

**NATIONAL BIODIVERSITY
STRATEGY AND ACTION PLAN
FOR ERITREA**

**Prepared by
The Department of Environment
Ministry of Land, Water and Environment**

Asmara

August 2000

**Photographs appearing in the National Biodiversity Strategy and Action Plan
were obtained from the Ministry of Agriculture and Ministry of Fisheries**

FOREWORD

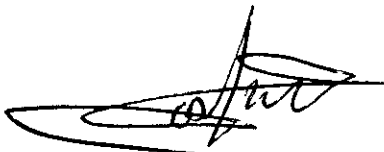
The importance of having a national biodiversity strategy and action plan need not be over emphasised. Given our past history, there was a complete neglect and mismanagement to our natural resources in general and to biodiversity resources in particular. The environmental scenario in Eritrea is featured by one of the most severe land degradation, deforestation, decreasing wildlife populations, loss of habitat, etc. Relatively speaking it may be argued that our coastal and marine biodiversity resources remained stable as compared to our terrestrial and agro-biodiversity resources. This does not mean, however, that there was sound marine environment protection and management practices put in place. This is due to the fact that there was not any meaningful program of activities to exploit marine biodiversity resources.

To reverse the situation, it is only after Eritrea's independence that the Government took the initiative to institute certain policy and practical measures to rehabilitate and restore the degrading environment. The preparation of the National Biodiversity Strategy and Action Plan (NBSAP) is a continuation of the Government efforts and is a step forward with respect to biodiversity conservation for a sustainable use. The NBSAP presents Eritrea's overall policy position with respect to biodiversity conservation and attempts to place this policy in the context of the Government's major development objectives for the next few years. The Ministry of Land, Water and Environment commits itself to facilitate, promote, and co-ordinate the implementation process of biodiversity conservation activities for a sustainable use.

The preparation of the NBSAP also demonstrates Eritrea's readiness to implement the provisions of the Convention on Biological Diversity (CBD), under whose obligation the NBSAP is prepared. We believe that the strategy and action plan identified in the NBSAP, while addressing national needs and priorities, will at the same time contribute to global biodiversity conservation and sustainable use. Nevertheless, national biodiversity planning and management capacity should be increased and strengthened if such contributions are going to be effective. The CBD should then endeavour to strengthen these capacities through its established financial mechanisms.

It is to be realised that the NBSAP will require adequate financial support for its implementation. We, thus, consider the Global Environmental Facility (GEF) and its implementing agencies, including the World Bank, United Nations Development Program and the United Nations Environment Program to be important partners in our endeavour to implement biodiversity conservation programs. In this connection we take this opportunity to humbly express our vote of thanks to the financial support made by the Global Environment Facility (GEF) for preparing the NBSAP and also to the World Bank for effectively implementing this support.

The NBSAP could not have been successfully produced without the active participation of all those institutions involved in the process. We wish then to express our full appreciation to the efforts made by concerned government agencies and others, while asking our sincere apologies for not being able to list all the names.



Woldemichael Gebremariam,

Minister of Land Water and Environment

July 2000

ACRONYMS

AMRF:	Assessment and Management Riverine Forest
CAAS:	College of Agriculture and Aquatic Sciences
CBD:	Convention on Biological Diversity
COP:	Conference of Parties
CMI:	Coastal and Marine Islands
CPT:	Core Planning Team
DANIDA:	Danish International Development Agency
DARHRD:	Department of Agricultural Research and Human Resource Development
DOE:	Department of Environment
ECDF:	Eritrean Community Development Fund
EEA:	Eritrean Environment Agency
EEQ:	Environmental Evaluation Questionnaire
EIA:	Environmental Impact Assessment
ER:	Eritrea
EAFRINET:	East Africa Biosystematics Network
FAO:	Food and Agriculture Organisation
FWD:	Forestry and Wild Life Division
GDP:	Gross Domestic Product
GEF:	Global Environment Facility
GIS:	Geographic Information System
GOE:	Government of Eritrea
ICIPE:	International Centre for Insects and Pests Ecology
ICARDA:	International Centre for Agricultural Research in the Dry Areas
ICRAF:	International Centre for Research and Agro-Forestry
ICRISAT:	International Crops Research Institute for the Semi-Arid Tropics
IDA:	International Development Agency
ILCA:	International Livestock Centre for Africa
IPGRI:	International Plant Genetic Resources Institute
IPM:	Integrated Pest Management
IUCN:	World Conservation Union

MARPOL:	International Convention for the Prevention of Pollution from Ships
MBF:	Department of Marine Biology and Fisheries (UOA)
MEM:	Ministry of Energy and Mines
MOA:	Ministry of Agriculture
MOD:	Ministry of Defence
MOE:	Ministry of Education
MOF:	Ministry of Fisheries
MOH:	Ministry of Health
MOI :	Ministry of Information
MOJ:	Ministry of Justice
MOLG:	Ministry of Local Government
MOT:	Ministry of Tourism
MLWE:	Ministry of Land Water and Environment
MSY:	Maximum Sustainable Yield
MTC:	Ministry of Transport and Communication
MTI:	Ministry of Trade and Industry
MICMEC:	Ministry of International Co-operation Macro Policy and Economic Co-ordination
NBSAP:	National Biodiversity Strategy and Action Plan
NDVI:	Normalised Difference Vegetation Index
NEMP-E:	National Environmental Management Plan for Eritrea
NEPFAP:	National Economic Policy Framework and Program
NGO's:	Non-Governmental Organisations
NUEW:	National Union of Eritrean Women
NUEYS:	National Union of Eritrean Youth and Students
PGRU:	Plant Genetic Resource Unit
EPFDJ:	Eritrean People's Front for Democracy and Justice
RUG:	University of Groningem
SOS:	Save Our Soul
WHO:	World Health Organisation
UNDP:	United Nations Development Programme
UNEP:	United Nations Environment Programme
UOA:	University of Asmara

TABLE OF CONTENTS

Foreword.....	i
Acronyms	iii
Table of contents	v
Executive Summary	vii
Section 1. Introduction.....	1
1.1 Background and context	1
1.2 The Convention on Biological Diversity (CBD)	2
Section 2. Country Profile	3
2.1 Location	3
2.2 Population	3
2.3 Climate and geography	3
2.4 Government	4
2.5 Economy	4
Section 3. The Status of Biodiversity in Eritrea	7
3.1 Terrestrial Biodiversity	8
3.1.1 Terrestrial Biodiversity at the Ecosystem Level	8
3.1.2 Terrestrial Biodiversity at the Species Level	13
3.2 Marine Biodiversity	17
3.3 Agricultural Biodiversity	20
Section 4. Assessment of the National Policy, Legislative and Institutional Framework in view of Environmental Protection and Biodiversity Conservation ..	25
4.1 National Constitution	25
4.2 National Development Policy	25
4.3 Implications of the National Development Policy for biodiversity conservation and sustainable use.....	26
4.4 Legislative framework for biodiversity conservation and sustainable use	27

Section 5.	The Principal Components of the Strategy and Action Plan	30
5.1	Goal	31
5.2	Objectives	31
5.2.1	Terrestrial Biodiversity.....	31
5.2.2	Marine Biodiversity.....	32
5.2.3	Agricultural Biodiversity	32
5.3	Strategic Elements	32
Section 6	Biodiversity-related Activities for Terrestrial Biodiversity	34
6.1	Integrated management	34
6.2	Sustainable use of natural resources	37
6.3	Alien invasive species	40
6.4	Pollution management	42
6.5	<i>In-situ</i> conservation (protected areas)	43
6.6	<i>Ex-situ</i> conservation	45
6.7	Taxonomic knowledge	46
6.8	Information acquisition and storage	47
6.9	Public awareness and education	48
6.10	Legal and institutional structure (capacity building)	49
6.10.1	Legislation	49
6.10.2	Institutions (capacity building)	50
Section 7.	Biodiversity-related Activities for Marine Biodiversity	52
7.1	Integrated management	53
7.2	Sustainable use of natural resources	54
7.3	Alien invasive species	55
7.4	Pollution management	56
7.5	<i>In-situ</i> conservation (protected areas)	56
7.6	<i>Ex-situ</i> conservation	59
7.7	Taxonomic knowledge	59
7.8	Information acquisition and storage	60
7.9	Public awareness and education	61
7.10	Legal and institutional structure (capacity building)	62
Section 8.	Biodiversity-related Activities for Agricultural Biodiversity	64
8.1	Integrated management	65
8.2	Sustainable use of natural resources	67
8.3	Alien species	70
8.4	Pollution management	72
8.5	<i>In-situ</i> conservation	73
8.6	<i>Ex-situ</i> conservation	74
8.7	Taxonomic knowledge	76
8.8	Information acquisition and storage	77
8.9	Public awareness and education	78
8.10	Legal and institutional structure (capacity building)	78

Executive Summary

This first Eritrean National Biodiversity Strategy and Action Plan (NBSAP) has been prepared over an extended period from June 1997 until July 2000 and presents Eritrea's overall policy position with respect to its biodiversity, the sum total of ecosystem, species and genetic diversity that lies within Eritrean territory.

The NBSAP builds upon the Government's previous commitment to broader environmental protection, as contained in the 1995 National Environmental Management Plan – Eritrea (NEMP-E). The NBSAP covers a range of existing and ongoing biodiversity-related activities taking place within different sectors of the economy.

An important principle of the strategy is that the most appropriate niche for biodiversity-related activities in Eritrea lies within the existing policy framework for sustainable economic development. The NBSAP attempts to place biodiversity policy in the context of the government's major development objectives for the next five years.

Environmental activities already form a prominent part of the Government development policy. Given the limited financial and human resources capacity available in Eritrea, the NBSAP seeks to integrate and co-ordinate these activities to increase their effectiveness for biodiversity conservation, rather than replace or add to them. Biodiversity-related activities must be made compatible with those designed to improve human welfare in Eritrea.

There are many situations where these two goals are complementary and can even be self-reinforcing. The NBSAP focuses on these "win-win" opportunities, plus those interventions which are considered to be essential to meeting the obligations to which Eritrea has committed itself to undertake the Convention on Biological Diversity (CBD), which the State of Eritrea formally approved on 21st March 1996.

The Department of Environment of the Ministry of Land, Water and Environment has been appointed by the Government to be the co-ordinating agency for biodiversity-related activities of the country. However, it is emphasised here that this NBSAP represents a joint commitment by all relevant authorities and agencies within the government, at both national and regional level.

The NBSAP comprises four major parts.

The first part, (Section 2 Country Profile), describes the broad geographic and socio-economic context of Eritrea within which any biodiversity strategy must be positioned. This section provides information on the geography of Eritrea and also on the main socio-economic systems across the country.

The second part, (Section 3 The Status of Biodiversity in Eritrea), documents what is currently known about the distribution and condition of biodiversity across both terrestrial and marine environments. Although Eritrea is not a biodiversity “hotspot”, it does contain a wide range of ecosystem types within a small geographic area. This diversity is an important component of Eritrea’s potential as a tourist destination. At the species level, Eritrea is home to a number of globally rare and endangered species (e.g. African Wild Ass; Nubian Ibex) as well as being part of one of the world’s major centres of crop diversity. These plant genetic resources have the potential to make a major contribution to national and global agriculture.

The third part of the NBSAP (Section 4 Assessment of the National Policy, Legislative and Institutional Framework in view of Environmental Protection and Biodiversity Conservation) reviews the evolving policy, legislative and institutional framework within which conservation and sustainable use of biodiversity must be effected in Eritrea. The policy and legislative framework in Eritrea is still developing since independence; this provides an important opportunity to introduce effective action for biodiversity conservation and sustainable use in an integrated

manner through the entire economy¹.

The fourth, and most important, part of the NBSAP consists of four inter-linked sections which describe the major components of the strategy and action plan.

The first part (Section 5 The Principal Components of the Strategy and Action Plan) describes the programmatic elements of the NBSAP. These elements are described under 10 themes: Integrated management; Sustainable use of natural resources; Alien invasive species; Pollution management; *In-situ* conservation (protected areas); *Ex-situ* conservation; Taxonomic knowledge; Information acquisition and storage; Public awareness and education; Legal and institutional structure (capacity-building).

The final three sections (Section 6: Biodiversity-related Activities for Terrestrial Biodiversity; Section 7: Biodiversity-related Activities for Marine Biodiversity; and Section 8: Biodiversity-related Activities for Agricultural Biodiversity) describe the principal activities which are considered to be essential elements of an effective programme for biodiversity conservation and sustainable use in Eritrea.

A total of 42 activities are described for improving conservation and sustainable use of terrestrial biodiversity. The majority of these are on going activities which would benefit from additional funding – others are new planned activities for which funding has yet to be allocated. Implementation of existing and planned activities would be undertaken by a range of government agencies at national and regional level.

A total of 31 activities are described for improving conservation and sustainable use of marine biodiversity. Biodiversity-related activities in this sector are dominated by the on-going programme of activities being undertaken by the Government of Eritrea as part of the Global Environment Facility-funded Conservation

¹ These three parts of the NBSAP are summaries of information contained in additional, more detailed reports: (i) The Eritrea Biodiversity Stocktaking Assessment Report, (ii) the Eritrea Biodiversity Economic Assessment and (iii) the Assessment of the National Policy, Legislative and Institutional Framework in view of Environmental Protection and Biodiversity Conservation, which are available from the Department of Environment.

Management of Eritrea's Coastal, Marine and Island (CMI) Biodiversity project. Responsibility for implementation of this project lies with the Ministry of Fisheries in close collaboration with other relevant sectors.

A total of 28 activities are described for improving conservation and sustainable use of agricultural biodiversity. Biodiversity-related activities in this sector are closely linked to the vital need to improve agricultural productivity and food security. The judicious use of agro-biodiversity resources can improve the livelihoods of the majority of Eritreans who are still dependent on low-intensity agriculture, while at the same time contributing to the conservation of globally-important plant genetic resources which have been developed over many years by Eritrean farmers.

The activities described in this first National Biodiversity Strategy and Action Plan represent the minimum set of actions considered necessary to ensure that Eritrea's biodiversity is maintained intact and can make a contribution to the economic development of the country for present and future generations. Successful implementation of the strategy will require strong commitment from the highest level of the government and a high level of co-operation and co-ordination between many institutions so that biodiversity conservation and sustainable use becomes integrated into the overall national development.

SECTION 1

INTRODUCTION

1.1 Background and Context

This National Biodiversity Strategy and Action Plan (NBSAP) has been prepared over an extended period from June 1997 until July 2000. As part of the NBSAP process those important assessment reports have also been prepared. These include:- 1. Eritrea Biodiversity Stocktaking Assessment Report and 2. Eritrea Biodiversity Economic Assessment.

The NBSAP presents Eritrea's overall policy position with respect to biodiversity and attempts to place this policy in the context of the government's major development objectives. The NBSAP presented here has adopted a pragmatic approach to what might realistically be achieved over the next 7 - 8 years with respect to biodiversity conservation and sustainable use. The NBSAP builds upon the Government's previous commitment to broader environmental protection, as contained in the 1995 National Environmental Management Plan – Eritrea (NEMP-E). Wherever possible, the activities and interventions recommended in the NBSAP expand and build upon this management plan, especially its Section B.2 (2.5) on Natural Heritage and Biological Diversity.

In addition, the NBSAP includes a range of existing activities already taking place within different sectors. Environmental activities already form a prominent part of the Government development policy – given the limited financial and human resource capacity available, the NBSAP seeks to integrate and co-ordinate these activities to increase their effectiveness for biodiversity conservation, rather than replace or add to them.

Similarly, it is implicit in the NBSAP that the most appropriate niche for biodiversity-related activities in Eritrea is within the existing framework of sustainable economic development. Put simply, biodiversity-related activities must be made compatible with those designed to improve human welfare in Eritrea. Fortunately, there are many situations where these two goals are complementary and even self-reinforcing. The NBSAP focuses on these “win-win” opportunities, plus those interventions which are considered to be essential to meeting the obligations to which Eritrea has committed itself to undertake the Convention on Biological Diversity (see below).

From time to time, this programme of activities can be expanded to suit the changing conditions. This is considered to be a more sensible response to the present situation than creating an over-ambitious wish-list with little practical chance of implementation.

1.2 The Convention on Biological Diversity (CBD)

The State of Eritrea formally approved the Convention on Biological Diversity (CBD) on 21st March 1996. Eritrea has been a participant at recent meetings of the Conference of Parties (COP) and supports international community attempts to reverse the overall global decline of biological diversity through the activities of the CBD.

In 1996, the Eritrean Environmental Agency (EEA) was named as the government institution responsible for co-ordinating Eritrea's activities under the Convention. In 1997, the EEA was restructured as the Department of Environment (DoE) in the newly created Ministry of Land, Water and Environment (MLWE) of the State of Eritrea. The DoE has assumed responsibility for co-ordination of CBD-related activities within Eritrea, although biodiversity-related activities are implemented by a wider range of government and public agencies.

Under the CBD, Eritrea has, like other signatory countries, agreed to a number of specific obligations and opportunities for enhancement of biological diversity conservation and sustainable use¹.

Amongst the obligations are the following:

- preparation of a National Biodiversity Strategy and Action Plan (Article 6);
- identification and monitoring of components of biological diversity important for its conservation and sustainable use (Article 7); and
- preparation of regular reports on measures taken for the implementation of provisions of the Convention (Article 26).

These three obligations form part of a long-term commitment to activities that conserve and promote sustainable use of biodiverse natural resources within member countries.

¹ The full text of the Convention on Biological Diversity may be obtained from the DoE on request.

SECTION 2

COUNTRY PROFILE

2.1 Location

Eritrea, Africa's youngest independent nation, declared its independence on May 24th 1993, two years after the end of a 30- year liberation struggle. It lies in the north-eastern corner of the Horn of Africa, bordered by Sudan to the west, Ethiopia to the south, Djibouti to the south-east, and the Red Sea to the east. The country is defined by borders created in a series of agreements signed between colonial powers and adjacent countries during the period from 1900-1908¹. The total land area is approximately 124,320 km², including over 350 islands².

2.2 Population

The total population of Eritreans is estimated at around 3.5 million, with up to 1 million of these living overseas. The annual population growth rate is estimated at between 2.7 and 3%. The population consists of nine ethnic groups: Tigrigna (50.4%), Tigre (31%), Saho (5%), Afar (5%), Hidareb (2.5%), Bilen (2.1%), Kunama (2%), Nara (1.5%), and Rashaida (0.5%), each with its own language and cultural diversity. The population is approximately 50% Christians (majority Orthodox and minority Roman Catholics plus Protestants) and 50% Muslims. Ethnic, religious and gender parity is a strong element of national government policy – harmony between Christians and Muslims has contributed to the strong national unity within the country.

2.3 Climate and Geography

The highlands have a cool temperate climate while the lowlands are characterised by a hot and humid climate, especially along the coast. Eritrea is in the Saharan rainfall zone and receives its heaviest rains from the south-west monsoons. In normal years, rainfall varies from an annual average of 400 mm to 650 mm in the highlands and from 200 mm to 300 mm in the lowlands. Over half of the total land area is unsuitable or marginal for agriculture due to steep topography or lack of reliable rainfall. A more complete description of the Eco-geography of the country in relation to biodiversity knowledge is provided in Section 3 below and also in the Eritrea Biodiversity Stocktaking Assessment³.

¹ Habtu Ghebre-Ab (1993) Ethiopia and Eritrea : a documentary study. Red Sea Press, Trenton NJ, USA

² DoE(1997) State of the Environment –Eritrea (Pilot Report)

³ Copies of the National Biodiversity Report may be obtained from the DoE.

2.4 Government

The National Constitution, approved and ratified on 23rd May 1997, establishes the National Assembly as “the supreme representative and legislative body of the State of Eritrea” (Article 31) with “a duty to enact an electoral law” to “ensure the representation and participation of the Eritrean people” (Article 30). The first National Assembly was elected in early 1997 and elections are to be conducted every 5 years.

Administratively, the country is divided into six *Zobas*, or regional administrations, which replaced the previous nine administrative provinces (*Awraja*) in 1996. As the country moves towards a decentralised system of government, the zoba administrations are responsible for implementing policies (economic and social) which have been developed in collaboration with the central government.

2.5 Economy

The economy could be described as a regulated free market⁴ – the overall development goal being “the establishment of a dynamic private sector-led market economy” with the role of the government restricted to “maintaining law and order, and sound macroeconomic policies, and to undertaking critical investments in strategic sectors of the economy”⁵

Economic recovery between 1992 and 1998 has increased per capita GDP from below \$150 to around \$190. Agriculture accounts for around 30% of GDP and also a large part of the subsistence economy; the contribution of agriculture to GDP fluctuates widely with the success of each harvest and is highly dependent upon annual rainfall.

Over 70 percent of Eritrea’s people are rural and depend for their livelihood on traditional subsistence agriculture, including crop farming, mixed agro-pastoralism and pure pastoralism. Average family plot size in the highlands is 1-1.5 hectares and around 2-3 ha. in the lowlands. Although up to 3.2 million hectares of land is estimated to have potential for agriculture⁶, only around 14% is cultivated at present (~450,000 ha; the exact figure varies from year to year). Only around 20,000 hectares is under irrigation.

Forestry and fishing currently account for less than 5% of GDP; artisanal fishing also makes a large contribution to the informal subsistence sector of the coastal economy. Historically, the fishing sector peaked in the 1950s at a catch of 25,000 tonnes when there were around 20,000 fisher-folk. Currently, the artisanal sector lands around 700 tonnes per annum; the commercial sector increased to 3,773 tonnes in 1995, but crashed to just 38 tonnes in 1997. The total maximum sustainable yield (MSY) from the Eritrean Red Sea continental shelf area of 52,000 km² is estimated at around 65,000 tonnes (Fisheries Sector Report, 1999).

Eritrea’s industrial base is still extremely narrow and is made up mostly of small- and medium-scale consumer-goods producing industries (food, beverages, leather goods, textiles, etc.)

⁴ Many prices have been deregulated but price controls remain on flour and bread, petroleum products, utility prices, and rents for government houses.

⁵ National Economic Policy Framework and Program, 1998

⁶ This figure is regarded as a very optimistic estimate by some experts.

whose technology is largely out of date as a result of neglect of investment during the long war. Industry and manufacturing accounted for around 25% of GDP in 1995 but production of this sector was increasing by around 50% per annum.

A summary of key physical, economic and social indicators is included in Table 1 below.

Table 1. Selected Physical, Economic and Social Indicators for Eritrea

Parameter	Measure	Unit
Land Area	124,320	km ²
Forested	1	%
Coastline	1900	km
Continental shelf	52,000	km ²
Per capita GDP	160-190	US \$
<u>Social Indicators</u>		
Population	3-3.5	Million
Population Growth Rate	2.7-3.0	% per annum
Rural	70-80	%
Population Density	24-28	per km ²
Crude Birth Rate	47	per 1000
Crude Death Rate	18	per 1000
Life expectancy at birth	46	Years
Total Fertility Rate	6.8	Number of children per child bearing women
Contraceptive prevalence rate	<1	%
<u>Health</u>		
Infant Mortality	135	per 1000 live births
Under 5 mortality	203	per 1000 live births
Under-5s underweight	>41	%
Access to immunisation	27	%
Maternal mortality rate	710	per 100,000 births
Population	28,000	per physician
Population	10,000	per hospital bed

(Table 1. continued) Selected Physical, Economic and Social Indicators for Eritrea

Parameter	Measure	Unit
<u>Water</u>		
Access to safe water	8	%
Access to sanitation services	14	%
Urban population access to sanitation services	44	%
Rural population access to sanitation services	<1	%
<u>Nutrition</u>		
Average daily intake	1,750	calories per capita
<u>Education</u>		
Female literacy rate	10	%
Adult literacy rate	20	%
Primary school enrolment	47.4	% of relevant population
Junior secondary enrolment	22.4	% of relevant population
Secondary school enrolment	13.7	% of relevant population
Pupils (Primary)	37	per teacher
Pupils	68	per textbook
<u>Infrastructure</u>		
Telephone lines	0.37	per 100 inhabitants

Source: World Bank (1996) IDA Country Assistance Strategy Paper (15324-ER)

SECTION 3

THE STATUS OF BIODIVERSITY IN ERITREA¹

The biodiversity of Eritrea may be described conveniently under three core areas:

- the natural terrestrial habitats characteristic of the region;
- the diverse agro-ecosystems which have developed as a result of traditional agricultural activities in the region; and
- the coastal marine and island ecosystems of the Red Sea.

The status of biodiversity across these three core areas is not known precisely at present. It is clear that throughout the 20th century, growing human influence, amplified by war and drought², has placed increasing pressure on the natural terrestrial biodiversity of the country. Similarly, the agro-biodiversity associated with indigenous, traditional farming systems has been disrupted severely by the same forces. By contrast, the marine ecosystems of the Eritrean Red Sea region have been much less affected by these pressures and are ecologically relatively intact.

Although the long-term trend in biodiversity status in Eritrea over this century has been negative, there are encouraging signs of improvement over the recent past decade. Between 1991 and 1998, the overall status of wild terrestrial biodiversity in Eritrea has improved, albeit from rather poor initial condition. This improvement has resulted from the cessation of armed conflict, the war of independence that lasted for 30 years, and a sequence of relatively good years of rainfall. This period of stability has allowed both natural habitat and agricultural systems to recover from their degraded state³. The period of relative stability and good rainfall has also contributed to the success of efforts to intensify agricultural production, increasing the (man-made) threat to some agro-biodiversity. In the marine sector, the increase in economic activity has proceeded fairly slowly and threats to marine biodiversity are still relatively localised (e.g. pollution impacts around Massawa and Asseb).

During the same time period (1990-99), empirical knowledge about biodiversity in Eritrea has increased, but from a very low baseline level. Thirty years of institutional neglect during the liberation struggle left Eritrea with few trained botanists, zoologists, ecologists, etc. who have the skills required to document biodiversity in detail. In spite of this limitation, Eritrea has made some progress towards establishing an information base upon which rational biodiversity planning can begin. The sections below, derived mostly from reports compiled during the NBSAP process, summarise this growing knowledge.

¹ A full report of the status of biodiversity in Eritrea can be found in the National Biodiversity Stocktaking Assessment Report, available from the DoE.

² There was widespread drought in much of Eritrea during the 1940's, 1960's and 1970s; few data are available for 1980-1990; since 1990, more complete records have been maintained.

³ The border conflict with Ethiopia could have reversed this trend in the conflict zones and its immediate environs.

3.1 Terrestrial Biodiversity

Terrestrial biodiversity is defined here as the natural biological systems occupying the land area of Eritrea, excluding the marine systems and also the biodiversity associated with agricultural systems. Obviously, there is a good deal of overlap between these systems, especially with regard to extensive rangeland and the coastal plains and islands of the Red Sea.

3.1.1 Terrestrial Biodiversity at the Ecosystem Level

Few studies of ecosystem biodiversity (*sensu stricto*) have been completed in Eritrea but a number of national land use classifications have been developed. Eco-geographical, agro-ecological, and vegetation cover classifications have been produced at coarse scales. These classifications capture the main regional ecological variations within the country but provide little detailed information about the species diversity, which exists within these regions. In almost all cases, the level of ecological/biodiversity information about particular ecosystems and habitats (e.g. *Juniperus* forest, riverine forest, coral reefs, traditional farming systems) is incomplete and in many cases historical and unlikely to reflect the current situation.

The Department of Land in the Ministry of Land, Water and Environment has classified Eritrea into 6 agro-ecological zones on the basis of altitude, temperature and rainfall regime and other agricultural factors (see Figure 1). These zones correspond broadly with the ecological zones produced by FAO (1997) from aggregate Normalised Difference Vegetation Index (NDVI) data derived from NOAA-AVHRR satellite images (see Figure 2). The agro-ecological zones clearly demonstrate the over-riding influence of available water on vegetation productivity. The latter is likely to correlate strongly with overall biodiversity richness, although it is likely that each agro-ecological zone will contain some plant and/or animal species/varieties not found in any other zone. This means that full biodiversity conservation will require that a minimum area of natural habitat is maintained under natural conditions in each agro-ecological zone. Fortunately, the six agro-ecological zones correlate, to a reasonable extent, with the six new regional administrative boundaries. Regional implementation of a national biodiversity conservation policy could provide an effective mechanism for ensuring that the maximum amount of diversity is maintained as efficiently as possible.

Figure 1: Agro-ecological Zone Map (1998)

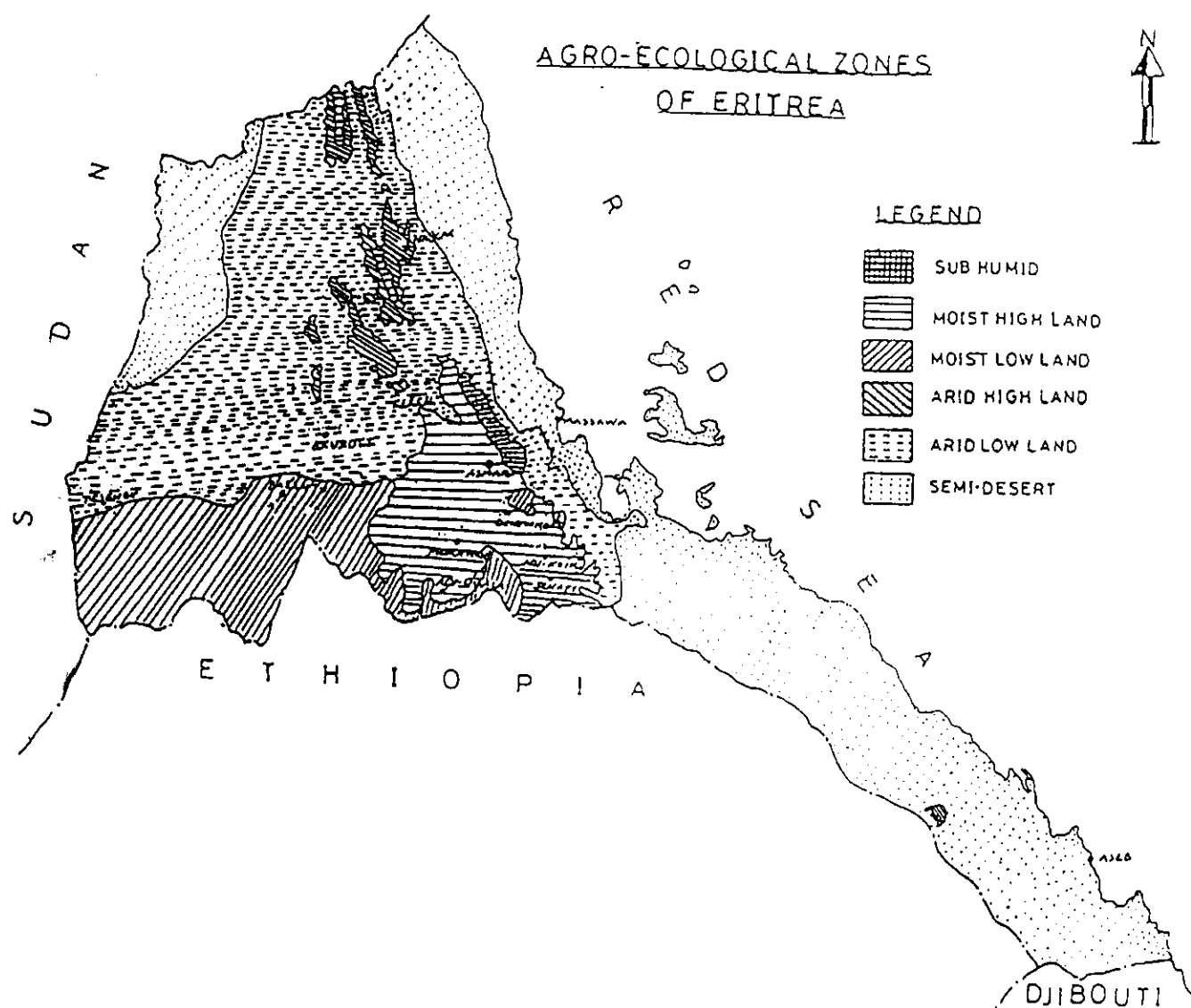
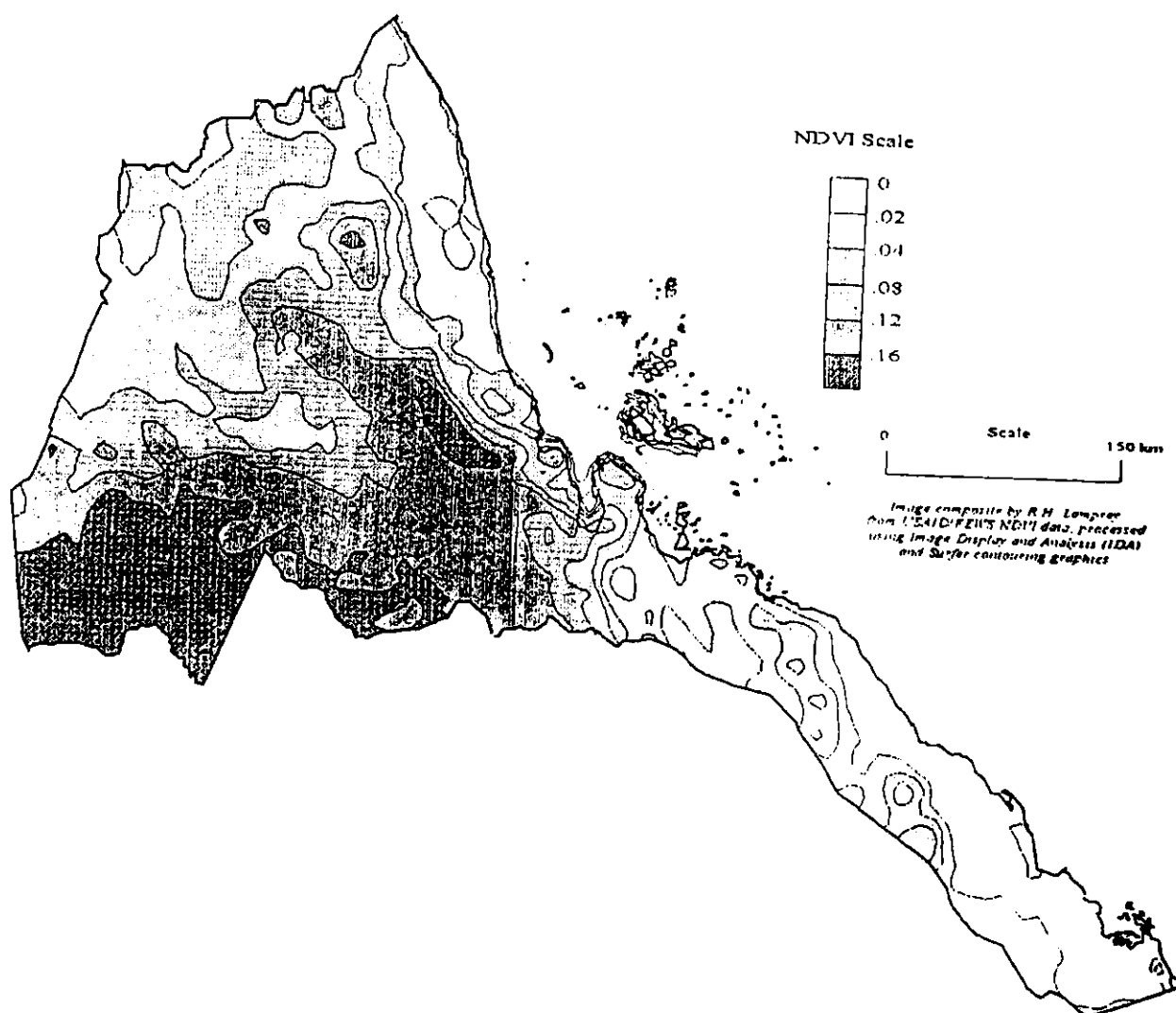


Figure 2: NDVI Vegetation Production Map of Eritrea



Currently, Eritrea has no formal protected areas, which are legally gazetted, although a number of potential locations have been identified and partially surveyed. It is unlikely that more detailed biodiversity information will change these priorities, although additional locations may be identified. The absence of formal protected areas does not mean that land is not being conserved in Eritrea. Up to 1999, around 192,734 ha⁴ of land has been placed under partial or complete closure (i.e. protection from human utilisation for fuelwood/grazing) through joint agreements between local communities and the Ministry of Agriculture. Although much of the land was placed under enclosure, because it was degraded to some extent, it still represents a significant area of potentially valuable land for biodiversity conservation – many closures are showing clear signs of increase in vegetation cover, but their biodiversity status is not being adequately monitored at present.

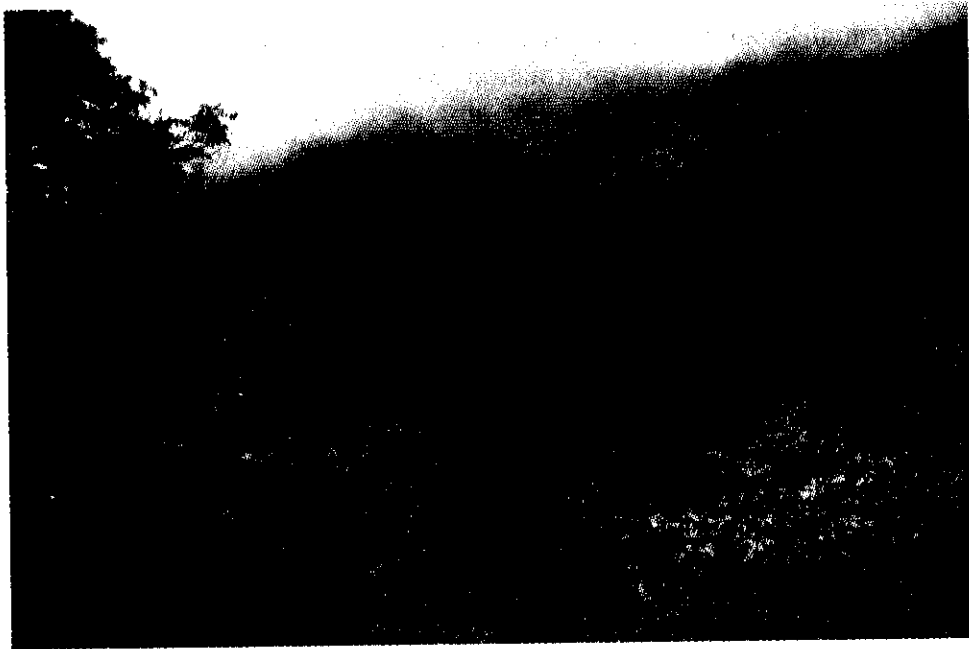
At this time, the status of natural terrestrial ecosystem biodiversity in Eritrea can be summarised conveniently under three broad categories:

Low biodiversity, but stable: Much land in Eritrea, for example, most of Agro-ecological zones namely Arid Highland, Arid Lowland and Semi-desert (see Fig 1), currently has very low human population density and use. This situation is likely to remain the same for the near future at least and the biodiversity status of such regions can be considered to be relatively stable. These areas are quite similar ecologically and mostly low in terms of biodiversity richness, although they may contain interesting and important endemic species in particular places (see below). The major threats to biodiversity in these areas are drought, fire and overgrazing.

Moderate biodiversity and threatened: The land in Agro-ecological zones namely Sub-humid, Moist Highland and Moist Lowland has a higher overall level of biodiversity due to increased rainfall. This higher potential productivity also makes the land more suitable for agriculture and thus for associated human habitation and the additional pressures which this brings. In these areas, the potential for conflict between biodiversity conservation and sustainable use and conversion to alternative uses is high. Careful planning and strong management will be required to avoid unnecessary loss of biodiversity. All of the key “pressure-point” locations identified in this NBSAP belong to this category.

Degraded land: Land of this type may be found in most agro-ecological zones, but degraded land within zones namely Sub-humid, Moist Highland and Moist Lowland is the most significant from a biodiversity perspective. Degraded land in these zones is likely to continue to lose its remaining biodiversity if it is left unmanaged. Active intervention of some kind is required to restore this land to a self-sustaining, ecologically useful condition (either as natural habitat or as productive land for agriculture).

⁴ Area estimate provided by MoA: March 2000



Northern Eastern Escarpment: Part of the remaining ever green forest of Eritrea



Regeneration of vegetative cover under closure system



Conservation of degraded land through terracing and other types of structures

3.1.2 Terrestrial Biodiversity at the Species Level

As with terrestrial ecosystem diversity, knowledge of the status of individual terrestrial species is incomplete and in need of improvement before it can be used for realistic biodiversity planning. Although national lists have been compiled, these are mostly historical and recent records are few and insufficient to provide clear data on present-day distributions of species. A brief summary of these data is provided below. [Note: For animals below the vertebrate level, data are almost non-existent].

Mammals: A total of 126 mammal species have been listed in a recent compilation of existing information. This total includes 9 marine mammal species known to occur in Eritrean territorial waters, but excludes 9 domesticated mammals (sheep, goat, cow, pig, horse, donkey, camel, plus cat and dog). The population status of most of these wild species is poorly known at present, but has been ranked in 6 categories (Critical [Extinct], Critical, Endangered, Rare, Common, or of Unknown Status). This rapid assessment was undertaken by the staff of the Forestry and Wildlife Division (FWD) of the Ministry of Agriculture (MOA), with the aim of identifying needs for improving knowledge of terrestrial wildlife. The status categories simply reflect observation status and do not reflect any direct assessment of threat. The summary results are given below.

Table 2. Assessment of population status of Eritrean mammals (April 1999)

Status category	Definition	Number of species
Critical (E)	Not reliably recorded since 1990 and certainly, or almost certainly, extinct in Eritrea	9
Critical	Not reliably recorded since 1990 but known from anecdotal (second-hand) evidence	9
Endangered	Known from less than 10 sighting and/or from less than 3 separate locations since 1990	13
Rare	Known from between 10 and 50 sighting and/or from between 3 and 10 separate locations since 1990	11
Common	Known from more than 50 sighting and/or from more than 10 separate locations since 1990	20
Unknown status	Not identifiable due to nocturnal habit, small size, lack of identification features, etc.	64*
Total		126

*This total includes three species (Brown and Black Rat and Domestic Mouse) which are common, but not seen "in the field" by wildlife staff.

Table 2 demonstrates the crucial need for simple investment in improving baseline biodiversity data. Over 50% of mammal species cannot be ranked for status due to lack of knowledge. Only 20 taxa can be considered to be secure in conservation terms. The rest must be considered threatened until further survey work is completed.

Of the seventeen mammal taxa (species/sub-species) listed in 1997 IUCN Red List of Endangered Animals, which appear on the Eritrean checklist, only the Eritrean sub-species of the warthog (*Phacochoerus africanus aeliana*), Soemmerring's Gazelle (*Gazella soemmerringi*) and Dugong (*Dugong dugon*) can be ranked as Common in Eritrea using the criteria above. Four species / subspecies, Gelada (*Theropithecus gelada*), Ethiopian Wolf (*Canis simienseis ruppell*), Walia Ibex (*Capra walie*), Black Rhinoceros (*Diceros bicornis*) are certainly extinct in Eritrea. Two species / subspecies, African Wild Dog (*Lycaon pictus*), Lion (*Panthera leo*) are considered Critical, probably extinct. Three, Hartebeest (*Alcelaphus buselaphus*), Red-fronted gazelle (*Gazella rufifrons*), Nubian Ibex (*Capra ibex nubiana*) are considered Endangered; and two, Elephant (*Loxodonta africana*), African Wild Ass (*Equus africanus*) are considered Rare. Three bat species are of unknown status in Eritrea.

It is also clear that a number of mammals, notably elephant, wild ass, greater kudu, and civet, are in danger of national extinction unless specific measures are put in place to protect them in the short-term.



African Wild Ass: one of the critically endangered species of Eritrea.

This is found in the Northern Red Sea Zone

Birds: A total of 577 bird species are listed in the latest national checklist⁵. This list is a compilation of all known records, some dating back to before 1900. Of the total of 577 species, around 320 are resident, of which about 50% have historical breeding records. Around 150 are Palearctic migrants moving south from Europe to Africa; of these, around 40 species are recorded as breeding in Eritrea. Around 45 are intra-African migrants, a few of which are thought to breed in Eritrea. The remainder are either vagrants or of unclear/unknown status.

Of this possible total of 577, only around 50% have one or more reliable recent sightings (since 1990). This demonstrates the weakness of baseline biodiversity information survey for birds in Eritrea. Some of the "missing" species may be (nationally) extinct; some may be present but truly rare, or vagrants not likely to be observed very often; some may have been mis-identifications.

Eritrea has no known national endemic bird species, but does share up to 13 "regional endemics" with Ethiopia alone. These are unrecorded since 1990 except a flock of about 10 Black-winged Lovebirds recorded at Melezanei in 1997 and two (separate) observations of Golden-backed Woodpeckers at Mai Aini and Segeneyti in 1998 (Dietmar Zinner; field observations). All 13 regional endemic species are recorded

⁵ The full checklist is contained in the National Biodiversity Stocktaking Assessment Report available from the DoE.

(historically) from the open upland country around Senafe, an area which has not been prioritised for protected area status. A further significant observation was of 5 Bald (Waldrapp's) Ibis near Massawa in February 1997 (Information from Chris Bowden, RSPB, UK; observation by Charles Dewhurst).



Ostrich: Commonly found in the Eastern Lowlands of Eritrea

Reptiles and Amphibians: Knowledge of biodiversity of reptiles and amphibians is extremely weak. A recent checklist has dramatically improved the historical knowledge-base but recent information is still almost non-existent. A total of 90 reptiles and 19 amphibian species have been recorded for Eritrea - this is almost certainly an underestimate because species which are common and widespread elsewhere in the Horn of Africa do not appear on the Eritrean list. On the other hand, many of the species on the list have been collected only a few times and may well be extinct from Eritrea. There are two possible endemic reptiles and one possible endemic amphibian on the list.

Flora: Although historically, plant biodiversity in Eritrea has been relatively well documented, much of this information is only available outside of Eritrea (notably in Ethiopia and Italy). Within Eritrea today, plant biodiversity is under-collected and under-studied. The regional Flora of Ethiopia and Eritrea⁶ is still incomplete (only four volumes from a projected total of eight are available) and no national plant checklist exists. A number of regional vegetation descriptions exist and are summarised in the Eritrea Biodiversity Stocktaking Assessment Report. In the absence of a national checklist, a

⁶ Flora of Ethiopia and Eritrea; Volume 2 (Part2): Canellaceae to Euphorbiaceae (26 families); Volume 3: Pittosporaceae to Araliaceae (44 families); Volume 6: Volume 7: Poaceae (Gramineae) (600spp.). Addis Ababa, Ethiopia/Uppsala, Sweden.

number of site-specific checklists are included in this report - one list of almost 700 species indicates that considerable plant diversity may persist in human-altered landscapes. A total of 33 tree species have been listed as endangered by the (FWD) of the MoA, but the quantitative basis for this status is not clearly documented.

Other taxa: For all other taxa (e.g. invertebrates and microbes), the level of knowledge of diversity makes compilation of national checklists impossible. There are a few collections of insect, plant and microbe agricultural pests at the Department of Agricultural Research (MOA) and at the University of Asmara; a list of agricultural weeds and insect pests is provided in the Eritrea Biodiversity Stocktaking Assessment Report. This is one of the major gaps to be filled by the relevant institutions in the future.

3.2 Marine Biodiversity

The Eritrean marine and coastal zone is situated in the southern sector of the Red Sea. The Red Sea is an almost enclosed, hot, saline body of water which harbours a flora and fauna partially isolated from the Indo-Pacific Ocean at some time in the last 10-20,000 years. The diversity of the Red Sea is a sub-set of that found in the Indo-Pacific Region, and is beginning to show signs of divergence following isolation, especially amongst the 1248 spp. of fish.

The Eritrean coastal plains are hot, dry and sparsely inhabited. This has contributed to the survival of a relatively pristine coastal and marine environment, of which the coral reefs and their associated fish assemblages represent the most diverse ecosystems in Eritrea. Over 100 birds, 500 fishes and 44 genera of hard corals have been recorded by recent surveys. In addition, the Eritrean coast is inhabited by up to 5 marine turtles, 8 or more cetaceans and the dugong - almost all of these species are of conservation concern globally.

Additional surveys are required to fully establish which of the many mainland coastal and island sites would be the best suited for protected area status⁷, but this should be decided before, or in parallel with, any increase in the levels of coral reef- based tourism. The number of coral reef sites of exceptional quality for dive tourism appears to be fairly limited - much of the Eritrea's reef is affected by natural turbidity, sedimentation and storm damage.

Increases in commercial fishing activity, oil and gas production offshore and pollution from onshore industry and urban waste flows all represent potential threats to marine biodiversity. The BSAP process should co-ordinate with the current GEF/MoF project "Conservation management of Eritrea's coastal, marine and island biodiversity", to ensure that appropriate safeguards are put in place to protect a natural resource with great conservation value and significant sustainable revenue-earning potential.

⁷ Three sites have been prioritised for protected area status and conservation management under the GEF/MoF project "Conservation management of Eritrea's coastal, marine and island biodiversity".



Biodiversity in the Eritrean waters of the Red Sea



Schools: Species of fish in large groups in the Eritrean waters of the Red Sea



Butterfly Fish in healthy coral ecosystem of the Eritrean waters of the Red Sea



Mangroves: Source of food and shelter for marine organisms and birds

3.3 Agricultural Biodiversity:

Agricultural biodiversity is defined as the variability among living organisms associated with agriculture: these include plants (utilised as food/feed, industrial, spices, medicinal, etc.), the wild relatives of these plants, animals, weeds and microbial. The diversity exists between species and within species in a given ecosystem.

Eritrea possesses highly variable agro-climatic condition with elevations ranging from below sea level to about 2600 m. and temperature from semi-desert hot to warm, mild to temperate. There are two rainy seasons, one between June and September covering the greatest part of the country and the other from November to March covering the eastern and southern escarpment and the coastal zone. These climatic and geographic variations create favourable conditions for the growth of different cultivated crop plants. Peasant farmers, who follow traditional farming systems for centuries, have passed on the genetic diversity of these crops from generation to generation. Thus, a considerable amount of agricultural biodiversity is still being conserved *in-situ*. The importance of genetic diversity in the increase of agricultural production need not be overemphasised.

Peasant farmers, who practice traditional farming systems, for centuries, have conserved landrace genetic materials *in-situ* and a considerable amount of it is still present. Of course, especially during the last 50 years due to artificial and natural calamities (war, drought and pests) plants, animals and ecosystems have been seriously affected by genetic erosion. Currently, to increase production for food self-sufficiency, the government started to implement new farming system (Integrated Farming System - Tumur Hirsha) since 1997 and appropriate measures should be taken to prevent agro-biodiversity decline. Thus, the present capacity of *ex-situ* storage of crop genetic resources must be strengthened and supplemented by a strong *in-situ* conservation program through appropriate projects.

N.I. Vavilov visited the northern highlands of Ethiopia, including Eritrea, in 1927. His writing confirmed these areas as one of the Vavilovian centres of diversity for a number of crops. These include, among others, barley, emmer, other tetraploid wheat, oats, flux, safflower, chickpea, lentil, grass pea, pea, horse bean, rape and mustard⁸.

Taff and noog are believed to be Abyssinian domesticates⁹, which include mainly the highlands of Ethiopia and Eritrea. A wild progenitor of cultivated taff known as *E. pilosa* is found in Eritrea, and other wild species could also exist in Eritrea. Although noog used to be grown widely in the central highlands of Eritrea in the past, its cultivation has now diminished quite significantly.

Eritrea is one of the possible areas of domestication for cultivated sorghum, the major crop in the country. The north east quadrant of Africa below the Sahara in the Ethiopia-Sudan region, which definitely includes Eritrea, is the region where the greatest variation of the genus *Sorghum* is found¹⁰, and this strongly implies that Eritrea is a possible centre of origin for cultivated sorghum.

⁸ Harlan, J. (1969). Economic Botany 23, pp.309-313

⁹ Et al

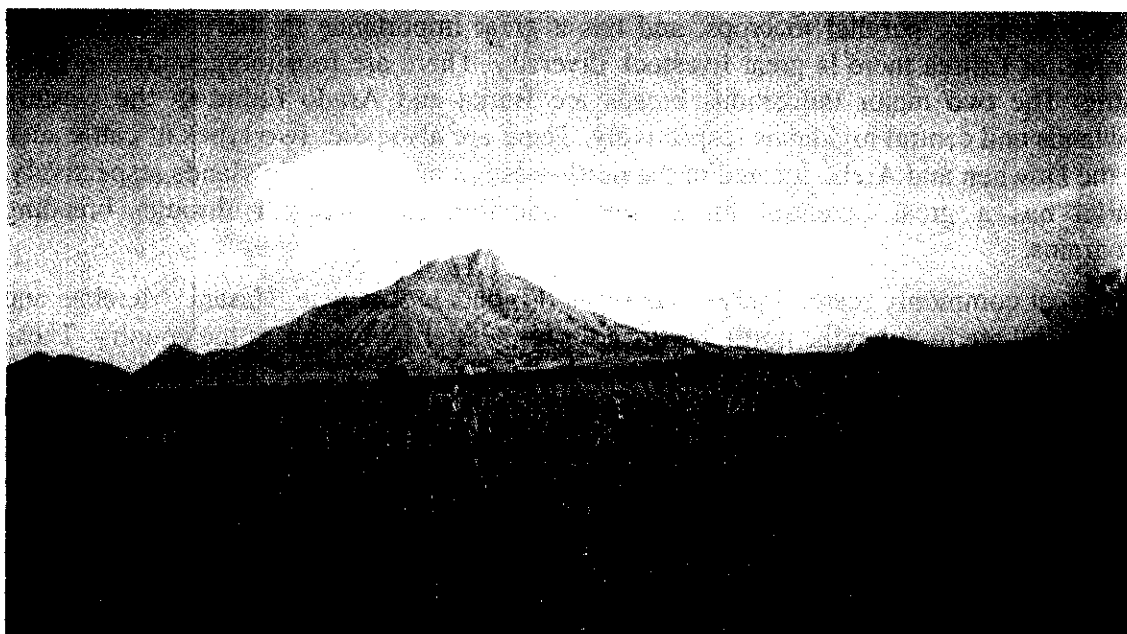
¹⁰ Dogget, H. (1988). Sorghum, 2 ed., Longman Scientific and Technical.

Work on the collection and conservation of crop species in Eritrea started in 1905 with the start of some research activities at the Agricultural Research Station at Paradiso in Asmara¹¹. Thereafter, information has also been documented for important cereals as indicated below:-

- A monograph of cereals collected in Eritrea¹².
- Classification of wheat varieties collected in Eritrea and Ethiopia¹³.
- Classification of taff¹⁴.
- Classification of barley¹⁵.
- Studies on various food crops and other plants of economic importance grown in

Eritrea in research stations and observation sites between 1905 - 1938¹⁶.

After independence, the Government of Eritrea initiated the establishment of a Plant Gene Bank, administered under the Ministry of Agriculture, for the collection and documentation of local Eritrean landraces. The Gene Bank now holds more than 1200 accessions of cereals, legumes and oil crops.



Sorghum: The most diverse cereal crop in Eritrea

¹¹ Brudi, G. (editor), 1947. Rome. Istituto Agricolo Coloniale Firenze "L'agricoltura nella colonia Eritrea e l'opera dell'Italia."

¹² Chiovenda, E., 1912. La collezione dei cereali della Colonia Eritrea. Monogr. e Rapp. Colon. Roma.

¹³ Vavilov, N.I., 1929. Wheats of Ethiopia. Bulletin of applied Botany, Genetics and Plant Breeding. 20: 224-356.

¹⁴ Ciferri, R. and Baldrati, I. 1939. I cereali dell'Africa Italiana II "Teff" (Eragrostis teff). Firenze, 1939 - XVIII.

¹⁵ Ciferri, R., 1940. Saggio di classificazione degli orzi con speciale riguardo a quelli Etiopici. Firenze, Italia. 29 Ottobre 1940 - XIX.

¹⁶ Baldrati, I., 1950. Trattato delle Coltivazioni tropicali e subtropicali pp. 1-615. Editore, Ulrico Hoepli, Milano, 1950.



Wheat: Commonly grown in the highlands of Eritrea

Livestock:- The production system of subsistence farmers is mostly agro-pastoralism and mixed farming , parallel to crops, and has a great importance in the economy of the people. In Eritrea there is great livestock diversity. There are four indigenous breeds of cattle. The two major indigenous breeds are Barka and Arado found in the western lowlands and central highlands respectively. There are also other two types of cattle such as the Dowhen and Arebo located in the north-western and eastern lowlands respectively. Barka has a great potential for future production improvement through breeding programs.

The most commonly reared indigenous types of goats are Langae, Hasani, Merebae and Habab. All are found in the north, north and south western lowlands of the country. These are famous for their high milk yield, which ranges from 1.5 to 2.5 litres per day. There are also many types of indigenous sheep. Some of them are Gerej, and Dereshawit, both found in the north eastern part of Gash-Barka region; Hamale, found in the Northern Red Sea region and the Shmejana sheep are found in the southern region of the country. There are two types of donkeys, the lowland donkey (Rifa'i) and the highland donkey. Mules and horses are confined to the central highlands. The widely known camel types are the Ariri, Arho and Rashaidi. They are distributed in the Gash-Barka, Anseba and Northern and Southern Red Sea regions.

Poultry production and bee keeping are important livestock production activities. The local poultry breeds are non-descript where feather colours, body sizes and productivity are varied. However, adequate knowledge about the types of bird varieties that exist in the country is not well established. Although the local birds are not high yielding, they could be improved through breeding with exotic varieties and better management practices. It is estimated that there are 1.13 million indigenous poultry population in the country.

Bee keeping is also a very important activity. Bee colonies are mainly found in the central highlands and in the eastern and western escarpments; bees are managed mostly under traditional system but modern hives are being introduced in order to improve the quality and quantity of honey and wax production. No work has been done so far to gather information about the types of bee that exist in the country. From a biodiversity point of view, this is an important task to be carried out in the future. Bees are important not only for the production of honey and wax but also ecologically important in the transfer of pollen between plants.

At present, the diversity of indigenous livestock species is relatively intact - all breeds are still widely distributed, population numbers are increasing and the rate of introduction of improved stock from overseas is low. However, there is a need to characterise the indigenous breeds more clearly as part of the national livestock improvement program in order to guarantee that the best characters of the different varieties can be sustained for future breeding work.



Dowhen Cattle: Common breed in the north western and eastern lowlands of Eritrea



Deresh Sheep: Common types
in North-Eastern part of Gash Barka Zone

Nara Sheep: Common types
in the Gash Barka Zone



Ariri Camel: Common in Gash-Barka Zone of Eritrea

SECTION 4

ASSESSMENT OF THE NATIONAL POLICY, LEGISLATIVE AND INSTITUTIONAL FRAMEWORK IN VIEW OF ENVIRONMENTAL PROTECTION AND BIODIVERSITY CONSERVATION

A detailed assessment of the present policy, legislative and institutional framework for overall environmental protection, and biodiversity conservation and sustainable use in particular, is provided in a separate report: “Assessment of the National Policy, Legislative and Institutional Framework and its Implications for Biodiversity Conservation and Sustainable Use”, which was prepared as part of the National Biodiversity Strategy and Action Plan. This report is summarised below.

4.1 National Constitution

The National Constitution of the State of Eritrea was ratified on 23 May 1997. Article 6 states that “unity in diversity” is a basic principle guiding national development objectives. Article 8 mandates the State to work for sustainable development and to “manage land, air, water and natural resources in a balanced and sustainable manner” and to “secure the participation of the people in safeguarding the environment”. The Constitution thus provides the foundation for a national development policy based on sustainable principles and the maintenance of diversity.

4.2 National Development Policy

The National Development Plan of the State of Eritrea has recently been revised and updated as the National Economic Policy Framework and Program (NEPFAP), covering the period 1998 - 2000. NEPFAP provides a framework for implementation of the Macro-Policy Statement of November 1994 ¹ and contains many statements which influence biodiversity conservation and sustainable use.

The NEPFAP is clear in its major development policy. This is:

- “to rebuild the war-ravaged economy”; by
- “establishing the legal, social and institutional framework required for achieving rapid economic, social, cultural and political development”; with
- “a strong focus on developing human capital internally and through the return of Eritreans currently residing overseas”; thus
- “creating an enabling policy environment for private sector development to generate a private sector-led market economy”. (Source : adapted from NEPFAP; Page 1-2; 11).

¹ The Macro-Policy Statement was the most important statement guiding national development between 1994-1998

Environmental policy and biodiversity conservation and sustainable utilisation must work in harmony with this overall development policy. The NEPFAP itself contains a number of strong statements about environmental policy, notably the following:

- ***“restoration, enhancement, and preservation of Eritrea's ecological integrity”***.

This objective is to be achieved through:

- *“prudent utilisation of land, forest, air and water resources;*
- *establishment of sound environmental standards;;*
- *introduction of sustainable land management practices;*
- *adoption and implementation of a comprehensive national environmental policy framework;*
- *sustainable exploitation of Eritrea's fishery resources; and*
- *monitoring and protection of Eritrea's Red Sea coastline”*.

The newly-established Ministry of Land, Water and Environment, *“in collaboration with other relevant agencies of government and the private sector”*, is identified as taking a leading role in *“protecting, restoring and enhancing the environment”*, also with *“developing standards, and taking steps to ensure that environmentally sustainable practices are pursued in Eritrea's economic endeavours”*.

(Source: NEPFAP, adapted from page 33-37).

NEPFAP also lays out the policy objectives and strategy for the main economic sectors, including agriculture, fisheries, manufacturing, energy and mining, tourism, infrastructure, health and education.

4.3 Implications of the National Development Policy for biodiversity conservation and sustainable use

Achieving the multiple objectives set out in NEPFAP represents a major challenge to the government, the private sector and the people of Eritrea. In many other countries, rapid economic growth has, historically, been incompatible with *“restoration, enhancement and preservation of ecological integrity”*, for the simple reason that economic growth has been achieved through the unsustainable exploitation of natural resources and a decline in overall environmental quality, especially biodiversity.

For this not to happen in Eritrea, practical mechanisms must be found to resolve the potential conflict between pure expansion of the economy and a more balanced form of social and economic development, thus ensuring a pathway towards sustainability. Each of the different sectors of the economy has the potential to have either positive or

negative impacts on biodiversity and sustainable use through the implementation of their development program. The majority of the sectors have stated, explicitly or implicitly, that environmental protection will be a part of their development program. But, achieving economic expansion and environmental protection at the same time will be a difficult challenge, requiring extensive consultation and collaboration between different sectors. The NBSAP, if implemented properly, can provide a framework for achieving this reconciliation.

4.4 Legislative framework for biodiversity conservation and sustainable use

At independence, all Ethiopian and other residual legislation was repealed. This created a legislative “vacuum” which the Government has been working to fill. The legislative framework for the State of Eritrea is in a process of rapid development. In the interim period, different government sectors are operating on the basis of (temporary) Legal Notices, Directives and Regulations, whilst working to prepare their formal legislation (Proclamations). A remarkable feature of the social cohesion of the country at present is that, even in the absence of formal legislation, hunting, poaching, unauthorised cutting of trees, etc. are not serious threats to biodiversity in most parts of the country.

At present, there is no formal environmental legislation for Eritrea – an Environment Proclamation is in preparation by the Department of Environment. Previous draft forms of the Environment Proclamation and a Biodiversity Proclamation have been subjected to further in depth review.

The absence of formal environmental legislation does not mean that the environment, including biodiversity, has no legal status. Recently promulgated legislation for other sectors contains a number of key articles, which have the potential to provide strong protection for the environment and biodiversity. These are summarised briefly here, in chronological order of gazettment.

Proclamation to Reform the System of Land Tenure in Eritrea, to Determine the Manner of Expropriating Land for Purposes of Development and National Reconstruction, and to Determine the Powers and Duties of the Land Commission No.58/1994

This proclamation defines the Government’s ownership of all land, with only usufructary rights for individuals. This gives the Government great power to use land in ways which can have positive or negative impacts on biodiversity. Under Article 50 of this proclamation, the Government can appropriate land for “*forestry and animal conservation projects*”, amongst others. There have been long delays in implementing this proclamation, which has the potential to improve land management with respect to biodiversity by eliminating the traditional *diesa* land management system that does not encourage tree planting and maintenance.

Proclamation to Promote the Development of Mineral Resources No. 68/1995

This Proclamation, in association with the Regulations of Mining Operations (Legal Notice 19/1995), provides the framework for the development of both commercial and artisanal mining in Eritrea; this includes extraction of mineral waters, brine and geothermal energy.

The legislation lays out some general requirements for environmental management and protection which, if fully implemented and enforced, would ensure that mining operations do not have unnecessary negative impacts on biodiversity. The legislation is, however, only as strong as compliance and enforcement allow it to be. In addition the legislation contains exemption clauses which effectively make all environmental protection subject to decisions of the Licensing Authority.

Regulations on Petroleum Operations Legal Notice No. 24/1995

These Regulations lay down the framework for development of the petroleum industry in Eritrea. Environmental protection is covered comprehensively in Article 11: Environment, Pollution Control and Safety Measures. This legislation has the potential to provide strong protection of the environment if well implemented. One potential weakness of the legislation, from a biodiversity perspective, is the lack of an explicit requirement of regular reporting of biodiversity monitoring data, which could be used to monitor environmental performance.

Proclamation 72/1995: A Proclamation to Provide for the Control of the Business Licensing System and for the Establishment of a Business Licensing Office.

This legislation creates a framework for regulation of the growing small-scale business sector in Eritrea and gives a wide range of powers to different "competent regulatory authorities". The main role of the Business Licensing Office (BLO) is to act as "clearing house" for license applications. The distribution of National Environmental Assessment Procedures and Guidelines by the Ministry of Land Water and Environment in June 1999 requires the acquisition of environmental clearance by project owners, without which the BLO is not expected to issue business licenses. From a biodiversity perspective, threats might arise from location of businesses in relatively biodiverse habitat, or from unsustainable utilisation of natural resources.

Proclamation for the Establishment of Local Governments No. 86/1996

This Proclamation is an important part of the Government's policy of regional decentralisation of administration and, more importantly, control and implementation of development policy; this has major implications for biodiversity conservation and sustainable use.

This Proclamation lays down clear responsibilities for environmental protection at the regional level and highlights the need to ensure that any policy for biodiversity conservation and sustainable use is implemented at the same level of decentralisation as the rest of the national development program.

The Press Proclamation No 90/1996

The Press Proclamation provides a legal framework for freedom of information within Eritrea. There are a number of restraints however, which seem to require that the majority of information about biodiversity, and the environment in general, be generated and disseminated by Eritrean-owned private businesses, or through Government agencies, with the Ministry of Information playing an important supervisory role. The Ministry of Information has the potential to be a major facilitator of the dissemination of biodiversity-related information and those sectors concerned with biodiversity conservation and sustainable use should work closely with this Ministry.

Fisheries Proclamation No 104/1998

The legislation covering the fisheries sector comprises two Proclamations and five Legal Notices (Regulations), all promulgated in May 1998. These laws provide comprehensive coverage of the marine sector in Eritrea and contain a number of Articles relevant to biodiversity conservation and sustainable use. From a biodiversity perspective, the legislation covering the fisheries sector is quite comprehensive. The largest potential weaknesses lie in the lack of clarity with regard to integration of the responsibilities of the Ministry of Fisheries with other government sectors in sustainable coastal management. This could lead to some problems of co-ordination and also restrict ability to respond to broader sectoral interests.

This weakness could be reduced if the composition of the Fisheries Advisory Council were broadened, at least to include the Ministry of Land, Water and Environment. In addition, the mechanism for the creation of protected species and protected areas is not described fully – without a formal procedure, this part of the legislation may be difficult to put into practice.

Draft Legislation

At present, there are only draft laws for the water sector, the forest and wildlife sector and the environment. Until these laws are promulgated, biodiversity conservation in Eritrea may be critically weak – finalisation of these laws and their promulgation must be a priority for the relevant sectors.

SECTION 5

THE PRINCIPAL COMPONENTS OF THE STRATEGY AND ACTION PLAN

As described above in Section 3, the NBSAP process has been undertaken mostly within three core areas (Terrestrial, Marine and Agricultural biodiversity). This reflects the need to fit with the existing institutional structure; however, careful attention has been paid to those issues which cut across different core areas.

The principal components of the National Biodiversity Strategy and Action Plan are the statements that comprise the Goal, Objectives, Strategic Elements and Actions of the Plan. These statements form an internally consistent, closely linked hierarchy that creates a logical pathway from high-level principles to activities on the ground.

Table 3. The hierarchy of terms used for the National Biodiversity Strategy and Action Plan

Term	Definition	Example
Goal	Ultimate end point - where we want to be but not easily measured	Conservation of Eritrea's biological diversity improved
Objective	A sub-set of the overall goal, restricted to a defined more easily quantified end-point	100 ha of degraded land rehabilitated for use as conservation area
Strategy	A broad level description of the mechanism by which an objective is achieved	Planting of indigenous tree seedlings in named closure areas
Activities	The individual steps which have to be taken to implement a strategy	Establish nursery, germinate seedlings; plant out; employ teams for planting and watering

5.1 Goal

The overall goal of the Eritrean National Biodiversity Strategy and Action Plan is as follows:

“The overall biodiversity of Eritrea restored, conserved and managed so that it provides environmental services and natural resources that contribute to sustainable and socially-fair national economic development”.

The goal makes clear the “desired endpoint” of the NBSAP following implementation, and reflects three major elements of the overall environmental situation in Eritrea which merit special mention:

- the need for environmental recovery from the overall degradation of natural resources generated by the long struggle for independence, periodic and severe drought conditions;
- the need for active intervention, in the form of environmental management, in order to increase the benefits flowing from biodiverse natural resources to the national economy;
- recognition that there exists a potentially complementary relationship between national economic development, people and biodiversity.

This overall goal will be achieved if the Action Plan outlined in this document is fully and successfully implemented. It is expected that this will occur within the next 10 years, with the majority of the activities being substantially put in place within the next 5 years. It is recognised that some activities, such as planting of indigenous trees, will not yield their full biodiversity benefits within a 10-year time frame, even if full implementation has occurred.

5.2 Objectives

A major objective for each core area has been developed and is presented here. Each major objective provides the key linkage between the overall goal and the strategic elements that guide the activities to be undertaken by different sectors. The major objective for each core area is given below:

5.2.1 Terrestrial Biodiversity

“Rehabilitation of degraded terrestrial ecosystems and their components through a combination of natural succession; protected area establishment and management; and sustainable use of terrestrial biodiversity resources”.

5.2.2 Marine Biodiversity

“The coastal, marine and island biodiversity of Eritrea conserved and human activity managed to promote the sustainable development and optimal use of these resources”.

5.2.3 Agricultural Biodiversity

“Agricultural biodiversity-resources conserved and utilised sustainable for food security, income generation and agriculture, whilst ensuring the socially-fair distribution of benefits arising from the use of national agricultural biodiversity resources”.

The three objectives above provide the first layer of elaboration of the overall biodiversity goal, making the goal statement more relevant to each of the three core areas, and providing the link to the strategic elements below.

The objectives provide one level at which quantification of the overall success of the strategy could be measured, although the lack of strong baseline data will make objective quantification of success difficult. Each of the three main objectives needs to be further “broken down” into a number of strategic elements – these strategic elements represent the major areas of activity for implementation of the NBSAP and provide a better basis for monitoring and evaluation.

5.3 Strategic Elements

The strategic elements of the NBSAP form the linkage between the major objective for each core area and the activities that will be undertaken in order to fulfil the objective. The strategic elements “breakdown” the objective into a series of more practically-oriented statements which better “fit” the institutional structure of the implementing agencies.

For convenience and clarity, the strategic elements have been reduced to 10 headings or themes. The themes may have more or less relevance to the three core areas and thus may contain none, one or more elements.

The 10 themes are:

- Integrated management
- Sustainable use of natural resources
- Alien invasive species
- Pollution management

- *In-situ* conservation (protected areas)
- *Ex-situ* conservation
- Taxonomic knowledge
- Information acquisition and storage;
- Public awareness and education;
- Legal and institutional structure (capacity building).

The strategic elements for each core area are presented below. Each strategic element will be implemented through the activities to which it is linked. Some activities are existing components of government programs, or other activities undertaken by government or private agencies. Some strategic elements may lead directly to a single institution and even a single activity, but in many cases, the strategic element will be achieved successfully only through the implementation of a number of inter-linked activities, possibly involving a range of different institutions – here, the strategic element “binds together” the individual activities of different sectors and creates the framework for greater collaboration.

SECTION 6

BIODIVERSITY-RELATED ACTIVITIES FOR TERRESTRIAL BIODIVERSITY

Terrestrial biodiversity is defined, for the purposes of the NBSAP, as all land area still dominated by “relatively natural habitats”. This includes those areas which are used as unimproved range land and also areas with low density human presence (small settlements and agriculture in a predominantly unaltered landscape) – this may comprise around 75% of the total land area. The review is arranged under the 10 strategic themes – for each strategic theme, the existing situation, needs and NBSAP activities are presented.

6.1 Integrated management

Existing situation: Integrated management of natural terrestrial habitat for biodiversity objectives is not occurring in Eritrea at present. The fundamental reasons for this are: (i) lack of a centralised national database containing the necessary physico-geographical and sociological information; (ii) lack of adequate information about the biodiversity status of large parts of the country; and (iii) a relatively new central and regional administration with little practical experience of planning at this scale. This places severe limitations on the amount of large-scale planning and integrated decision-making which can be undertaken at present.

In spite of these limitations, a number of separate activities demonstrate that, in the future, integrated, landscape-level biodiversity management may become more effective in Eritrea. These are discussed below.

(i) Establishment of a national land capability classification scheme

The Department of Land, Ministry of Land, Water and Environment intends to extend its pilot land classification scheme to the whole country. The scheme is based on 8 land-use categories, derived from field estimates of slope; soil depth; soil texture; erosion hazard; drainage class; stoniness; and management type. Pilot surveys undertaken around Asmara have been used to create land-use plans, which include zonation for residential, commercial, industrial, arable and conservation purposes. It is difficult to see how the existing labour-intensive scheme can be extrapolated to the entire country, but a similar scheme making more use of remote sensed data and including some simple biodiversity indicators might provide a useful basis for integrated planning¹.

¹ The land classification scheme plans to include conservation areas as one of its land categorisations (see in situ conservation).

(ii) Increased digitization of other planning information

A number of ministries in Eritrea are now digitising information in the form of GIS databases. For example, the Department of Mines maintains an accurate GIS map of all mining concession areas (the only mining actually taking place at present is small-scale artisanal), and the Ministry of Local Government has assembled a GIS map of all villages. Outside of Eritrea, there is much information being digitized. The University of Berne, Switzerland has compiled a 23-layer GIS database of topography, watercourses, roads, etc. whilst biologists at the Deutsches Primatenzentrum, Göttingen are assisting the FWD of MOA to initiate mapping of mammal and bird distributions.

(iii) Increased levels of coordinated planning at central and regional level

As the 6 new regional administrations become established and fully-staffed, the level of integrated planning which can take place at the landscape and regional levels will increase. Central government ministries should support regional administrations by ensuring that national-level information and technical assistance is available to the developing administrations.

(iv) Small-scale integrated management projects

The government is gaining experience in implementing projects at a landscape level. From a biodiversity perspective, the most important of these are:

- MoA/SOS Sahel project: Assessment and Management of Riverine Forests, which has now gathered the information required for long-term sustainable management of the Gash and Barka riverine forests, a key biodiversity “pressure point”; long-term funding for implementation of the management plan is now required.
- The MoA closures policy, which covers 192,734 ha. of land, also has the potential to develop into a major feature of the national biodiversity action plan.
- The DANIDA/MoA Integrated Watershed Development Project has also established watershed closures, where after being treated, natural regeneration of indigenous vegetation is reported to be occurring. The project has also planted over 500,000 tree seedlings on 655 ha in hillside terraces, but most of these were exotic species.
- The GEF/MoF project, Conservation Management of Eritrea’s Coastal, Marine and Island Biodiversity is about to begin implementation; this project will include the coastal plains region, which comprises over 50% of the total land area of Eritrea.

Needs: The NBSAP should support and guide the emerging capacity for integrated environmental management by ensuring that information about biodiversity status is available for all planning and project implementation activities decisions. This would be best achieved by ensuring that national biodiversity objectives, such as establishing a representative set of protected areas, are translated into appropriate regional activities. Biodiversity related goals may be best achieved by providing the right kind of biodiversity information to other decision-makers, and through the careful modification of existing programmes, rather than through generation of new isolated projects which may over-stretch the limited capacity of implementing authorities. The NBSAP should support community participation in the decision-making process as to the areas that are to be designated as closure or wildlife protected areas (see Section 6.5). The community should be involved in the management of the closures/wildlife protected areas.

Strategy: To improve integration of biodiversity conservation into integrated land management.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Improved land classification and zonation by completion of National Land Capability Classification	Dept of Land/ DoE, (MLWE)	On-going	Needs additional fund	
(ii) Integrated watershed development by expansion of MoA/DANIDA programme to other watersheds	MoA/DANIDA support programme	On-going		DANIDA
(iii) Integrated Management of Riverine Forests through implementation of management plan produced by AMRF project	MoA/Regional Administration Gash Barka	Planned	Needs funding	
(iv) Completion and implementation of National Action Plan for Combating Desertification	MoA/MLWE	On-going		IGAD/ DANIDA

6.2 Sustainable use of natural resources

Existing situation: Natural resources still play a vital role in the economy of the majority of the population. Almost 80% of total energy consumption is from biomass, mostly as fuelwood/charcoal. About 70 - 80% of the population is dependent upon agriculture and many local communities use wild plants for a range of domestic purposes and to supplement incomes, e.g. doum palm (*Hyphaene thebaica*) and gaba (*Zizyphus spina-christa*). Natural resources, in the form of attractive landscapes, etc. can make a large contribution to the tourist sector if they are not spoilt by careless development.

The pressure on existing natural resources, already weakened by drought and war, is intense. Striking a balance between demand and the need to restrict use to allow regeneration of the resources is a major challenge for the government and the people.

A decrease in the pressure on natural resources can be brought about either by increasing the supply of the resource (supplementation) or by providing alternatives to reduce use of the resource (substitution). Increases in indigenous terrestrial biodiversity can only occur slowly in Eritrea, due to the constraints imposed by large water deficits (evapo-transpiration:rainfall ratios of >4) and poor soils. This places a relatively low upper limit on the rate at which "supplies" of natural resources can be increased – thus resource substitution is essential to relieve pressure on natural diversity.

Among the most important existing initiatives undertaken by the government are the following:

(i) Fuelwood substitution: The government has made major commitments to increasing alternative energy resources. The Liquid Petroleum Gas (LPG) depot at Massawa has been rehabilitated; tariffs on LPG, kerosene and electricity are kept low; the new Hirgigo power station will increase electricity supply by 50% when it is commissioned whilst a rural electrification programme will extend electricity to villages around major towns; and solar and wind power research programmes are underway. A recent pilot project to produce fuel briquettes from cotton stalk waste from the Alighider Estate has the potential to replace 40,000 quintals² of fuelwood; the Alighider Estate can produce enough cotton waste to supply 10 such projects, replacing 40,000 MT of fuelwood.

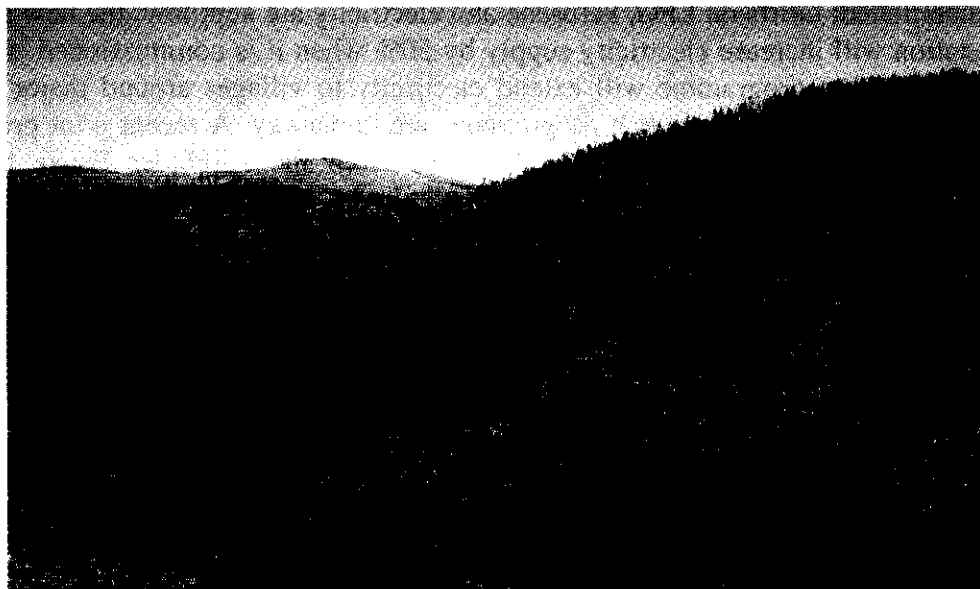
(ii) Afforestation: The FWD of the MoA is responsible for the establishment of new plantations and the reforestation of existing forest areas. To date, a total of 21,163 ha of new plantations have been established, whilst a further 192,734 ha of existing forest is under controlled regeneration. The MoA/DANIDA National Tree Seed Project has a long-term objective of "improved wood production and provision of other benefits from growing woody plants, contributing to the rehabilitation of degraded environments and help meeting the national requirements for timber, poles, fuel, fodder, food and shelter in Eritrea" through "the provision of genetically suitable seed and plant material of good physiological quality from selected seed sources of both indigenous and exotic woody

² 1 quintal is equal to 100kg.

species to meet the present and future needs for tree planting activities in Eritrea in a sustainable way, by strengthening national institutional capacity”.



Community participation in soil and water conservation work in Eritrea



Regeneration of vegetative cover on hillsides

Strategy 1: Reduction of pressure on plants in natural habitat through promotion of alternative fuels.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and other Needs	Funding Agency
(i) Implementation of wood-fuel substitution projects	MoA/MEM	Planned	Needs funding	
(ii) Increased use of improved traditional stoves	MEM	Ongoing		
(ii) Increased use of cotton briquettes	Alighider Estate	Ongoing		GoE

Strategy 2: To increase production of wood-fuel from "converted habitat".

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) National Tree Planting Campaign	MoA/MoE/ MoLG/MoD	Ongoing	Needs additional funding	
(ii) Afforestation via summer School Programme	MoA/MoE	Ongoing	Needs additional funding	
(iii) Encouraging trees and farming system (tree cultivation and management – community forestry);	MoA	Ongoing	Needs additional funding	

Strategy 3: Promotion of the economic benefits to be derived from non-destructive utilization of trees, etc. in natural habitat.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Survey of traditional plant medicinal use; potential for commercial production	MoH/WHO proposal; also UoA project	Planned	Needs funding	
(ii) Sustainable use of Doum palm	MoA, AMRF project	Planned	Needs funding	
(iii) Sustainable use of Gum Arabic and Resin production from <i>Boswellia</i> trees	MoA/ MTI	On-going	Needs additional funding	
(iv) Survey of distribution and regeneration of <i>Boswellia papyrifera</i>	MoA/MoLG/ MTI	Planned	Needs funding	
(v) Increased honey production through promotion of use of new hives	MoA	Planned	Needs funding	

6.3 Alien invasive species

Existing situation: Eritrea is in danger of being over-run by alien invasive plant species. The fragile and degraded ecology of much of the landscape provides great opportunities for alien invasive plant species to establish themselves and spread. Although less significant at the moment, the spread of annual “weeds” is also likely to occur, as demonstrated by the colonization of the Massawa area by the Indian House Crow (*Corvus splendens*) since its introduction in 1970.

Four alien species can be identified as being of major concern to natural habitat at present: Beles (*Opuntia ficus-indica*); Asha Ghereb (*Nicotiana glauca*); Temr musa (*Prosopis chiliensis*) and Bano (*Xanthium (spinosum) strumarium*). All four species have shown an ability to spread aggressively into natural habitats. *Opuntia ficus-indica* is estimated to cover over 10,000 ha. of the Central Highlands and is now spreading in the western lowlands. *Nicotiana glauca* has spread rapidly into a range of habitats in the last 20 years, especially on disturbed soils near roads, dams, etc.. *Prosopis chiliensis* is believed to have spread spontaneously into Eritrea from the Sudan and is now encroaching into the riverine habitats of Gash-Barka. *Prosopis* is also establishing itself naturally on the eastern coast around Massawa following its deliberate introduction there. *Xanthium spinosum* is widespread at the interface between agricultural land and natural habitat and can be used as an indicator of degraded land.

To date, little action has been taken to study or control the spread of these (or other) plant species. Although immediate "eradication" may not be advisable (or possible) because of the positive socio-economic role played by these species (e.g. harvest of *Opuntia* fruits; use of *Prosopis* for fodder and fuelwood), these species may represent a significant threat to the maintenance of representative natural habitat in the longer-term future.

Needs: The most urgent need is to establish the baseline distribution and rate of spread of all major alien invasive species. This is probably best achieved through surveys co-ordinated through the Ministry of Local Government and the Regional Administrations. A second priority is to become familiar with potential control options. Successful control of alien invasive species is not an easy or speedily-achieved task. Widely spread species can usually only be controlled cost-effectively using a combination of chemical and biological control. The major alien plant species in Eritrea are all serious pests elsewhere (in Africa) and there exists much experience with control from other countries. This experience is available through the scientific and 'grey' literature and through direct contacts with relevant experts. For example, South Africa has long experience with integrated biological and chemical control of *Opuntia* spp., including *O. ficus-indica*. Informal contacts have already provided information about biological control methods which can be made specific to wild-spreading *Opuntia ficus-indica* whilst having no impact on (spineless) cultivated varieties.

Strategy: To increase capacity for the control of alien invasive species within Eritrea.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Survey of distribution and spread of selected alien invasive species and their economic/social benefits;	MoA/MLWE/ UoA	Planned	Needs funding	
(ii) Collection of information on control methods of known and potential invasive and exotic species;	MoA/MLWE/ UoA	Planned	Needs funding	
(iii) The human resources of quarantine and services at points of entry are to be strengthened and improved. All imported varieties of crops to be quarantined at MoA Research Station before release to farmers	MoA	On-going	Needs additional funding	

6.4 Pollution management

Existing situation: At present, pollution does not represent a severe threat to biodiversity in Eritrea. The nature and scale of current industrial activity in Eritrea is not sufficient to have a direct impact on any natural areas of major biodiversity interest. At independence, there were only 42 large scale (public) and 650 small-scale (private) industries in the country, mostly confined to Asmara, Massawa, Dekemhare and Keren. Similarly, the virtual absence of chemical inputs into agriculture means that, at present, little threat to terrestrial biodiversity arises from agricultural practices. In fact, some of Eritrea's most interesting wildlife, especially birds, may be found close to agricultural landscapes. This is almost certainly due to the need to share a common, scarce resource – water.

Pollution management is still developing in Eritrea after years of neglect of the industrial sector. All new industrial projects must pass through the National Environmental Impact Assessment Procedures and Guidelines which are now being implemented, although legislation for enforcement of EIA is not yet promulgated (except in the mining and petroleum sectors). The environmental impact assessment procedures and guidelines contain sufficient screening to adequately protect biodiversity from pollution impacts, especially if project location is carefully chosen and appropriate environmental performance standards are put in place.

Needs: An urgent need is the rapid implementation of the Environmental Impact Assessment Procedures and Guidelines, even in the absence of full legal status. This will bring immediate returns in terms of improved protection of biodiversity and, at the same time, provide an important opportunity for government agencies to become familiar with the procedures and allow time for modifications to be made prior to implementation under law. An overall strengthening of capacity for environmental regulation is also needed. This should occur in all relevant ministries, not just the DoE, and should be based on building knowledge of cost-effective mechanisms for improved environmental performance, not "command and control" regulations.

Strategy: To increase protection of Biodiversity resources from pollution.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Survey of hazardous chemicals used in Eritrea	MLWE	Planned	Needs funding	
(ii) To develop control procedures for hazardous chemicals used in Eritrea	MLWE	Planned	Needs funding	

6.5 *In-situ* conservation (protected areas)

Existing situation: Eritrea does not have a formal protected area system at present. Historical protected areas established under colonial regimes have not been maintained and no longer have any legal status. A number of new sites have been prioritised for increased conservation and management but no legislation exists under which a protected area can be gazetted, except perhaps the Land Proclamation 58/1994³ and the Fisheries Proclamation 104/1998⁴. There is some ambiguity over which ministries have the mandate for creation of protected areas. The responsibility for management of protected areas is also not clearly defined in law.

This lack of legal authority has slowed progress towards establishing protected areas and should be clarified as soon as possible.

In the absence of formal legislation, the MoA has, in collaboration with local communities established over 192,734 ha. of closures. Closures are areas of land, ranging in size from 1 ha. to 40,000 ha. which are "set aside" from human use for an extended period (some are permanent, some are temporary) in order to allow natural regeneration or replanting to occur and for trees to grow beyond grazing height. In places where the rainfall has been normal or better, these closures are showing clear signs of regeneration and improved water infiltration to feed springs which flow for longer into the dry season.

Needs: The legal responsibilities and procedures for gazettment of protected areas must be clarified as soon as possible. This is a major limiting factor to any progress in the creation of protected areas. In the interim, survey work to document biodiversity significance of high priority sites should continue, as can the local consultations required to ensure that increased biodiversity conservation is compatible with other social requirements. In addition to survey of priority sites, knowledge of the conservation needs of particular species should also be improved through "targeted surveys". The ecological survey work and community consultation undertaken by the MoA on the globally-threatened African Wild Ass (*Equus africanus*) around Ila Isa can serve as a model for this kind of activity. It should be a priority to survey the open uplands around Senafe area in order to establish the current status and conservation management needs of the 13 regional endemic bird species likely to occur in Eritrea⁵.

³ Article 50. Expropriation from Usufructuaries: empowers the government to expropriate land for (amongst other reasons) agricultural development, including all land, forestry and animal conservation projects.

⁴ Article 13: Protected Areas: describes the powers of the Minister to create protected areas and the implications of protected area status.

⁵ This is close to the on-going border conflict with Ethiopia and it is not practical to undertake this kind of survey work at present.

Strategy: Formalization of the process for establishing protected areas system appropriate for the current and future Eritrean conditions by establishing a working group of MoA, MoF and MLWE (and others) to harmonize policy/legislation on protected areas.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) The preservation of the flora and fauna through identification, survey and border demarcation of representative protected area(s) in the Central and Northern Highlands	MoA/MLWE/ MoLG	Planned	Needs funding	
(ii) Identification, survey and demarcation of protected areas in Semenawi & Debubawi Bahri	MoA/MLWE/ MoLG	Planned	Needs funding	
(iii) Identification, survey and border demarcation of representative protected area(s) for the Western Lowlands (e.g. North Setit (Tekeze) River: Elephant preserve; Greater Kudu, <i>Tragelaphus strepsiceros</i> ; Duiker, <i>Cephalophus</i> sp.; Warthog, <i>Phacochoeros aethiopicus</i>)	MoA/MLWE/ MoLG	Planned	Needs funding	
(iv) Identification, survey and border demarcation of representative protected area(s) for the Eastern Lowlands (e.g. North Eastern Dankalia (Buri peninsula): Ostrich, <i>Struthio</i> sp; Soemmering's gazelle, <i>Gazella soemmeringii</i> ; Dorcas gazelle, <i>G. dorcas</i> ; Wild ass, <i>Equus equus</i>)	MoA/MLWE/ MoF/ MoLG	Planned	Needs funding	

(v) Identification, survey and border demarcation of representative protected area(s) for the Red Sea Coastal Zone (e.g. Islands proposed for national parks: Sciumma; Black Assarca; Dissei)	MoF/MoA/ ML WE/MoLG	Planned	Needs funding	
(vi) Improved biodiversity benefits associated with closure programmes by formalization of selection criteria for closures; increased monitoring of established closures; establishment of new closures	MoA/MLWE/ MoLG	On-going	Needs additional funding	
(vii) Increased documentation of trans-boundary species in Eritrea and increased collaboration with appropriate international agencies through exchange of information on migratory species between relevant in-country and international organizations	MoA/MLWE/ MoLG	Planned	Needs funding	

6.6 *Ex-situ* conservation

Existing situation: There are no *ex-situ* facilities for terrestrial or marine plant or animal wildlife in Eritrea. There is no botanical garden, no herbarium, no aquarium facilities and no natural history museum. The "Zoo" at Asmara is very poorly maintained. The conditions under which animals are kept are well below acceptable levels and the mislabelling and lack of information means that the establishment serves no useful biodiversity education role.

Needs: Although there are no terrestrial species in Eritrea which are known to be in need of *ex-situ* conservation (within Eritrea) in order to conserve the species from global extinction, some poorly-known species may need *ex-situ* conservation. However, lack of information about distribution and status prevents informed decision-making. There is a growing need for *ex-situ* conservation of some locally-threatened species, especially plants and fish. A national botanical garden and a national aquarium could fulfil both conservation and an educational role simultaneously. The "Zoo" should either be extensively improved to also fulfil this role or should be closed down.

Strategy: To increase biodiversity benefits arising from *ex-situ* conservation facilities.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Preparation of a feasibility study for the establishment of Zoological and Botanic Gardens; Natural History Museum; Aquarium	MoA/MLWE/ UoA	Planned	Needs funding	

6.7 Taxonomic knowledge

Existing situation: The level of modern scientific taxonomic knowledge about biodiversity in Eritrea is very weak. There are no comprehensive reference collections for any major taxon, although small collections are maintained in some sections of the MoA. There are few up-to-date checklists for animals or plants; the existing lists have been compiled in the National Biodiversity Stocktaking Assessment and are slowly being updated by MoA, plus visiting experts. There are few identification keys, field guidebooks and binoculars available to assist staff to conduct surveys in the field. The absence of these “cornerstones” of practical biodiversity documentation represent a major limiting factor on effective biodiversity management. For example, the CAAS of the University of Asmara has plans to conduct biodiversity inventories for the entire country but will not be able to do this unless they can collect, identify preserve and curate specimens.

Strategy: To increase biodiversity benefits arising from improved taxonomic knowledge.

Activities:

Activity	Responsibility (Lead institution and collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Establish herbarium and zoological collections. Undertake training activities to improve capacities of taxonomic knowledge of relevant institutions	MoA/MLWE/ UoA	Planned	Needs funding	
(ii) Conduct inventories on all aspects of (terrestrial) biodiversity	MoA/MLWE/ UoA /MoLG	Planned	Needs funding	
(iii) Increased participation in regional taxonomic networks (e.g. BIO-NET/EAFRINET, ICIPE)	MoA/ UoA / MLWE	Planned	Needs funding	

6.8 Information acquisition and storage

Existing situation: Although there is a growing amount of environmental information being compiled in Eritrea, there is no centralised repository for this information and gaining access to data can be a difficult, time-consuming process. There is less biodiversity information being collected and stored, because of the critical shortage of appropriate skills in field inventory, survey and monitoring.

The FWD of the MoA maintains records of mammals and birds encountered during field surveys but is unable to identify many species without specialised equipment and more training. The FWD also maintain records of tree species from their surveys. Several overseas researchers and visiting experts are also contributing to these checklists.

Needs: There is a clear need to:

- improve the organisation and accessibility of existing “in-country” biodiversity information;
- identify and acquire as much historical and “out-of-country” information as possible;
- establish and make available a set of standardised biodiversity indicators and survey methods which can be used in all surveys to make data more cross-comparable; and
- improve data exchange between those ministries with potential negative impacts on biodiversity and those responsible for biodiversity management.

Strategy: To increase biodiversity benefits arising from improved use of biodiversity information.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Compilation of baseline data surveys, using GIS tools on important habitats, species and resource uses.	MoA/MLWE/ UoA	Planned	Needs funding	
(ii) Participate actively in the acquisition and exchange of biodiversity information with relevant organizations (such as BIO-NET/EAFRINET, ICIPE).	MLWE/MoA/ UoA	Planned	Needs funding	
(iii) Periodical preparation of biodiversity state of environment reports (3-4 years).	MLWE	Planned	Needs funding	

6.9 Public awareness and education

Existing situation: The Ministries of Information and Education are responsible for the broadcasting and dissemination of environmental information in Eritrea, but neither have direct access to good sources of environmental information. The National Union of Eritrean Women (NUEW) and the National Union of Eritrean Youth and Students (NUEYS) are also potentially powerful mechanisms for disseminating environmental information, which the Department of Environment need to establish strong linkages with these organisations.

The available media for spreading biodiversity information (newsprint, radio and TV) are developing rapidly and their capacity to use information exceeds the supply of quality information, especially on biodiversity, rather than general environmental information. To date, dissemination of information on biodiversity has been opportunistic rather than planned and has focused on problems, rather than solutions. The lack of a centralised environmental information database and lack of attention to this issue, limits producing better organised, higher-quality sets of biodiversity-related information.

The school curriculum is under major review and re-development. To date, there has been no formal review and modification of the environmental information content of the curriculum. There are now plans to integrate environmental education into the school curriculum, and to that effect the Department of Environment has already drafted a paper, to be presented to a national workshop expected to be organised by the Ministry of Education. The University of Asmara has begun to incorporate (since 1997) environmental modules in its biology undergraduate programme. The modules have proved popular but a shortage of equipment and specialist teaching skills limits what can be achieved.

Strategy: To improve documentation and dissemination of information on the conservation and sustainable use of biodiversity resources.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Integration of environmental education in general and biodiversity in particular in the national educational system.	MLWE/MoA/ MoE/UoA	Planned	Needs funding	
(ii) Increased use of the media to disseminate and promote conservation and use of biodiversity resources	MoI/MLWE	On-going	Needs additional funding	
(iii) Use of relevant government institutions and NGOs in the dissemination of information for the conservation and sustainable use of biodiversity resources.	MLWE/MoA/ NUEW/NUEYS/ UoA	Planned	Needs funding	
(iv) Preparation of newsletters, audiovisuals, etc., to promote the conservation and sustainable use of biodiversity resources.	MLWE	On-going	Needs additional funding	GoE

6.10 Legal and institutional structure (capacity-building)

6.10.1 Legislation

Existing Situation: The legislation of Eritrea is being re-established “from scratch”. All existing colonial and Ethiopian legislation is effectively degazetted, although some may still be used for practical guidance. New legislation, in the form of Proclamations and Legal Notices (Regulations/Directives) is being prepared by individual ministries or departments in order to establish their mandate and operational scope. Draft legislation must be approved by the Ministry of Justice before being published in the Legal Gazette. There is much overlap of responsibilities for environmental issues across the existing legislation, in spite of the absence of an Environment Proclamation.

Needs: It is imperative that the Environment Proclamation be completed as soon as possible. It is inevitable that this will overlap with existing legislation and special care will need to be taken to ensure that overlapping articles are in harmony and complementary, not contradictory. Also, the draft Forestry and Wildlife Proclamation

should be completed as soon as possible. It is strongly recommended that these two pieces of legislation are completed by a common working group. Future revisions of existing legislation would benefit from the inclusion of statement which mention biodiversity as a specific component of the broader environment.

6.10.2 Institutions (capacity-building):

Existing situation: Human resource development is a priority of the government national development programme. The need for increased training, work experience and technical advisory support is clear in almost every section of government and society; biodiversity-related activities are no exception. This demonstrates that there is a shortage of qualified biologists, ecologists and environmental scientists within all of these institutions. Building capacity whilst at the same time maintaining day-to-day functions in these institutions is a difficult challenge. The shift towards decentralisation of practical government to the regional administrations will make this shortage of expertise even more apparent. Decentralisation means that more and more decisions which affect biodiversity will be taken at regional and sub-regional level but environmental staff in the regional administrations are either lacking or are recently employed graduates with little theoretical or practical experience. They will need strong support from the line ministries if they are to fulfil their duties effectively.

With regard to terrestrial biodiversity, by far the most important institution is the Ministry of Agriculture. It is the government institution with the largest impact on land use throughout the country, through both farming and livestock activities. The MoA is also "home" for the FWD, which is responsible for many biodiversity conservation and sustainable use activities. The Ministry of Land, Water and Environment has responsibility for land classification decisions (Land Department) and for general environmental management (Department of Environment) which overlap, to some extent, with those of the FWD. The University of Asmara has the potential to play an important role in training biodiversity professionals and increasing biodiversity information through the research programme of the Department of Biology and College of Agricultural and Aquatic Sciences (CAAS).

Strategy: To increase representation of biodiversity issues in relevant sectoral legislation, and increased institutional and technical capacity to promote conservation and sustainable use of terrestrial biodiversity.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Capacity building of institutional resources to meet the need of decentralization policy of the government	MoLG/MLWE/ MoA/MoJ	Planned	Needs funding	
(ii) Completion of Environmental Proclamation; provision of biodiversity information to other sectors preparing legislation; regulations; guidelines	MLWE/MoJ	On-going	Needs additional funding	
(iii) Preparation of regulations for managing and administering Protected Area System (National Parks, Nature Reserve, etc.)	MLWE/MoA/ MoLG	Planned	Needs funding	
(iv) Drafting of Biodiversity Legislation	MLWE/MoJ	Planned	Needs funding	

SECTION 7

BIODIVERSITY-RELATED ACTIVITIES FOR MARINE BIODIVERSITY

The marine biodiversity of Eritrea has come through the past years of liberation struggle relatively intact. As a result, the Eritrean Red Sea area remains relatively pristine, due to the lack of pressure from fishing, tourism or coastal and offshore industrial development. The coastal plains, which represent about 60% of Eritrea's total land area, are thinly populated with about 100,000 people scattered predominantly in the main urban areas of Assab and Massawa and to a lesser extent in scattered villages along the coast. With the exception of Massawa and adjacent areas, these areas were relatively unaffected by fighting during the struggle for independence.

Within the next few years, this historical condition of low human impact is set to change rapidly. The Government of Eritrea has identified the use of the marine resources of the Red Sea as an area of major economic expansion, including increased fishing effort, tourism and exploration of oil and gas reserves. Associated with this will be an increase in urbanization of coastal-dwelling communities (both in terms of intrinsic growth and immigration) and increases in economic activities.

The Government is committed to take care of the environment and the sustainable use of natural resources, including coastal, marine and island (CMI) environments. The recently implemented GOE/GEF-funded "Conservation Management of Eritrea's CMI Biodiversity Project" reflects this national commitment. A "Coordination, Planning and Implementation Committee" (*CMI Committee*) has been established with representation from MoF, MLWE, MoA, MOLG, UoA, GEF Project Team, UNDP, MICMEC, plus other co-opted national agencies where necessary (e.g. MTC, MoT, etc.).

The main activities relating to CMI biodiversity are described in the following subsections, according to the framework used for Terrestrial and Agricultural Biodiversity within the NBSAP, in order to identify synergies, duplications and gaps or potential conflicts with activities identified within these other national biodiversity sectors.

7.1 Integrated management

Existing situation: CMI management is not fully integrated at present. The area involved is large, comprising approximately 60,000 km² of coastal plains, over 350 islands and the territorial waters of Eritrea. Integrated environmental management at this scale therefore represents a major administrative and financial challenge to a small and developing nation such as Eritrea. Existing national capacity for CMI management is limited and the problem is compounded by poor transport and communication infrastructure within the area.

Effective CMI management in Eritrea will rely primarily on developing an integrated participatory process for coordination and decision making in order to avoid adverse anthropogenic impacts and prevent further degradation to CMI biodiversity in urbanized areas and zones of exploitation. Due consideration must be given to potential conflicts of interest that may arise within government agencies mandated to both exploit and protect CMI biodiversity.

Strategy: Develop a comprehensive, integrated and participatory management framework for the conservation management and sustainable development of Eritrea's coastal, marine and island biodiversity.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
Implement and strengthen the existing GEF/GOE CMI Biodiversity Project "Coordination, Planning and Implementation Committee" (CMI Committee)	MoF/MLWE/ MoA/MoLG/UoA /GEF Project Team, UNDP/MTC/ MICMEC/ plus other co-opted national agencies.	Ongoing	Funds available	GEF/GoE

7.2 Sustainable use of natural resources

Existing situation: Current levels of CMI resource utilization in the Eritrean Red Sea are believed to be well below sustainable utilization due to the slow rebuilding of commercial sectors (e.g. tourism, fisheries, etc.) following independence. However, because of limited information available regarding CMI resources (including baseline data on biodiversity and commercial fish stocks), an accurate assessment of the economic potential of these resources is not available.

CMI resources are limited and must therefore be carefully assessed and monitored and exploitation carefully controlled. For example, whilst the recently promulgated Fisheries Legislation will help ensure the sustainable use of fisheries resources, it will only be effective if a baseline is established and compliance is monitored and enforced. Thus, an integrated CMI Development and Zoning Plan should be developed which sets standards which all sectors should comply with.

Strategy: Formulate an integrated CMI Development and Zoning Plan.

Activities:

Activity	Responsibility (Lead Institutions and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Establish a baseline of CMI biodiversity and initiate monitoring programs.	MoF/MLWE/MoA/ MoLG/UoA/MoT.	Planned	Funds available	GoE/GEF
(ii) Undertake sector-specific/cross-sectoral analyses of the impacts and management implications of key development activities on CMI biodiversity.	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC.	Planned	Funds available	GoE/GEF
(iii) Formulate an integrated CMI Development and Zoning Plan, incorporating CMI-specific EIA guidelines.	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC/MTI	Planned	Funds available	GoE/GEF

7.3 Alien invasive species

Existing situation: The Eritrean Red Sea territorial waters are part of a major shipping route between the Mediterranean Sea and the Indian Ocean, with many hundreds of ships passing every year. The potential for the accidental introduction of alien invasive marine species is therefore high, especially through bilge discharge. Similarly, increasing numbers of alien species are being introduced by coastal development projects without due regard to issues of environmental testing and impacts, monitoring or containment security, reflecting a conflict of interest between development and conservation at the Ministerial level.

The Indian House Crow (*Corvus splendens*) now dominates the urban area of Massawa following its recent introduction and is now spreading inland. Some introduced plants, such as *Prosopis chiliensis*, are also spreading following introduction to Massawa. The impacts of the recent introduction of at least seven exotic species at the new aquaculture venture in Massawa remains unknown but poses a potentially serious threat to CMI biodiversity, particularly with the introduction of potentially competitive marine and halophytic species such as tilapia, *Peaenus sp.*, *Salicornia sp.* and *Rhizophora sp.*

Strategy: Protection of the coastal, marine and island environment from alien invasive species.

Activities:

Activity	Responsibility (Lead Institutions and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Establish a database of known CMI invasive species.	MoF/MLWE/MoA/ MoLG/UoA.	Planned	Funds available	GoE/GEF
(ii) Establish policies for safeguarding against alien invasive species, including licensing, screening, monitoring and containment procedures.	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC.	Planned	Funds available	GoE/GEF
(iii) Establish an eradication and containment programme for known and potentially harmful alien invasive species.	MoF/MLWE/MoA/ MoLG/UoA/MoT.	Planned	Funds available	GoE/GEF

7.4 Pollution management

Existing situation: The CMI environment is potentially threatened by pollution from a variety of sources, including: marine shipping (especially oil tankers); oil and gas exploration; urban and industrial waste; and industrial developments. At present, almost all industrial activity in the CMI areas is concentrated in the ports of Massawa and Assab and includes cement and salt manufacture, shipping and power generation. These urban areas lack proper sewage and solid waste management facilities. The Government plans to develop a number of key sectors, all of which will require proper EIA compliance and pollution mitigation, management and control, in order to avoid serious adverse impacts to CMI biodiversity.

Strategy: Identify, monitor and control potential sources of pollution within CMI areas.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Monitoring of critical pollutants which impact on marine and coastal environment.	DoE (MLWE)	Ongoing	Funds available	GoE
(ii) Install and maintain reception facilities for Crude Oil Wash (COW) at Massawa & Assab	MTC	Planned	Needs funding	
(iii) Establish and implement Oil Pollution Contingency Plan	MTC/MEM	Planned	Needs funding	
(iv) Install receptacles at all fishing centers in which fishermen can dispose of used engine oil.	MoF	Planned	Needs funding	
(v) Issue a norm for the construction of septic tanks for all present and future coastal buildings.	MoLG/MLWE/ Zoba administration	Planned	Needs funding	

7.5 In-situ conservation (i.e. protected areas)

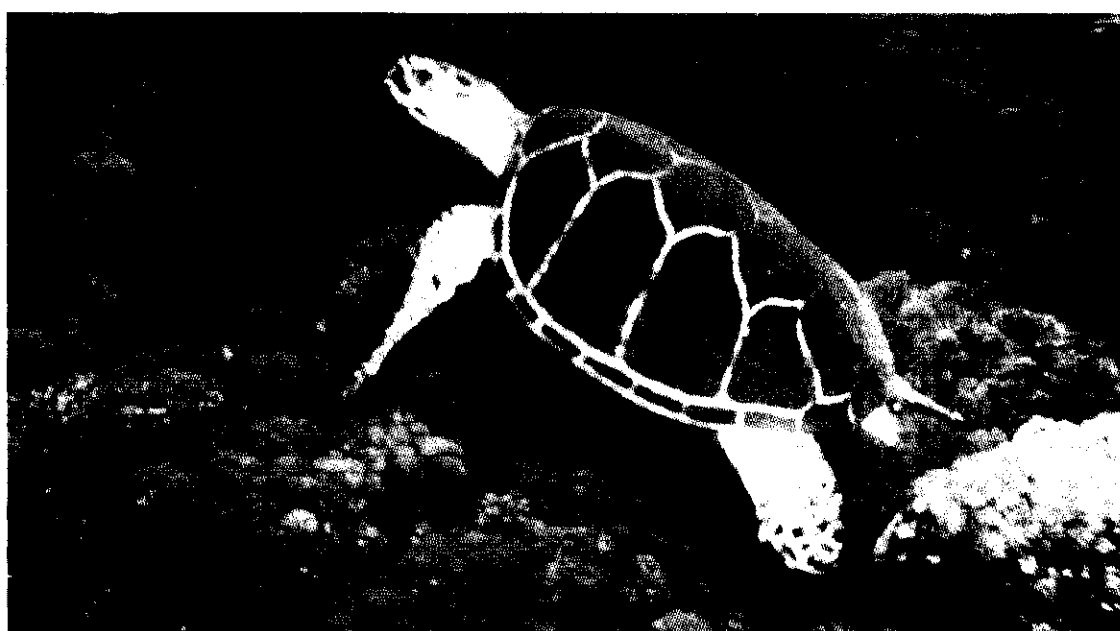
Existing situation: *In-situ* conservation is an effective way of protecting biodiversity, providing for: protection of endangered species; maintenance and/or restoration of viable populations of native species, communities, habitats, breeding areas and genetic diversity; protection of breeding and feeding areas for migratory species; and provision of space to allow species migrations in response to environmental change.

There are currently no formal protected areas within the CMI zones of Eritrea, although a number of potential sites have been identified, including: Dur Gaam and Dur Gella islands; the Fatuma and Museri island groups; and the Buri Peninsula. In the coastal region, the area around Ila Isa has been prioritized for increased protection for the

endangered African Wild Ass (*Equus africanus somaliensis*) and other terrestrial wildlife. In addition, negotiations to expand the closure system in the coastal plains are underway.



Dolphins: Large marine mammals in the Eritrean waters of the Red Sea



Sea Turtle: One of the threatened marine mammals of the Eritrean waters of the Red Sea



Dugongs: One of the endangered marine mammals graze exclusively on seagrass of the Eritrean waters of the Red Sea

Strategy: Develop and implement a participatory program for conservation and management of key CMI areas and for habitats and species of special concern outside of these areas.

Activities:

Activity	Responsibility (Lead Institutions and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Identify and delineate protected areas for the conservation of CMI biodiversity.	MoF/MLWE/MoA /MoLG/UoA/MoT /MTC.	Planned	Funds available	GoE/GEF
(ii) Establish protected area management plans and monitoring programmes.	MoF/MLWE/ MoA/MoLG/UoA/ MoT/MTC.	Planned	Funds available	GoE/GEF
(iii) Prepare a species conservation network and action plans for the protection of endangered endemic, migratory and/or indicator species, including marine turtles and mammals, migratory birds and sharks.	MoF/ MLWE/ MoA/ MoLG/ UoA/MoT/MTC.	Planned	Funds available	GoE/GEF

7.6 Ex-situ conservation

Existing situation: There are no current *ex-situ* initiatives for the protection of CMI biodiversity in Eritrea. Whilst there may be a strong case for captive-breeding programmes for critically endangered species, a more secure and cost-effective strategy for the protection of such species is *in-situ* conservation initiative through protection of critical habitats. *Ex-situ* interventions for the conservation of CMI species are therefore not considered as a viable option at this time within the NBSAP.

7.7 Taxonomic knowledge

Existing situation: Existing taxonomic knowledge and national capacity for acquisition of taxonomic data of CMI biodiversity is extremely limited, as highlighted in a recent independent report commissioned by the GOE/GEF-funded “Conservation Management of Eritrea’s CMI Biodiversity Project”. A sound understanding of CMI taxonomy and a national capacity for taxonomic profiling is a prerequisite for understanding CMI biodiversity, from which informed and rational decisions regarding the conservation management of CMI biodiversity can be developed. Without investment in this fundamental aspect of biodiversity knowledge, all other “down-stream” conservation, management and sustainable use activities will be compromised by “fuzzy” knowledge.

Strategy: Increase national capacity for CMI taxonomic data acquisition.

Activities:

Activity	Responsibility (Lead Institutions and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Develop national expertise in CMI taxonomy through training.	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC.	Planned	Funds available	GoE/GEF
(ii) Establish a curated reference collection of CMI biodiversity and improve library acquisitions of key reference literature.	MoF/MLWE/MoA/ UoA/MoT	Planned	Funds available	GoE/GEF
(iii) Co-opt international expertise to assist in short-term CMI taxonomic profiling initiatives.	MoF/MLWE/MoA/ UoA/MoT	Planned	Funds available	GoE/GEF

7.8 Information acquisition and storage

Existing situation: During the course of the GEF-PRIF (Pre-Investment Facility) Project, MoF has established a pilot GIS geo-referenced database on CMI biodiversity. However, this database does not incorporate the numerous other Eritrean CMI-relevant datasets held nationally within other government agencies or other relevant datasets known to exist elsewhere. Furthermore, the structure and content of the MoF CMI database does not provide for adequate analysis or synthesis of the data sets held.

Establishment of a comprehensive CMI biodiversity database is fundamental to the goal of protecting CMI biodiversity and a prerequisite for effective CMI management. It should not be viewed simply as the existing MoF database but rather as the entirety of CMI environmental, biological, ecological and sociological data and information available to support informed CMI biodiversity management decisions.

Strategy: Establish a comprehensive GIS database on CMI biodiversity and related cross-cutting information.

Activities:

Activity	Responsibility (Lead Institutions and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Upgrade the MoF, CMI biodiversity database.	MoF/MLWE/MoA/ MoLG/UoA/MoT	Planned	Fund available	GoE/GEF
(ii) Establish a meta-database of all relevant CMI datasets and update the MoF CMI database, including data from ongoing and planned baseline and monitoring data acquisition initiatives (Section 7.2).	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC.	Planned	Fund available	GoE/GEF
(iii) Establish data exchange linkages and forums at national, regional and international levels.	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC.	Planned	Fund available	GoE/GEF

7.9 Public awareness and education

Existing situation: There is a strong government commitment to human resource development in recognition that education and training are essential to the national development initiatives. This applies to environment and biodiversity as well as to the economic sectors. There are already a number of projects designed to increase the productive capacity of fishing communities and other commercial sectors of the coastal communities – this needs to be integrated with more general environmental information if a sustainable development pathway is to be followed. The need to improve national expertise in CMI taxonomy has already been identified (Section 7.7) and there is an additional need to enhance national capacity throughout the technical spectrum of CMI biodiversity assessment and monitoring.

There are currently no significant national campaigns for public awareness of CMI biodiversity values. This is an important activity if full community awareness and participation in CMI biodiversity conservation is to be successfully achieved.

Strategy 1: Increase national capacity to undertake CMI biodiversity assessments and monitoring through education and training.

Activities:

Activity	Responsibility (Lead Institutions and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Undertake a national Training Needs Assessment for CMI biodiversity-related activities.	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC.	Planned	Funds available	GoE/GEF
(ii) Identify trainees and suitable training courses and agencies (where possible, training should be conducted <i>in-situ</i>)	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC/MoE.	Planned	Funds available	GoE/GEF

Strategy 2: Increase public awareness of CMI biodiversity values.

Activities

Activity	Responsibility (Lead Institutions and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Develop suitable CMI biodiversity awareness supporting materials and establish a national campaign and network for community-based CMI biodiversity awareness.	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC/MoE	Planned	Funds available	GoE/GEF
(ii) Incorporate CMI biodiversity awareness programmes into the national curriculum.	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC/MTI/MoJ/ MoE	Planned	Funds available	GoE/GEF
(iii) Develop a suitable mechanism for routine dissemination of CMI biodiversity information at both technical and non-technical levels.	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC/MoE	Planned	Funds available	GoE/GEF
(iv) Encourage community-based involvement in CMI biodiversity assessments and monitoring (i.e. increase community 'stewardship' of CMI biodiversity).	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC/MoE	Planned	Funds available	GoE/GEF
(v) Develop plans for a national marine aquarium and CMI educational facility.	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC	Planned	Funds available	GoE/GEF

7.10 Legal and institutional structure (capacity-building)

Existing situation: The recently promulgated Fisheries Legislation provides a strong foundation for legal protection of CMI biodiversity. However, any legislation is only as effective as the system for its implementation. Currently, both MoF and the Regional Administration lack expertise and experience in the use of legislation to protect CMI environments. Whilst there is a need for additional legislation and regulations to ensure conservation and sustainable use of CMI biodiversity, there is an equally important need for the development of human resources for the efficient and effective use of legislation. There is also an urgent need to ensure national coordination of legislation relating to the protection and sustainable use of CMI biodiversity.

Strategy: Improve legislative arrangements and coordination for the protection and sustainable use of CMI biodiversity and enhance institutional capacity to implement legislation.

Activities:

Activity	Responsibility (Lead Institutions and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Preparation and coordination of laws/regulations for Integrated Coastal Zone Management.	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC/MTI/MoJ	Planned	Funds available	GoE/GEF
(ii) Preparation and coordination of laws/regulations for CMI Protected Areas.	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC/MTI/MoJ	Planned	Funds available	GoE/GEF
(iii) Identification of capacity needs for effective enforcement of CMI-related laws/regulations.	MoF/MLWE/MoA/ MoLG/UoA/MoT/ MTC/MTI/MoJ	Planned	Funds available	GoE/GEF

SECTION 8

BIODIVERSITY-RELATED ACTIVITIES FOR AGRICULTURAL BIODIVERSITY

The agricultural sector accounts for around 30% of total GDP and a much larger proportion of the subsistence economy which is not fully documented in national economic statistics. Over 70% of the population are directly or indirectly engaged in either subsistence or commercial agricultural activities. From a biodiversity perspective, the agricultural sector has considerable importance both in global and local terms. The diversity of crop, forage, shrub and tree browse landraces found in Eritrea has global conservation significance because Eritrea is a centre of diversity or centre of domestication for a number of cultivated crops. More importantly, the genetic diversity of these and other crops and forages in Eritrea plays an important role in the agricultural strategy of farmers, especially those practising rain-fed agriculture. Cultivation of a range of different landraces provides a “bet-hedging” strategy minimising the risk of total failure of crops and livestock and maximising production of crops and livestock under harsh local conditions.

The objective of biodiversity conservation is to minimise the decrease or irretrievable loss of landrace materials due to genetic erosion. In general, local genetic resources are low yielding but they possess a much wider genetic base than uniform high yielding varieties. The conservation of local genetic resources ensures a primary source of gene variation useful for today and tomorrow production improvement through breeding and selection programs.

Much of the documentation on crop diversity in the Horn of Africa has been focused on Ethiopia and much of the information on crop diversity in Eritrea is “embedded” in the literature of Ethiopia.

There is a large diversity of livestock in Eritrea which is widely distributed over the country. There are four indigenous breeds of cattle, four breeds of goats, four breeds of sheep, two types of donkeys and three types of camels. Mules and horses are found mainly in the highlands.

Although the grasses, shrubs and trees utilised by livestock have not been studied and documented in detail, the country has highly important grass species such as *Cynodon dactylon*, *Eragrostis* species, *Cenchrus ciliaris*, etc.; for shrubs, there are the *Acacia* species, *Phrosia* species, *Atriplex numularia*, *Cadaba rotundifolia*, etc.; for browse trees, *Acacia tortilis*, *Acacia nilotica*, *Salvadora persica*, *Acacia seyal*, *Acacia senegal* and *Hyphaene thebaica*, etc.

The existing situation with regard to biodiversity-related activities in the agricultural sector is reviewed below with respect to the 10 strategic themes used for this report.

8.1 Integrated management

Existing Situation: The Ministry of Agriculture is responsible for the overall policy and planning for the agricultural sector but implementation of the policy is effected through the regional administration offices.

The overall policy is geared towards increased production, both in the crop and livestock sector. Whilst this is a clear national need and priority, the policy must be implemented in an integrated manner in order to prevent a significant decline in biodiversity value in the country. Low yielding, drought sensitive and not easily marketable landraces which have been maintained by peasant farmers until now could be replaced by high yielding, early maturing and easily marketable products. In such cases, efforts must be exerted to conserve them before they are lost. Local plant varieties possess a much wider genetic base than uniform high yielding varieties. Therefore, the conservation of local genetic resources ensures primary source of gene variation useful for today and tomorrow production improvement through breeding and selection programs. In this section, we focus on the impact on agricultural biodiversity resources themselves, not the impact on natural terrestrial biodiversity.

The Integrated Farming Systems (IFS – Tumur Hirsha) has the aim of increasing agricultural production through the introduction of mechanized farming on larger areas. The program plans to increase output through the supply of both improved landraces and outstanding exotic varieties and increased levels of chemical inputs (fertilizers and pesticides).



Community participation in crop harvest as part of the integrated farming system

The Integrated Watershed Development project described under terrestrial biodiversity does not make any direct intervention at the level of crop and forage choice and thus has little positive impact on agricultural biodiversity. The project has the potential to influence diversity of both trees and forage through its interventions in catchment areas where both indigenous and introduced species are being used.

In the livestock sector, the development objective is to increase productivity through improved animal health, better feedstock supply and selection of improved breeding stock. Although this program will include introduction of foreign livestock, these will not deplete indigenous breeds which are dominant in the harsher open-grazing systems which form 90% of the livestock sector.

Needs: From a biodiversity perspective, there is a need for integrated management of agricultural biodiversity resources to ensure that globally and nationally significant genetic varieties of crops, forages and livestock are not "lost" as production systems change to improve the human welfare of Eritrean farmers and pastoralists. This is not a difficult task but cannot be achieved until the distribution of these resources is better known. It is unrealistic to wait for surveys to complete documentation of these resources at a national level to be completed. A more pragmatic approach would be to ensure that all areas proposed for significant "change in use" are surveyed for their agricultural biodiversity significance before conversion is approved; in this way, threatened crop, forage and livestock resources could be identified and conserved before project implementation. This could be completed within the framework of the National Environmental Impact Assessment Procedures and Guidelines which require projects to address these issues before they are granted environmental clearance. Conservation practices should focus at the ecosystem taking into consideration the geographic distribution of the agricultural biodiversity resources.

Strategy: Inclusion of agricultural biodiversity criteria in the zoning of potential agricultural land.

Activities:

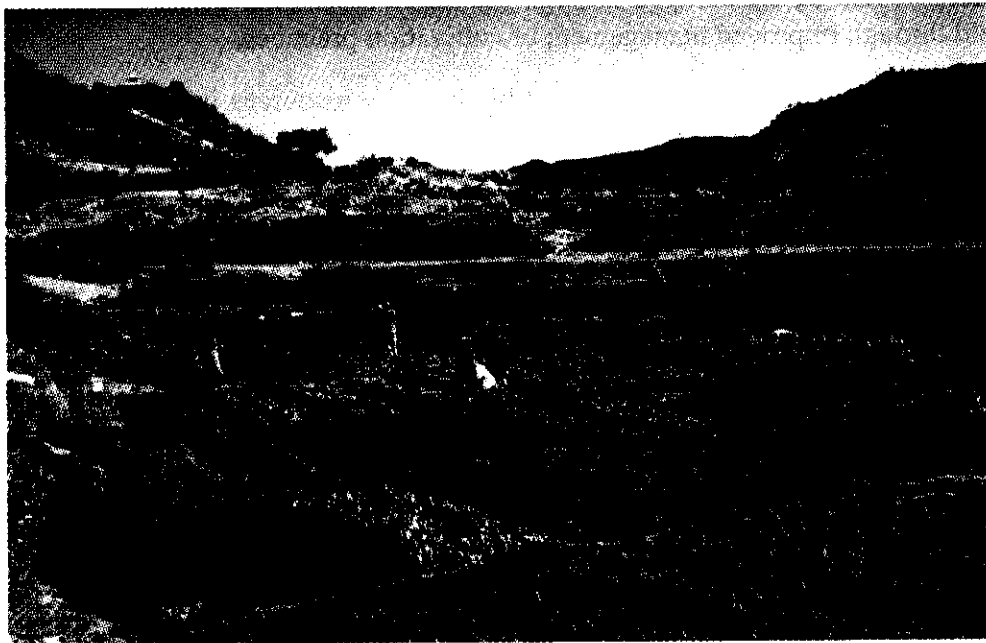
Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
Identification of zones of high landrace (crop and livestock) diversity and incorporation of zones into national land use classification	MoA	Planned	Needs funding	

8.2 Sustainable use of natural resources

Existing situation: This theme is strongly linked to the previous one. Sustainable use of agricultural biodiversity comes from the integration of these resources into a broader, sustainable agricultural system. Traditional rain-fed agriculture is becoming unsustainable in many parts of Eritrea as plot sizes diminish, soil erosion continues and soil fertility declines. The situation is aggravated further by crop failures arising from drought and war, leading to loss of crop diversity. In the highlands, intensification is a viable solution to this problem¹, since there is little or no land available for increases in agricultural activities. In the lowlands, a mixture of extensification and intensification can be implemented. Long-term maintenance of crop diversity will only occur in intensified agricultural systems if indigenous crop landraces continue to meet farmers' needs. As agricultural systems change some landraces may become less important in farmer's cropping strategy and will not be maintained at the level of individual farmers. Where these landraces may have potential useful long-term genetic potential (e.g. for future breeding), they should be conserved at the national level, i.e. taken into *ex-situ* conservation. At present, however, many farmers indicate that they have trouble maintaining the landraces, which they would wish to continue to use. Output is so low that it is often difficult to set aside sufficient quality seed for the next season, creating a vicious circle of declining yields, less seed, etc.. There is scope for national/ regional level intervention here, creating a system where rare but valued crop varieties are multiplied up for redistribution to farmers; this could occur either at research stations or on those farms which still use these landraces/varieties. Farmers who grow landraces should be encouraged through economic incentives which assist them to enhance yield through improved management of cultivation practices.

Needs: The most urgent need for agroicultural biodiversity resources in Eritrea should be better documentation of the distribution and status of the resources themselves. Without this information, the exact nature of any threat cannot be realistically assessed, nor can mitigation steps be taken to eliminate the risk of loss of diversity be put in place. Wherever possible, conservation of genetic resources should take place *in-situ*, maintaining crop and livestock diversity in an active farming environment. *Ex-situ* conservation facilities are limited and need to be strengthened if they are to act as a realistic "safety-net" to on farm, *in-situ* conservation. Wherever land constraints allow, the diversification of the agricultural landscape through agro-forestry, woodlots, closures, etc., should be encouraged – these activities can nearly always be included in soil and water conservation interventions.

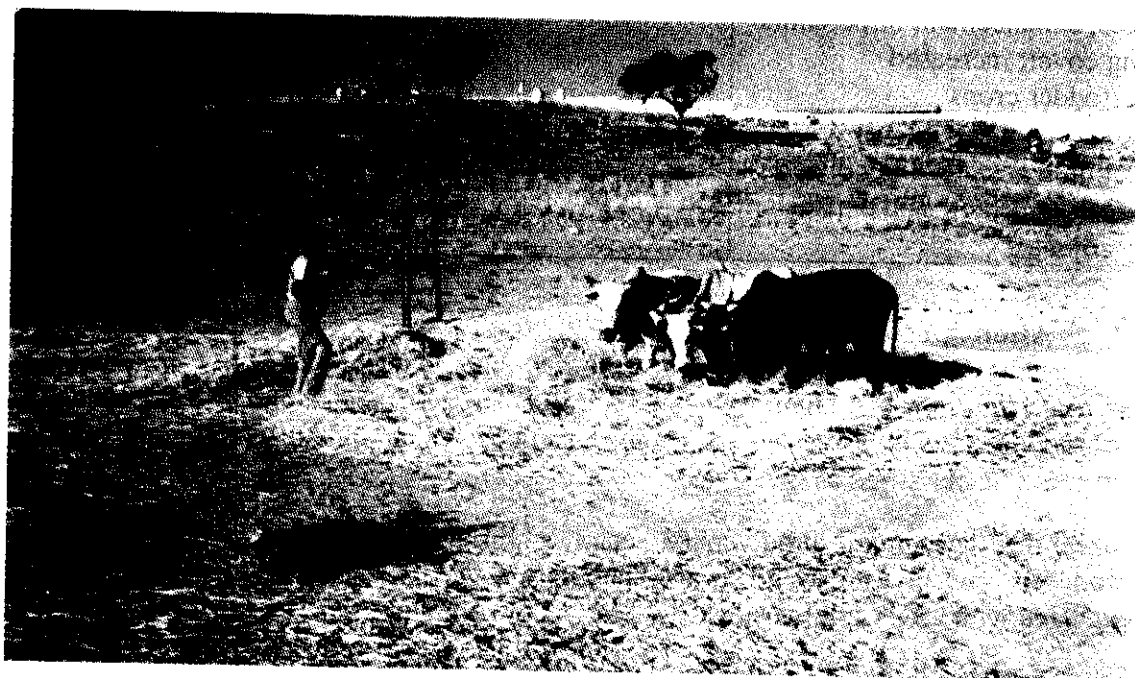
¹ Diversification, i.e. people shifting away from farming as a source of income is another alternative, but this is not easily included in a NBSAP.



Sustainable crop and vegetable production through the introduction of water harvesting technologies in Eritrea



Sorghum selection/breeding in a research station in Eritrea



Traditional crop threshing in the highlands of Eritrea

Strategy: To improve documentation of the distribution and status of agricultural biodiversity resources.

Activities

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Promote the conservation, enhancement production, utilization and marketing of high value/industrial indigenous crops and livestock for income generation and economic development	MoA	Ongoing		
(ii) To produce and distribute to farmers improved varieties of indigenous landrace (crops and livestock) materials	MoA	Ongoing		
(iii) Improving the crop management practices that enhance soil moisture retention of agricultural land	MoA	Ongoing		
(iv) Improvement of rangeland quality through temporary closures, enhancement of perennial grazing cover; increased forage/fodder crops	MoA	Ongoing		
(v) Increase honey and wax production by establishing queen (bee) rearing centers and expansion of bee colonies	MoA/DANIDA	Ongoing	Needs additional funding	

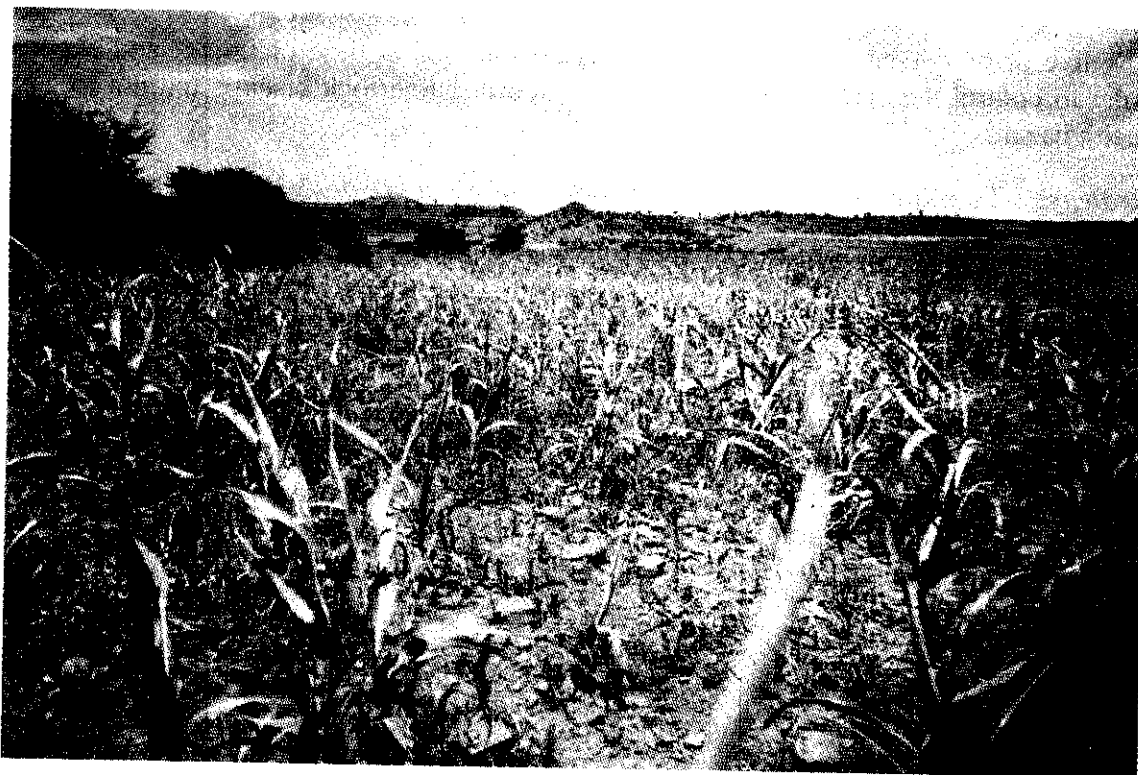
8.3 Alien species

Existing situation: All alien species of crop and forage species and livestock should be assessed for their invasiveness. Alien introductions which spread without the support of man could be classified as invasive.

Within the agricultural biodiversity sector, alien introductions are of two kinds: (i) introduced crop, livestock and forage species and varieties; and (ii) the introduced pests associated with crops and livestock.

High Yielding Varieties (HYVs) of sorghum and pearl millet are being introduced to Eritrea but the total area of these varieties grown is small relative to total cultivated areas. Wheat is the most threatened cereal to genetic erosion since old (Kenya varieties) and

recent introductions (Canada, Australia, Boohoy, HRD, Pavoni varieties) are cultivated by farmers in scattered but relatively frequent in Zoba Maekel and Debub subzones. Exotic barley varieties are being studied by DARHRD but so far no outstanding variety has been released to farmers.



Striga: Common invasive weed species on sorghum

Weeds and other crop pests are a major problem in Eritrean agriculture where the level of use of chemical pesticides is extremely low. A total of 94 weed species were identified recently by the Ministry of Agriculture survey², with the most serious being: *Striga hermonthica* (Purple witch weed), *Orobanche minor* (Broomrape), *Convolvulus arvensis* (Creeping Jenny) and *Cyperus rotundus* (Purple Nutsedge). The majority of the serious weed species in Eritrea are introduced species which have “followed” their preferred crops around the globe³. These pests in general reduce agricultural productivity rather than representing direct threat to indigenous biodiversity. Lists of some major crop insect pests and diseases in Eritrea indicates a similar pattern of a wide range of “global” pests.

² Adhanom Negasi (Ed.) (1999) Workshop on the weed status of the Integrated Farming Schemes (IFS)/Turnur Hirshas in the different Agro-ecological Zones of Eritrea

³ Some of these species may have been introduced hundreds, even thousands of years ago, along with the original crop.

Despite the fact that plant quarantine is the first line of defense against the invasion of alien species, there are some constraints to achieve the goal of this activity efficiently. These are:-

- absence of well facilitated laboratory for identification of pests and diseases; and
- absence of bye laws.

Any live or processed biological material is quarantined at time of import and export in order to control the spread of economically important livestock disease and not to create health hazards.

Strategy: To improve knowledge and control of alien species within agricultural ecosystems.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) To design a monitoring program to identify changes in crop and forage diversity at farm level and establish baseline data for the program	MoA/MLWE	Planned	Needs funding	
(ii) Increased surveillance and quarantine activities at "points of entry" for live biological material	MoA	On-going but requires strengthening of capacities		
(iii) Increased survey and documentation of agricultural and livestock pests	MoA	On-going		

8.4 Pollution management

Existing situation: So far, pollution is not a serious problem for the majority of agriculture in Eritrea. The level of industrial activity is currently very low so that whatever air and water pollution that exists is localized and distant from most agriculture. Pollution from agriculture itself is also of minor significance due to the low levels of chemical inputs, both fertilizer and pesticides. As the economy grows, this situation will change but should not represent a serious threat to agricultural biodiversity if the proposed National Environmental Impact Assessment Procedures and Guidelines are implemented effectively. If use of fertilizers and pesticides allows intensification of agricultural production and helps to prevent additional land conversion, then it will be beneficial for biodiversity.

Needs: The most important needs for this strategic theme are: (i) the effective implementation of environmental assessment of all new industrial activities, especially with regard to project location; (ii) the development of an effective system for the regulation of agro-chemical import and supply and for ensuring that pesticide use takes place in the framework of Integrated Pest Management (IPM).

Strategy: To reduce impact of industrial pollution on agricultural systems.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
Use of environmental assessment procedures for new projects and monitoring of potential impacts of industry on agricultural biodiversity.	MoA/MLWE	Planned		

8.5 In-situ conservation

Existing situation: *In-situ* conservation of plant genetic resources is taking place spontaneously at the level of individual farms throughout Eritrea. It is estimated that 3-4 landraces of each major crop species may be found in each "locality" but it is not clear how many landraces exist across all localities. Sometimes the same landraces have a different name in different localities; sometimes different landraces can have the same name in different locations. Landrace conservation at this uncoordinated level carries a risk that local landraces will be lost if (i) farmers suffer severe crop failure due to drought, pest damage or war; or (ii) farmer's agricultural strategies change so that some varieties are no longer maintained. There is some evidence that this type of genetic erosion is happening but the extent is not clear due to lack of documentation of landrace distribution.

Needs: There is a clear need for a "safety net" to assist individual farmers to cope with the first of these problems and to ensure that, if farmers choose not to use a landrace, that the landrace is not lost forever. This is best achieved through a combination of on-farm (*in-situ*) conservation of those landraces which are in demand but scarce, coupled with a strategy of off-farm (*ex-situ*) conservation of less popular landraces which still have long-term breeding potential. The former could be achieved by contracting farmers to grow threatened varieties for guaranteed prices, so that the harvested seed can then be distributed to more farmers. Alternatively, threatened landraces can be multiplied on government research farms. This is the existing strategy of the MoA Plant Genetic Resources Unit (PGRU) but full implementation has proven to be difficult due to human resource, equipment and funding constraints.

In the livestock sector environmentally, socially and economically important indigenous livestock species could be conserved *in-situ* through conservation and proper use of range resources and the establishment of breeding centers for cattle, sheep, goats, poultry, etc. This could be done at representative locations in the six zobas. Establishment of queen rearing centers in the central highlands could also have paramount importance in the conservation and expansion of bee colonies in the country.

The livestock export market should be regulated so as to not exceed the sustainable exploitation of our livestock off-take.

Strategy: To increase conservation of agricultural biodiversity within on-farm systems.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) Implementation of existing plans for <i>in-situ</i> conservation of landraces (crops and livestock)	MoA	Planned	Needs funding	
(ii) Develop a system of effective incentives for farmers to maintain diverse landraces (funding, training, input supply, etc.)	MoA	Planned	Needs funding	
(iii) To develop and adopt complementary conservation strategies and methods (<i>in-situ</i> and <i>ex-situ</i> - contracting farmers to grow threatened landraces; multiply threatened landraces in research stations)	MoA/MLWE	Planned	Needs funding	

8.6 Ex-situ conservation

Existing situation: There is an *ex-situ* collection of agricultural biodiversity resources maintained at the PGRU of the MoA Research and Human Resources Development Department. This gene bank has limited capacity for collection, storage and characterization of agricultural biodiversity genetic resources. A total of 1900 accessions, predominantly cereals, legumes, oil crops and few wild relatives have been collected and stored. This represents a considerable amount of the total crop landrace variation in Eritrea. Human resource availability and physical space limitations are being reduced through the DANIDA funded construction of new buildings and employment of additional staff – this will allow to increase the coverage of the collections. Characterization of over 70% of the accessions has been completed and the gene bank can make this information and small amounts of seed available for research use.

There are relatively good linkages between the gene bank and international organizations concerned with plant genetic resource conservation. Few out-of-country material has been

returned although some exotic material has been provided by ICRISAT and ICARDA for screening, whilst IPGRI and FAO provide mostly technical support. There is a partial inventory of Eritrean genetic resources held in other countries (e.g. Ethiopia) and the legal situation with regard to ownership and use of these plant genetic resources remains unclear.

Needs: Space and other infrastructure capacities of the gene bank, operating under the DARHRD of the MoA, is expected to improve greatly under the DANIDA funded project currently being implemented. This will definitely strengthen the exploration and collection, conservation, characterization / evaluation and utilization of landraces germplasm. In 1997 and 1998, in collaboration with DANIDA, ICARDA and ICRISAT, collections of barley, lowland sorghum, pearl millet and wheat cultivars had been undertaken for further breeding programs. However, for safer maintenance and enhancement of landrace materials, *ex-situ* conservation must be complemented by new project of *in-situ* conservation.

The gene bank currently focuses mainly on orthodox crops and their wild relatives but in the future should aim to conserve biological diversity which includes recalcitrant crops (field gene bank) and forages. Commonly, the conservation of threatened breed in livestock in the form of frozen semen and embryos are maintained in separate specialized laboratories.

Strategy: To increase conservation of agricultural biodiversity within *ex-situ* systems.

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) To increase representation of indigenous landrace material in <i>ex-situ</i> collections through: (a) in country collection; (b) repatriation of material from international collections	MoA	Planned	Needs funding	
(ii) Combating drought as an agent of genetic erosion through selection and improvement of drought tolerant/resistant varieties from local landraces	MoA	On-going	Needs additional funding	
(iii) Promote conservation of threatened species in the form of frozen semen and embryos	MoA	Planned	Needs funding	

8.7 Taxonomic knowledge

Existing situation: The role of taxonomic knowledge in the agricultural biodiversity core area is primarily for (i) knowledge of crop and livestock diversity; and (ii) knowledge of the biota associated with crops and livestock (weeds, pests and pathogens; fodder and forage crops, etc.). For (i) the level of knowledge at both government and farm level appears to be quite strong – farmers know their crops and livestock! For (ii) the knowledge base is not so strong, especially at the scientific level; there are few personnel fully-trained in identification of crop and livestock “pests”. Taxonomic knowledge of microbes, especially plant diseases and soil biota in general appear to be especially weak. More significant than a weakness in pure taxonomic knowledge, there is a lack of “associated knowledge” for pest species. Associated knowledge is the applied information needed for effective pest management and control; for example, the most up-to-date and relevant methods and materials for integrated pest management (IPM) which maximizes control with minimal use of chemical inputs.

Needs: The main needs for agricultural biodiversity in this strategic theme are: (i) an improved taxonomic skill base for full identification of crop and livestock “pests and diseases” – this would be best achieved through short and long intensive overseas training courses; (ii) increase capacity to undertake field surveys of pest status; (iii) increased access to “associated knowledge” to provide farmers with appropriate, cost-effective pest control strategies.

Strategy: To increase taxonomic knowledge of biodiversity within agro-ecosystems.

Activities: Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) To survey and document the distribution of indigenous landraces and their wild relatives	MoA/MLWE	Planned	Needs funding	
(ii) To conduct surveys of soil biota associated with different crops and livestock, especially indigenous landraces	MoA/ UoA	Planned	Needs funding	
(iii) Increased knowledge of biodiversity of agro-ecosystems	MoA/MLWE	Planned	Needs funding	
(iv) To conduct general insects, pests, diseases and weeds survey in all agro-ecological zones; General fruit & vegetable insect pest survey on the major growing areas of Eritrea	MoA/ UoA	On-going		
(v) Study and Identification of races of fungi on sorghum (Leaf blight, Anthracnose and rust)	MoA/ UoA	On-going		

8.8 Information acquisition and storage

Existing situation: This strategic theme is related to those discussed above. As already mentioned in most previous themes, there is a need to undertake field surveys in order to improve the knowledge base on distribution of crop and livestock diversity and the kinds of threats acting on this diversity. A good deal of information of indigenous knowledge and traditional farming systems has been collected over the past few years and is available in a variety of published reports and government papers.

Needs: There is no central collection of the existing data, nor any useful synthesis of the entire set of information to provide a national overview. This kind of analysis would be best undertaken by either the College of Agriculture and Aquatic Sciences (CAAS) of the University of Asmara, or the DARHRD of the MoA, with the DoE having the role of co-ordination and facilitation. These institutions would be the logical repository for centralized storage of existing survey information. With respect to "associated knowledge", this would be best located in Land Resources and Crop Production Department so that knowledge can be passed to farm level as efficiently as possible. Until Eritrea gains full access to the Internet and increases its international contacts through the return of staff from overseas training, the best approach to filling the gap in "associated knowledge" lies in linkages to international organisations which compile and distribute such information to users. Examples include ICIPE, ILCA, ICRAF, IPGRI, technical departments of FAO and UNEP, etc. Where these organisations make charges for services, the NBSAP could assist with subscription and service charges.

Strategy: To increase use of knowledge about biodiversity within agro-ecosystems

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
(i) To conduct surveys to document farmers/agro-pastoralists and pastoralists knowledge of use of biodiverse production techniques.	MoA/MLWE	Planned	Needs funding	
(ii) Study biodiversity system of crops and livestock in all agro-ecological zones	MoA/MLWE	Planned	Needs funding	
(iii) To map rangeland quality in relation to livestock density and seasonal patterns of use	MoA	Planned	Needs funding	
(iv) Develop and strengthen early warning system for sustainable management	MoA/MLWE/ Meteorological Office/Grain Board	Ongoing		
(v) To develop a national system for agricultural biodiversity information collection, dissemination and exchange;	MoA/MLWE/ UoA	Planned	Needs funding	

8.9 Public awareness and education

Existing situation: This theme can be considered as an extension of the above. It is unclear how much use is being made of the media for the promotion of agricultural biodiversity. Farmers appear to be well aware of local diversity and genuinely concerned about its actual and potential loss. They are perhaps less aware of the actions which could be taken to reverse these trends. Radio would appear to be the best medium to use for dissemination of information on farming methods to promote on-farm biodiversity given the lack of TV and low levels of literacy in many villages. At school level, much environmental education appears to be set at a very general level, discussing global rather than local issues.

Needs: There is need for increased dissemination of agricultural biodiversity information through the national media. The Ministry of Information is willing to disseminate information on environmental issues in general, including biodiversity. There is a good deal of potential to prepare short information bulletins which could assist biodiversity surveys or disseminate information on pest management, etc. Similarly, there is scope for inclusion of more information on Eritrean agricultural systems and their associated biodiversity into the school curriculum. Wherever possible, relevant local information should be incorporated into teaching materials and this should be reflected in changes being made in the on-going revision of the school curriculum.

Strategy: To increase knowledge of benefits arising from biodiversity within agro-ecosystems

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
To create awareness at scientific, policy and community level on the importance of agricultural biodiversity conservation and use through the national media, bulletins and incorporate in teaching materials.	MoI/ MoE/MLWE/ MoA/ UoA / MoLG	Planned	Needs funding	

8.10 Legal and institutional structure (capacity-building)

Existing situation: There is no formal legislation covering biodiversity in the agricultural sector. The MoA has drafted some laws (the Plant/Animal Quarantine draft laws, the draft Seed Law, for example), which in one or the other would promote the conservation and sustainable use of agricultural biodiversity resources.

It is likely that the National Environment Proclamation, which is in the process of drafting, will also contain articles covering biodiversity conservation, both within the agricultural sector and elsewhere. The Environment Proclamation should contain legislation to regulate some threats to biodiversity in the agricultural sector (e.g. pollution from industry, pesticides, etc.).

In the interim period, until this legislation is promulgated, all projects proposing to make commercial use of indigenous species or for access to genetic resources should be passed through an Environmental Evaluation Questionnaire [EEQ 3.2 (g) and 3.2 (j) respectively], presented in the National Environmental Impact Assessment Procedures and Guideline, as part of the overall project approval process. This will ensure that issues of intellectual property rights, farmers rights, etc. are resolved before projects are implemented.

It is clear that the capacity of the government agricultural sector to fully implement and monitor the activities described above is fairly limited. Capacity building from such low levels is a difficult and slow process. The collaboration between relevant government agencies involved in the conservation and use of agricultural biodiversity resources could lessen shortages of human and technical capacities.

Strategy: To increase protection of agricultural biodiversity within agro-ecosystems

Activities:

Activity	Responsibility (Lead Institution and Collaborators)	Priority Ongoing or Planned	Funding and Other Needs	Funding Agency
Make assessment studies on how agricultural biodiversity resources, including local knowledge and practices, are better protected and sustainably used through the legal means.	MoA/MLWE	Planned	Needs funding	