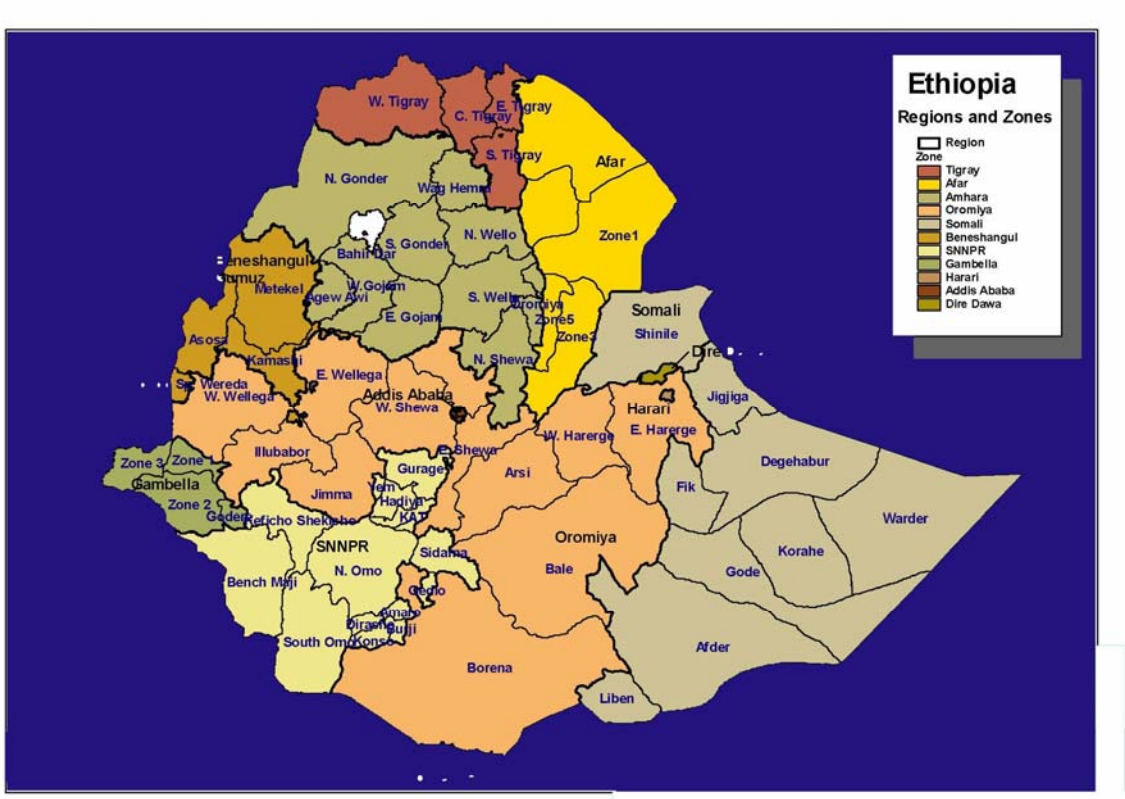

Figure 1. Map of Ethiopia with 11 administrative regions and their respective zones

The state administers all land in the country. Apparently some sectors believe that this arrangement acts as a disincentive to the millions of the country's farmers to invest in land stewardship. The government is introducing a land certification scheme that aims to improve the situation. Further research is required in order to deeply understanding the situation.

2.1.2 NATURAL ECOSYSTEMS IN ETHIOPIA

Attempts to identify or classify ecosystems of Ethiopia have been very limited or non-existent thus far. Vegetation types (Anonymous, 1992; Sebsebe Demissew et al. 1996; EPA, 1997; Zerihun Woldu, 1999, Friis and Sebsebe Demisssew, 2001) in the country are being considered as ecosystems. The new classification of ecosystems in Ethiopia is as follows: Afroalpine and Sub-Afroalpine, Dry Evergreen Montane Forest and Grassland Complex, Moist Evergreen Montane Forest, *Acacia-Commiphora* Woodland, *Combretum-Terminalia* Woodland, Lowland Semi-evergreen Forest, Desert and Semi-Desert Scrubland, and Inland Waters.

These diverse ecosystems have endowed Ethiopia with a diverse biological wealth of plants, animals, and microbial species. However, the attention given to the conservation and sustainable use of these biological resources has been inadequate. Some of the major contributory factors to accelerated decline of the biological resources are the size and

pattern of the distribution of human and animal population, the level of resource consumption, market factors and policies. Under-valuation of environmental resources due to low-level of awareness about the role of ecosystems and the rate at which it is being deteriorated or lost and poor regard to the conservation problems have also contributed to under-investment in biological resources management.

2.1.2.1 Afroalpine and Subafroalpine Ecosystem

The ecosystem includes areas, which on the average are higher than 3200 m. The subafroalpine areas occur between 3200 and 3500 m, while the afroalpine areas occur between 3500 m and 4620 m. The ecosystem is characterised by the most conspicuous giant Lobelia, *Lobelia rhynchopetalum*, and evergreen shrubs including the heather, *Erica arborea* and perennial herbs such as *Helichrysum* species.

The endemic mammals in this ecosystem include Walia Ibex, Mountain Nyala, Starck's Hare, Ethiopian Wolf and Gelada Baboon. The Giant Mole Rat is also a characteristic species to this ecosystem. Of the 199 species of birds that have so far also been recorded, the characteristic birds include Chough, Ruddy Sheld Duck, Spot-breasted Plover, Blue-winged Goose, Wattled Crane, Lammergeyer, and Golden Eagle.

Ethiopia has the largest extent of afroalpine and subafroalpine habitats in Africa. These environments are peculiar in that there are no seasonal variations in temperature, but rather pronounced diurnal variations with "summer every day and winter every night" with strong insolation and outward radiation, frequent frost heaving on bare soil all year round (Hedberg, 1995). Until as recently as 10,000 years ago (Messerli et al., 1977), the highlands of Ethiopia were widely covered with Afroalpine moorlands and grasslands. But, man has altered large regions of the highlands for centuries, especially through conversion to agriculture. The rate of change is very alarming resulting in the reduction of the original species richness. Thus the original afroalpine and subafroalpine natural communities are now restricted almost entirely to scattered and not easily accessible areas, which are surrounded and isolated by agricultural areas. More attention is needed to stop further the threats and rate of destruction.

Threats: Because of the increasing population pressure there are frequent encroachments by man that resulted in widespread destruction of wildlife and their habitats. As a result of intensive human pressure most of the faunal and floral resources are now at risk. The Ethiopian Wolf, Golden Jackal and Walia Ibex that are endemic to this ecosystem are the most threatened mammals. Ten species of birds are unique to the ecosystem, and these have hardly been recorded in other protected areas.

Apart from the Simien and Bale, most of the afroalpine and subafroalpine ecosystems in Ethiopia are not effectively conserved through effectively managed protected area or through sustainable use systems.

Figure 2. Afroalpine and Subafroalpine Ecosystem, Senaiti Plateau, Bale Mountains National Park

2.1.2.2 Dry Evergreen Montane Forest and Grassland complex

This ecosystem represents a complex system of successions involving extensive grasslands rich in legumes, shrubs and small to large-sized trees to closed forest with a canopy of several strata occurring between (1600-) 1900-3300 m. This ecosystem covers much of highland areas and mountainous chains of Ethiopia in Oromia region (Shewa, Arsi, northern Bale and western Hararge), Amhara Region (Gojam, Welo, Gonder), Tigray Region (Tigray) and SNNP region (Shewa, Sidamo and Gamo Gofa). See (Annex 1 Tables 3 and 4).

The areas with Dry Evergreen Afromontane forest have canopies usually dominated by Tid/Gatira (*Juniperus procera)* as a dominant species, followed by Weira/Ejersa (*Olea europaea* subsp. *cuspidata*), etc. Zigba/Birbirsa (*Podocarpus falcatus)* is also found in sheltered valleys.

The areas with Afromontane woodland, wooded grassland and grassland include the natural woodlands and wooded grasslands of the plateau with *Acacia abyssinica* and *A. negrii.*

The grasslands occur in the areas where human activity has been largest and most intense, and found at altitudes between 1500 and 3000 m. The montane grassland in most places is derived from forest and other woody vegetation types. There exist also some edaphic grassland.

The evergreen scrub vegetation occurs in the highlands of Ethiopia either as an intact scrub in association with the dry evergreen montane forest or usually as secondary growth after deforestation of the dry evergreen montane forest.

The characteristic mammals of the dry evergreen montane forest and grassland complex are more or less similar with the Afroalpine ecosystem. The endemic species in this ecosystem include Mountain Nyala is considered rare as well as globally threatened. The characteristic birds include Black-headed Forest Oriole, Abyssinian Woodpecker, White-backed Black Tit, Rouget's Rail, Abyssinian Longclaw, Yellow-fronted Parrot, Wattled Ibis, and Abyssinian Catbird. Erlanger’s House snake, Bale Mountains Two-horned Chameleon, Arena Heather Chameleon, Ethiopian Mountain Viper, Stripped Ethiopian Mountain Snake and Ethiopian House Snake are representatives of the reptilian group.

Threats: In general, the Dry evergreen Montane Forest and grassland complex is inhabited by the majority of the Ethiopian population and represents a zone of sedentary cereal-based mixed agriculture for centuries. The forests have diminished due to human interference and replaced by bushlands in most areas. This forest is under severe pressure as a consequence of inhabitants’ need for agricultural and grazing land. There is a severe and increasing fuel wood gap in the country, which leads to depletion of standing stock and, hence, further degradation of the remaining forest stands. This is also an ecosystem where livestock density is one of the highest in the country thus exacerbating the degradation process.

Figure 3. Dry Evergreen Montane Forest and Grassland complex, Gaysay near Dinshu, Bale Mountains National Park

2.1.2.3 Moist Evergreen Montane Forest Ecosystem

This ecosystem is in most cases characterised by one or more closed strata of evergreen trees, which may reach a height of 30 to 40 m. The vegetation type in this ecosystem can be further divided into two (Friis, 1992; Sebsebe Demissew et al. 2004). One type includes what is traditionally referred as the Afro-montane rainforest. These forests occur in the southwestern part of the Ethiopian Highlands at between 1500 and 2600-mm elevation and the Harenna Forest on the southern slopes of the Bale Mountains. The forests characteristically contain a mixture of Zigba (*Podocarpus falcatus*) and broad-leaved species as emergent trees in the canopy including Kerero (*Pouteria (Aningeria) adolfi-friederici*). Kerkha (the mountain bamboo- *Arundinaria alpina*) is also one of the characteristic species, although not uncommon is found locally. There are also a number of medium-sized trees, and large shrubs. The second type includes the Transitional Rainforest, which includes forests known from the western escarpment of the Ethiopian Highlands, in Wellega, Illubabor and Kefa. The forest type occurs between 500 and 1500 m elevation. The characteristic species in the canopy includes *Pouteria (Aningeria) altissima, Anthocleista schweinfurthii*, *Ficus mucuso* and species of *Garcinia, Manilkara* and *Trilepisium* (see Annex 1, Tables 5 and 6).

Although this ecosystem is rich in floristic composition, its importance for reptiles, mammals and avian fauna is very minimal. The larger mammals that are characteristic include the Blue Monkey, De Brazza's Monkey, Leopard and, Guereza. The characteristic birds that occur in this ecosystem include African Hill Babbler, Banded Barbet, Abyssinian Woodpecker, Abyssinian Crimsonwing, Sthulman's Starling, Grey Cukoo Shrike, Narina's Trogon, Crowned Eagle and Silvery-cheeked Hornbill. It is important to note that the Harena Forest includes wild dogs and lions, which characteristically are found in, open *Acacia* woodland ecosystems.

Threats: The most striking changes in the moist evergreen montane forest ecosystem are caused by human activities in the form of timber extraction, Coffee and Tea plantations, agricultural expansion, settlement and deliberate or accidental fire hazards. At present, Maize and Teff cultivation is infringing upon parts of the southwestern Ethiopia, which together with high leached acidic soils and rugged topography intensify the degradation processes.

The State Forest Conservation and Development Department of the 1980's designated 58 important forest areas as National Forest Priority Areas (NFPA's). The aim of designating NFPA's is for their production, protection and biological conservation services (EFAP, 1994). These areas comprise natural forest, plantation and non-forested land. Among the National Forest Priority Areas designated for protection the moist evergreen montane forest ecosystem include Harenna-Kokossa, Godare, Gebre Dima, Setema, Sigmo-Geba, Yayu, Babya-Folla, Belete-Gera, Tiro-Botor-Becho, Masha-Anderacha, Bonga and Sheko forests. In some of the NFPA no natural high forests remain, in most of them the forest stands have been partly deforested or severely degraded in quality and quantity (Reusing, 1998). The present management of the high forest fails to achieve its conservation objective. The forests have declined both in quality and quantity, especially in the last decade. Existing forest laws are not working. None of the National Forest Protection Areas (NFPAs) have legal protection any more. At present, except for the Menagesha Suba Forest, all Forests designated under NFPAs are under Regional Governments. Moreover, the lack of accountability and commitment from government, political parties or civil groups has aggravated the situation.

Figure 4. Moist Evergreen Montane Forest Ecosystem, Sheka, Keffa

2.1.2.4 *Acacia-Comiphora* Woodland Ecosystem

This ecosystem is characterised by drought resistant trees and shrubs, either deciduous or with small, evergreen leaves occurring between 900 and 1900 m. This vegetation type occurs in the northern, eastern, central and southern part of the country mainly in Oromia, Afar, Harari, Somali, and Southern Nations, Nationalities and Peoples Regional States. The trees and shrubs form an almost complete stratum and include species of Grar/Lafto (*Acacia senegal, A. seyal, A. tortilis*), Bedeno (*Balanites aegyptiaca*), Kerbe (*Commiphora africana, C. boranensis, C. cilliata, C. monoica and C. serrulata*). The ground cover is rich in sub-shrubs, including species of *Acalypha*, *Barleria*, *Aerva*, and succulents with a number of Ret/Argessa (*Aloe*) species.

The characteristic mammals include African Wild Ass, Grevy's Zebra and Black Rhinoceros. The characteristic birds include Hunter's Sunbird, Shining Sunbird, Somali Golden-breasted Bunting, Salvadori's Seedeater, Yellow-throated Serin, Ruppell's Weaver, White-headed Buffalo Weaver Golden-breasted Starling and Abyssinian Bush Crow.

The three characteristic mammals known in this ecosystem namely, the African Wild Ass (endemic), Grevy's Zebra and Black Rhinoceros are globally threatened. In addition, of the bird species known in this ecosystem, the endemics, Abyssinian Woodpecker, Yellow-fronted Parrot and Abyssinian Bush Crow and the near-endemics, Lappet-faced Vulture, Imperial Eagle, Lesser Kestrel, Wattled Crane, Abyssinian Bush Crow, White-tailed Swallow and Nechisar Night Jar, are categorised as vulnerable.

Most of the National Parks in the country are found in this ecosystem. Of these parks, only the Awash National Park is gazetted. All the other conservation areas (Abijata-Shala Lakes National Park, Nechisar National Park, Omo National Park, Mago National Park, and Yangudirassa National Park.) attempt to function without proper legal recognition.

Threats: The *Acacia-Commiphora* woodland is currently under strong environmental stress. Extraction of fuel wood and charcoal for major towns in the country has increased the rate of deforestation and natural resource depletion. The ever increasing of woodland clearance for rain-fed agriculture and irrigation under takings further enhanced the vulnerability of the ecosystem. Over forty taxa in this ecosystem are threatened, much of which are found in the Bale, east and west Hararge and Borena Zones (Ensermu Kelbessa et al., 1992). The failure to manage the expansion of exotic invasive species, such as *Prosopis juliflora* in this ecosystem is threatening the biodiversity.

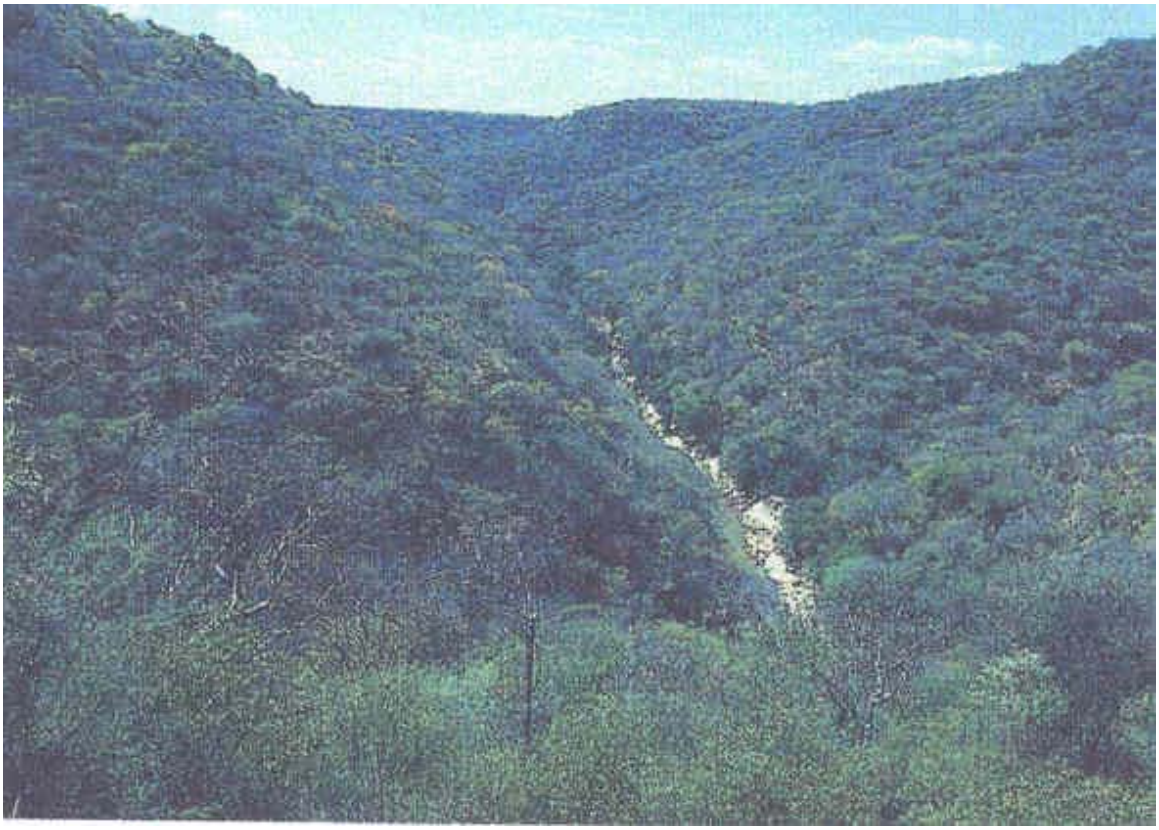

Figure 5. *Acacia-Comiphora* Woodland Ecosystem, Sof Omar, Bale

2.1.2.5 *Combretum-Terminalia* Woodland Ecosystem

This ecosystem is characterised by small to moderate-sized trees with fairly large deciduous leaves. These include Yetan Zaf (*Boswellia papyrifera*), *Anogeissus leiocarpa* and *Stereospermum kunthianum* and species of Weyba (*Terminalia*), *Combretum* and *Lannea*. The solid-stemmed lowland bamboo, Shimel (*Oxytenanthera abyssinica*) is prominent in river valleys [and locally on the escarpment] of western Ethiopia.

The vegetation type occurs along the western escarpment of the Ethiopian Plateau, from the border region between Ethiopia and Eritrea to western Kefa and the Omo Zone (in the SNNP Region); it is the dominant vegetation in Benshangul-Gumuz and Gambella Regions, and the Dedessa Valley in Wellega in Oromia Region, where it occurs between 500 and 1900 m. The vegetation in this ecosystem has developed under the influence of fire. The soil erosion rate is very high especially at the onset of rains.

The characteristic birds include Fox Kestrel, Red-throated Serin, Red-pate Cisticola, Green-backed Eremomela, Bush Petronia and Black-rumped Waxbill.

Although it is not demarcated, the Gambella National Park is the only protected area in this ecosystem

Threats: Although relatively, *Combretum-Terminalia* woodland ecosystem is still perhaps the least affected of the ecosystems, however there are threats as a result of indiscriminate fire and settlement of refugees from neighbouring countries and people from the highlands and inappropriate agricultural practice.

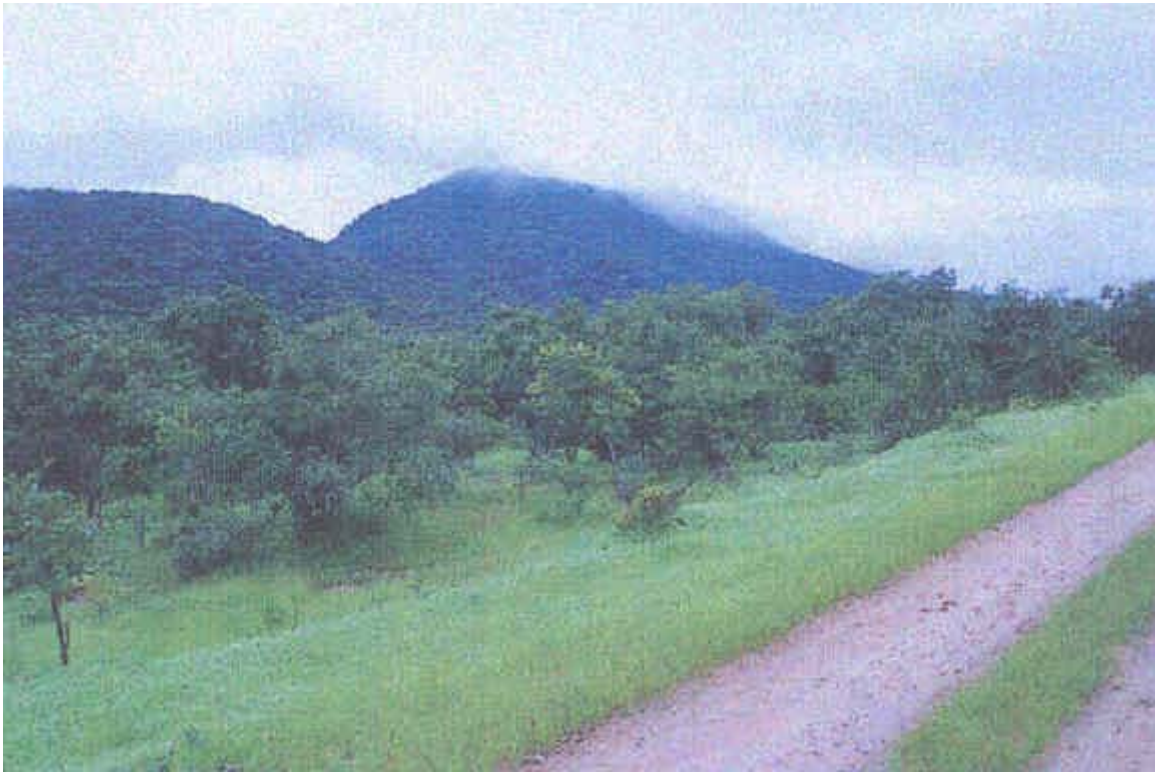

Figure 6. *Combretum-Terminalia* Woodland Ecosystem, Bewa Mountains, Benshangul-Gumuz

2.1.2.6 Lowland, Semi-evergreen Forest Ecosystem

This ecosystem includes forests that are restricted to the Lowlands of eastern Gambella Region in Abobo and Gog Weredas. They occur between 450 and 650 m on sandy soils.

They are semi-deciduous, with a 15-20 m tall, more or less continuous canopy in which *Baphia abyssinica* is dominant, mixed with less common species including *Celtis toka*, *Diospyros abyssinica, Malacantha alnifolia,* and *Zanha golungensis* and species of *Lecaniodiscus, Trichilia* and *Zanthoxylum*.

The characteristic mammal species of this ecosystem include White-eared Kob, Nile Lechwe and Lesser Canerat, also found in the neighbouring Sudan. Of these, the Nile Lechwe, Giant Forest Hog, Bush Elephant and Leopard are subjected to serious threats. The characteristic birds include Yellow-fronted Parrot, Swallow-tailed Bee-eater, White-throated Bee-eater, Red-throated Bee-eater, Red-tailed Buzzard, Grasshopper Buzzard, Lizard Buzzard, Yellow-fronted Canary and Basra Reed Warbler.

Even though Abobo-Gog forest is recognised as priority forest for conservation, nothing was done so far to protect the forest from ruthless exploitation. The villagers and other users pose threats to the forest in general and to some species in particular.

Threats: The fires set to establish agriculture has contributed to the depletion of forestland. Clearing for road construction/building of the Alwero Dam has enhanced forest destruction.

Figure 7. Lowland, Semi-evergreen Forest Ecosystem, Gog, Gambella

2.1.2.7 Desert and Semi-desert Scrubland Ecosystem

This ecosystem is characterised by highly drought tolerant species of Grar/Lafto (*Acacia brichettiana, A. stuhlmanii* and *A. walawlensis*), Etan (*Boswellia ogadenenesis*) Kerbe (*Commiphora longipedicillata* and *C. staphyleifolia),* as well as succulents, including species of *Euphorbia* and *Aloe.* The doum palm (*Hyphaene thebaica*), grasses such as

Dactyloctenium aegyptim and *Panicum turgidum* are also characteristic species. The characteristic birds include Kori Bustard, Arabian Bustard, Blackhead Plover, Temminck's Courser, Two-banded Courser, Tawny Pipit, Chestnut-bellied Sandgrouse, Lichstenstien's Sandgrouse, Singing Bush Lark and Masked Lark. This ecosystem type occurs in the Afar Depression, the Ogaden, around Lake Chew Bahir and the Omo Delta below an altitude of 500 m.

The semi-desert parts are found in the northern western and Northeastern parts of the country (Amhara, Tigray and Afar), Southern (Oromia and Southern Nations and Nationalities and Peoples Region) and the Southeasternn and eastern (Somali) parts. The northern parts of Afar and northeastern Tigray are predominantly desert.

Fragmentation and overgrazing of the rangeland has also affected wild animals. In this ecosystem, Wild Ass is critically endangered and has appeared in the 1996 IUCN list of threatened animals.

Threats: The semi-desert and scrub ecosystem is being subjected to increased grazing, threatened by bush encroachment and the failure to manage the expansion of invasive exotic species, such as *Prosopis juliflora*. Six of the seven endangered endemic plant species of this ecosystem are found in the Ogaden region of the ecosystem only, which is floristically the most rich in endemism in Ethiopia (Ensermu Kelbessa et al., 1992). This ecosystem is deteriorating in areas inhabited by humans and wildlife. There is high possibility of reversing the situation if adequate research and implementation of the results could be conducted.

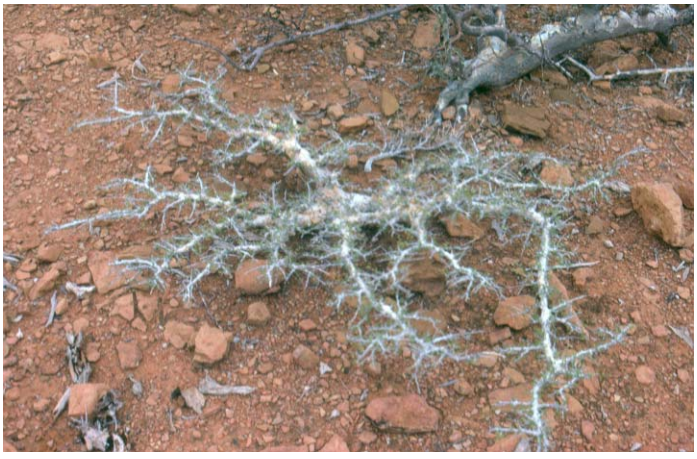

Figure 8. Desert and Semi-desert Scrubland Ecosystem, Dolo, Sidamo

2.1.2.8 Aquatic Ecosystem

This ecosystem consists of both running (lotic) and standing (lentic) inland water bodies, including rivers, lakes, reservoirs, swamps, wetlands and aquatic bodies with transient water contents during some time of the year. The strict IUCN definition of wetlands has

been slightly modified to include all types of lakes in this document (See Annex 1, Table 7).

Although the floristic composition of the riverine vegetation varies depending on altitude and geographical location, in general it is mainly characterised by species of *Celtis africana*, *Mimusops kummel*, *Tamarindus indica*, etc. The swamps, reservoirs and shores of lakes are dominated by species of sedges and grasses.

Aquatic resources in this ecosystem include over 180 fish species of which some 30 to 50 are endemic. In addition several invertebrates groups with variable endemicity are listed in Annex 1, Table 8 (Golubstov and Mina, 2003). In the rivers and lakes, numerous species of planktonic and bentic fauna have been reported. Moreover, the aquatic ecosystem harbours over 200 species of phytoplankton, including many important Blue-green algal species such as *Spirulina* (*Arthrospira*). Studies of the planktonc life forms started only recently. These diverse aquatic habitats serves as breeding, feeding and roosting sites for a large number of resident and migrant birds including the endemics such as Spot-breasted Plover, Blue-winged Goose and Rouget's Rail and about 10 species that are globally threatened. Aquatic mammals that frequently use this ecosystem include Hippopotamus, Nile Lechwe, Common Waterbuck and Bush Elephant. The habitat is also used by considerable species of reptiles such as the Nile crocodile.

Some of the lakes harbour endemic fish species; for example Lake Tana is unique for its Barbus flock. This is the only remaining stock after the demise of similar population in Lake Lanao (Philippines). Thus this lake has international significance and serves as a natural laboratory for evolutionary investigation. Baro and Akobo are also 'hotspot' of aquatic biodiversity.

Ethiopian streams and rivers, and lakes are much influenced by various development activities. Land and water development, pollution, introduction of exotic species, over exploitation of fish stocks, etc are some of these activities. The effects of these activities have resulted to the demise of some aquatic biota that cannot tolerate conditions created by human activity, an increase in others cultured by human beings or favoured by human-induced alterations in this aquatic environment (McClanahan et al., 1966).

Threats: The removal of vegetation cover increases erosion and sediment in-outs into water bodies. Farming of the catchments contributes to enhanced nutrients and particulate runoff where grasslands are overgrazed or fields are fertilised. It is known that some of the soluble fertilisers pass into the water body and leads to eutrophication (Zinabu Gebre-Maraim et al., 2002). As a result of these effects sediments will cover bentic communities, scrap the bodies of aquatic animals, and inhibit oxygen penetration and photosynthesis. The introduction of fertilisers into water bodies through runoff will result to increased nutrient load of the ecosystem-eutrophication, accumulation of toxic chemicals in the bodies of fish, etc. Eutrophication results to changes in algal composition, especially cyanobacteria, and biomass. This in turn results to fish kill caused by decreased dissolved oxygen levels and other interrelated consequences (Amha Belay and Wood, 1982; Zinabu Gebre-Mariam, et al. 2002).

Direct human effects such as damming and diversion of rivers, channelling and building water distribution facilities; and indirect influences such as removal of vegetation cover of drainage basins for agricultural, urban, industrial, mining etc. expansion have played a role in changing the habitat.

The decrease in the level of the lakes' water occurs as a result of natural phenomena of shortage of rainfall and human phenomena of a number of irrigation schemes, especially of rivers flowing into lakes. Rivers Meki and Katar, Bulbula and Gogessa which flow into lakes Ziwai and Abijata respectively, are being used for irrigation, subsequently this decreased the lakes' water level and resulted in drastic effects on the fish and other aquatic communities of the lake. Fish species like *Oreochromis niloticus* that spawns in shallow parts of the lake are adversely affected by the change in water level (Zinabu Gebre-Mariam, et al. 2002).

The introductions of organic sewage and domestic wastes into water bodies have become threats to aquatic ecosystem. It causes large increase in microbial respiration, a decrease in the level of dissolved oxygen, causes appearance of "sewage fungus" and disappearance of most macro invertebrates (McClanahan et al., 1966).

The conversion of swamps to agricultural land with long-term drainage and cultivation reduce the diversity of the wetland habits; species are replaced by non-wetland species (Hughes & Hughes, 1992).

Figure 9. Wetlands, Benshangul-Gumuz

BIOLOGICAL RESOURCES

2.1.3 Micro-organisms

Microorganisms are of great value to mankind because they benefit agriculture, industry, medicine, and environment in various ways.

2.1.3.1 Agriculture

Microorganisms play important roles in agriculture. The biological nitrogen fixation by *Rhizobium species* and other bacteria is safe and cheap source of nitrogen fertiliser. Fertiliser nitrogen will continue to serve for increasing grain production until a foreseeable future, but effort should also be oriented towards augmenting biological

nitrogen fixation mediated by microorganisms. Microorganisms also provide the plants with phosphates and other nutrients (Rangaswami and Bagyaraj, 2001).

The increasing use of chemical pesticides to control crop pests has led to increasing resistance, environmental pollution, high cost, pest resurgence, secondary pest out-break etc. The most effective alternative to these problems is the use of microorganisms as biological control agents. Certain species of bacteria such as *Bacillus thuringiensis* have been successfully used in the control of insect pests belonging to Lepidoptera, Diptera, and Coleoptera (Aronson *et al,* 1986). A number of fungal species such as *Metarhizium anisopliae, Beauveria bassiana, Paecilomyces fumusoroseus, and Verticillium lecanii* are applied in a number of countries in control of locust and other insect pests. Some viral preparations are also used to control pathogens and pests. These include *Neodiprion setifer* for the control of pine sawfly, *Mamestra brassiae,* cabbage moth and some important pests of food and fibre crops (Aronson et al., 1986).

2.1.3.2 Industry

In the field of chemical industry, microorganisms are used in the production of compounds such as steroids, citric acids, and amino acids, with great specificity and at incredibly low cost. They can also be used in the production of low cost high tonnage alcohols such as ethanol, and methanol (Rangaswami and Bagyaraj, 2001; Pelczar et a1, 1986).

In the food industry microbial activity is used in the production or preservation of food, for example vinegar, beer, Yogurt, and cheese etc are the result of microbial fermentation. Microorganisms have the ability to upgrade low protein materials to high protein foods *(Wood, 1985).* The large–scale industrial exploration of this phenomenon by growing *Saccharomyces cerviseae* for human consumption was made practical in Germany during World War I. The largest sector of industrial microbiology still depends on the yeast *Saccharomyces cerviseae* (Wood, 1985).

2.1.3.3 Medicine

In the field of medicine, microorganisms are the most important source of clinical antibiotics. Antibiotics production accounts for a substantial fraction of the industrial–scale use of microorganisms to manufacture substances for our welfare (Pelczar *et a1 1986).* Fungi, actinomycetes and bacteria, are the most important groups of microorganisms in the production of antibiotics. Examples of antibiotics derived from microorganisms include penicillin (from species of *Penicillium*), cephalosporins (from species of *Cephalosporium*), tetracycline, actinomycin, and adrimycine (from species of *Streptomyces*), polymyxin B and bacitracin (from species of *Bacillus*).

Because of their direct and indirect value in development, the conservation of microbial gene pools is a crucial issue. In the past this issue has been addressed almost entirely from the standpoint of *ex-situ* conservation. However, it has become increasingly obvious that

this strategy on its own is quite inadequate for ensuring conservation in anything approaching a meaningful way.

2.1.3.4 Microbial diversity and Conservation status

Although very little is known about microbial diversity in Ethiopia, various institutions are carrying out activities related to microbial genetic resources (Addis Ababa, Alemaya and Debub Universities, AHRI, EARO, EHNRI, IBC, ILRI, etc).

Significant efforts have been made to study microorganisms of value in agriculture, medicine, food and beverage industries. It was found that a total of 200 genera and 445 species of bacteria, fungi, algae, protozoa and viruses were isolated and identified in different sectors as shown in Annex 1. Tables 9-12. These efforts were disorganised and lacked continuity. Furthermore, the isolated organisms have not been conserved or preserved for sustainable utilisation. Some of the gaps are lack of:

- Organising efforts of the different institutions
- Culture collection centres
- Conservation facilities for maintaining of micro-organisms
- Continuity in research undertakings
- Awareness on the value of micro-organisms
- Trained manpower

Threats: Although efforts are being carried out on the microbial resources by different institutions in the country as indicated above, very little is known on microbial genetic resources as compared to the expected number of species in the country. The threats to microbial resources have not been recorded except those associated with deforestation and land degradation.

2.1.4 Flora (including Crops)

The flora of Ethiopia is estimated to include about 6000 species of higher plants with 10-12% endemism. The Ethiopian flora in the various ecosystems fosters numerous plants used for various purposes.

Figure 10. *Aloe otallensis*, endemic to Ethiopia and known only from Gamo Gofa and Sidamo Floristic regions (picture taken by Sebsebe Demissew in 2005 at Arba Mich)

Figure 11. *Kniphofia insignis*, endemic to Ethiopia and known only from the highlands of Shewa Floristic Region (picture taken by Sebsebe Demissew in 2004 near Chancho, Shewa)

Figure 12. *Disa facula*, endemic to Ethiopia and known only in Wellega Floristic Region (picture taken by Christoff Herrmann in 2001 from Benshangul-Gumuz)

Figure 13. *Habenaria vollesenii*, endemic to Ethiopia and known only from Sidamo Floristic Region

2.1.4.1 Forest Resources

The Ethiopian forests and woodlands are depositories and gene pools for several domesticated and/or important wild plants and wild relatives of domesticated plants. For example Coffee (*Coffea arabica*) is found in the wild in the moist evergreen montane forests of the south and southwest of the country.

Forests are important not only for the products that can be harvested from them and for the complex interactions they make with other organisms to build up and/or maintain the complex fabric of biodiversity, but also for preventing erosion and for affecting the climate in a positive way. See Annex 1, Tables 4, 5 and 6.

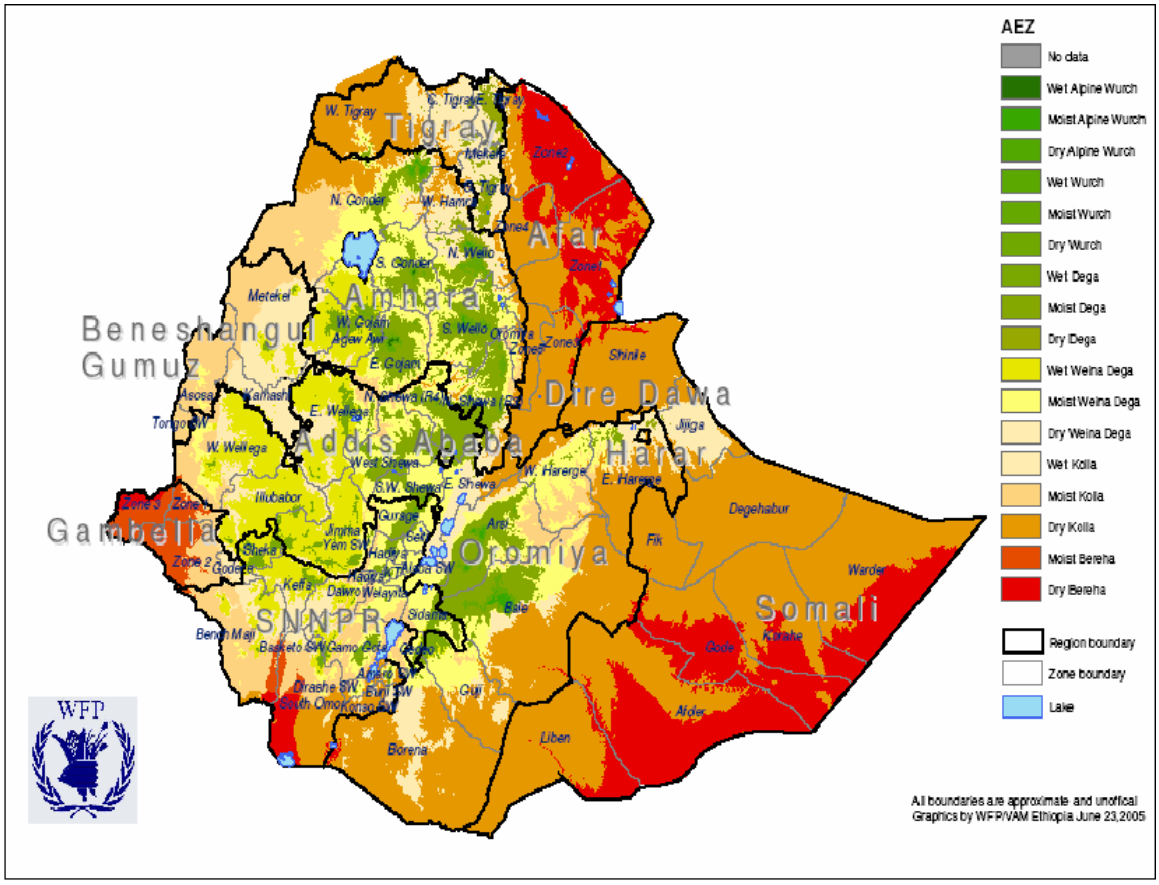

Figure 14. Agro Ecological Zone (AEZ) in Ethiopia

Threats: The forest resources are seriously threatened by deforestation, habitat destruction and subsequent decline in regeneration, forest fire and vegetation clearance for farm/settlement establishment. Absence of policy and law addressing farm forestry (agroforestry) and issues related to land and tree tenure have also contributed to the prevailing genetic erosion of fruits and nuts.

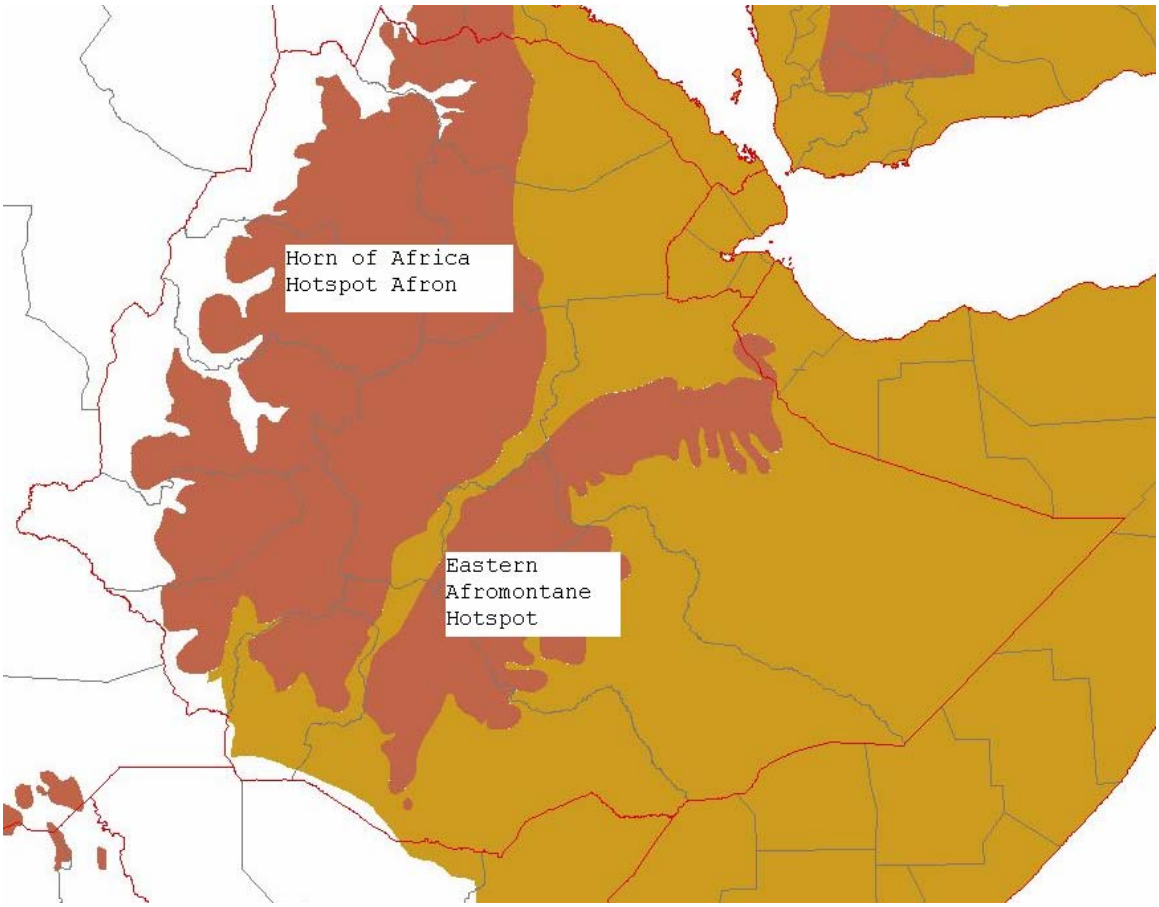

Figure 15. Hotspots in Ethiopia (Source: Stuart Williams and Lakew Berhanu, Ethiopia's Protected Area System Plan Project, Wildlife Conservation Department, Ministry of Agriculture)

2.1.4.2 Field Crop Resources

Ethiopia is one of the main centres of origin/diversity for several cultivated crops and their wild weedy relatives.

Ethiopia has a very high genetic diversity in four of the world's widely grown food crops (wheat, barley, sorghum, peas), in three of the world's most important industrial crops (linseed, castor, and cotton), in the world's most important cash crop (coffee), in a number of food crops of regional or local importance (teff, finger millet, cowpeas, lentil, enset, etc) and in a umber of groups of forage plants of world importance (clovers, lucerns, oats, etc.). Ethiopia is one of the twelve Vavilov Centres of crop diversity. In this regard the contribution of Ethiopian farmers in generating and maintaining the diversity of many crop plants has been indispensable.

Ethiopia is considered as the primary gene centre for field crops such as Noun *(Guizotia abyssinica),* Teff *(Eragrostis tef),* and Ethiopian mustard *(Brassica carinata*). Introduced field crops have developed wide ranges of genetic diversity under local ecological conditions and agricultural practices.

The indigenous landraces of various crop plants species, their wild relatives, and the wild and weedy species are all highly prized for their potential value as sources of important variations for crop improvement programmes. Among the most important traits that are believed to exist in these landraces are, disease and pest resistance, nutritional quality, resistance to drought and other stress.

Threats: Changes in the development of agriculture or land use, displacement of indigenous landraces by new, genetically uniform crop cultivars, and drought are the main causes of crop biodiversity loss.

2.1.4.3 Horticultural Crop Resources

Root and Tuber Crops Ethiopia offers favourable conditions for the production of root and tuber crops. The most important ones and those that are native to Ethiopia include Anchote *(Coccinia abyssinica*), Enset *(Ensete ventricosum*), Yams (*Dioscorea spp*) and Oromo Dinich (*Plectranthus edulis*). Exotics include Taro (*Colocasia esculenta*), tannia (*Xanthosoma sagittifolium*), yam (*Dioscorea alata*), Cassava (*Manihot esculenta*), potato (*Solanum tuberosum*), sweet potato (*Ipomea batatas*). Some of the exotics such as Taro have been cultivated for long, and as a result substantial genetic variability exist in these crops.

Vegetable Crops Ethiopia also offers favourable conditions for the production of a number of cultivated. The widely cultivated species include Pepper, garlic, shallot, tomato, cabbage, carrot, beetroot, pumpkin, etc.

Fruit /Nut Resources By virtue of the prevailing varied agro-ecological conditions in the country, several tropical, sub-tropical and temperate fruits are successfully grown; both

under rain fed and irrigation agriculture. At present there are about 40 tropical, sub-tropical and temperate fruits grown under home-gardens, home-farm-stead and small and large commercial farms.

Other Stimulants and Beverage Species Resources - Coffee *(Coffea arabica)* is one of the major stimulants, which is consumed throughout the globe. It grows in many parts of the country; however, the bulk of the produce comes from western and southern parts of the country, and a limited area in the east. This is a genetic resource that Ethiopia has given to the world community.

The usage of 'Chat' (*Catha edulis)* as a stimulant has become commonplace in the last 20-30 years. There is likely a wealth of genetic variability in 'Chat' as expressed in variations in morphological and agronomic characteristics of this plant species. Gesho (*Rhamnus prinoides)* is used in home brewing of local beverages such as 'Tella' and 'Tej, and it is an endemic species.

Spice Resources Different herbs and spices are traditionally grown in various parts of the country, Ethiopia is either a primary centre or a secondary centre of origin for spices like Korarima *(Aframomum corrorima*), long pepper *(Piper longum),* black cumin (*Nigella sativ*a); white cumin/bishop's weed (*Carum copticum*), coriander (*Coriandrum sativum*), thyme (*Thymus schimperi*) and fenugreek *(Trigonella foenum-graecum*). A large number largely wild grown species of spices, condiment and herbs of medicinal value reportedly exist in Ethiopia.

Wild edible Plants are widely distributed in the country; however there is paucity of information concerning their taxonomy, genetic diversity, uses, among other issues. There are about 170 species that are consumed in different parts of the country; including herbs, trees, shrubs, and climbers. The edible parts mainly, constitute leaves, roots and tubers and seeds, other parts being rarely consumed. Most of the wild edible species are endangered due to genetic erosion.

Threats: Not much attention has been paid to horticultural crops, essential oil bearing plants, wild edible plants, etc. Despite the immense wealth of genetic resources and amicable environment, for these crops production is low quantitatively and qualitatively. Present day agricultural practice in Ethiopia pays little attention to valuable habitats, and multi-purpose wild edible fruits, vegetables and spices such as *Aframomum corrorima,* the latter is in the verge of extinction.

2.1.4.5 Essential Oil Bearing Plant Resources

Essential oil bearing plants are widely distributed in Ethiopia. Ninety-two oil-bearing species have been recorded in Ethiopia. The plant parts, which contain essential oils, include primarily roots, barks, stems, seeds, leaves, flowers and fruits. Essential oil bearing plants are annual, biennial or perennial herbs, shrubs or trees.

Essential oils are often used in foods, drinks, confectionery items, perfumes, deodorants, shampoos, lotions, toilet soaps, tooth pastes and mouth wash preparations, medicine, detergents, tobacco products.

Threats: As a result of deforestation, natural calamity, unsustainable agricultural practices, habitat destruction, valuable aromatic plants are being lost. For instance *Boswellia* spp., which are sources of incenses (Etan), are chopped and used for charcoal production.

Many aromatic plant species are harvested from wild without considering the population of plants leading to uncontrollable exploitation. Therefore, the need for conservation is vital.

2.1.4.6 Medicinal Plant Resources

Plants have been used as source of medicine for centuries. About 80% of the people of Ethiopia depend on traditional medicine for their health care practices; and more than 95% of traditional medical preparations are of plant origin. See Annex 1 Tables 13 and 14.

Threats: Medicinal plants utilised in Ethiopia are harvested from the wild. Wild occurring medicinal plant species and the associated traditional knowledge are getting eroded due to natural and manmade factors (traditional values undermined by the new generation). It is often the roots that are used for medicinal purposes (Annex 1.Table 10). Threatened species include *Hagenia abyssinica*, *Securidaca longepedunculata* and *Warburgia.*

2.1.4.7 Pasture and Forage Genetic Resources

There are diversified pasture and forage resources adapted to different ecosystems of the country. These pasture and forage genetic resources have great potential to be developed and used as sources of feed for the improvement of animal production. Ethiopia is known to be a centre of origin and diversity to a number of herbaceous legumes species included in the genera: *Trifolium*, *Vigna, and Lablab*, among others. The genetic threat of herbaceous legumes is particularly serious since it is more palatable and subsequently selectively fed upon by livestock. The situation is exacerbated by over grazing and over stocking. See Annex 1, Tables 16 and 17.

Threats: The major threat of pasture grasses is overgrazing, which causes the disappearance of the palatable and high yielding species. The genetic threat of herbaceous legumes is particularly serious since they are more palatable and subsequently selectively fed upon by livestock.

Forage diversity is lost as farmers cultivate their pasture land, more and more pasture land is lost yearly as cultivated land expands annually, responding to crop requirements of the ever increasing population size.

2.1.5 Wild and Domestic Fauna

2.1.5.1 Wild Faunal Resources

Ethiopian encompasses a broad range of ecosystems with great varieties of habitats contributing for the occurrence of high faunal diversity. However, information on terrestrial fauna as a whole is limited to mammals, birds, reptiles, amphibians and a few groups of arthropods. The variety of species and great proportion of endemicity within the groups especially in the highlands is the result of the isolation of the highland areas of the country, from other highland within and outside the country by the surrounding lowlands. See Annex 1. Tables 18-22.

Figure 16. Ethiopian Wolf (*Canis simensis*) – A critically endangered species dwelling mainly in Afro-alpine meadows and moorlands of few southeast, central and northern highland massifs of Ethiopia

Figure 17. Walia Ibex (*Capra wallie*) – An endemic ungulate with world population of less than 550, confined only in Afro-alpine habitat of Semien Mountain National Park, Ethiopia

Figure 18. Mountain Nyalya (*Tragelaphus buxtoni*), a montane specialist endemic ungulate, localized in southeast highlands of Ethiopia (photo by Yirmed Demeke)

A total of 277 mammalian species of which 29 are endemic are known to occur in Ethiopia including those that require urgent conservation action i.e. Walia Ibex (*Capra walie*), Gelada Baboon (*Theropithecus gelada*), Mountain Nyala (*Tragelaphus buxtoni*), Ethiopian Wolf (*Canis simensis*), Starck's Hare (*Lepus starcki).* Some of these endangered species have very restricted distribution, including Walia Ibex, which is the most endangered mammalian species in the world.

Figure 19. Harwood's Francolin (*Francolinus harwoodi*), an endemic and central highland Restricted Range species (photo by Yirmed Demeke)

Ethiopia has a rich avifauna, with a total of 861 species (about 40% of Africa's total), of the total 29 are endemic, 16 are exclusively restricted to the geographical boundary of Ethiopian while 13 are shared with Eritrea; there are 14 bird species which are vulnerable to extinction (10% chance of disappearance within a 100 years) including Hartwood's Francolin, Prince Ruspoli's Turaco, Greater Spotted Eagle, Lesser Kestrel, Yellow-throated Serin, Nechisar Nightjar, Wattled Crane, Degodi Lark, White-tailed Swallow, Sidamo Long-clawed Lark, Lappet-faced Vulture, Abyssinian Bush Crow, Corncrake and Imperial Eagle. There are 16 species, which are near threatened.

Figure 20. Wattled Crane (*Bugeranus carunculatus*), a highly threatened large waterfowl, Boyo wetland. (photo by Yirmed Demeke)

Ethiopian fresh water bodies are known to contain over 180 species of fish of which some 37-57 are reportedly endemic (see Annex Table 8) (Golubstov and Mina, 2003). The Rift Valley lakes basin has over 25 fish species and accounts for about 50% of total inland fish production. Also, it has already been indicated that the most important commercial types of fish are tilapia, Nile perch and catfish.

Ethiopia's arthropod fauna, including insects, is poorly known. Many insects are of great use to human kind since there are the primary agents of plant pollination and in most communities they occupy intermediate positions along the food chain. Some are harmful to human kind as they act as vectors to diseases of humans and domestic animals.

Insects are dominant in freshwater systems and occupy all conceivable habitats of the earth. However, insect ecosystems can broadly be classified into three major ecosystems, namely aquatic ecosystem, agro-ecosystem and forest ecosystem. The majority of almost all orders of insect species are associated with forest ecosystems.

Threats: The major factors that contributed to the decline of insect diversity include, human population growth, which led to faster transformation of the environment; agriculture led extensive encroachment on natural habitats; destruction of forests for crop cultivation; forest fires; use of uniform plant genetic material and large-scale monoculture; and insect behavioural change in relation to environmental changes.

Out of 277 mammals 29, out of the 862 birds 16, out of 201 reptiles 10, and out of 63 amphibians 34 are endemic to Ethiopia. Out of the bird species, 31 are globally threatened; among these 5 are critically endangered, 12 endangered and 14 are classified as vulnerable species. Various migratory birds considered endangered at the international level also visit about fifty sites in Ethiopia every year (Annex 1 Table 18).

2.1.5.2 Protected Areas

In order to conserve the wildlife genetic resources, Ethiopia has established protected areas at different levels and dedicated ca 193,600 Km^2 of land to wildlife protection area (Annex 1. Tables 18-22).

The Wildlife Conservation Areas are divided into two main categories, namely, Principal Wildlife Conservation Areas, which include National Parks (9) and Wildlife Sanctuaries (4), and Secondary Wildlife Conservation Areas comprising Wildlife Reserves (8) and Controlled Hunting Areas (18) (Annex 1 Tables 18 and 21). However, all the important ecosystems in the country are not represented in the existing wildlife protection areas**.** This is a major drawback to conservation of threatened endemic and unique species. Even the areas dedicated for wildlife protection are faced with many problems.

Threats: The major threats to protected areas emanate from settlement within the parks or adjacent to them (Awash, Siemen Mountains, Bale Mountains, Abijata-Shalla, Nechisar, Gambella, Mago, Omo); crop cultivation (Abijata-Shalla, Bale Mountains, Gambella, Siemen Mountains); grazing (Abijata-Shalla, Awash, Bale Mountains, Mago, Nechisar, Omo, Senkelle, Siemen Mountains, Yangudi-Rassa), deforestation (all parks and sanctuaries), and mineral extraction (Abijata-Shalla).

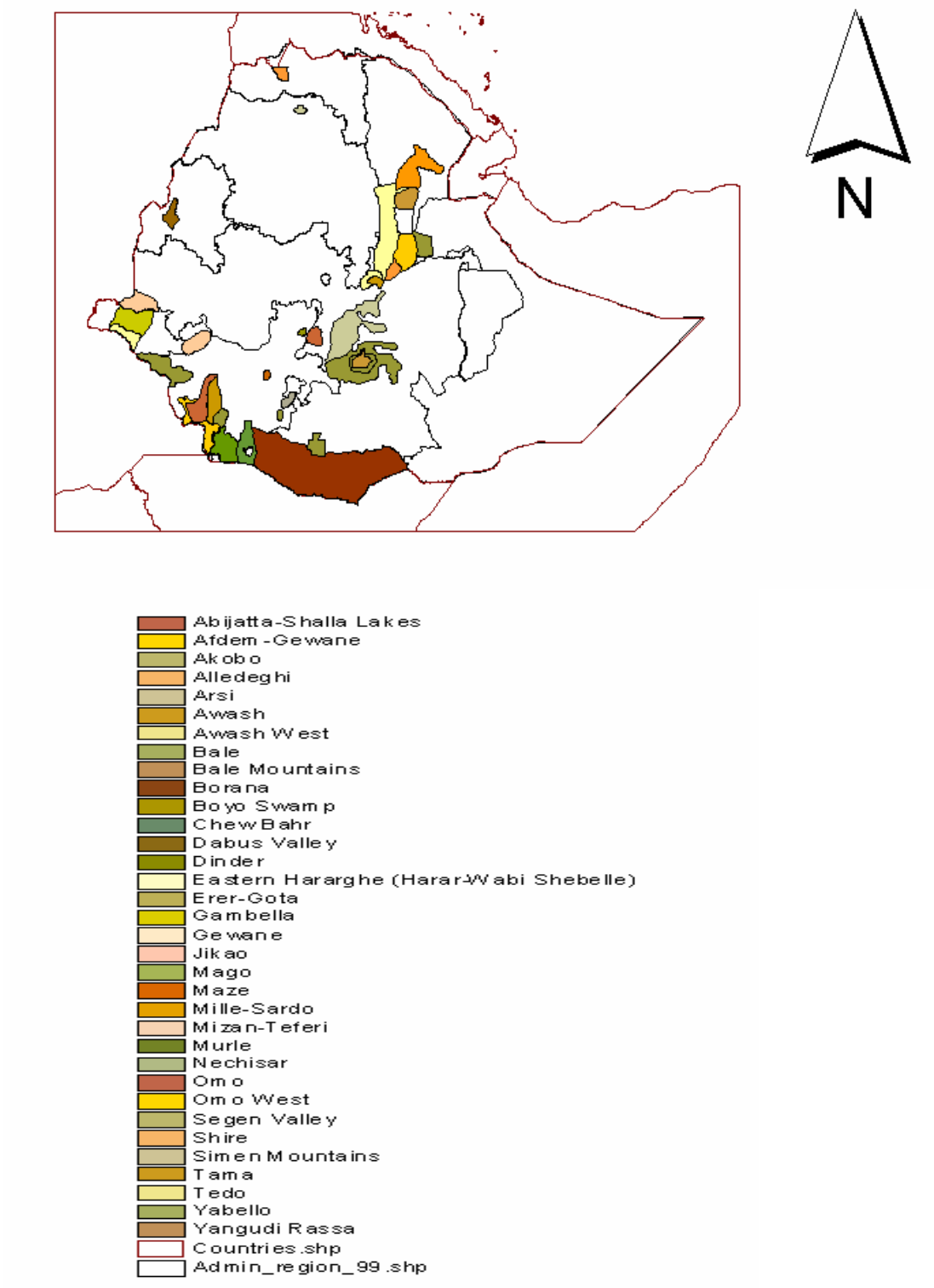

Figure 21. Protected areas in Ethiopia (Source: Lakew Berhanu, Ethiopia's Protected Area System Plan Project, Wildlife Conservation Department, Ministry of Agriculture)

2.1.5.3 Domestic Faunal Resources

Ethiopia has long been recognised as a centre of diversity for domestic animal genetic resources. It appears that the country has served as a gateway to genetic material from Asia to Africa and its diverse ecology gave rise to further diversification and thus contributed to develop the huge genotypes the country host today. In terms of livestock population Ethiopia stand first in Africa and third in world. The domestic animal population of the country is estimated to be 27 million cattle, 25 million sheep, 24 million goat, 3 million camel, 56 million chickens, 2.5 million horses, 1 million mules and 3.5 million donkeys. At present there are about 27 cattle (Annex 1 Tables 23 & 24), 13 sheep (Annex 1 Table 25), 15 goat (Annex 1 Tables 26), 4 camel (Annex 1 Table 27), 4 donkey (Annex 1 Tables 28), 2 horse (Annex 1 Table 29), 2 mule (Annex 1 Tables 30) and 5 chicken (Annex 1 Tables 31) and 6 honeybee (Annex 1 Tables 32) breeds in the country.

In terms of estimated livestock population, the country holds the ranks of first, second and third positions in cattle sheep and goats populations in Africa respectively. Ethiopia also ranks third in livestock population in world. Of the total cattle, sheep, goats and equine population in Africa 17%, 12%, 11% and 49% are found in Ethiopia respectively (Million Tadesse). Regarding to the equine population, these same authors indicated that Ethiopia constitutes 32.4% of the donkeys, 41.6% of the horses and 65% of the mules of Africa. Economically, livestock accounts for about 40% of the agricultural GDP, 15.0% of the total GDP and 19% of the export earrings.

Despite the fact that a number of attempts to classify the Ethiopian domestic animal have been made, none of which are entirely satisfactory and all of which are certainly incomplete. There is little work done so far on identification, characterisation and development of the resources. There is no breed level statistics for all breeds, as a result the status and trend of breeds is not known. However, from limited information the shako and Fogera cattle breeds, and sennar donkey breed are some of domestic animal breeds at risk to be lost. Begayit, Ogaden Afar, Borena cattle breeds, and Afar sheep breeds are currently at declining rate.

Threats: Major threat for the cattle populations include, a) feed shortage as a result of degradation of rangelands/grazing areas; (b) resettlement of refugees in pastoral areas; (c) overgrazing and overstocking; (d) sporadic invasion of exotic weeds and shrubs; (e) expansion of crop cultivation practices both on grazing land in the highlands and also on the marginal areas in the lowlands (rangelands). Additional threats emanate from artificial insemination (crossbreeding), Inbreeding and interbreeding as well as Trypanosomiasis infection. Trypanosomiasis is a major threat to cattle breeds. The indigenous chicken population could be pictured as a pool of gene under pressure from many direction including replacement by exotic breeds (crossbreeding), diseases, predation, lack of food and drinking water of good quality, and poor housing. The main threat to honeybees emanate from diseases (Nosima and Amoeba), pests, predators and agro-chemicals (pesticide/Herbicides)

2.2 ROOT CAUSES OF BIODIVERSITY LOSS IN ETHIOPIA

2.2.1 Direct Threats and Root Causes of Ecosystem Biodiversity Loss

Clearing for Agriculture Conversion of natural forests, woodlands and savannah ecosystems to agriculture is the greatest single threat to ecosystem biodiversity. Conversion results in the loss of nearly all species of fauna and flora on the site and leads to increasing fragmentation of the remaining ecosystems. Root causes of clearing for agriculture include population growth, low productivity of agriculture, unsustainable agricultural systems (soil erosion and inability to maintain soil fertility), tenure systems that allow the conversion of common lands to farmland and lack of enforcement – even some of natural parks have been heavily encroached by farmers.

Over-cutting and unsustainable levels of harvest Over-harvest of both woody and non-woody products are occurring on a widespread basis leading to deforestation, ecosystem degradation and biodiversity loss. Root causes include demographic pressures and growing demand, especially urban demand, for firewood, charcoal and other products, land tenure and resource access rights resulting in de facto open access to forest/wild lands, lack of political will to enforce forestry legislation, lack of sustainable management models for most ecosystems and lack of incentives for local communities to conserve.

Over-grazing Overgrazing results in decreased soil cover, increased erosion, decreased quality and productivity of range resources, reduction or elimination of the natural regeneration of woody species and preferred forage species, bush encroachment in some areas and loss of biodiversity. Root causes include demographic growth, the breakdown in traditional pastoral/range management systems, land tenure and de facto open access to rangelands in some parts of the country, lack of incentives for sustainable use and lack of range management models in some areas.

Over-hunting Wildlife populations have been severely depleted by over-hunting. Root causes include the lack of incentives for local people to conserve wildlife, the low risk of being caught and prosecuted for poaching, availability of firearms, growing demographic pressures, and conflicts between wildlife and farmers.

Alien invasive species are one of the major factors threatening biodiversity resources globally. Alien invasive species lead to ecosystem disruption by destroying or displacing indigenous species through rapid reproduction and expansion. Alien species cause severe damage by reducing crop yields, displacing indigenous species, obstructing irrigation infrastructures and aiding the spread of other crop pests.

Alien species are found in many parts of the country. Although no detailed studies have been available on their impact, they are causing enormous problems in the various ecosystems and the economy. The prominent alien species that cause damage across the country include *Parthenium hysterophorus, Prosopis juliflora, Eichornia crassipes* and

Lantana camara. Introduced, or alien invasive, species can have significant negative impact on global and national levels. *Prosopis* is becoming a major problem on semi-arid rangelands.

The effects of other exotic but useful species on the native fauna and flora of Ethiopia have not been well documented. In attempts to meet the increasing demands of a rapidly growing human population, fast growing exotics have been introduced to alleviate shortages in timber, fodder, and fuelwood. Prominent among the exotics tree species are *Eucalyptus* spp.

Extreme care is required in the selection of species to be introduced to minimise any impacts on native species. Introductions should be considered only if absolutely necessary and should be accompanied by strategies to assess the magnitude of any threats to indigenous species. Where practical, indigenous flora and fauna should be restored to reduce loss of native biodiversity.

Change in fire regime Fire is a basic part of the ecology of semi-arid rangeland ecosystems, but government has often sought to ban its use. Elimination or reduced frequency of fire often results in bush encroachment, greatly reduced forage production and major changes to the structure and species composition of the vegetation. Fire bans result from well-meaning initiatives taken by politicians and technicians who lack a good understanding of the role of fire in the ecology of dryland ecosystems.

Climate change/drought Average global temperature has been rising for more than a century, either as a result of natural fluctuation or the build-up of greenhouse gases. Climate change is likely to reduce biodiversity, and the goods and services that ecosystems supply in Ethiopia by:

- increasing desertification in arid and semi-arid areas;
- increasing flooding;
- the desiccation and die-back of forests; and
- reduced agricultural production.

2.2.2. Threats to agro-biodiversity

Drought is probably the main threat to crop diversity. During extended severe drought, farmers sometimes consume all of their seed resulting in loss of genetic diversity and entire crop varieties.

Crossbreeding of local races of livestock with introduced breeds leads to genetic erosion of the native breeds.

Future intensification Worldwide, agricultural intensification is the major cause of loss of agricultural biodiversity. This occurs through the replacement of traditional crop varieties with high-yielding varieties that are dependent on high levels of agricultural inputs. This has not occurred on a large scale in Ethiopia, but the threat needs to be monitored closely.

2.2.3 Cross-cutting Causes of Biodiversity Loss

The analysis of direct threats and root causes above shows that there are many crosscutting causes of biodiversity loss. The Global Biodiversity Strategy identifies six fundamental causes of biodiversity loss:

- the unsustainably high rate of human population growth and consumption;
- economic systems that fail to value the environment and its resources;
- inequity in the ownership, management and flow of benefits from both the use and conservation of biological resources;
- deficiencies in knowledge and its application;
- legal and institutional systems that promote unsustainable exploitation.

While these causes are common to most countries, the relative importance of each cause, and the particular ways in which each is manifested, are particular to each country and will be discussed for Ethiopia below.

2.2.3.1 Population growth and Increasing Demand for Natural Resources

Though people are without doubt the most valuable resource in Ethiopia, uncontrolled population growth puts undue pressures on all other national resources. Ethiopia's population grew from about 30 million in the 1960's to over 67 million by 2003 and is expected to reach 130 million by 2020. According to the population forecast based on the 1994 population and housing census, the total population of Ethiopia in the year 2002 was 67.22 million, of which 56.9 million (84.7%) were rural and 10.3 million (15.3%) were urban dwellers. Increasing natural resource consumption is exacerbated in Ethiopia by low primary productivity in agriculture, rangelands, forestry, and fisheries.

Although almost all-arable land in the highlands is already cultivated, the productivity per hectare is among the lowest in the world. There are three main contributing factors to this low productivity: limited availability of water technology for irrigated agriculture, poor land and crop management and land degradation and soil erosion. There is some scope for increasing the area of agricultural land in Ethiopia primarily in the lowlands by improving the technical knowledge of the farmers to increase production capacity.

2.2.3.2 Economic systems and valuation of the environment and its resources

Decisions to exploit natural resources in Ethiopia are often taken without taking full account of the social costs of habitat losses or extinction, nor shared equitably. Conversely, the social benefits of conserving biodiversity are rarely taken into account. Further, conventional methods of measuring national income in Ethiopia (such as per capita GNP) do not recognise the drawing down of the stock of natural capital, and instead consider the depletion of national resources, i.e. the loss of national wealth, as net income.

Many conservation activities yield 'global benefits' as well as benefits to Ethiopia. If, for

example, biodiversity is conserved in Siemen Mountains, the Bale Mountains and its forests, it yields benefits to people in other countries, because they provide potentially important goods (e.g. medicinal properties of plants), biogeochemical services (e.g. carbon sequestration) and water (many rivers that flow out of Ethiopia originate in these mountains). But if Ethiopia receives no financial or other resources to pay for the 'incremental cost' of these 'global benefits', it will have less incentive to look after these biological resources. This has been called 'global market failure' (Pearce and Moran 1994).

Governments have a habit of intervening in markets. They may do so with the best of intentions. The principal form of intervention failure is 'sub-optimal pricing' - for example, of timber, agricultural products, water and energy. Underpricing is often deliberate, with the intention of promoting greater use and access to water and energy and thus contributing to national development. In Ethiopia, for example, irrigation water is underpriced (Pearce and Moran 1994), leading to overuse, wastage, and the consequent degradation of aquatic habitats and agro-ecosystems. Energy is similarly underpriced to stimulate development, leading to policies that obscure the environmental costs of energy production - whether based on hydropower or fossil fuels i.e. renewable and non-renewable resources. Under open access, forest and range resources (and fisheries and wildlife), are assigned no price at all – other than the costs of exploiting them. This is a fundamental root cause of destructive overuse of these resources.

2.2.3.3 Inequity in Ownership

Market and intervention failures are exacerbated by the weak ownership regimes in natural resources. A large proportion of Ethiopia's forests, rangelands are open access resources, or are ineffectively controlled under crumbling common property regimes and the state. Open access is probably the most equitable of all access systems – but it inevitably leads to the destruction of the resource and pressures on the resource build. Under permit or licensing systems, exploitation is allocated to those who pay most for the rights, not to those who most value the resources (McNeely 1988).

There is a growing tendency for multinational firms to take biological and genetic materials as well as knowledge from indigenous cultural groups for their own study and exploitation without acknowledging their sources. However, there is an opportunity for benefit sharing if the capacity of the indigenous people to negotiate to get value for their knowledge and resources. Each country needs to have a legal framework in place to defend these intellectual property rights.

In an uncertain future, the time horizon of people shrinks, and the discount rate increases. The discount rate is the percent by which we prefer current consumption to future consumption. A higher discount rate means that future consumption has less value, and therefore that people would prefer immediate benefits rather than greater delayed benefits.

In Ethiopia, a weakening of customary community responsibilities for the use of natural

resources can be attributed to several causes. With development, new sources of income have weakened reliance on local biodiversity resources, eroding the need and concern for sustainable use of these resources. This concern has been further eroded by the dis-empowerment of local communities, for example, by state intervention in the management of land resources. Increasing uncertainty (due, for example, to changing prices and inconsistent government policies) discourages a long-term view of resource use.

2.2.3.4 Deficiencies in knowledge and its application

Education brings about economic growth through increasing individuals' productive capacity. An educated person will be more productive. Education also helps to achieve more rapid technological adaptation and innovation, and better natural resource management. Education is therefore one of the most powerful instruments societies have for reducing deprivation and vulnerability; it helps lift earnings potential, expands labour mobility, promotes the health of parents and children, and reduces fertility and child mortality.

The most basic capability deprivation in Ethiopia is the fact that about two-third (64%) of the adult population is illiterate, and only about half of the school age children are enrolled in schools, with women and girls well below the average figure. Net primary school enrolment rate is only 52 %. Net secondary school attendance ratio is only 11.5%.

Whereas Ethiopia's achievement in social development is very poor, the pace of knowledge creation is dramatically accelerating at international level. The fact that most developing countries including Ethiopia are falling further behind in their ability to create, absorb, and use this knowledge is a serious concern. Ethiopia's connection to the rapidly expanding global knowledge system is weak and it will increasingly become disadvantaged if current trends continue unchanged. Ethiopia needs to develop the requisite infrastructure and manpower in order to participate in the new global business models of intermediation, business process outsourcing and value chain integration.

Academic, developmental and culture-related educational activities need to be promoted using both formal and non-formal channels. Social awakening and developmental dynamism can also be enhanced through encouragement of civil society institutions' engagement in developmental and culture oriented non-formal educational activities.

2.2.3.5 Legal and institutional systems that promote unsustainable exploitation

Under-valuation of environmental resources due to low-level of awareness about the role of ecosystems and the rate at which it is being deteriorated or lost and poor regard to the conservation problems have contributed to marginalisation of biological resource management. In most cases, decisions about exploitation/ use of natural resource are made without consideration of their environmental values.

Incentives by way of regulated prices, taxes and subsidies send important signals to resource users about economic opportunities, and may determine sustainability as well. Natural resource utilisation should not be seen only in the context of limiting access and exploitation, but should be viewed from the perspective of opportunities for sustainable economic opportunities.

Land use policies The land tenure system is a major factor behind the poor adoption of land improvement and management practices. In land management, another crucial issue is the need to take into account the trade-offs between long-term versus short-term benefits. In many instances, exploiting a natural resource may have short-run poverty alleviation benefits, but these actions may entail long-run costs in terms of resource destruction/degradation, loss of biodiversity or accumulation greenhouse gasses.

Repeated studies have confirmed that land security enhances proper land management and increased productivity. When the state administers the land, the farmers may not feel secure enough to invest in soil protection and land improvement activities. Moreover, with growing population pressure, the degree of land fragmentation continuously increases which aggravates tenure insecurity as well as land degradation with consequent degradation in environmental resources and productivity.

Policy and Law enforcement The government conservation effort is undermined by a number of factors including weak management, poor Cupertino among government sectors, weak law enforcement capacity, and lack facilities/ infrastructure. These factors have negatively impacted on investment and natural resources such as forests that have been degraded both quantitatively and qualitatively.

2.3 REVIEW OF KEY BIODIVERSITY CONSERVATION ISSUES

2.3.1 Planning and Polices

Identifying the Issues

Article 6 of the Convention on Biological Diversity (CBD Secretariat, 2003) requires parties to develop national strategies, plans or programmes for conservation and sustainable use, and to integrate these into other relevant sectoral plans. This requirement is partially met by the current Biodiversity Strategy and Action Plan for Ethiopia. There are policies and strategies in place that address biodiversity conservation directly such as Federal Environmental Policy (1997), the National Biodiversity Conservation and Research Policy (Approved in 1998) and the Conservation Strategy of Ethiopia (CSE) (1997) and Regional Conservation Strategies (RCSs) specific to the regions.

The Federal Environmental Policy focuses on directing environment and related activities that are being undertaken by the Environmental Protection Authority and by the various institutions. The overall objective of the Policy is to promote sustainable social and economic development of the country through the conservation and sustainable utilisation of natural, man made and cultural resources, and the environment of the country. It specifies the policy objectives, key guiding principles, sectoral and cross-sectoral policy

frameworks and implementation strategies to be followed so that the overall objective can be realised.

Section 3.3 of the Environmental Policy, which is entitled as “genetic, species and ecosystem biodiversity" includes the following policy elements which aims to:

- promote *in-situ* conservation as a priority measure and *ex-situ* conservation as a complement;
- develop laws that help protect community rights and regulate access to genetic resources and biosafety;
- ensure that threat, rarity, demand, and environmental and economic factors are taken into account when setting conservation criterion;
- ensure that local communities participate in the planning and management of protected areas in their surrounding;
- ensure that protected areas cover the various areas and ecosystems and when necessary connect them by corridors;
- ensure that price policies and tools support biodiversity conservation;
- give to local communities the lion's share of the income accrued from the utilisation of genetic resources;

The policy provides a framework to promote conservation and sustainable utilisation of biodiversity.

Both the federal and regional conservation strategies have dealt with the broad spectrum of issues relating to the environment, the goals of the CSE are expressed in broad terms: “conservation of natural resources”, “sustainable development” and “improved efficiency in the use and management of resources”. There are 22 core programmes addressed in the CSE, and though one of them deals with conserving biodiversity and many of the others touch on biodiversity related issues, they are clearly not detailed enough to address in a deeper and more comprehensive way the issues relating to the depletion of biodiversity in Ethiopia. The NBSAP will fill this void and give direction and set out an action programme for conserving the nation’s biodiversity.

The National Biodiversity Conservation and Research Policy was approved in April 1998 with the view to provide for policy guidance towards the effective conservation, rational development and sustainable utilisation of the country's biodiversity.

The policy specifies objectives and directions to be followed towards the realisation of the sought overall objective. The policy objectives are to:

- ensure that the genetic resources and essential ecosystems of the country are conserved, developed and sustainably utilised;
- assert national sovereignty of the country over its genetic resources;
- enrich the country's genetic resources through introduction, repatriation and restoration;
- build national scientific capacity to collect, conserve, evaluate and utilise the country's biodiversity;

- integrate biodiversity conservation with sectoral and cross-sectoral strategies and programs;
- recognise and protect traditional knowledge;
- encourage public participation in biodiversity conservation, development and utilisation;
- ensure that communities share from the benefit accrued from the utilisation of genetic resources and their traditional knowledge; promote regional and international Cupertino in biodiversity conservation, development and utilisation.

There are several policies and strategies in Ethiopia that impact on biodiversity. Most pertinent to the conservation and sustainable use of biodiversity are the draft Forestry Policy and Strategy, the draft Policy on Wildlife Development, Rural Land Use and Management Policy and Strategy.

At the federal level, the formulation and co-ordination of wildlife policy and plans have been, since the 1970s, the responsibility of the Ethiopian Wildlife Development and Protection Department (EWDPD). At the regional level, wildlife policy and planning are the responsibility of the regional bureaus. Ethiopia's existing laws /regulations relevant to wildlife management tend to place heavy emphasis on fauna to the exclusion of flora, and on game animals as opposed to non-game species. They relate almost exclusively to the establishment of protected areas, and taking and trade controls for listed species. Many of the more comprehensive requirements of the CBD are therefore not addressed. A new national Wildlife Policy has been drafted by the FDRE. This policy is more comprehensive in that "wildlife" is defined to include all wild species and their habitats; however, it does not include domesticated fauna or flora, or genetic material.

Sectoral laws dealing with biological resources tend to address biodiversity as a marginal issue. The Forestry Laws (FDRE, 1994; Proc. No.94/94) have included provisions that at insuring the conservation of forests. One of the objectives for the establishment of 'State Forests' is to conserve genetic resources and/or conserve the ecosystem. For example the law prohibits the utilisation/harvesting of *Hagenia abyssinica, Cordia africana, Podocarpus falcatus, Juniperus procera* from either state or 'regional forests'.

Even though there is no comprehensive agricultural policy approved to date, the draft Agricultural Policy covers sectors that have not been specifically addressed by any other policy: *landuse; fishery; animal resources; forestry; and wildlife*. One of the objectives is bringing about sustainable agricultural development through proper conservation and utilisation of natural resources. The conservation emphasis, however, appears to be limited to the physical resources. The invisible aspect of natural resources, i.e. genetic resources seems to be given lesser emphasis. The conservation aspect of genetic resources needs to be built in the agricultural development goals and endeavours. In addition, the policy should be in agreement and integrated with policies in other sectors, directly or indirectly related to agriculture.

2.3.2 Legislation

Identifying the Issues

Legislative support is required for the implementation of many of the articles of the CBD. Although the term "biological diversity" has been in use globally, it does not find expression in much of the existing legislation. Ethiopia has a wide range of laws relating to the conservation of the different components of biodiversity (forests, land, wildlife, seed, etc). One of the objectives of the Constitution of FDRE (FDRE, 1995; Proclamation No. 1995) is to ensure clear and healthy environment. The Constitution also states that. Government and all Ethiopian citizens shall have the duty to protect the country's environment. What is required is to review the relevant existing laws, to relate them to the CBD, and where necessary to amend them or to enact new laws.

With regard to the conservation of species, a serious weakness in the relevant law is that it deals excessively with animal species and no provision is made for the protection of threatened and endangered plant species. The existing laws attempt to control the hunting of designated game animals, but most of these regulatory measures have proved difficult to enforce due to low capacity both in human and resources.

Under the existing wildlife law in Ethiopia, the Wildlife Conservation Areas are divided into two main categories, namely, Principal Wildlife Conservation Areas, which include National Parks (9) and Wildlife Sanctuaries (4), and Secondary Wildlife Conservation Areas comprising Wildlife Reserves (8) and Controlled Hunting Areas (18). Current thinking on Protected Area management is that, to be effective, the communities living alongside the area should participate in management and should derive some benefits from the area. None of the existing categories of protected areas make allowance for participatory management by communities. A draft Wildlife law empowering local communities to participate in joint wildlife management with governments has been prepared and is currently under review.

The Forestry Proclamation (Proclamation No.94/1994) was enacted with a view to consolidate existing forestry laws and provide for the inclusion of new provisions that enhance better conservation, development and utilisation of forests. However, in practice, there is no clear jurisdiction over the forests, and different government agencies use this resource for their purposes through the mandates provided by their own pieces of sectoral legislation. Conservation of forest biodiversity therefore goes by default.

Due to the introduction of the decentralisation process from the federal to local governments, considerable potential for the conservation of biodiversity exists at the local government level. The functions delegated to local government coincide with many aspects of biodiversity conservation and these could provide windows of opportunity for the implementation of conservation measures at the regional, zonal, Wereda and community levels.

2.3.3 Identification and Monitoring

Identifying the Issues

Two of the objectives of the CBD relate to the conservation of biological diversity and the sustainable use of the components of biological diversity. In order to target conservation and sustainable use measures, each country party has to have a clear idea of the ecosystems, species, and genomes that are under threat through overuse, habitat degradation, and spread of invasive species. Annex 1 of CBD gives guidelines to the parties on identifying the component of biodiversity, which should be the target of attention. They are described as:

1) Ecosystems and habitats: containing high diversity, large numbers of endemic or threatened species, or wilderness; required by migratory species; of social, economic, cultural or scientific importance; or, which are representative, unique or associated with key evolutionary or other biological processes;
2) Species and communities which are threatened; wild relatives of domesticated or cultivated species of medicinal, agricultural or other economic value; of social, scientific or cultural importance; or of importance for research into the conservation and sustainable use of biological diversity, such as indicator species; and
3) Described genomes and genes of social, scientific or economic importance. Article 7 goes on to stress the need for monitoring changes in the components of biological diversity, which are under threat and identifying processes, or activities that continues to cause adverse impacts on biodiversity, so that effective remedial measures could be taken through the other Articles of the Convention.

In Ethiopia, information about the components of biodiversity is very incomplete. There is no biodiversity information and monitoring centre to maintain, store, and organise data or to analyse, evaluate and disseminate data in a usable form. Data derived from the identification and monitoring of biological diversity are scattered among a large number of organisations. Data on the flora of Ethiopia, for example are available at the National Herbarium, Addis Ababa University. Additional data are also available at IBC and EARO, Herbaria and Museums in Europe and North America. Information on Ethiopia's biodiversity should be complied and located in Ethiopia where it could be made available and accessible to government and non-government institutions, the private sector, individuals (including researchers), etc. who would like to make use of them.

2.3.4 *In-Situ* Conservation

Identifying the Issues

The Convention on Biological Diversity recognises *in-situ* conservation as the primary approach to biodiversity conservation (Article 8). Of particular importance is the balance to be struck between conservation measures within Protected Areas (PAs) and measures for sustainable use of natural areas outside of PAs in the wider countryside. It is generally recognised that activities, which occur in areas adjacent to PAs, may be critical to the viability of the PAs themselves. Adjacent communities ultimately control the PA to the

extent that if the PA negatively affects the local population, then this area may be destined to fail. However, if local people are involved in the management of PAs and other forms of development compatible with the goals of the protected area are promoted in adjacent areas, then the protected area's long-term viability is likely to be enhanced.

The majority of Ethiopia's PAs were created in the 1960s and 1970s, and paid insufficient attention to ecological criteria for biodiversity conservation and for the requirements of local communities. Today, many of the PAs are too small and isolated to be effective. Ethiopia's ecosystems are not adequately represented within the protected area network, including most of the critically threatened ecosystems identified in this plan. For example, there is no truly protected area representing the inland waters ecosystem. A total of 193,600 Km^2 of land has been put aside as PA. Most of the existing PAs were created in a limited range of low altitude, semi-arid ecosystems with the principal objective of wildlife conservation.

There is an urgent need to assess the strengths and weaknesses of the existing protected area network and to develop appropriate strategies/plans for improving the effectiveness of its coverage and of its management. The assessment should include a gap analysis to identify gaps in the coverage of Ethiopia's ecosystems. In recent years, some efforts have been taken to address this situation, and management plans have been developed for the Awash NP, Semen Mountains NP and the Bale Mountains NP. Given the limited resources available for PA management, a major emphasis should be placed on developing new forms of public/private/civil society partnerships for PA management.

Few efforts have been made at raising public education and awareness in areas adjacent to protected areas, providing environmentally sound and sustainable development assistance to local communities or formulating appropriate packages of incentives and disincentives. Consequently, local communities either continue to disregard protected area provisions leading to degradation of the PA. Where those provisions are enforced against local communities' interests, conflicts have arisen. The conflict between local communities and park authorities arising mainly from the loss of grazing rights is well known. An attempt has been made to resolve and manage the recurrent conflicts, but deep-rooted structural problems remain.

Local community knowledge of natural ecosystems and wild taxa is widespread and significant, but the existing systems of research and information gathering have not adequately documented, exploited or supported such knowledge. There is an urgent need to facilitate the continuation, systematisation, and, where appropriate, recording such knowledge and information. In addition communities do not have access to relevant information and data from outside resources, and it is important to find ways and means to access such information.

In Ethiopia, institutions involved in *in-situ* conservation of biodiversity include the Institute of Biodiversity Conservation (IBC), the Ethiopian Agricultural Research Organisation (EARO), Regional Agricultural departments, Higher Learning Institutions, etc. However, the impact of their work to conserve biological resources on the ground is

very limited.

The efforts made by IBC in collaboration with various institutions on *in-si*tu and *ex-situ* conservation, and sustainable use has been documented in Fassil Kebebew & Girma Balcha (2004).

2.3.5 *Ex-Situ* Conservation

Identifying the Issues

The Convention on Biological Diversity specifically recommends that *ex-situ* measures be adopted as necessary in situations where *in-situ* conservation programmes do not prove to be adequate. These measures have most extensively been applied to conserve cultivated and domesticated agrobiodiversity, employing techniques such as seed banks, field gene banks, *in vitro* storage, and captive breeding measures. Other groups in need of *ex-situ* conservation measures include: threatened species, wild relatives of cultivated plants and domesticated animals; medicinal plants; plant crops of local and regional importance; pasture and forage species; ornamental plant species; tree species; and micro-organisms. *Ex-situ* conservation is complementary to the rehabilitation and restoration of degraded ecosystems, and the recovery of threatened species.

Ex-situ conservation facilities provide excellent opportunities for researchers to study plants, animals, and microorganisms in controlled conditions, and to improve collection, storage and regeneration techniques. *Ex-situ* facilities can also be used for germplasm evaluation, as centres for documentation and information systems and for providing information on genetic resources on a commercial basis.

Captive breeding of wild animals can be used to restore endangered species populations. It is important to increase populations as quickly as possible and reintroduce the animals back to their original habitat to minimise genetic erosion. Plants can also be re-introduced to their natural areas of occurrence. Such re-introductions should, however, be carried out in such a way that other indigenous species are not harmed or adversely affected. Similarly, care must be taken while collecting material/animals for *ex-situ* conservation not to endanger other native species and genetic resources. The regulation and management of such transactions requires accurate information to determine the impact of collection on populations and ecosystems.

The establishment of a National Microbial Culture Collection would be essential for the preservation and use of the rich microbial diversity present in Ethiopia. In Ethiopia, institutions involved in *ex-situ* conservation of biodiversity are very limited and include primarily the Institute of Biodiversity Conservation (IBC) and the Ethiopian Agricultural Research Organisation (EARO). The IBC is maintaining crop genetic diversity in collaboration with farmers.

2.3.6 Sustainable Use

Identifying the Issues

The CBD recognises the need for countries to use their indigenous biological resources for socio-economic development. Key sectors of the economy of Ethiopia (such as agriculture, fisheries, and forestry) are dependent on the use of biological resources. While recognising the need to use resources, the CBD requires parties to ensure that the use of biological resources does not deplete the country's biological diversity.

The sustainable use of the components of biological diversity is specifically established in Article 10 of the Convention, which *inter alia* requires parties to integrate consideration of the conservation and sustainable use of biological resources into national decision making and to adopt measures relating to the use of biological resource to avoid or minimise adverse impacts on biological diversity.

Being one of the objectives of the Convention, the sustainable use of biodiversity figures prominently in other Articles of the Convention besides Article 10. For example, in the Article on *in-situ* conservation (Article 8), such conservation does not necessarily exclude use of the resource. Article 8(c) states: "Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use". In practice, in Ethiopia as in many other developing countries, conservation of biological diversity is traditionally considered to be the exclusive role of organisations such as the Wildlife Department, Forestry Department, EPA and IBC. Efforts made to document indigenous knowledge associated with biodiversity has been documented in IBC Program Document (IBC, 2000).

Institutions that use biological resources (e.g. the agriculture and fisheries sectors) have paid little attention to aspects of depletion of biological diversity and of the resources base. Clearly, there is a need for integrating sustainable use considerations into national decision-making in different sectors of the economy. The adoption of the NBSAP should remedy this problem.

The CBD requests parties to respect, preserve and maintain knowledge, innovation and practices of indigenous and local communities for the conservation and sustainable use of biological diversity. In Ethiopia, traditional natural resource management systems have declined with the advent of state-controlled protected areas and the creation of centralised management agencies. Although many rural communities have developed specialised, area-specific systems of use and conservation, few of these systems - or the customary rights and traditions, which comprise them, are recognised by current laws. As a result, many traditional activities have become illegal and are now sources of conflict between the authorities and local communities. A new approach is clearly needed in which local people are no longer considered to be the problem but, rather, part of the solution.

The inappropriate use of natural resources resulting from lack of land use policy and land use planning and from policies on land tenure/resource access rights; uninformed

government decisions that have been disregarding and often overriding local organisations and management systems, and the impact of wide spread poverty have exacerbated the situation.

Among the factors, which can help to promote sustainability of use, regimes at the species and ecosystem levels are the following.

- Social/Policy Factors to:
  - carry out a comprehensive research on the merits and demerits of the existing land tenure system in Ethiopia;
  - ensure effective information exchange between users, decision-makers, and the public;
  - identify effective means for developing sustainable management systems within the existing policies on land tenure/access right;
- Economic Factors that provide:
  - Adequate income/incentives for communities to sustain conservation of the resource;
  - reinvestment of income earned into the conservation or "sustainable management" of the resource.
- Biological factors that help in establishing the biological basis for use (i.e. status, trend, and biological requirements); setting objectives for the size of the target population.
- Management inputs that result in:
  - Testing/development of sustainable integrated management systems for natural forests, rangelands, fisheries and wildlife for each of the ecosystem/habitat types;
  - Training or "development of public, NGO and private sector institutional capacities for replicating and adapting sustainable management systems";
  - monitoring & evaluation systems.

As a general rule, sustainability has been accorded insufficient emphasis within those sectors that use biological resources. There is a need to strengthen the regulation and management of Ethiopia's resource utilisation programmes, taking into consideration the criteria and factors outlined above.

2.3.7 Incentive Measures

Identifying the Issues

Article 11 of the Convention on Biological Diversity requires that incentives be adopted to promote conservation and sustainable use of biological diversity; the Convention stresses that these incentives should be economically and socially sound. Incentives measures that promote desired practices and behaviour may be direct (e.g., the provision of grants or subsidies) or indirect (e.g. tax exemptions). Disincentives, such as fines or pollution charges, are used to discourage practices, which deplete biodiversity or lead to unsustainable use. "Perverse" incentives are measures which have been taken to promote other social objectives, but which have a negative impact on biodiversity. For example,

many countries provide grants or tax breaks for land clearance and the replacement of local crop varieties by High Yielding Varieties (HYVs) – activities, which can severely reduce biodiversity.

One of the most powerful incentives is the empowerment of communities to manage, harvest and commercialise biological resources in exchange for their adoption of sustainable management systems. They have the incentive to respect the sustainable use rules/plans or risk losing their management and harvest rights. This type of incentive has been the basis of the greatest success stories in sustainable NRM in Africa.

The integrated use of incentives and disincentives is a particularly powerful means of promoting conservation and sustainable utilisation, and is being accorded increasing attention by many governments. Ethiopia, however, has made relatively little use of incentives approach to date and has relied instead primarily on enforcement systems and penalties. This has not produced satisfactory results. Because the benefits of biodiversity are not widely understood or accounted for, very few incentives have been instituted to encourage conservation or sustainable use; similarly, appropriate disincentives are scarce and weakly enforced. **"**Perverse" incentives are also widespread, particularly in the agricultural sector; irrigation subsidies, for example, encourage the wastage of water, and contribute to the degradation of inland water ecosystems. Thus irrigation incentives need to be adequately formulated.

An additional cause of biodiversity depletion in Ethiopia is the disproportionate distribution of costs and benefits associated with the conservation and use of biological resources. Those who benefit from the exploitation of biodiversity do not bear the proportional costs of biodiversity depletion; rather, they pass on many costs to other segments of society, which do not have an equal share in the benefits. At the local level, communities often bear the ecological costs of unsustainable resource use practices carried out by external organisations, but receive few of the benefits. For example, when firewood and charcoal are harvested unsustainably from natural forests and are marketed in urban centres, the urban consumers are buying the wood fuels at subsidised prices that do not include the costs of sustainable management of the forest. The same is true for meat and livestock products from open access use of rangelands and of fish and wildlife harvested unsustainably.

At the national level, there is no adequate pricing and valuation system for biodiversity; as a result, the government does not determine and, therefore, does not charge for, the real costs of biodiversity use. The Total Economic Value of Biodiversity Resources can be divided into direct values (outputs that can be consumed directly such as timber, medicine, food, etc.), indirect values (such as flood control, storm protection, carbon sequestration, climate control, etc.); option values (the premium placed on maintaining resources and landscapes for future direct and indirect uses) and existence values (the intrinsic value of resources and landscapes such as cultural, aesthetic, etc.) (Muramira and Wood, 2003).

The appropriation of natural resources by the state and the subsequent development of

centralised structures have also deterred communities from taking an interest in the long term sustainability of their natural resources. This has had detrimental effects on biodiversity conservation in Ethiopia.

2.3.8 Capacity Building in Research and Training

Identifying the Issues
Article 12 of CBD focuses on the need for research and training, recognising the special needs of developing countries in this regard.

Much is yet to be learned about biodiversity conservation and sustainable use. The study and management of the interactions between people and biological resources requires training in both the social and biological sciences and forms the basis for the multidisciplinary field of conservation biology.

In Ethiopia, current opportunities for capacity building i.e. in training professionals in the area of conservation biology are very limited. There are institutions offering strong programmes in forestry and agriculture, but there are no degree programmes and/or adequate curricula in wildlife management, biosystematics, biodiversity conservation or community-based conservation of natural resources. A shortage of funding and lack of trained staff have also limited the amount of research on the identification, conservation, and sustainable use of biological diversity in Ethiopia. There is little integration of research among institutions and disciplines, and very limited use of traditional knowledge in defining management programs.

2.3.9 Public Education and Awareness

Identifying the Issues
Ethiopia has already developed an overall strategy for environmental education and awareness under the Conservation Strategy of Ethiopia, and additional plans are contained in the Regional Conservation Strategies. However, the Ethiopian Biodiversity Strategy and Action Plan needs to ensure that the particular needs of biodiversity are not marginalised in a more general “greening” of public education and awareness. In the formal education systems, teacher training is perhaps the weakest area. Problems include quantity (not enough trained), quality (adequate training has been seriously neglected), deployment (reluctance to serve in rural areas), and supervision (lack thereof). Although several NGOs (local and international) including professional association, and environmental clubs have been working to incorporate environmental education in the informal sector, it is apparent that a lot more need be done.

Given the low literacy rates in Ethiopia, informal education will remain a vital component of any strategy for environmental education and awareness. The challenge lies in finding ways to reach this majority that largely resides in rural areas. Transmitting new information on biodiversity is not necessarily the most effective means of achieving “education”. Fostering appreciation for traditional knowledge on biodiversity, its local uses and management can be equally effective. Helping communities to document their

knowledge raises community awareness of the importance and values of biodiversity. Building the capacity of the local communities to derive benefits from these resources should follow this. Another potential tool for awareness raising is the development of interpretative facilities in and around protected areas and *ex-situ* conservation sites. With more resources, much better use could be made of the educational opportunities, which these sites provide.

2.3.10 Environmental Impact Assessment

Identifying the Issues

Article 14 of the CBD requires parties to introduce appropriate Environmental Impact Assessment (EIA) procedures for projects, programmes, and policies that may have significant adverse impacts on biodiversity. EIA is most commonly used as a tool at the project level, to identify the environmental effects of a proposed project and to plan ways of reducing negative impacts. Most projects are typically designed in a series of stages, involving needs identification, prefeasibility and feasibility studies, appraisal, and approval. In many cases, EIAs have been undertaken very late in this design process, when it has become too expensive to redesign or halt the project - even if significant negative impacts have been identified (Glowka et al., 1994). To be most effective, EIAs need to be initiated at an early stage in project development and include adequate means for public participation in the review of potential effects of the development on human health, property, and local livelihoods. EIA has now been made mandatory for all major development projects in Ethiopia. The Draft 'Environmental Impact Assessment Proclamation' (FDRE, 2002; Proclamation No. 299/2002) covers a wide scope, wide enough to encompass strategic impact assessment, which clearly indicates that:

1) No proponent of a Federal project shall commence construction or operation unless the proponent has filed with the Environmental Protection Authority for an Initial Environmental Examination (IEE) or, where the project is likely to cause an adverse environmental effect, an Environmental Impact Assessment. Similar measures are taken with the relevant bodies at regional levels. There is very limited capacity in EIA in all sectors and at all levels including Federal, Regional and local levels.
2) The Federal Agency shall:
    - review the IEE and recommend the approval of the project, or require submission of an EIA by the proponent
    - review the EIA, with public participation where it may deem appropriate, and recommend that the project be approved subject to such conditions as it may deem fit to impose, or rejected in the interest of such modifications as may be stipulated, or rejected in the interest of environmental objectives.

2.3.11 Access Issues

Identifying the Issues

The CBD is the first international convention, which acknowledges a state's sovereign rights over the genetic resources within its jurisdiction and the resulting authority to regulate and control access to these resources (Article 15). However, the degree and

extent to which the state could exercise this right has to be determined by national law. Parties to the Convention are also required to promote the fair and equitable sharing of benefits arising from the use of genetic resources and the development of biotechnologies (Articles 15 and 19); and to facilitate access to, and transfer of technology, including biotechnology (Article 16).

Genetic resources have been developed and used since the dawn of civilisation in Ethiopia. Although the use of some traditional genetic materials has declined over time as new, high-yielding varieties have been introduced, there is still considerable potential for further development of native genetic resources. For example, there are hundreds of species of wild plants found in different parts of Ethiopia, which can be used for medicinal purposes. At present, their use is limited to traditional medical practice, often localised.

Ethiopia has drafted a law based on the African Model Law, to which it is a signatory. This law is designed to regulate access to genetic resources and its associated community knowledge, innovations, practices and technologies, and to protect the rights of local communities (Ekepere, 2001).

2.3.12 Exchange of Information

Identifying the Issues
The knowledge and experience about environmental problems and their solutions are unequally and poorly distributed around the globe. In particular, there is an information gap between developed and developing countries, which must be bridged. A provision on exchanging information has now become a standard addition to international environmental and conservation agreements. Article 17 of CBD urges Parties to take into account the special needs of developing countries and include repatriation of information, where feasible. Much original and unique information about species and ecosystems in developing countries is held by museums and other research institutions in developed countries, yet this information is often very difficult to access by the country where those specimens were collected. The Convention encourages the holders of such information, largely in the developed countries, to take measures to ensure that the information held is shared with the countries where it originated (Glowka et al., 1994).

Ethiopia is data-deficient in many respects. As previously noted under Section 4.3, information about the biodiversity of Ethiopia is presently scattered among a wide range of institutions (national and global), and current capacity to collect, store, analyse, and disseminate information is limited. A considerable number of actions will need to be undertaken, therefore, if Ethiopia is to fulfil its commitments under this article of the Convention.

2.3.13 Financial Resources

Identifying the Issues
Article 20 of the CBD requires each Party to provide financial support, in accordance

with its capabilities, for the national activities, which will be undertaken to implement the Convention. Article 20 also commits the developed nations to provide "new and additional financial resources" to assist developing countries with their biodiversity conservation and management programmes. Some of these funds are currently being channelled through the GEF.

The successful implementation of Ethiopia's Biodiversity Strategy and Action Plan will require a significant financial investment. It is important to emphasise, however, that many of the recommendations contained within the Plan can be implemented through policy and legal changes (e.g., the use of incentives and the removal of "perverse" incentives", as discussed in Section 4.7 above, and do not require large expenditures). Similarly, ongoing development activities and existing government programmes can be made more sensitive to biodiversity concerns, often at relatively little cost (e.g., through better use of EIA procedures). It is not necessary, therefore, to await the arrival of new funding before commencing implementation of the Plan. For those measures, which do require new funding, possible sources could include:

- the development of innovative funding mechanisms;
- bilateral/multilateral aid for stand-alone, biodiversity projects;
- debt-for-nature swaps;
- partnerships with the private sector, NGOs and other civil society institutions;
- GEF

Finally, it should be emphasised that funds spent on biodiversity conservation and management are not unrecoverable expenditures; rather, they are investments in Ethiopia's future ecological, economic, and social security - investments which will yield substantial benefits at virtually all levels and sectors of society. In addition, GEF recognises that not all investments in biodiversity will generate national benefits. This is the incremental reasoning for GEF investments – to secure global benefits beyond those that would accrue to an individual country. Present economic tools and measurements, such as the national income accounts, fail to recognise or accord a value to these benefits.

2.3.14 Technology Transfer

Identifying the Issues

Ethiopia is searching for long-term solutions to its economic and ecological problems. Of recent, some countries have started to focus on the role of technological innovations in long-term economic revival. Numerous technological options are available; including biotechnology (which is used here to include the conservation of biological diversity) is increasingly being recognised as a new source of economic revival.

However, biotechnology is one of the most controversial areas of technology innovation. This is partly because biotechnology poses both opportunities and risk at different levels of its introduction into economic and ecological systems. In this respect, policy related issues have become major concerns in the development of biotechnology. The task of making informed choices about biotechnology requires the development of indigenous policy-making capacity.

Biotechnology regulation is associated with the potentially irreversible character of biotechnology and associated fears of environmental damage and dangers posed to occupational health. Biotechnology represents interference with nature at the most fundamental level - the manipulation and modification of life itself.

Issues of indigenous technological capacity relate to basic proposition that the only way Ethiopia will be able to engage sensibly in biotechnology is when it has built up a critical minimum level of biotechnological competence and capability in areas that can be utilised in biotechnology. The notion 'technological capability' is designed to conceptually capture precisely this idea of competence of being able to control the ways in which a new technology is deployed for socio-economic and ecological ends. It has been emphasised largely because most technology transfer mechanisms often fail to bridge the 'technology gap' between the rich and poor countries. The issue has become enough in the field of biotechnology to warrant attempts by deploying countries such as Ethiopia to require that the use of genetic material emerging from their countries be linked to the transfer of biotechnology to them.

The Convention on Biological Diversity recognised that biotechnology can make a contribution towards achieving the objectives of the Convention, if developed and used with adequate safety measures for the environment and human health. The Contracting Parties agreed to consider the need to develop appropriate procedures to address the safe transfer, handling and use of any LMO/GMO resulting from biotechnology that may have adverse effect on the conservation and sustainable use of biological diversity, which states that the Parties shall consider the need for and modalities of a protocol setting out appropriate procedures, including, in particular, advance informed agreement, in the field of the safe transfer, handling and use of any living modified organism resulting from biotechnology that may have adverse effect on the conservation and sustainable use of biological diversity.
Article 8(g) of the Convention on Biological Diversity requires countries to establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking also into account the risks to human health.

After several years of negotiations, the Protocol, known as the Cartagena Protocol on Biosafety to the Convention on Biological Diversity, was finalised and adopted in Montreal on 29 January 2000 at an extraordinary meeting of the Conference of the Parties.

The conclusion of the Biosafety Protocol has been hailed as a significant step forward in that it provides an international regulatory framework to reconcile the respective needs of trade and environmental protection with respect to a rapidly growing global industry, the biotechnology industry. The Protocol thus creates an enabling environment for the environmentally sound application of biotechnology, making it possible to derive maximum benefit from the potential that biotechnology has to offer, while minimising

the possible risks to the environment and to human health. Thus the Protocol is one of the tools for implementing the Convention, especially with regard to the provisions to regulate, manage or control risks associated with the transfer, handling and use of GMOs that may have adverse effect on the conservation and sustainable use of biodiversity, focusing on their transboundary movement.

The coming into force of the Biosafety Protocol, presents a new challenge. For the protocol to function in practice, countries after they have become parties, need to have systems in place to ensure biosafety while handling the products of modern biotechnology.

National Biosafety Frameworks are developed and implemented by the parties in accordance with the precautionary approach contained in Principle 15 of the Rio declaration of Environment and development and Article 1 of the Convention on Biological Diversity.

Ethiopia has actively participated in the negotiations and development of the Convention on Biological Diversity, the Cartagena Protocol on Biosafety and the African Model Law on Safety in Biotechnology. It has ratified the Cartagena Protocol on Biosafety (CPB) on May 24, 2000 and the Convention came into effect on September 22, 2003.

The Environmental Protection Authority, the institution responsible to develop and implement the National Biodiversity Framework (NBF) in consultation with other stakeholders has prepared a document, which is hoped to be legalised soon (Zerihun Woldu & Sebsebe Demissew, 2004).

CHAPTER THREE

PRINCIPLES, GOAL, STRATEGIC OBJECTIVES AND SPECIFIC OBJECTIVES

This chapter forms the heart of Ethiopia's National Biodiversity Strategy and Action Plan. It consists first of the presentation of the basic principles on which the Strategy is based. The Goal of the NBSAP is then presented, followed by its four Strategic Objectives. The Strategic Objectives define Ethiopia's highest priorities for biodiversity conservation. The Strategic Objectives are then followed by a much longer list of Specific Objectives. Each Specific Objectives is to be achieved through a set of individual Actions. A timeframe and performance indicator is defined for each Action and institutional responsibilities are proposed.

3.1 BASIC PRINCIPLES

The national goals and aims for the conservation and sustainable use of biodiversity in Ethiopia should first and foremost relate to the specific problems affecting biodiversity in the country. The needs of the people and their activities must be reconciled with the maintenance of biodiversity. Most often, successful conservation is achieved by changing human attitudes and use regimes and by promoting collaborative management. Conservation must be carried out with the Cupertino of government institutions, NGOs and local communities. For this to happen, there is a need to agree upon a set of guiding principles, goals, and broad aims.

The principles that could provide guidance to Ethiopia's efforts to conserve and manage its biodiversity include the following:

- Every form of life is unique and warrants respect from humanity;
- Indigenous biodiversity is a key indicator of the health of the environment in which we live;
- We depend on biodiversity for a vast array of goods and services, and should, therefore, accord priority to its conservation, management and sustainable use;
- Conservation of biodiversity is a common concern to all citizens of Ethiopia and this should be adequately mainstreamed in all government and civil society actions;
- Biodiversity conservation is an investment that can yield substantial benefits; ensuring a larger market share of benefits to local communities can reduce biodiversity losses;
- All sectors and stakeholders that influence biodiversity should help plan its conservation;
- Biodiversity management actions must be based on sound ecological principles, scientifically valid information and local knowledge.
- Representative samples of viable size should be conserved of each of Ethiopia's ecosystems/ habitats;
- The costs and benefits of biodiversity conservation should be shared equitably;

- Effective public/private/civil society partnerships should be developed for biodiversity conservation – both for protected areas management and for sustainable use systems;

Exclusively either communities or governments should not manage natural resources. The government must recognise the interests and rights of the local communities, while the communities must recognise that such management is part of a larger political and environmental framework.

3.2 THE GOAL OF THE BIODIVERSITY STRATEGY AND ACTION PLAN

As a signatory to the CBD, Ethiopia has endorsed the global priority accorded to biodiversity conservation and sustainable use. Through this Biodiversity Strategy and Action Plan, Ethiopia is developing its own strategy for containing the erosion of biological diversity and ensuring its conservation for the benefit of present and future generations. The overall goal of the Ethiopia's Biodiversity Strategy and Action Plan is, therefore, stated as follows:

> *Effective systems are established that ensure the conservation and sustainable use of Ethiopia's biodiversity, that provide for the equitable sharing of the costs and benefits arising therefrom, and that contribute to the well-being and security of the nation.*

3.2 STRATEGTIC OBJECTIVES

Within the framework of the overall goal, Ethiopia's priorities for biodiversity conservation are reflected in a set of Strategic Priorities. As we have seen in Chapter Two, Ethiopia's ecosystems are not being effectively conserved through the existing network of protected areas. Furthermore, sustainable use systems of natural ecosystems are very poorly developed in the highlands and the traditional use systems in the arid and semi-arid lowlands are breaking down or are under severe stress. The first two Strategic Objectives reflect the first two objectives of the Convention on Biological Diversity. The CBD prioritises the conservation of ecosystem level biodiversity through protected area networks and through sustainable use and management systems. Ethiopia's third Strategic Objective again reflects the CBD's third objective on equitable sharing of benefits. Finally, the fourth Strategic Objective reflects Ethiopia's unique position as one of the world's principal centres of domestication of agricultural crops and the high levels of genetic diversity of both crops and livestock. Ethiopia's agro-biodiversity is not under the same level of immediate threats as its wild biodiversity, but conservation of agricultural biodiversity must forever remain one of Ethiopia's highest conservation priorities.

The four Strategic Priorities of Ethiopia's this Biodiversity Strategy and Action Plan are the following:

1. Representative examples of Ethiopia's remaining ecosystems are conserved

through a network of effectively managed protected areas.

2. By 2020, all remaining natural ecosystems outside of the protected are under sustainable use management.

3. The costs and benefits on biodiversity conservation are equitably shared through a range of public, private, community/CBP and NGO partnerships for PA management and for sustainable use and marketing of biodiversity.

4. The rich agro-biodiversity of Ethiopia is effectively conserved through a mix of *in situ* and *ex situ* programs.

3.3 SPECIFIC OBJECTIVES AND ACTIONS

The four Strategic Objectives will be achieved through 23 Specific Objectives. The Specific Objectives are presented in the following table. Each Specific Objective is supported by one or more Actions. The timeframe and a performance indicator have been defined for each Action and institutional responsibilities are suggested. The Specific Objectives have been grouped under Sector headings that reflect the principal articles of the Convention on Biological Diversity.

SPECIFIC OBJECTIVES AND ACTIONS, TIME FRAME, PERFORMANCE INDICATORS AND INSTITUTIONS

Sector/Specific Objective	Actions	Time Frame (yr.)	Performance indicator	Indication of institutions
Protected Areas Conservation				
1. **Objective**: A reclassification plan is completed for development of a PA network that contains viable, representative examples of the full range of remaining ecosystems.	1.1. Prepare an updated forest/ecosystem cover map of Ethiopia including inland water ecosystem that identified and delineates all remaining non-agricultural areas.	1-2	Forest/ecosystem cover map published	**EWCO**[1], EWDCD, IBC, EPA, MOARD, EMA, REGIONS, EARO
	1.2. Conduct a gap analysis by digitally superimposing the best ecosystem map with a map of all PAs & reserves and the new forest cover type map – to identify gaps in PA coverage.	2	Gap analysis published	**EWCO**, EWDCD, IBC, EPA, MOARD, EMA, REGIONS, EARO
	1.3. Identify candidate areas for declassification, classification and reclassification and conduct field verification & biodiversity surveys & obtain local stakeholder inputs. Include special emphasis on conservation of wild relatives of agricultural crops	2-3	List of candidate sites Reports on field verification, biodiversity surveys and stakeholder meetings	**EWCO**, EWDCD, IBC, EPA, MOARD, EMA, REGIONS, EARO **IBC**, EWCO, EWDCD, EPA, MOARD, REGIONS, EARO, CBO
	1.4. Finalise a reclassification plan that identifies the most suitable status and form of management for all	3	Reclassification Plan published	**IBC**, EWCO, EWDCD, EPA, MOARD,

[1] Institutions in bold are lead institutions to implement an action plan

	remaining natural areas – all areas should be targeted for either a specified category of PA or for some form of sustainable use/management area.			REGIONS, EARO, CBO
2. **Objective**: Effective management of the modified PA network is achieved through public/ private/ NGO/ CBO partnerships then ensure equitable sharing of costs and benefits.	2.1. Conduct a national, regional and a desk study review of lessons learned and best practices for effective PA management with an emphasis on innovative forms of public/ private/ NGO/ CBO management partnerships.	1	Review/lessons learned & best practices published	**EWCO**, EWDCD, IBC, EPA, MOARD, ESTC, REGIONS, EARO, CBO
	2.2. Develop a 10-yr PA Network Management Plan implementing the Reclassification Plan and for bringing the PA under effective management through innovative partnerships (identify need for policy and legislative reform).	1-3	10-yr PA Network Management Plan published	**EWCO**, EWDCD, ETC, EPA, IBC, MOARD, MOFED
	2.3. Develop new management partnerships, test them in the field and improve them through the use of M&E systems developed for use in adaptive management approaches.	2-5	Document on M&E strategy, guidelines and partnerships established Document describing M&E system M&E periodic reports	**EWCO**, EWDCD, ETC, EPA, IBC, MOARD, MOFED, NGO, CBO **EWCO**, EWDCD, ETC, EPA, IBC, MOFED, MOARD, NGO, CBO **EWCO**, EWDCD, ETC, EPA, IBC, MOARD, NGO, CBO

	2.4. Conduct capacity building program for PA management partners	2-3 & 6-7	Capacity building plan	**HLI**, UNIVERSITIES, MOCB, MOE, EWCO, IBC, EPA, MOARD
			Reports on training conducted	**HLI**, UNIVERSITIES, MOE, EWCO, IBC, EPA, MOARD
			Assessment of training effectiveness	**MOCB**
	2.5. Revisit existing transboundary wildlife agreements (Eritrea/Sudan) for the establishment of Peace Parks for Wildlife protection, invasive alien species and benefit sharing	3-7	One new transboundary Peace Park established	**EWCO**, EWDCD, EPA, IBC, ETC, REGIONS
	2.6. Conduct a major five year review of the effectiveness of PA management and revise the PA Network Management Plan including control of invasive alien species	5	Five-yr. review published	**EWCO**, EWDCD, ETC, EPA, IBC, MOARD, NGO, CBO
	2.7. Complete the establishment of effective PA management partnerships/ systems for the entire PA network including mountain biodiversity	5-10	Annual M&E reports	**EWCO**, EWDCD, ETC, EPA, IBC, MOARD, NGO, CBO
			10-yr review report	**EWCO**, EWDCD, ETC, EPA, IBC, MOARD, NGO, CBO

Sustainable Use 3. **Objective**: Effective, integrated sustainable use NR management systems are developed at pilot sites using innovative public/ CBO/ private/ NGO partnerships in accordance with the Reclassification Plan	3.1 Conduct a national, regional and a desk study review of lessons learned and best practices for the sustainable use/ management of natural forests, range, wildlife (including birds) and fisheries in ecosystems similar to Ethiopia's and with an emphasis on innovative forms of public/ CBO/ private/ NGO/ management partnerships.	1	Review published	**IBC**, EWCO, EWDCD, UNIVERSITIES, EARO, REGIONS
	3.2 Mobilise funding/ resources/ project design/development and implementation for a set of pilot projects to develop sustainable management systems for both intact and degraded natural ecosystems outside of PA in accordance with the Reclassification Plan. Build upon indigenous knowledge and traditional systems.	2-5	Project design documents approved and funded	**IBC**, EWCO, EWDCD, UNIVERSITIES, EARO, NGO, CBO, PRIVATE SCETOR, REGIONS
	3.3 Develop M&E systems for resource managers and for government oversight for monitoring the ecological, social (equitable sharing of costs and benefits) and economic aspects and use results in the development of adaptive management approaches.	2-4	M&E manual	**IBC**, EWCO, EWDCD, UNIVERSITIES, EARO, NGO, CBO, PRIVATE SCETOR, REGIONS
			M&E reports	**IBC**, EWCO, EWDCD, UNIVERSITIES, EARO, NGO, CBO, PRIVATE SCETOR, REGIONS
	3.4 Develop natural resource-based	2-5	M&E system reports detail	**IBC**, EWCO, EWDCD,

	enterprises that maximise revenues and incentives for community and private sector NR partners.		enterprises developed, revenues generated, people employed, etc.	UNIVERSITIES, EARO, NGO, CBO, PRIVATE SCETOR, REGIONS
	3.5 Develop sustainable funding mechanisms for NRM whereby part of the revenues are reinvested in management costs	2-5	Account books of CBO/ private sector/ NGO management partners	**EPA**, MOFED, IBC, NGO, CBO, PRIVATE SECTOR, REGIONS
	3.6 Strengthen mechanism for sectoral co-ordination and collaboration in development of integrated NRM	2-5	M&E system documents roles and support from the sectoral agencies	**EPA**, MOFED, IBC, NGO, CBO, PRIVATE SECTOR, REGIONS, MOARD, PARLIAMENT
4. **Objective:** Sustainable management systems are replicated/ adapted and applied to all remaining natural areas outside of PA.	4.1 Conduct a major review of the sustainable use & management systems/ trials/ pilot projects and develop a 10-yr strategy for bringing all remaining natural resources	5	Five-yr. review published	**IBC**, EPA, MOARD, REGIONS
	4.2 Undertake a major training programme to build the capacity of government (mostly regional to district), NGO, CBO and private institutions to assist new communities to build their own capacities for adapting the sustainable NRM systems developed under Objective 3.	5- 7 & 10-11	Training reports Assessment of training effectiveness	**MOCB** **MOCB**
	4.3 Mobilise resources to replicate and adapt the sustainable management systems to all remaining natural areas outside of the PA and complete	5-15	Project design documents and funding approved	**MOARD**, MOFED, PARLIAMENT, RGIONS

	this program by Yr. 15.		Annual project reports	**MOARD**, EPA
Policy 5. **Objective:** Appropriate policies and plans are adopted that promote the conservation and sustainable use of biodiversity and integrate biodiversity conservation measures into sectoral plans and programmes	5.1. Adopt NBSAP	1-3	NBSAP document and contents known and understood by planners in all sectors of the economy	**IBC**, MOARD, MOFED
	5.2. Integrate biodiversity conservation into Agricultural, Wildlife and Forestry policies at National and Regional levels	1-5	Draft agricultural, forestry, and Wildlife policies approved	**MOARD**, IBC, EARO
	5.3. Formulate and approve land use policy	1-5	Nation-wide land use policy formulated and approved	**MOARD**, REGIONS
	5.4. Promote co-ordination between institutions (e.g. workshops, seminars, etc.)	1-3	Efforts made to institutionalise the NBSAP at all levels; workshops held; capacity built.	**IBC**, EPA, REPA, MOARD
	5.5. Revisit CSE/RCSs to strengthen the biodiversity component	1-5	Program to revisit CSE/RCSs set in motion; workshops held	**IBC**, EPA, REPA, MOARD
Legislation 6. **Objective**: An effective legal framework for the Implementation of the CBD, related conventions, and national policies is developed	6.1 Review all relevant existing legislation in Ethiopia against the obligations under the CBD, related conventions and national concerns	1-5	Existing relevant legislation reviewed to address both national concerns and international obligations	**EPA**, IBC
	6.2 Ensure that the relevant draft laws currently under review embody conservation measures including those suggested for adoption by the CBD and other related conventions	1-5	Draft laws (Federal/Regional) under preparation to effectively address biodiversity concerns.	**IBC**, EPA, MOARD, PARLIAMENT
	6.3 Ensure, as far as possible, that	1-5	Integrate laws/programmes that	**IBC**, MOARD

	reforms in the forestry sector are integrated with reforms in the wildlife sector and the new forestry laws are also framed fully within the context of the CBD and other International Conventions such as CITIES		impact on biodiversity	
	6.4 Develop access and benefit sharing legislation as a matter of priority to comply, among other concerns, with Article 15 (genetic resources), Article 16 (technology) and Article 19 (handling of biotechnology and distribution of benefits)	3-7	Biodiversity access legislation enacted	**IBC**, EPA
	6.5 Develop guidelines/regulatory measures with regard to biosafety relating to the development use, transport and import of Genetically Modified Organisms (GMOs)	3-7	Regulation/guidelines that address management of GMOs formulated	**EPA**, ESTC, IBC
	6.6 Legislate benefit sharing incentives	3-7	Regulations that guide benefit sharing enacted	**EPA**, ESTC, IBC, MOARD, REGIONS
7. **Objective**: Enforcement of biodiversity-related laws enhanced	7.1. Enhance capacity for law enforcement related to conservation	1-3	Training programmes for law enforcement officers put in place; trainings effected	**IBC**, CUSTOMS, EPA, MOARD
	7.2. Promote enabling environment for civil society to challenge government in conservation related issues	3-5	NGO/CBO Advocacy activities for upholding conservation laws facilitated by government at all levels; radio/TV programmes, news media; advocacy workshops held	**IBC**, NGOs, CBOs, MOJ, MOCB, UNIVERSITIES

	7.3. Comply with International Conventions related to biodiversity management	1-5	Guidelines/regulations providing for fulfilment of international agreements put in place	**EPA**, IBC, EARO
Identification and Monitoring 8. **Objective:** Information base on the biodiversity of Ethiopia expanded and improved	8.1. Strengthen the capacity of the existing National Herbarium and the Natural History Museum (Addis Ababa University) (flora and fauna)	1-5	The National Herbarium and the Natural History Museum at Addis Ababa University strengthen both in manpower and infrastructure	**AAU**, IBC, EARO, MOARD
	8.2. Promote the establishment of herbaria and zoological museums in all universities and relevant institutions	1-7	Nuclei for the establishment of herbaria and zoological museums in at least two universities (in addition to AAU) be established	**IBC**, MOE, REGIONAL UNIVERSITIES
	8.3. Promote the establishment of microbial and aquatic culture collections	1-7	Enrich the microbial and aquatic culture collections; capacity built for the same	**IBC**, EARO, AAU, AHRI
	8.4. Strengthen the existing computerised database at IBC and other institutions	3-5	Capacity of the establishment in human resources, staff training and computers doubled	**IBC**, HLI, REGIONS
	8.5. Identify national/regional conservation priorities	3-7	National 'hot spots', threatened ecosystems and species identified	**IBC**, EPA, MOARD, CSA, REGIONAL INSTITUTIONS
	8.6. Create National Red List of threatened species (flora and fauna).	1-5	National Red Data listing threatened species produced	**IBC**, AAU, MOARD, NATIONAL & INTERNATIONAL (IUCN) NGOs
	8.7. Enhance and/or strengthen existing	2-7	Workshops, special training	**IBC**

	information sharing mechanism		programmes, etc. carried out	
	8.8. Establish mechanisms for sharing biodiversity information, including relevant traditional knowledge	2-7	Regular distribution of information on biodiversity (bulletins, newsletters, etc), including information on relevant traditional knowledge.	**IBC**, MOARD
	8.9. Promote taxonomic activities including integrating taxonomic capacity building activities into thematic and cross-cutting programmes	1-5	Workshops/training programmes for taxonomic capacity held; tertiary education in taxonomy strengthened	**IBC**, AAU, MOARD, UNIVERSITIES
9. **Objective**: Develop and Institutionalise Systems to Monitor Key Elements of Biodiversity	9.1. Develop and Institutionalise resource monitoring	2-7	Biological resource monitoring institutionalised	**IBC**, MORAD, EPA
	9.2. Develop capacity to regularly monitor the state of Ethiopia's environment	2-7	Regular production of 'State of the Environment Report' institutionalised	**EPA**, REPA
Ex-*Situ* Conservation 10. **Objective:** Contribution of *ex-situ* biodiversity conservation programmes strengthened.	10.1. Develop national legislation and guidelines on *ex-situ* conservation	3-5	Guidelines on *ex-situ* conservation developed and laws enacted	**IBC**, EARO, EPA, PARLIAMENT, REGIONS
	10.2. Compile directory of conservation initiatives	1-5	Directory of institutions/ organisations engaged in biodiversity conservation compiled. Copies made available to relevant institutions	**IBC**, REGIONS
	10.3. Identify and prioritise ex-situ conservation measures	3-7	Information on Ethiopia's genetic resources compiled and the information made available to	**IBC**, EARO, REGIONS

			appropriate bodies and institutions	
	10.4. Strengthen capacity and scope	3-7	Available fund for *ex-situ* conservation at least doubled	**IBC**, REGIONS
	10.5. Establish microbial and aquatic resources culture collections	3-7	Enrich existing microbial and aquatic culture collections	**IBC**, EARO, UNIVERSITIES, EPA, REGIONS
	10.6. Promote integration among institutions	3-5	Regular meetings/consultations carried out	**IBC**, EARO, EPA
Incentive Measures 11. **Objective:** An integrated system of incentives and disincentives is created at the national, regional and local levels to encourage the conservation and sustainable use of biodiversity	11.1. Legislation and guidelines to introduce a system of direct and indirect incentives to promote the conservation and sustainable use of biodiversity	3-10	Direct and indirect incentives identified and publicised	**IBC**, MOARD, REGIONS, MOFED
	11.2. Legislation and guidelines to introduce a system of disincentives to discourage unsustainable utilisation and practices which deplete biodiversity	3-10	Disincentives identified and publicised	**IBC**, MOARD, MOFED, REGIONS
12. **Objective:** Identify "Perverse" incentives and minimise their impacts on Biodiversity.	12.1. Carry out a comprehensive review of GoE programmes and policies, to identify "perverse" incentives, use right and benefit sharing and suggest measures to ameliorate their impacts	3-7	All relevant policies and programmes reviewed and amended	**IBC**, MOARD, REGIONS
Capacity Building in Research and Training 13. **Objective:**	13.1 Program to strengthen current	3-10	Special funds established	**IBC**, MOFED

Research strengthened on the conservation and sustainable use of biodiversity, particularly on indigenous species under threat.	biodiversity research on conservation biology, ethnobiology, etc.			
	13.2 Identify gaps and priorities for research	3-5	Workshops organised to identify gaps	**IBC**, MOARD, MOE
	13.3 Establish legally binding regulations on biodiversity research	3-7	All important research undertakings in biodiversity regulated	**IBC**, MOARD, REGIONS
	13.4 Conduct participatory research in order to establish the knowledge base on biodiversity	3-10	Results of research undertaken in a participatory manner by local communities output and participation of local communities (farming and /or pastoral) documented and publicised	**IBC**, EARO, MOARD, REGIONS
14. **Objective**: Human and infrastructure capacity in Bbiodiversity conservation and management strengthened	14.1. Assess biodiversity related training needs	1-3	Biodiversity training needs assessed	**IBC**, MOARD, UNIVERSITIES, REGIONS
	14.2. Design opportunities for international linkages	2-5	Workshops/training programmes carried out	**IBC**, MOARD, MOE
	14.3. Strengthen existing degree programs in biodiversity and conservation biology	2-7	At least one programme in each of the country's universities strengthened to address biodiversity concerns	**AAU**, AUA, IBC, MOE
	14.4. Create diploma course for PA Managers	3-7	Diploma programmes established	**MOE**, IBC, UNIVERSITIES
	14.5. Promote postgraduate specialisation	3-7	'Twinning arrangements' with universities abroad for the purpose	**AAU**, AUA, IBC, MOE IBC, EPA, NGO'S

			established	
	14.6. Initiate training programs with NGOs	3-7	Joint training programmes with 'umbrella NGOs' established.	**MOE**, IBC, REGIONS, UNIVERSITIES
	14.7. Integrate biodiversity concerns in training curricula of rural development and extension staff, particularly in the field of agriculture, forestry and fisheries	3-10	Biodiversity concerns addressed in curricula	**MOE**, IBC, MOARD, REGIONS, UNIVERSITIES
	14.8. Identify the needs required in infrastructure development.	2-5	Identify the needs required in infrastructure development including Laboratory, software, hardware, and equipment needs in centres of excellence on various biological resources identified.	**IBC**, MOARD, EARO, EPA, HLI, REGIONS
Public education and awareness 15. **Objective:** A comprehensive strategy for public education and awareness developed.	15.1. Develop public education/ awareness strategy	1-5	Workshops held / public media utilised	**IBC**, MOE, MOI, MOARD
16. **Objective**: Awareness increased, using the formal education system, about the need for biodiversity conservation.	16.1. Develop/enhance the status of biodiversity in curricula (all levels)	3-7	School curricula revised	**MOE**, IBC, REGIONS
	16.2. Develop relevant course material	3-10	A method/system of gradual introduction of specific local concerns in school programmes devised and put in place and used	**MOE**, IBC, REGIONS

	16.3. Promote/Encourage partnerships in curricula development	3-7	Regional level consultations in local curriculum development carried out on pilot basis in at least 10% of the county's Woredas	**MOE**, IBC, REGIONS
	16.4. Develop interpretative facilities	3-7	Interpretative facilities established in all PAs	**MOE**, IBC, REGIONS, MOARD
17. **Objective**: Use Informal Channels to Increase Awareness about Biodiversity and the Need for Its Conservation.	17.1. Promote informal and adult education programs including traditional channels and focused campaigns	3-10	Radio programmes, public discussions, Pamphlets/ brochures produced and distributed	**MOE**, MOI, IBC, MOARD, REGIONS
	17.2. Document local knowledge	3-10	Local knowledge documentation institutionalised and documents produced by each Regional State	**IBC**, MOARD, REGIONS
	17.3. Encourage growth of membership groups in biodiversity conservation	3-10	Associations and clubs established, at least one in each Regional State	**MOE**, IBC, REGIONS
	17.4. Develop locally relevant resource materials including field guides	3-10	Field guides for common plants and animal groups produced and widely distributed and used	**MOE**, IBC, REGIONS
Environmental Impact Assessment				
18. **Objective:** EIA procedures for projects, programmes, and policies institutionalised and strengthened	18.1. Finalise rules and guidelines for IEE/EIA under the draft act	1-3	Rules and regulations finalised.	**EPA**, REPA, MOARD
	18.2. Strengthen capacity of EPA staff to evaluate EIA	1-5	Training of personnel, both at Federal and Regional levels carried out	**EPA**, REPA, MOARD
	18.3. Encourage effective public	1-5	The public advantage of the EIA	**EPA**, REPA, MOARD

	participation in EIA process		process/outcome well publicised	
	18.4. Expand the Standard Environmental Assessment (SEA) concept	3-10	Same as above	**EPA**, REPA, MOARD
	18.5. Review National Environmental Quality Systems (NEQS) for specific ecosystems	3-5	NEQS for threatened ecosystems reviewed.	**EPA**, REPA, MOARD
Access Issues 19. **Objective**: Policies and laws to regulate access to genetic resources developed and equitable sharing of benefits between resource owners and users promoted.	19.1. Collect baseline data on current practices of access of genetic resources	3-5	Base-line data collected	**IBC**, MOARD, EARO
	19.2. Prepare existing legal/institutional profile	3-5	Existing institutional/legal profile compiled.	**IBC**, MOARD, EARO
	19.3. Develop action plan	3-7	Action plan prepared	**IBC**, MOARD, REGIONS
	19.4. Develop legislation to support national policy based on a regional approach	3-7	Legislation put in place	**EPA**, IBC, MOARD, REGIONS
Exchange of information 20. **Objective**: Information management systems on the biodiversity of Ethiopia/Clearing House Mechanism	20.1. Strengthen the national clearinghouse on biodiversity information	3-7	Strengthen the capacity of the national clearinghouse at IBC both in infrastructure and human resource	**IBC**, EPA, MOARD
	20.2. Exchange information with outside institutions and communities	3-7	Information exchange mechanism devised and used	**IBC**, EPA, MOARD

strengthened	20.3. Enhance institutional capacity to manage information	3-5	Workshops/training programmes managed	**IBC**, EPA, MOARD, ESTC, CSA
Financial resources 21. **Objective**: National funding mechanisms developed for support of priority biodiversity conservation and management programmes.	21.1. Reassess national spending priorities *vis* a *vis* biodiversity conservation	1-3	The contribution of conservation to well being of the nation is assessed and national budget reviewed to address biodiversity management.	**MOARD**, MOFED, IBC
	21.2. Assign budget to address NBSAP priorities	3-5	Budget use prioritised	**MOARD**, MOFED, IBC
	21.3. Establish task force to generate funding	3-5	Taskforce established and made operational.	**MOARD**, MOFED, IBC, EPA
22. **Objective**: Increased bi-lateral and multi-lateral funding mobilised for biodiversity programmes.	22.1. Establish group of aid agencies/donors for biodiversity conservation in Ethiopia	3-7	Interest in Ethiopia's Biodiversity inculcated among international donors and visible actions taken by the same	**IBC**, EPA, MOARD, MOFED
	22.2. Co-ordinate donor interest/ activities to maximise conservation efforts	3-7	Same as above	**IBC**, EPA, MOARD, MOFED
	22.3. Strengthen capacity to develop GEF proposals	1-5	Training/workshops in proposal writing given to IBC/EPA personnel.	**EPA**, IBC, MOARD, MOFED
	22.4. Strengthen Ethiopia's "voice" at CBD-COP	1-5	GEF requirements understood/ appreciated by planning officer/managers	**EPA**, IBC, MOARD

Biotechnology Capacity and Technology Transfer 23. **Objective**. Biotechnology capacity built and biotechnology transfer enhanced	23.1. Establish/strengthen public agencies to address intellectual property concern within a framework of national legislation and use them as a basis for international negotiations	3-7	Institution strengthened to address intellectual property rights	**ESTC**, IBC, EARO, MOARD, EPA
	23.2. Legislate /Institutionalise biodiversity prospecting and biotechnology development	3-5	One department established at IBC Law enacted	**ESTC**, IBC, EARO, MOARD, EPA
	23.3. Build biotechnological capability/capacity primarily through national/ regional/ international Cupertino	3-7	Agreements entered into and put in action	**ESTC**, IBC, EARO, MOARD, EPA, REGIONS
	23.4. Establish legal and institutional regimes to exert and enforce sovereignty over biodiversity resources to leverage technology transfer	3-7	Biodiversity and biotechnology needs linked to technology transfer	**IBC**, EARO, ESTC, MOARD, REGIONS

CHAPTER FOUR

COORDINATING BIODIVERSITY CONSERVATION EFFORTS

There are many stakeholders that have interest on the biodiversity of Ethiopia and to be effective, conservation efforts must be co-ordinated across many sectors of society. The Federal and Regional governments are some of the most important stakeholders with overall responsibility for providing an adequate policy and legal framework, enforcing regulations, building capacity and providing incentives and funds for the conservation of biodiversity. The policies and programs of key Federal Ministries (Ministry of Agriculture and Rural Development; Finance and Economic Development, the Ethiopian Science and Technology Commission) and Regional Bureaus addressing Agriculture, Livestock, Forestry, Wildlife, and Fisheries among others are crucial to the conservation and sustainable use of biological diversity. To help ensure commitment and compliance to implementation of the Biodiversity Action Plan across Ministries and Departments with different (and often divergent) priorities, the strong support of the Planning and Development Divisions at all levels is also essential. IBC is the lead agency for the co-ordination and implementation of the NBSAP in collaboration with EPA. Implementation of the Biodiversity Action Plan will need to be carried out at both the Federal and Regional levels by establishing linkages with the planning process (see Implementation Measures, Chapter 6).

Research Institutions under Federal and Regional Governments, Higher Learning Institutions are responsible for documenting elements of biodiversity in Ethiopia and for monitoring the health of ecosystems. Training Institutions play an important role in building professional capacity in the fields of conservation and sustainable use. As direct users and potential managers of biological diversity, local communities have one of the most important stakeholder's roles in resource conservation and use. The active involvement of communities in the management of wild species and ecosystems, where communities become the custodians and beneficiaries of biodiversity, may be the most promising approach to halt further loss of biodiversity in Ethiopia. Non-governmental Organisations can help bridge the existing gap between government and local communities to enhance conservation efforts. NGOs can be particularly valuable in providing technical tools and building capacity and awareness for the environment both locally and with government. NGOs can assist in monitoring implementation of the CBD both locally and nationally. The private sector should be made aware of the importance, and value, associated with the conservation and sustainable use of biodiversity. The private sector has a strong influence in developing and maintaining markets for natural resources. Private sector companies can form partnerships and joint ventures with community managers. Government and NGOs/civil society must work, to establish policies, programs and strategies to ensure that both costs and benefits of sustainable resource management are shared equitably. It is also an important stakeholder in ensuring the equitable sharing of benefits from the use of natural resources. Finally, the general public (both nationally and globally) has a stake in the natural heritage of Ethiopia and can influence policy and decision-making affecting biodiversity. To gather sufficient funds and support, the general public must be better sensitised to the rapid loss of

biodiversity and the need for its conservation.

Ethiopia is one of the countries, which has suffered from environmental problems. It faces three major problems: biodiversity loss, land degradation and climate change. The three conventions, CBD, CCD, and FCCC are trying to address the above-mentioned environmental problems synergistically at international and national levels. Ethiopia is in the process of developing and implementing the synergies between the three conventions (EPA, 2004).

CHAPTER FIVE

IMPLEMENTATION MEASURES

Overall responsibility for creating the implementation arrangements of the Biodiversity Strategy and Action Plan will fall on the Ministry of Agriculture and Rural Development, while IBC that falls under the said Ministry will follow the mechanism of implementation.

To oversee the implementation process, it is recommended that a Biodiversity Steering Committee be established at the Federal level. This committee will provide high-level policy guidance and will create a linkage mechanism to the Environmental Council. The Steering Committee will be composed of three members of government, one private sector representative and one NGO member. The Committee will meet only infrequently when needed to make policy decisions or to give policy guidance. IBC will serve as the Secretariat to the Committee.

While the Steering Committee will provide high-level policy guidance and the Ministry of Agriculture with IBC will provide overall co-ordination, the implementation of individual Actions will primarily be the responsibility of sectoral institutions. The last column of the Table of Specific Objectives at the end of Chapter Three presents the suggested institutional responsibilities for implementation of these Actions. One of the first tasks of the Steering Committee should be to provide guidance on institutional responsibilities, especially for those Actions that are cross-sectoral in nature. Institutional responsibilities, of course, will need to evolve over time as the mandates of the different institutions evolve.

CHAPTER SIX

MONITORING AND EVALUATION (M & E)

Most national strategies and action plans have been rather weak on monitoring and evaluation. These are often carried out on piecemeal basis and do not involve the concerned communities and institutions. For any action plan and programme to be successful, it is important that M & E is an important component from the beginning. It is important that communities are involved in M & E, through the use of their own indicators and methods.

To effectively implement the M & E of the NBSAP in the country, it is wise to use the existing institutional structures and mechanisms. M & E mechanisms should be put in place at federal, regional, Wereda and community levels. All concerned federal and regional institutions must integrate M & E mechanisms as part of their plans and programmes for the implementation of the NBSAP; this include wildlife – related programmes of the Ethiopian Wildlife Development and Protection Department, extension packages and livestock programmes of the Ministry of Agriculture and Rural Development, *ex-situ* conservation programmes of IBC, etc.

Federal Biodiversity Task Force (FBTF) could be established to co-ordinate and follow-up of the NBSAP process in the country. This body should include IBC, EARO, EPA, MoA, EWDPD, NMSA, MoWR, ESTC, the National Herbarium and other relevant NGOs and higher learning institutions' representatives. All other environmental units, which are going to be established in the federal ministries, will work closely with the FBTF. The FBTF will have regular meetings and produce reports to be submitted to the Environmental Protection Council. The FBTF will organise annual national meetings to discuss on the progress made and challenges faced by NBSAP implementation process.

At the regional level the M & E mechanism will be in place and Regional Biodiversity Task Force will be established. Its mandates and roles will be the reflection of the FBTF at regional level. Awareness creation and capacity building efforts must be strengthened in order to carry out the M & E at all levels; especially local communities should get the necessary support in order to involve them in the process. Substantial budget is required to carry out the M & E process. Technical guidelines and monitoring methodologies must be formulated to assess the performance of NBSAP at national, regional and local levels.

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ANNEXES

ANNEX 1. Tables

Table 1 Annual runoff from major drainage basins in Ethiopia

Basin	Countries sharing	Area in km^2	Annual runoff $x10^9m^3$
Wabi Shebele	Somalia	202 697	3.16
Abay (Blue Nile)	Sudan, Egypt	201 346	52.60
Genale-Dawa-Weyib	Somalia, Kenya	171 042	5.88
Awash	-	112 697	4.60
Tekeze-Angereb-Goang	Sudan, Egypt	90 001	7.63
Omo Gibe	-	78 213	17.96
Baro-Akobo	Sudan, Egypt	74 102	11.89
Ogaden	-	77 121	0.00
Afar	-	74 002	0.86
Rift Valley Lakes	-	52 739	5.64
Mereb-Gash	Sudan, Eritrea	23 932	0.88
Aysha (Gulf of Aden)	-	2 223	0.00
Total		1 160 115	111.10

Source: Ethiopian Valleys Development Studies Authority (1989)

Table 2. Soil types in Ethiopia

Soil Types	%
Calcic Arenosols	5.0
Calcaric and Eutric Fluvisols	8.5
Calcaric and Eutric Regosols	11.0
Chromic Eutric and Calcic Cambisols	7.5
Chromic and Orthic Luvisols	5.0
Chromic and Pellic Vertisols	10.0
Dystric Nitosols	7.5
Dystric and Humic Cambisols	2.0
Gleyic and Orthic Solonchaks	4.5
Gypsic Yermosols	3.0
Haplic, Calcic and Luvic Xerosols	5.0
Humic, Mollic and Vitric Andosols	1.0
Lithosolos	17.0
Orthic Acrisols	4.5
Rendzinas, Haplic and Luvic Phaeozems	4.0
Vertic Cambisols and Vertic Luvisols	3.0

Source: Ethiopian Mapping Agency (1988)

Table 3. Distribution and size of some forests in the Dry Evergreen Montane Forest and Grassland Complex Ecosystem

No.	Forest	Zone	Region	Area (ha)
1	Kahtasa	Agew Awi	Amhara	58000
2	Lake Tana forests	Bahir Dar Zuria	Amhara	-
3	Choke	East Gojam/West Gojam	Amhara	-
4	Limalimo	North Gondar	Amhara	-
5	Angereb	North Gonder	Amhara	56,000
6	Gonder Zuria	North Gonder	Amhara	-
7	Kundi-Mehal Meda Forest	North Shoa	Amhara	-
8	Alewaha	North Wello	Amhara	
9	Gerado-Wegeltena	North Wello	Amhara	-
10	Wof Washa	Northern Shoa	Amhara	13000
11	Borkena Mille	Oromia	Amhara	-

Cont. of Table 3				
12	Yerqe	Oromia	Amhara	2200
13	Guna	South Gonder	Amhara	1054
14	Tara Gedam	South Gonder	Amhara	560
15	Denkoro	South Wello	Amhara	8000
16	Yegof Erike	South Wello	Amhara	1526
17	Sekela Mariam	West Gojam	Amhara	10000
18	Dengego-Hawale Forest	DireDawa/East Hararghe	DireDawa /Oromia	-
19	Angada	Arsi	Oromia	-
20	Arba Gugu	Arsi	Oromia	21000
21	Chilalo-Galema	Arsi	Oromia	22000
22	Adaba Dodola Lajo	Bale	Oromia	59000
23	Noname	Bale	Oromia	-
24	Angetu Mena	Borena	Oromia	164660
25	Arero Yavello	Borena	Oromia	40000
26	Mega	Borena	Oromia	-
27	Megada/ Jemjem	Borena	Oromia	21000
28	Negele	Borena	Oromia	10000
29	Gara Muletta	East Hararghe	Oromia	7000
30	Jarso Gursum	East Hararghe	Oromia	7000
31	Hora	East Shoa	Oromia	-
32	Zequala	East Shoa	Oromia	-
33	Yerer Dire Gerbicha	Eastern Shoa	Oromia	12000
34	Debre Libanos Monastery Forest	North Shoa	Oromia	-
35	Asebot monastery forest	West Hararghe	Oromia	-
36	Dindin	West Hararghe	Oromia	19000
37	Jelo Muktar	West Hararghe	Oromia	-
38	Metakesha-Ades	West Hararghe	Oromia	16000
39	Abey Albasa	West Shoa	Oromia	2920
40	Debele-Gefere	West Shoa	Oromia	-
41	Sululta-Bereh	West Shoa	Oromia	-
42	Chilimo Gaje	Western Shoa	Oromia	22000
43	Gedo	Western Shoa	Oromia	10000
44	Menagesha Suba	Western Shoa	Oromia	15000
45	Buta Jira	Gurage	SNNP	15000
46	Arba Minch	North Omo	SNNP	928
47	Bako	North Omo	SNNP	-
48	Gidole Kamba	North Omo	SNNP	16000
49	Demi Lebiya Bulk	South Omo	SNNP	-
50	Ambalage	Eastern zone	Tigray	-
51	Atsibi	Eastern zone	Tigray	57675
52	Dessa	Eastern zone	Tigray	60000
53	Hugumburda-Grat-Kahsu forest	Southern zone	Tigray	40000
54	Hirmi	Western zone	Tigray	12000

Source: Taye Bekele et al. (2002, unpublished) and Zerihun Woldu (1999)

Table 4. Dry Evergreen Montane Forest and Grassland Complex Ecosystem

Forest name	Region.	Area (ha)	No. of Species	Genera	Family	Important Species
Tara – Gedam	Amhara	516	52	48	35	*Olea europaea, Apodytes dimidiata, Albizia schimperiana, Nuxia congesta, Teclea nobilis, Carissa edulis, Calpurnia aurea, Schefflera abyssinica, Ekebergia capensis* and *Croton macrostachyus*
Lake Tana	Amhara	-	57	49	32	*Albizia gummifera, Acokanthra schimperi, Bersama abyssinica, Calpurnea aurea, Chionanthes mildbraedi, Dombeya torrida, Dracaena steudneri, Entada abyssininca, Euclea schimperi, Ficus lutea* and *Gardenia ternifolia*
Jello-Muktar	Oromia	-	81	-	36	*Podocarpus falcatus, Juniperus procera, Croton macrostachyus Olea europaea, Teclea nobilis, Allophylus abyssinica, Dodonea angustifolia, Maytenus undata, Maytenus gracilipes* and *Calpuria aurea*
Asebot Monastery	Oromia	-	77	-	-	*Celtis africana, Podocarpus falcatus, Junperus procera, Olea europaea, Calpurnea aurea, Maesa lanceolata* and *Cordia africana*
Dinidin	Oromia	19000	82	72	43	*Juniperus procerea, Podocarpus falcatus, Celtis africana, Croton macrostachyus, Dombeya torrida, Ekbergia capensis, Olea europaea, Ficus sp., Allophylus abyssinicus Hagenia abyssinica, Ilex mitis, Polyscias fulva, Prunus africana* and *Schefflera abyssinica*

Source: FGRC Techical Reports as indicated in Taye Bekele etal. (2003)

Table 5. Dominant plant species, major genera and families in some of the Moist Evergreen Montane Evergreen Forests

Forest Name	No. of Woody Plants Recorded	Identified to Species level	Identified to Genus Level	Unidentified	Major Genera	Major Families	Predominant Species
Magada	69	64	2	4	*Maytenus*, *Olea* and *Teclea*	Oleaceae, Rubiaceae, Apocynaceae, Euphorbiaceae, Fabaceae, Meliaceae, and Rutaceae	*Celtis africana, Calpurnia aurea, Podocarpus falcatus*, and *Maytenus arbutifolia*.
Godere	123	94	3	21	*Acacia, Albizia, Celtis, Dracaena, Ficus, Hippocratea, Pouteria, Schefflera, Trichilia* and *Vernonia*	Moraceae, Rubiaceae, Euphorbiaceae, Asteraceae, Meliaceae, Sapindaceae, and Sapotaceae.	*Pouteria adolfi – friedericii, Pouteria altissima, Schefflera abyssinica, Trichilia dregeana, Manilkara butugi, Morus mesozygia, Ficus mucuso, Cordia africana, Celtis africana, Albizia grandibracteata* and *Trilepisium madagascariens*.
Bonga	106	94	5	8	*Albizia, Combretum, Erythrina, Euphorbia, Myrsine, Rubus, Schefflera, Solanecio, Teclea, Vepris, Acacia, Dracaena, Ficus, Maytenus* and *Vernonia*.	Bignoniaceace, Combretaceae, Fabaceae, Moraceae, Myrsinaceae, Myrtaceae, Rubiaceae, Rutaceae, and sapindaceae	*Ocotea kenyensis, Prunus africana, Syzygium guineense, Pouteria adolfi – friederici, Olea capensis, Ekebergia capensis, Ficus vasta, Syzygium guineense, Prunus africana, Albizia gummifera, Schefflera abyssinica, Ficus sur* and *Schefflera volkensii*.
Sigmo	54	53	-	1	*Schefflera, Maytenus, Vernonia* and *Solanecio*.	Celastraceae, Asteraceae, Araliaceae, Myrsinaceae, Rutaceae, and Rubiaceae	*Ekebergia capensis, Olea capensis, Macaranga capensis, Pouteria adolfi – friederici, Apodytes dimidiata, Ilex mitis, Hagenia abyssinica, Syzygium guineense, Allophylus abyssinicus, Millettia ferruginea, Schefflera abyssinica, Vepris dainellii, Ficus sur, Schefflera volkensii, Myrsine melanophloeos, Schefflera myriantha* and *Croton macrostachyus*.

Cont. of Table 5

Yayo	146	128	3	15	*Ficus, Vernonia, Maytenus* and *Acacia*	Fabaceae, Moraceae, Celastraceae, Asteraceae, Ephorbiaceae and Meliaceae	*Coffee arabica, Prunus africana, Ficus vasta, Celtis africana, Albizia grandibracteata, Ehretia abyssinica, Sapium ellipticum, Cordia africana, Albizia gummifera* and *Ficus sur*.
Boginda	73	66	4	3	*Albizia, Euphorbia, Ficus, Maytenus, Schefflera, Tiliachora* and *Vernonia*.	Rubiaceae, Euphorbiaceae, Celasteraceae, and Fabaceae.	*Pouteria adolfi – friederci, Bersama abyssinica, Schefflera abyssinica, Trilepsium madagascariense, Polyscias fulva* and *Coffea arabica.*
Masha – Anderacha	118	103	4	11	*Ficus, Schefflera* and *Vernonia*	Rubiaceae, Euphorbiaceae, Fabaceae, Asteraceae, Celastraceae, Moraceae, Meliaceae and Ulmaceae.	*Syzygium guineense, Ilex mitis, Schefflera abyssinica, Schefflera volkensii, Cyathea manniana, Galiniera saxifraga, Arundinar alpina, Canthium oligocarpum, Rytigynia* and *Vangueria apiculata*.
Belete – Geras	101	95	1	5	*Ficus, Dracaena, Hippocratea, Schefflera, Solanecio, Vernonia* and *Maytenus*	Rubiaceae, Euphorbiaceae, Fabaceae, Moraceae, Rutaceae, Araliaceae, Asteraceae, Celastraceae, Oleaceae and Rosaceae.	*Olea capensis, Schefflera abyssinica, Prunus africana, Elaeodendoron buchannanii, Diospyros abyssinica, Albizia gummifera, Syzygium guineense, Bersama abyssinica, Pouteria adolfi – friedericii, Apodytes dimidiata, Cassipourea malosana, Celtis africana, Croton macrostachyus, Ekebergia capensis* and *Ficus sur*.
Setema	82	82	-	-	*Maytenus, Vernonia, Albizia, Combretum, Dracaena, Ficus* and *Solanecio*.	Fabaceae, Rubiaceae, and Asteraceae	*Acacia abyssinica, Albizia gummifera, Allophylus abyssinicus, Apodytes dimidiata, Croton macrostachyus, Ekebergia capensis, Ficus sur, Ficus sycomorus, Flacourtia indica, Hagenia abyssinica, Macaranga capensis, Prunus africana, Sapium ellipticum, Schefflera abyssinica* and *Syzygium guineense*.
Sheko	66	63	1	2	*Ficus, Celtis, Dracaena, Vernonia, Hippocratea, Albizia* and *Pouteria*.	Moraceae, Euphorbiaceae, Ulmaceae, Celastraceae, Fabaceae, Rubiaceae, Sapotaceae, Dracaenaceae, Rutaceae, Oleaceae, Sapindaceae, Meliaceae, Boraginaceae, and Asteraceae	*Cordia africana, Manilkara butugi, Pouteria alitissima, Ficus vasta, Olea capensis, Celtis zenkeri, Celtis philippensis, Ficus vallis – choudae, Lecaniodiscus fraxinifolius, Mimusops kummel, Millettia ferruginea, Ficus ovata, Ficus sur, Diospyros abyssinica, Blighia unijugata, Cassipourea malosana, Croton macrostachyus, Polyscias fulva, Pouteria adolfi – friederic*cii and *Trichilia dregeana*.

Source: IBC-FGRCP (2002; 2003) as cited in Taye et al. (2003)

Table 6. Location and area of some Moist Evergreen Montane Rainforest Ecosystem

No	Forest	Location		Area (ha.)
		Region	Zone	
1	Deme Laha	SNNP	South Omo	30,000
2	Bulki Malokoza	SNNP	North Omo/South Omo	11,000
3	Bonga	SNNP	Kefa-Sheka	52,000
4	Sele Anderacha	SNNP	Kefa-Sheka	160,000
5	Tinishu Gesha	SNNP	Kefa-Sheka	n.a
6	Gura Ferda	SNNP	Bench-Maji	140,000
7	Yeki	SNNP/Gambella	Kefa-Sheka /Zone 4	122,000
8	Bodere	SNNP/Gambella	Bench-Maji/Zone 4	80,836
9	Sheko Forest	Gambella	Bench-Maji/Kefa-Sheka/Zone 4	82,980
10	Godere	Oromiya/SNNP	Zone 2	160,000
11	Abelte Gibe	Oromiya	Jimma/Yem/Gurage	10,000
12	Tiro Botter Becho	Oromiya	Jimma	85,000
13	Babiya Folla	Oromiya	Jimma	174,000
14	Belete Gera	Oromiya	Jimma	74,000
15	Sigmo Geba	Oromiya	Illubabor/ Jimma	280,000
16	Yayu	Oromiya/SNNP Oromiya	Illubabor	150,000
17	Saylem-Wangus	Oromiya	Illubabor/ Kefa-sheka	13,640
18	Gebre Dima	Oromiya	Illubabor	165,000
19	Sibo Tole Kobo	Oromiya	Illubabor	100,000
20	Fotoka	Oromiya	Illubabor	8,980
21	Jargo Watto	Oromiya	W.Wellega	20,000
22	Konch	Oromiya	W.Wellega	20,000
23	Linche Dali Gewe	Oromiya	W.Wellega	13,000
24	Chato Sengi Dengob	Oromiya	E.Wellega	50,000
25	Komto Woja Tsege	Oromiya	E.Wellega	63,000
26	Goro Bele	Oromiya	Bale	100,000
27	Harena Kokossa	Oromiya	Bale	182,000
28	Kubayu	Oromiya		60,000
29				

Source: Taye Bekele et al. (2000, unpublished)

Table 7. Major Characteristics of Lakes and Reservoirs

Name	Coordinates		Elevation (m)	Drainage Area (km^2)	Surface Area (km^2)	Maximum Depth (m)
	Long	Lat				
Tana	37° 23’	11° 36’	1788	15319	3000	14
Zeway	38° 45’	7° 54’	1636	-	485	9
Langano	38° 31’	7° 32’	1582	14600	225	46
Abyata	38° 35’	7° 33’	1577	-	200	13
Shala	38° 35’	7° 00’	1570	-	315	266
Awassa	38° 27’	7° 03’	1680	1300	92	22
Abaya	37° 38’	6° 07’	1285	14487	1070	13
Chamo	37° 32’	5° 56’	1230	18573	350	13
Chew-Bahir	36° 56’	4° 45’	500	-	308	-
Haik	39° 41’	11° 19’	1960	86	35	23
Ashengie	39° 31’	12° 34’	2440	129	20	25
Koka	39° 10’	8° 28’	1590	11250	236	13
Fincha	37° 23’	9° 33’	2219	1391	345	7
Beseka	39° 53’	8° 54’	1900	420	30	7
Rudolph/Turkana	36° 05’	4° 38’	375	-	-	-
Abe	41° 45’	11° 10’	243	-	320	-
Gamari	41° 40	11° 30’	339	-	63	-
Afambo	41° 43’	11° 24	339	-	26	-

Source: Ethiopian Valleys Development Studies Authority (1989)

Table 8. Documented cases of the total and endemic invertebrates and fish species in Ethiopia

Invertebrate group	Number of endemic species	Total number reported
CALANOIDA (COPEPOD)	3	10
CYCLOPOIDA (COPEPOD)	4	57
CLADOCERA	2	19
ROTIFERA	1	98
NEMATODA (ROUNDWORMS)	13	91
TRICOPTERA (STONEFLIES)	24	30
GYRINIDAE (BEETLES)	3	260
BAETIDAE (MAYFLIES)	2	
HYDROPSYCHIDAE (“)	6	
HYDROPTILIDAE (“)	2	
ELMIDAE (BEETLES)	6	
OSTRACODA (CRUSTACEA)	9	
CORIXIDAE (INSECT)	9	35
NOTONECTIDAE (INSECT)	5	
MOLLUSKA	16	67
CHIRONOMIDAE (MIDGEFLIES)	3	90
ODONATA (GRADONFLIES)	4	23
SIMULIDAE (BLACKFLIES)	6	
LEPIDOPTERA		380
ORTHOPTERA		50
FISH	37-57	168-183

Source: Golubstov & Mina (2003)

Table 9. Bacterial species of Agroecological Importance Studied in Ethiopia

Genera	Species	Specimen	Importance
Azosprillum	*Lipoferum*	Grasses	Biofertilizer
Bacillus	*Thuringensis*	Soil	Biocontrol
	Sp	Soil	
Rhizobium	*Leguminosarum var viceae*	Highland pulses	Biofertilizer (nitrogen fixer)
	Leguminosarum var		
	Trifolli	Trifollium	
	Medicago	Medics	
	Spp	Acacia	
	Sp	Sesbania	
Bradyrhizobium	*Sp*	Erythrina	
		Melletia	Biofertilizer
		Tephrosia	(Nitrogen fixer)
		Stylosanthes	
		Leucaena	
		Glircidia	
Pseudomonas	*Sp*	Soil	Biofertilizer (phosphate solubilizer)

Source: Zeleke Wolde Tensay et al. (2003)

Table 10. Bacterial species of industrial and nutritional importance Studied in Ethiopia

Genera	Species	Source	Importance
Acetobacter	*Xylenum*	Traditional beverage	Preservation and fermentation
	Spp	"	"
Arthrobacter	*Pascens*	"	"
	Oxydans	"	"
	Simplex	Traditional food & beverage	"
Bacillus	*Bacificus*	"	Thermo stable enzyme production
	Brevis	Hot springs	Fermentation and preservation
	Cerculans	"	"
	Cereus	"	"
	Firmus	Traditional food	"
	Lentus	"	"
	Licheniformis	"	Thermo stable enzyme production
	Lavae	Hot spring	"
	Maceranus	"	"
	Megatrium	"	"
	Pumilis	"	"
	Panthotenicus	"	Fermentation and preservation
	Stearothermophilus	"	"
	Subtilis	Traditional food	"
Brevibacterium	*Spp*	"	"
	Spp	"	"
Clostridium	*Butyricum*	"	"
	Beijerinekii	"	"
	Sticklandi	"	"
Enterococcus	*Fecalis*	"	"
Lactobacillus	*Acetotolerans*	"	"
	Acidophilus	"	"
	Casei	"	"
	Delbruekii	"	"
	Homohiochi	"	"
	Graminis	"	
	Plantarum	"	"
	Sanfrancisco	"	"
	Vaccinostectus	"	"
	Fermenti	"	"
Lactococcus	*Brevis*	"	"
Leuconostock	*Coryneformis*	"	"
	Spp	"	"
Listeria	*mesenteroides*	"	"
Microbacterium	*monocytogens*	"	"
	Spp	"	"
Micrococci	*Spp*	"	"
Pediococcus	*Spp*	"	"
	Dextrinicus	"	"
	Acidilactici	"	"
	Pervulus	"	"
	Cervisieae	"	"
Streptococcus	*Spp*	"	"

Source: Zeleke Wolde Tensay et al. (2003)

Table 11. Fungal species of industrial and nutritional importance

No	Species	Source	Importance
1	*Candida milleri*	food	fermentation
	C. pseudotropicalis	"	"
	C. guillermondi	"	"
2	*Debaromyces phaffi*	beverages	fermentation
3	*Pichia mebranefaciens*	"	"
	P. naganishii	"	"
4	*Kluyveromyces lactis*	"	"
	K. bulgaricus	"	"
	K. maximus	"	"
	K. veronae	"	"
5	*Rhodotorula glutinis*	food	"
	R.. mucilaginosa	"	"
6	*Sacchromyces* cerviceae	food	"
7	*Torulopsis spp.*	"	"
8	*Tricosporum spp.*	"	"
9	*Chaetomium spp.*	"	"
10	*Pencilium spp.*	"	'
11	*Trichoderma spp.*		
12	*Cladosporium spp.*		

Source: Zeleke Wolde Tensay et al. (2003)

Table 12. Total number of microorganisms isolated and characterized in Ethiopia

Microorganism	Genera	Species	Strain/isolate
Algae	96	247	-
Bacteria	61	89	214
Fungi	35	45	
Protozoa	8	20	
Viruses	-	44	
Total	200	445	214

Source: Zeleke Wolde Tensay et al. 2003

Table 13. Status of medicinal plants in Ethiopia

State of existence	Number of species	%
Wild	357	40.2
Cultivated	89	10
Weed	52	5.9
Undetermined	389	43.9

Source: Tesema Tanto et al. (2003)

Table 14. Distribution of the medicinal plants in different ecosystems of Ethiopia

Ecosystem	Number of species	%
Acacia-Commiphora woodland	109	12
Montane grassland	93	10.5
Dry evergreen montane forest and evergreen scrubland	83	9.3
Combretum-Terminalia woodland	69	7.8
Moist Montane Forest	48	5.4
Desert and semi-desert scrubland	45	5.1
Afroalpine and sub-afroalpine	44	5.0
Lowland forest	33	3.7
Aquatic	30	3.4
Wetland	23	2.6
Undetermined	300	33.8

Source: Tesema Tanto et al. (2003)

Table 15. Plant parts used for the preparation of traditional remedies in Ethiopia

Plant part used	Number of plant species	%
Roots	378	58.3
Leaves	209	32.2
Whole part	76	11.7
Fruits	76	11.7
Flowers	66	10.2
Bark	58	8.9
Stems	37	5.7
Seeds	35	5.4
Above ground	18	2.7
Latex	15	2.3
Resin	10	1.5
Sap	5	0.8
Gum	5	0.8
Rhizomes	2	0.3
Young shoot	1	0.15
Twig	1	0.15

Source: Dawit Abebe and Ahadu Ayehu (1993); Tesema Tanto et al. (2003)

Table 16. Summary of forage grass, legumes and browse trees documented in Ethiopian Flora

Forage type	Number of species
Grass	736
Legumes	358
browse trees	179

Source: Getahun Mulat et al. (2003)

Table 17. Forage grass, legumes and Browse trees reported to be important (medium to high level) for pasture and forage purpose and species systematically collected and conserved

Forage type	No. of important species	Species collected and conserved	
		No. of Species	No. of accession
Grass	164	77	371
Legumes	58	140	2076
Browse trees	51	41	185

Source: Getahun Mulat et al. (2003)

Table 18. Summary of information on Principal Wildlife Protected Areas

Name	Area (km^2)	Ecosystem category	Total species of mammals	Total species of birds	Major wild animal species conserved	Other unique species
Abijata-Shalla Lakes National Park	887	*Acacia-Commiphora* woodland	76	457	Aquatic birds - Great-white Pelican, Lesser Flamingo, etc. Mammals - Greater Kudu, Oribi, Klipspringer, Guereza & Warthog	Mammals - Scott's Hairy Bat, Mahomet's Mouse, White-footed R at, Ethiopian Grass Rat & Harrington's Scrub Rat Birds - Wattled Ibis, Yellow-fronted Parrot, Black-winged Lovebird, Banded Barbet, Black-headed Forest Oriole & Thick-billed Raven.
Awash National Park	756	*Acacia-Commiphora* woodland & Evergreen scrub	76	451	Beisa Oryx, Swayne's Hartebeest, Soemmerring's Gazelle & Ostrich	Birds - Wattled Ibis, Banded Barbet, Abyssinian Woodpecker, White-winged Cliff-chat & Thick-billed Raven.
Bale Mountains National Park	2,471	Afroalpine and sub-afroalpine, Dry evergreen montane forest & Evergreen scrub	67	262	Mountain Nyala, Ethiopian Wolf, Menelik's Bushbuck & Giant Mole Rat	Mammals - Scott's Hairy Bat, Lovat's Mouse, Nikolaus' Mouse, Mahomet's Mouse, White-footed Rat, White-tailed Rat, Grey-tailed Rat, Starck's Hare & a few others Birds - Blue-winged Goose, Rouget's Rail, Spot-breasted Plover, Yellow-fronted Parrot, Abyssinian Longcla w, Abyssinian Catbird & Black -headed Siskin
Gambella National Park	5,061	Lowland (semi) evergreen forest, *Combretum-Terminalia* woodland and savanna & Moist Evergreen Montane forest	43	327	Roan Antelope, White-eared Kob, Nile Lechwe & Bush Elephant	Mammals - Topi & Hippopotamus Bird - Whale-headed Stork
Mago National Park	2,162	Desert and semi-desert scrubland, *Acacia-Commiphora* woodland & *Combretum -Terminalia* woodland and savanna	81	237	Bush Elephant, Cheetah, Lelwel Hartebeest, Black Rhinoceros & Buffalo	Mammals - Leopard, Lesser Kudu, De Brazza's Monkey, African Hunting Dog & Gerenuk Birds - Wattled Ibis, White-winged Cliff-chat, Black-headed Forest Oriole & Thick-billed Raven
Nechisar National Park	514	*Acacia-Commiphora* woodland & Evergreen scrub	84	332	Burchell's Zebra & Swayne's Hartebeest	Greater Kudu, Hippopotamus, Crocodile, Nile Perch,

						Wattled Ibis, Thick-billed Raven & Kori Bustard
Omo National Park	4,068	Desert and semi-desert scrubland, *Acacia-Commiphora* woodland & *Combretum-Terminalia* woodland and savanna	69	300	Common Eland, Bush Elephant, Black Rhinoceros, Giraffe & Cheetah	Mammals - Buffalo, Topi, Burchell's Zebra & Lesser Kudu Birds - Black-winged Lovebird, Kori Bustard, Secretary Bird & Ostrich
Simien Mountains National Park	179	Afroalpine and sub-afroalpine & Dry evergreen montane forest	33	125	Walia Ibex, Ethiopian Wolf & Gelada Baboon	Mammals - Klipspringer, Hamadryas Baboon, Ethiopian Grass Rat, Simien Mouse, White-footed Rat, Grey-tailed Rat, Lovat's Mouse & Mahomet's Mouse Birds - Spot-breasted Plover, White-collared Pigeon, Black-winged Lovebird, Abyssinian Longclaw, White-winged Cliff-chat, Ruppell's Chat, Abyssinian Catbird, White-backed Black Tit, Black-headed Forest Oriole, Thick-billed Raven, White-billed Starling, Black-headed Siskin & Wattled Ibis
Yangudi-Rassa National Park	4,731	Desert and semi-desert scrubland & *Acacia-Commiphora* woodland	36	229	African Wild Ass & Soemmerring's Gazelle	Mammals - Oryx, Hamadryas Baboon, Leopard & Cheetah Birds - Wattled Ibis & Thick-billed Raven
Babille Elephant Sanctuary	6,982	Desert and semi-desert scrubland, *Acacia-Commiphora* woodland & Evergreen scrub	22	106	Bush Elephant, Hamadryas Baboon, Cheetah & Leopard	Bush Elephant
Kuni-Muktar Sanctuary	-	Dry evergreen montane forest	23	24	Mountain Nyala & Menelik's Bushbuck	Mammals - Giant Forest Hog, & Bush Pig Birds - Wattled Ibis, Black-winged Lovebird, White-backed Black Tit & Thick-billed Raven
Senkelle Swayne's Hartebeest Sanctuary	54	*Acacia-Commiphora* woodland & Evergreen scrub	37	191	Swayne's Hartebeest	Bohr Reedbuck, Greater Kudu, Oribi & Mahomet's Mouse
Yabello Sanctuary	2,496	Desert and semi-desert scrubland & Evergreen scrub	43	280	Swayne's Hartebeest, Grevy's Zebra & Abyssinian Bush Crow	Burchell's Zebra, White-tailed Swallow, Thick-billed Raven & Ostrich

Source: Hillman (1993); Mohammed Abdi et al. (2003)

Table 19. Summary of information on Wildlife Reserve Areas of Ethiopia

Name	Area (Km^2)	Region	Ecosystem	Major Animal Species Conserved
Alledeghi	1,832	Oromiya	Desert and semi-desert scrubland & *Acacia-Commiphora* woodland	Oryx, Soemmerring's Gazelle, Lesser Kudu, Greater Kudu, Ostrich, etc.
Awash West	1,781	Oromiya	*Acacia-Commiphora* woodland & Evergreen scrub	Greater Kudu, Oryx & Lesser Kudu
Bale	1,766	Oromiya	Dry evergreen montane forest & Afroalpine and sub-afroalpine	Mountain Nyala & Menelik's Bushbuck
Chew Bahir	4,212	South Ethiopia	Desert and semi-desert scrubland	Grevy's Zebra, Vervet Monkey, Caracal, Lion, Oryx, lesser Kudu, Defassa Water, Gerenuk, Grant's Gazelle
Gewane	2,431	Afar	Desert and semi-desert scrubland & *Acacia-Commiphora* woodland	Soemmerring's Gazelle, Ostrich, Greater Kudu & Lesser Kudu
Mille-Sardo	8,766	Afar	Desert and semi-desert scrubland & *Acacia-Commiphora* woodland	Soemmerring's Gazelle, Ostrich, Greater Kudu & Lesser Kudu
Shire	753	Tigray	*Combretum-Terminalia* woodland and savanna & Evergreen scrub	Red-fronted Gazelle, Greater Kudu, Bush Elephant, Roan Antelope, Oribi & Crocodile
Tama	3,269	South Ethiopia	*Acacia-Commiphora* woodland & *Combretum-Terminalia* woodland and savanna	Giraffe, Burchell's Zebra & Lelwel Hartebeest

Source: Hillman (1993), Mohammed Abdi et al. (2003)

Table 20. Protected areas of Ethiopia designated for wildlife conservation processes

Category	Number	Area (km^2)	Percentage area
National Parks	9	20,832	1.8
Wildlife Sanctuaries	4	9,532	0.8
Wildlife Reserves	8	24,810	2.2
Controlled Hunting Areas	18	131,821	11.7
Total	39	187,004	16.5

Source: Hillman (1993); Mohammed Abdi et al. (2003)

Table 21. Summary of information on Controlled Hunting Areas of Ethiopia

Name	Area (km^2)	Region	Ecosystem	Major Wild Animal Species Conserved
Afdem-Gewane	5,932	Afar	Desert and semi-desert scrubland & *Acacia-Commiphora* woodland	Soemmerring's Gazelle, Ostrich, Greater Kudu & Lesser Kudu
Akobo	5,049	Gambella	Lowland (semi) evergreen forest, *Combretum-Terminalia* woodland and savanna & Moist evergreen montane forest	Roan Antelope, White-eared Kob, Nile Lechwe, Topi & Bush Elephant,
Awash West	9,136	Oromiya	*Acacia-Commiphora* woodland & Evergreen scrub	Beisa Oryx, Greater Kudu, lesser Kudu, & Soemmerring's Gazelle
Arsi	10,876	"	Afroalpine and sub-afroalpine	Mountain Nyala, Menelik's Bushbuck & Bohor Reedbuck
Bale	9,663	"	Dry evergreen montane forest & Afroalpine and sub-afroalpine	Mountain Nyala, Menelik's Bushbuck & Bohor Reedbuck
Borana	45,366	"	Desert and semi-desert scrubland & *Combretum-Terminalia* woodland and savanna	Bush Elephant, Buffalo, Beisa Oryx, Greater Kudu & Buechell's Zebra
Boyo Swamp	-	South	Aquatic ecosystem	Hippopotamus, Wattled Crane Wattled Ibis & Great White Pelican
Chercher & Arba Guggu	3,045	Oromiya	Afroalpine and sub-afroalpine & Dry evergreen montane forest	Mountain Nyala, Menelik's Bushbuck & Bohor Reedbuck
Dabus	2,127	Benshangul	*Combretum-Terminalia* woodland and savanna	Giant Forest Hog, Bohor Reedbuck & Colobus
Erer-Gota	2,386	Oromiya	*Acacia-Commiphora* woodland & Evergreen scrub	
Jikau	3,375	Gambella	Moist evergreen montane forest & *Combretum-Terminalia* woodland	Bush Elephant, Buffalo,
Lower Wabe Shebelle	23,788	Somali	*Acacia-Commiphora* woodland & Desert and semi-desert scrubland	Greater Kudu
Mizan-Teferi	-	Southern Peoples	Mainly Moist evergreen montane forest & *Combretum-Terminalia* woodland	Buffalo, Bush Elephant & Leopard
Maze		"	*Combretum-Terminalia* woodland	Swayne's Hartebeest, Buffalo, Defassa Waterbuck, Lion & Leopard
Murle	4,172	"	Desert and semi-desert scrubland and *Combretum-Terminalia* woodland	Tiang, Oryx, Grant's Gazelle, Greater and Lesser Kudus, Gerenuk, Lion, leopard, Cheetah, Crocodile & including Ostrich the area is known to hold 150 species of birds
Omo West	4,561	"	*Acacia-Commiphora* woodland, Desert and semi-desert scrubland & *Combretum-Terminalia* woodland	Elephant, Lesser Kudu, Buffalo & other plain animals
Tedo	2,347	Gambella		
Segen	1,385	South Ethiopia	*Acacia-Commiphora* woodland & Evergreen scrub	Waterbuck, Lesser Kudu, Greater Kudu, Ostrich & Serval Cat

Source: Hillman 1993; Mohammed Abdi *et al.* (2003)

Table 22. Conservation Status of Major Mammals and Birds

Type of species	Critically endangered	Endangered	Vulnerable	Near threatened
Mammals				
Gelada Baboon			3	3
Grevys Zebra		3		
Swaynes Hartebeest		3		
Speake's Gazelle			3	
Mountain Nyala		3		
Walia Ibex	3			
African Wild Ass	3			
Ethiopian Wolf	3			
Tora Hartebeest				
Dibatag		3		
		3		
Birds				
Ankober Sern		3		
White-winged Fluftail		3		
Prince Ruspoli's Turaco			3	
Sidamo Long-Clawed Lark			3	
Ferruginous Duck			3	
Great Spotted Eagle			3	
Imperial Eagle			3	
Lesser Kestrel			3	3
Taita Falcon				
Harwood's Francolin				3
Wattled Crane			3	
Corn Crake		3		
			3	

Source: EWCO (2001) as cited in Mohammed Abdi et al. (2003)

Table 23. Classification and population size of Ethiopian cattle breed

	Class/group	Breed/types	Population size (Number)
1	Humpless Brachyceros Hamatic Longhorn		
		Sheko	18,000
		Kuri	NA
2	Large East African Zebu		
		Barca (Begait)	76706
		Boran	1,896,000
3	The Senga of east Africa		
3.1	The Nilotic group		
		Abigar	548,000
3.2	Abyssinian senga		
		Danakil (Adal, Keriyu, Afar)	680,000
		Raya Azebo	521,000
4	Intermediate Sanga/Zebu		
		Horro	3,286,000
		Fogera	636,000
		Arado	510,000
		Jiddu	NA
5	Abyssinian Short horned Zebu		
		Arsi	NA
		Adwa	NA
		Ambo	NA
		Bale	NA
		Goffa	NA
		Gurage	NA
		Harar	NA
		Smada	NA
		Mursi	NA
		Hammer	NA
		Black Zebu (Jem-Jem)	434,000
		Small Zebu (Jijjiga)	100,000
		Ogaden	
6	Others		
		Fella (Red Bororo)	100,000
		Medenese	71906
		Abergelle	82257

Sources: Alberro & Haile-Mariam (1982a & 1982b); Million Tadesse et al. (2003)

Table 24. Eco-system and agro-ecological distribution of cattle breeds/types

Breeds/types	Locality	Eco-system	Agro-ecologicl zone
Arsi	Oromiya (Arsi, Bale, E. Shoa)	*Acacia-Commiphora* ecosystem, Dry Montane Evergreen and Scrub	A12, SA1-2 SM1-2
Boran	Borana, lowlands of Bale, part of Somali	Desert and Semi desert Scrub, *Acacia-Commiphora* ecosystem	A1-2 M2
Ogaden	Somali & E. Harrerghe Dire Dawa	Desert and Semi desert Scrub, *Acacia-Commiphora*	A1-A2
Barca (Bagait)	N.W. Tigray	*Combretum-Terminalia*, Desert and Semi desert Scrub	A1, SM1-2
Short-horn Zebu	Highlands of Sidamo : Harer plateau & Shewa	Dry Montane Evergreen and Scrub	Sm1-2 M2
Small Zebu (Jijjiga)	Jijjiga & Neighbouring areas of E.Harrerghe	Desert and Semi desert Scrub, *Acacia-Commiphora* ecosystem	A2
Highland Zebu	Highlands of Bale (Goba, Sinana)	Dry Montane Evergreen and Scrub,	SM2
Black Zebu	Highlands of Sidamo, Jem-Jem area	Dry Montane Evergreen and Scrub,	M2
Abisinia	Tigray	*Acacia-Commiphora* & *Combretum-Terminalia*	M2
Horro	E.Wollega, W. Shoa, Keffa, Illubabor	Dry Montane Evergreen and Scrub	H2
Fogera	Around lake Tana & Gondar	Dry Montane Evergreen and Scrub & Wetland ecosystem	
Jiddu	S. lowlands of Bale & Somali Region	Desert and Semi desert Scrub *Acacia-Commiphora* ecosystem	A1, SA1-2
Arado	N. Highlands Tigray	Dry Montane Evergreen and Scrub	
Danakil	N.E lowlands Afar, Rift valley	Desert and Semi desert Scrub and, *Acacia-Commiphora* ecosystem	A1, SA1-2
Abigar	S. OMO Assoca & Gambella	*Combretum-Terminalia* Woodland & Savanna	SH1
Raya Azebo	Tigray, Amhara region (Raya)	Desert and semi-desert & *Acacia-Commiphora* woodland	A1, SA1-2
Sheko/Goda/Mitzan	Sheko & Bench Wereda of SNNP	*Combretum-Terminalia* woodland	PH1, PH2
Kuri	Djikao District, Gambella Region	*Combretum-Terminalia* woodland	SH1, SA2
Fellata (Red Bororo)	West of Gambella	*Combretum-Terminalia* woodland & Lowland Tropical Forest	SH1, SA5
Medenes	Tigray Western Zone	Desert and Semi desert Scrub, *Acacia-Commiphora* & *Combretum-Terminalia* woodlands	SM1-2
Abergelle	Tigray Central Zone	*Combretum - Terminalia*, Desert and Semi desert Scrub & *Acacia-Commiphora* wodland	A1-2 SA1

Source: Alberro, M and S. Haile-Mariam (1982a and 1982b); Million Tadesse et al. (2003)

Table 25. Classification, estimated population size, and locality of sheep breeds/types

Classes	Breeds/types	Pop Size	Locality
Hairy Thin Tailed	Begait	31715	Tigray Western Zone
	Horro	1030154	Wollega, part of Western Shoa and Illubabor
Fat Tailed	Menz	2202784	North Shoa, & South Wello
	Arsi	1904541	Arsi, Bale & East Shoa
	Tukur	400871	North Wollo (Lasta)
Fat Rumped	Adal/Afar	231993	Afar, Dire Dawa, lowland of Eastern Shoa
	Blackhead	383842 58750 430040 9925632	Somali, Ogaden & adjacent area Oromiya (Boran) South Omo Total
Others	Farta		Southern Gonder
	Dangilla	129063	Amhara (Awi Zone)
	Bonga / Gesha	465346	South West Ethiopia, Keffa zone (Bonga & surrounding Weredas
	Abergelle	86532	Tigray Central Zone
	Ille	27116	Tigray Southern Zone
	High land sheep	715434	Tigray in all Zones

Sources: MOA (1975) as cited in Million Tadesse et al. (2003)

Table 26. Classification estimated population size of indigenous goat breeds/types in Ethiopia

Class	Goat type	Local name	Population
Rift Valley family			
	Afar	Adal/Denakil	1,000,000
	Abergelle	Abergelle	300,000
	Arsi-Bale	Gishe/Sidama	1694417
	Woyto-Guji	Woyo/Guji/Konso	1659190
Somali family			
	Hararghe highlands	None	1,000,000
	Short-eared Somali	Denghier/Deghyer	1,500,000
	Long-eared Somali	Large white somali/Degheir	1,500,000
Small E.Africa family			
	Central highlands	Brown goat	6,000,000
	Western highlands	Agew	3,000,000
	Western lowlands	Shakela/Gumez	400,000
	Felata sub-type		
	Arab sub-type		
	Gumuz sub-type		
	Agew sub-type		
	Oromo sub-type		
	Keffa	None	1,000,000
Other			
	Bagait	Bagait	39303
	Medense	Medense	113702
	Widar	Widar	19977
	Maefur	Maefur	38810

Sources: Farm Africa (1992 & 1996); Million Tadesse et al. (2003)

Table 27. Major types of camel estimated population, locality and their use

Camel type	Population	Locality	Eco-system	Use values
		Camel		
Ogaden	1078000	Somali region (Ogaden)	Desert and Semi-desert & *Acacia-Commiphora* woodland	Milk & meat Transport & trade
	83300	Oromia Eastern Harerghe		Pack animal
Afar	871832	Afar, Oromia Tigray Region	Desert and Semi desert & *Acacia-Commiphora* woodland	Milk & meat Transport & trade Pack animal
	13661	Amhara region N.S.Welo		
	7000			
Boran	824690	Oromia, Somali(Liben Zone)	Desert and Semi desert & *Acacia-Commiphora* wodland	Milk & meat Transport & trade Pack animal
	954000			
Anfi	NA	Amhara region	Desert and Semi desert & *Acacia-Commiphora* wodland	Meat Transport & trade Pack animal

Source: Million Tadesse *et al.* (2003)

Table 28. Major types of Donkey estimated population, locality and their use

Donkey type	Population	Locality	Use values
		Donkey	
Ogaden	213000	Somali region	Transport & trade Pack animal
	9576	Dire Dawa	
Jimma	139400	Oromia region Jimma, Illub. Wellega	Transport & trade Pack animal
Sennar	20702	Benshangul	Transport & trade Pack animal
	---------	Amhara Region	
	---------	Tigray region	
Abyssinian		Oromia, SNNRP & other	Transport & trade Pack animal

Source: Million Tadesse et al. (2003)

Table 29. Major Horse locality, eco-system, status and their use value

Horse types	Population	Locality	Eco-system	Use and Value
Oromo	Na	Oromia region	All region	Transport
Dongola	1368456		All region	Transport

Source: Million Tadesse et al. (2003)

Table 30. Major Mule types, locality, eco-system, status and their use value

Mule types	Population	Locality	Eco-system	Use and values
Sennar Mule		All region	All	Transport
Wollo Mule		Amhara Region		Transport
				Transport

Source: Million Tadesse et al. (2003)

Table 31. Major Chicken breeds/types and their locality, distribution and use value in Ethiopia

Types	Population	Locality	Eco-system	Use value
Tilili	NA	Amhara Awi Zone Tilili Wereda	Ever green Montane	Egg, Meat Ceremony
Neck necked				
Gambella type	210730	Gambella,Anfilo,	CTWLF	Egg, Meat Ceremony
Melata		Amhara		
Teken Local	24325	Tigray	DSD	Egg, Meat Ceremony
Walayita		SNNP		Egg, Meat Ceremony
Dero Habesha	2080358	Tigray	DSD	Egg, Meat Ceremony
Horro		Oromiya		
Colour				
Red colour	Unknown	All region	All	Egg, Meat Ceremony
White	Unknown	All region	All	Egg, Meat Ceremony
Mixed colour	Unknown	All region	All	Egg, Meat Ceremony
Black	Unknown	All region	All	
Gebsema	Unknown	All region	All	Ceremony, Meat egg
Kokima	Unknown	All region	All	Ceremony, Meat egg
Wesera	Unknown	All region	All	Ceremony, Meat egg

Source: Million Tadesse et al. (2003)

Table 32. Classification, distribution and estimated colony size of Honey Bee types in Ethiopia

Breed	Colony size	Locality	Use value
Apis Melifera Adansol		Awassa, Angergutin, Arbaminch, Negele, Bebeka, Neqemt and Asela	For Honey and wax production, cross pollination
Apis Melifera Jementica (Yellow bee)		Harar Jijjoga & Ogaden	For Honey and wax production
Apis Melifera Monticola		South eastern mountain; Balle, Dinsho	For Honey and wax production
Apis Melifera Litorea		Gambella	For Honey and wax production
Apis Melifera Abyssinical		Jimma, Bedelle, Suba, Yiba Muda, Mocha & Holetta	For Honey and wax production
Apis Melifera Dansol **?**		Gojam, Bore	For Honey and wax production
Total colon	10 Million		

Source: National Honey Bee Research Strategy (1999) as cited in Million Tadesse et al. (2003)

Table 33. Biodiversity Features and GIS presentation

.	Feature Type	GIS Presentation		
		Area	Point	Atribute
1	Livestock	*	*	*
2	Crop Types	*	*	*
3	Horticulture	*	*	*
4	Wildlife	*	*	*
5	Forest	*	*	*
6	Aquatic Animals	*	*	*
7	Cultural Data	*	*	*
8	Medicinal Plants	*	*	*

Source: Degelo Sendabo and Tekle Wolde-Gerima (2003)

Table 34. Classification and Standardization for Mapping

No.	Type of Data	Classification and Standardization for Mapping	
		Administrative Unit	Ecological Zone
1	Livestock	*	*
2	Crop Types	*	*
3	Horticulture	*	*
4	Wildlife	*	*
5	Forest	*	*
6	Aquatic Animals	*	*
7	Cultural Data	*	*
8	Medicinal Plants	*	*

Source: Degelo Sendabo and Tekle Wolde-Gerima (2003)