Environmental Threats & Opportunities Assessment
E.T.O.A

USAID/Madagascar

March 2002

ACRONYMS

AFARB	Action en faveur de l'arbre
AFD	French Development Agency
AGERAS	Support to the Regionalized Management and Spatial Approach
AGEX	Executing Agencies of the National Environmental Action Plan
ANAE	National Environmental Action Agency
ANGAP	National Association for the Management of Protected Areas
CAPE	Protected Areas and Ecotourism Component
CAMP	Conservation Assessment of Management Plan
CBNRM	Community Based Natural Resources Management
CFE	Environmental Funds Committee
CIME	Interministerial Committee on Environment
CITES	International Convention on Trade in Endangered Species
CNE	National Council on Environment
CNRE	National Environmental Research Center
COAP	Law on Protected Areas
CONARAM	National Ramsar Convention Committee
DCPE	Economic Policy Framework Document
DEF	Direction des Eaux et Forêts
DSRP	Poverty Reduction Strategy Document
DWCT	Durrell Wildlife Conservation Trust
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMC	Marine and Coastal Ecosystems
EP1	Environmental Program, Phase 1
EP2	Environmental Program, Phase 2
EP3	Environmental Program, Phase 3
ESFUM	Forestry Component
ETOA	Environmental Threats and Opportunities Assessment
FAA	Foreign Assistance Act
FFN	National Forestry Funds
FFR	Regional Forestry Funds
GACPM	Groupement d'Armateurs de Pêche aux Crevettes de Madagascar
GCF	Forest Management Contract
GELOSE	Secured Local Management
GOM	Government of Madagascar
GTDR	Groupe de Travail pour le Développement Rural
HIPC	Highly Indebted Poor Countries Initiative
ICDP	Integrated Conservation and Development Project
ICZM	Integrated Coastal Zone Management
IEFN	National Ecological Forest Inventory
IMF	International Monetary Fund
INSTAT	Institut National de la Statistique
JIRAMA	National Energy Distribution Company
KEPEM	Knowledge and Effective Policies for Environmental Management

LDI	Landscape Development Interventions
MECIE	Madagascar Legislation Governing Environmental Impacts
MEF	Ministère de Eaux et Forêts
MPRH	Ministère de la Pêche et des Ressources Halieutiques
NEAP	National Environmental Action Plan
NGO	Non-Governmental organization
NSSMB	National Strategy for the Sustainable Management of Biodiversity
ONE	National Environment Office
OSF	Forest Observatories
PADR	Rural Development Support Program
PAGE	Projet d'Appui à la Gestion de l'Environnement
Plan GRAP	National Plan for the Management of the Protected Areas
PSDR	Rural Development Support Project
PST	Transport Sectoral Program
QMM	QIT Madagascar Minerals
RFB	Biodiversity Forestry Reserve
RFR	Reforestation Reserve
SAGE	Support to Environment Management
SAVEM	Sustainable Approaches to Viable Environmental Management
SNGF	Silo National des Graines Forestières
SOLIMA	National Petroleum Company
SRI	Intensive Rice Production
STA	Technical Secretariat for Adjustment
WWF	World Wide Funds for Nature
ZAC	Zone d'Aménagement Concerté
ZPI	Priority Intervention Zones

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1 Introduction

1.1 Biophysical context

Madagascar is the world's fourth largest island and an island continent. It is 1600 km long, up to 500 km wide, and has a surface area of 587,000 km^2 (making it a little larger than France). Its coastline of 5000 km is fringed with some 260 small islands.

Now lying an average 500 km from the East African coast, Madagascar originally formed part of the Gondwana super-continent. Madagascar and India, then together, broke off from the African mainland around 180 million years ago (late Middle Jurassic). Madagascar split from India around 80 million years ago (late Late Cretaceous) and has since occupied its present solitary position in the Western Indian Ocean.

Madagascar is made up of an ancient (Pre-Cambrian), crystalline basement in the form of a lozenge aligned south west-north east which has been tilted to create an escarpment along its eastern edge, and overlaid in the west by millions of years of accumulated sediments in the west (Western sedimentary plain). The continental shelf is mostly narrow and steep in the east, shallow sloping in the west. The eastern side is bathed in moist trade winds, while the west is mainly dry, and arid in the southwest, providing a large range of climatic conditions and diversity of habitats.

Due to its isolation, Madagascar has developed a unique fauna and flora derived from forms present on the island at its separation and from numerous subsequent accidental colonists. It is best known for the lemurs, primitive primates, related to the bushbabies of Africa, that have diversified into numerous forms (over 32 taxa) some already extinct. Similar patterns of radiation are known from the birds (vangas) and indeed for many other plant and animal groups. The level of endemism of the native flora and fauna is high – an average of about 80% for all taxa at the species level, with many genera and even families unique to the island. Referred to a "laboratory of evolution", Madagascar is one of the world's mega-diversity countries and Africa's highest conservation priority.

1.2 Human context

Madagascar was first settled by humans around the 2nd century AD, in scattered settlements along the west coast. Earliest east coast settlements date from the 5th century AD, and the earliest settlements known from the highlands date from the 7th century AD. While settlement has been dominated by Austronesian peoples originating from the Borneo region, Madagascar has also been settled at different times by people of African, Arab, Chinese and European origin, generating considerable ethnic variation across the country.

Although well known to Arab traders since before the 9th century, Madagascar was first visited by Europeans (Portuguese) in the 16th century. Until the end of the 18th century, European settlements were limited to coastal colonies and trading posts (notably in the south west and north east). Madagascar was united under the first king of Madagascar in around 1800. There followed a period of primarily French and British influence until colonization by France in 1896. France abolished the monarchy and the teaching of English and developed Madagascar as a French-speaking colony. Madagascar gained independence in 1960, since when it has evolved as a republic of the Malagasy people.

The human clearance and use of land in Madagascar comprises two basic tendencies – the Austronesian tendency based on clearance for rice growing, raising pigs and chickens (supporting dense human populations), and the African tendency based on the pasture of herds of cattle and annual grassland burning (with sparse human populations). Human occupation of the land typically brings about extinction of the local large fauna (Madagascar has lost giant birds, lemurs and other

fauna since man's arrival). Both types of land use are highly destructive ecologically, with the result that Madagascar has already lost around 80% of its original forest cover.

1.2.1 Human population and migration

According to the World Health Organization, Madagascar's population in 2000 was of 15970000, growing at an average rate of 2.9% per year since 1990.

The population of Madagascar is mainly concentrated in the central highlands (about 75%) with the highest densities occurring south of Fianarantsoa along the east facing slopes (***Figure 1.2a***, see Annex 5).
In the west, the populations are sparse except in the big coastal towns, which now account for about 10% of the total population. Human migration in Madagascar has not been systematically analyzed. The principal zones of out-migration are the southeast (where population densities are high and lands deforested and exhausted) and the far south, which suffers from drought. The principal in-migration zones are the capital, the large coastal towns and generally the northwest, far north and northeast. In addition there are seasonal regional migrations induced by seasonal activities such as shrimp fishing and sugar cane harvesting.

Among the greater migratory "pressure points" in Madagascar from a biodiversity standpoint are: 1) all of the eastern rain forest corridors; 2) the zones around the coastal towns, particularly Toliara and Toamasina and 3) the whole of the northern tip of the island from Mahajanga across to Mananara and the Masoala peninsular and north to Antsiranana).

1.3 Economic context

Madagascar is today one of the world's poorest countries, with GDP per capita of around $260. Its total estimated GDP in 2000 was US $ 4,020 million, compared to US $ 9,882,842 million for the United States and US $ 1,286,252 million for France.

Madagascar's economy is based primarily on the extraction of natural resources (renewable and non-renewable) and subsistence agriculture. 80% of the population is rural and dependent on the surrounding environment for food and resources. The principal industries generating US $ 673 million (or 17.7% of total GDP) in exports in 2000 are agriculture (cash crops such as vanilla, cloves, pepper and coffee represented (17% of export value), fisheries, tourism, mining and export processing zones clothing production (40% of total export value) (IMF statistics, 2000).

1.4 Environmental laws, policy & institutions

1.4.1 Laws

Madagascar has ratified most of the major international environmental conventions including the Algiers Convention on the Conservation of Nature and Natural resources (Law 70-004), the Convention on Biological Diversity (Law 95-013), the International Convention on Trade in Endangered Species (CITES) (Law 75-014), the Ramsar Convention on Wetlands of International Importance (Law 98-004), the World Heritage Convention (ratified 9/12/82), the UN Convention on the Law of the Sea (ratified in October 2000) and the Climate Change Convention (Law 98-020). Of particular note is that Madagascar's protected areas system is currently based on the direct application of the Algiers Convention of 1968.

Madagascar's principal national law and policy on environment is the National Charter for Environment (Law 90-033) which lays down basic environmental principles and promulgates the national environmental action plan (NEAP) and its three successive 5-year phases (EP1,EP2 and EP3). Among other matters, the Charter requires EIA for all investment projects, which has been

implemented through successive decrees and regulations on compatibility of investments with the environment known as "MECIE" (the current version being Decree 99-954). The Charter is noteworthy in that it pre-dates the Biodiversity Convention, but is based on similar principles. Madagascar may thus be considered a leader in this sense.

Other key laws in the environmental sphere include wildlife laws under the forestry legislation (e.g. Ordinance 60-126) and dependent regulations (notably Decree 88-243 that lists protected species), the law on transfer of management of natural resources to local communities known as GELOSE (Law 96-025) and the decree permitting relative securitization of land subject to GELOSE contracts (Decree 98-610). There is also a new law on industrial pollution. A draft consolidating law on protected areas (known as COAP) has been approved by the National Assembly but has met with technical problems at the level of the Senate that remain to be resolved.

1.4.2 Policies

Apart from the Environmental Charter itself, the key policies relevant to environment are the national policy on forests (Decree 97-1200) and the national biodiversity strategy (negotiated during 2001 but not yet legally decreed). The elements of a policy on coastal zones have also been negotiated, but the instruments remain to be drafted. The majority of sectoral policies now include environmental provisions (e.g. mines, industry) but some remain to be fully "environmentalized" (e.g. fisheries). A further key document is the National Plan for the Management of the protected areas (Plan GRAP)

1.4.3 Institutions

The institutional framework for environment has evolved over the years and is now relatively complex. The first higher environmental body to be created was the National Council for Nature established in 1984. Upon the launching the NEAP a new National Environment Office (ONE) was created, initially attached to the Prime Minister's Office with the mandate to co-ordinate implementation of NEAP. Subsequently a Ministry for Environment was created which became the overarching authority on environmental affairs to which ONE became attached. The Ministry of Environment has the mandate to implement the national environmental policy while the sector ministries (forests, fisheries, livestock, transport, mines, energy etc.) retain sovereignty over development of their respective sectors.

ANGAP (national protected areas management association) is the institution created in 1991 with the mandate to develop and manage the national protected areas network under powers delegated under forestry legislation. However, bringing charges for breach of park rules still requires the agents of the competent ministry (forest or fisheries).

Other bodies include the National Council on Environment (CNE) which is primarily a consultative body attached directly to the President's Office. The CNE has a non-executive, consultative role and comprises several membership colleges, including the private sector, rendering it potentially a highly influential body but which is not yet fully exploited. There is also an Interministerial Committee on Environment (CIME) chaired by the Minister of Environment, which meets infrequently.

The current status of the Ministry for Environment is unclear. The new government led by the popularly proclaimed president, Ravolomanana, has restructured the ministries, integrating environment with transport, forests and tourism, with environment being at the level of directorate. While the status of the new ministries is politically in dispute, the World Bank and IMF had already stipulated that the number of ministries should be drastically reduced from the existing 32 to 12. Thus, it is likely that environment will not be returned to the level of full ministry. One potential advantage of the re-structuring is that forests and environment now come under the same ministry, facilitating the management of forests as a priority for biodiversity conservation rather than as a traditional, productive, sector. Fisheries, on the other hand, will be grouped with livestock and agriculture, reflecting its perceived status as a productive sector.

1.5 Overview of current environmental programs and initiatives

1.5.1 National Environmental Action Plan (NEAP)

The National Environmental Action Plan (NEAP) as defined in the Charter for the Environment and subsequent texts and as manifested by the three 5-year phases (EP1 1992-1996, EP2 1997-2002 and EP3 2003-2007) constitutes the principal current environmental program in Madagascar. The program is co-ordinated by the National Environment Office (ONE) under the aegis of the Ministry for Environment.

Programs 1 and 2 of NEAP each comprised a number of components, with each component being assigned exclusively to one of the recognised NEAP implementing agencies (AGEX), with no unifying framework other than the Charter itself. Phase 3 is being planned using a more rigorous results-based approach, in which a comprehensive logical framework is first defined before attributing activities to particular agencies. In order to promote greater integration with other national programs, EP3 adopts as its higher level objective the national goal of poverty reduction and intervenes primarily at the level of the Commune in common with the rural development program (PADR).

During EP1 and EP2, environmental activities implemented otherwise than by a recognized AGEX have not been treated as administratively within NEAP. Examples include the three principal environmental support programs of USAID – MIRAY (support to protected areas), PAGE (support to environmental policy) and LDI (Landscape Development Initiative) contracted out to private sector operators. LDI, in particular, is regarded by the EP2 machinery as outside EP2. Under EP3 such activities, assuming they matched with elements of the EP3 logical framework, should be regarded as part of NEAP, irrespective of the implementing agency.

The content of the NEAP/EP program will be described in detail in Section III of this report. NEAP and the EPs implement the Charter for Environment. EP1 focused primarily on putting in place the necessary institutions for environment (ONE, ANGAP, Ministry of Environment). The various "direct" (i.e. on the ground) components of EP2 have focused on approaches and tools for sustainable environmental management, including the regional/spatial approach to management (AGERAS), protected areas and ecotourism (CAPE), community-based management (GELOSE), integrated coastal management (EMC) and rational forestry management (EFSUM).

In EP3 the focus will be on mainstreaming the tools and approaches for environmental management (AGERAS, GELOSE and EMC) and integrating them with development activities, notably by adopting the same framework of intervention as the rural development program (PADR) in priority intervention zones (ZPI) important for biodiversity. Environmental policy activities will continue at a central level, mainly through the National Environment Office.

1.5.2 Environmental initiatives outside NEAP

As noted above, up until now NEAP has been considered to include only activities defined within a program component and implemented by an AGEX. Examples of environmental activities outside NEAP include a substantial number of conservation initiatives undertaken by NGOs both national and international. Thus, the initiative of a number of NGOs to help Madagascar ratify and implement the Ramsar convention proceeded without reference to EP2. Other examples include the environmental education program of WWF, community-based conservation programs of the Durrell Wildlife Conservation Trust (DWCT) and numerous minor initiatives.

Under the results based approach of EP3, the NEAP should acquire a more open, pluralist, nature, with all operators having the opportunity to contribute to and influence EP3 implementation. Furthermore, agencies formerly limited to activities within NEAP, such as the National Association

for Environmental Action (ANAE) and the new NGO Support Services to Environmental Management (SAGE – recently split off from ONE) should also be free to act as operators within the framework of the rural development plan (PADR).

1.5.3 Other relevant initiatives

A number of other programs and initiatives are relevant to the management of the environment in Madagascar, the principal ones being:

- Political decentralization
- Structural adjustment
- Highly Indebted Poor Countries initiative (HIPC)
- Poverty reduction strategy (DSRP)
- Rural development support program (PADR)
- Climate Change Program
- Sector projects and policies, especially in the areas of forestry, agriculture, fisheries, energy, mines, transport, population and health)

1.6 Purpose of present review

The present review aims to provide an objective assessment of environmental threats and opportunities for action to address those threats. The review will then identify suitable entry points for USAID in the light of prevailing legal and policy requirements and USAID's particular strengths and orientations.

In accordance with the FAA, the assessment places particular emphasis is placed on biological diversity and tropical forests. The review aims to provide a balanced, informative account that will enable the non-technical reader with limited prior knowledge of Madagascar to understand the issues and to evaluate the proposed Integrated Strategic Plan of USAID's Madagascar mission against the FAA and other policy requirements or criteria.

2 State of Natural Resources

2.1 Forests and terrestrial biodiversity

2.1.1 Biophysical setting

Madagascar is an island continent that spans 14° of latitude and encompasses two major global climatic systems. Eastern Madagascar lies in the tropical rainforest belt while southwestern Madagascar lies in the belt of dry climate that runs across the southern Indian Ocean from Australia to Southern Africa. The varied relief and atmospheric systems (trade winds in the east, monsoon in the northwest) generate further climatic subdivisions, at least five principal climatic regions being recognized.

Geologically, Madagascar was separated from the Gondwana land mass some 180 my ago, and later separated from India about 40-60 my ago, since when it has occupied its current isolated position. Species assemblages have thus had millions of years to evolve.

Underlying geology also plays a part in determining local hydrology and soil type. An assessment prepared by Kew Botanic gardens (DuPuy & Moat 1996) distinguished over 100 types of primary vegetation based on four principal regions (West, East, Central and South) and 25 sub-regions. In sum, the large variety of habitats coupled with Madagascar's large surface area and the ancient and varied origins of its flora and fauna result in an exceptional diversity of species and ecosystems.

2.1.2 Types and location

Overall, there are five types of forests around Madagascar. The North and the East are characterized by dense humid forests (low, mid- and high altitudes). The most important dense humid forest blocks are found around the Masaola peninsula and on the Mananara coast (NorthEast). The rest of the humid forest stretches from Mananara down to the South East in Tolagñaro in the form of a narrow, fragmented 'corridor'.

Dense dry forests, littoral forests (NorthEast), and mangroves are the principal forest types found in the West. Spiny forests are found in the sub-humid and arid South and the SouthWest.

Table 2.1a below summarizes the data on Madagascar's forest types and location, as well as their importance for biodiversity.

2.1.3 Importance of forests for biodiversity

Malagasy forests comprise 4220 known species of trees and large shrubs. An analysis of the tree flora reveals that 33% of the 490 indigenous genera with tree species are endemic to Madagascar (including the Comoro Islands). The 329 non-endemic genera are represented by an additional 3280 species of trees and large shrubs, of which 95% are endemic (Schatz in Lourenço and Goodman, 2000).

Indeed, it has been estimated that approximately 90% of the Madagascar's unique biodiversity is forest-dependent (J. M. Dufils, 2001 in Stiassny, M. & Sparks, J., in press.).

Assessments of changes in Madagascar's forest cover have estimated that forest loss is currently occurring at an average rate of 1.5 to 3% per annum. The remaining 13 463 000 hectares of forests (primary and degraded) account for 23% of the island's total area (J. M. Dufils, 2001 in Stiassny, M. & Sparks, J., in press.) and harbor the overwhelming majority of Madagascar's endemic species, as revealed in ***Table 2.1a*** below.

Madagascar's flora accounts for about 12,000 species, out of which approximately 10,000 species are forest dependent; 81 to 86% of these being endemic. Madagascar alone harbors a higher number of orchid species than does the whole of Africa. A substantial proportion (33%) of the native flora consists of trees or shrubs, of which 96% are endemic. Most of the remaining native flora is forest-associated.

Dry forests in the South West comprise more than 1000 species of which more than 90% are endemic (Toliara Biosphere Proposal, ONE 2001). Unusually for littoral vegetation, the dune bush of south west Madagascar comprises at least 112 species, 95% of which are endemic.

As regards the fauna, 3317 taxa of terrestrial macrofauna have been identified on the island, including mammals, amphibians, reptiles and birds, of which over 90% are forest associated or restricted (ONE 1999).

Within the mammal taxon, 156 species have been inventoried, including at least 32 lemurs, all of which are endemic. Endemism in other mammal groups is high – insectivores 97%, rodents 89%, carnivores 87%. Over 90% of mammals are restricted to forest habitats.

Madagascar has 258 species of birds. While this is a low number in comparison with African countries, 120 of these species are endemic, of which about 100 are forest-restricted.

The reptile category includes 333 species, of which 91.6% (305 species) are endemic. Of the 65 genera of reptiles, 60.3% are endemic. There are 182 amphibian species in Madagascar (of which 179 are frogs), 98.4% of which are endemic. Of the 18 amphibian genera 83.3% are endemic to

Madagascar. The majority of amphibians are forest-restricted and most are confined to dense humid forests, such as those found in the South East (Glaw and Vences in Lourenço and Goodman, 2000).

At least 42-68 amphibian and 24-34 reptile species are still awaiting description or "resurrection" (Glaw and Vences in Lourenço and Goodman, 2000).

Table 2.1a- Madagascar's forest types, location, proportion of endemic species and biodiversity importance/ecological function of flaura within protected areas

Forest type	Location	Proportion of Endemic Species of flora (%)	Biodiversity Importance/ Ecological Function Importance
Low altitude rainforest	East	77	*Extremely high biodiversity importance* Extremely important ecological function
Mid-altitude rainforest	East	73	*High biodiversity importance* High ecological function
Dense dry forests	West	78	*High biodiversity importance* High ecological function
Spiny forests	South West	Over 90	*High biodiversity importance* High ecological function
Dry forests on Karstic sub-strata	West Southwest	n/a	*Extremely high biodiversity importance* High ecological function
Mangroves	All major Western rivers mouths	n/a	*Low biodiversity importance* High ecological function
Littoral and sub-littoral forests	Southeast Northeast West	n/a	*High biodiversity importance* High ecological function

Source: Adapted from Conservation International and Direction des Eaux et Forets, 2000

The term ecological function in the above table refers to the ability of these forests to preserve genetic diversity, original biodiversity, and to protect and sustain watersheds.

2.1.4 Economic Importance and Potential

2.1.4.1 Global Economic Importance of Madagascar's Forests

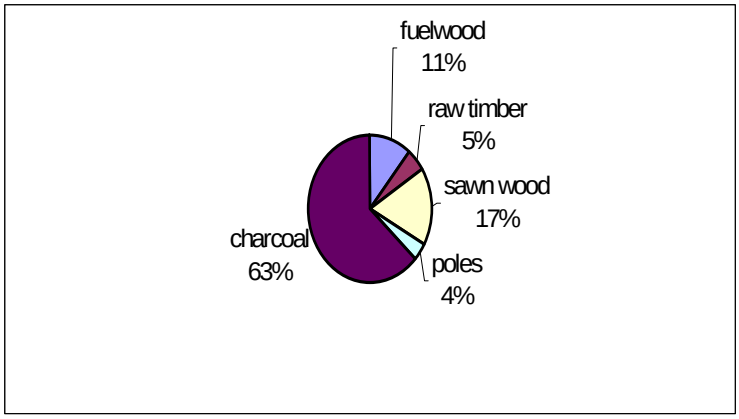
The existence of a wide variety of forest endemic faunal and floral species, confer an extremely high existence value on Madagascar's forests. This high existence value is reflected in international organizations' investment in Madagascar forest conservation over the past 20 years. USAID, for instance, has invested approximately US $56.5 millions in various forest/biodiversity conservation projects (SAVEM, KEPEM, MIRAY, WWF Agents de Protection de la Nature, LDI, PAGE) over the last ten years. The total investment in NEAP is expected to reach $450 million by 2008. Economic valuations of tropical forests (Kramer et al., 1995) have revealed that people's willingness to pay for preserving these forests is relatively high (ranging from US $ 24 to 65 per US household), and could generate considerable revenues for conservation activities.

2.1.4.1.1 Local Economic Importance of Madagascar's Forests

Forests in Madagascar are perceived locally as a source of goods such as fuel, shelter and medicine. Local people's livelihoods heavily depend on forest resources. It was estimated that in 1998, 96% of collected forest products in Madagascar consisted of wood for household consumption, especially in the form of charcoal, as shown in ***Fig 2.1a*** below. Most importantly, Malagasy people regard forests

as a means to acquire land for the expansion of agricultural production; they usually acquire that land for cultivation through slash and burn (*tavy* in Malagasy).

Figure 2.1a- Domestic use of forest wood in Madagascar in 1998



In economic terms, the total value wood for domestic consumption was equal to US $60 millions in 1998 with US$6.6 millions for fuelwood and US$36.5 millions for charcoal. (Ramamonjisoa, 2000)

Source: Ramamonjisoa, 2000

At the national level, forest resources are considered a source of foreign currency and energy. Indeed, 75 % of forest export revenues in Madagascar are generated through the export of timber. However, these export revenues are relatively insignificant and lower than the economic value of forest in a conserved state (CI, DEF, 2000).

2.1.5 Trends in biophysical condition, abundance, and distribution

2.1.5.1 Biophysical condition

It is only recently that forest indicators have been formulated, in order to monitor biodiversity loss and to evaluate the potential impacts of the National Environmental Action Plan's conservation activities on Madagascar's biodiversity. Forest cover indicators reveal changes in the biophysical condition of four main types of forests: rainforest (Northeast and East), low altitude rainforest (East), spiny forests (SouthWest) and dense savanna (West).

For the dense humid forests, figures indicate an average reduction in overall cover of 0.76% per annum (F. Hawkins, unpublished data).

Satellite images showing forest cover loss in the USAID priority Eastern forest corridors reveal that loss is occurring along the edges of the forest block for Mantadia-Zahamena and Ranomafana-Andrigitra, but along the edge of the forest block *as well as inside* it for the Anosibe/Anala-Ranomafana corridor. The recent comparative analysis of forest cover loss based on the above satellite images between areas where USAID is intervening and areas where it is not (Hawkins & Horning 2001) reveals that:

- "*Forest is disappearing much more rapidly in areas where USAID is not intervening*." Compared to the USAID priority Mantadia-Zahamena (2.2% of cover loss from 1993/94 to 1999/2000) and Ranomafana-Andrigitra corridors (3.8% of cover loss from 1993/94 to 1999/2000), the control/non-USAID priority corridor experienced a 6.7% forest cover loss over the same period;

- "Forest at high altitudes has also been lost at a disproportionately high rate in the control corridor compared to the USAID focal corridors."

For the low altitude rainforest, the average yearly rate of change is of 1.53% (data is however missing for some of the low altitude rainforests). For the spiny forests, the annual loss is 3.44%, making it the

most threatened forest type (yet the least represented in protected areas). Dense savannas exhibit a loss of 0.67% per annum. (Hawkins and Horning, 2001).

2.1.5.2 Abundance

Trends in forest loss can be determined through estimations of forest cover over a certain period of time, as it is by ***figure 2.1b*** (see Annex 5.5) .

A national forest and ecological inventory, the IEFN (*Inventaire Ecologique et Forestier National)* was undertaken between 1994 and 1996. IEFN estimated the remaining forest cover of Madagascar to consist of 13,453,000 ha, covering about 23 % of the island's land area, classified in three main types of forests or formations (evergreen, deciduous and other natural forest formations).

A more recent satellite-based estimation of Madagascar's forest cover was undertaken in 2000 by the Joint Research Center (J.M. Dufils in Stiassny, M. & Sparks, J., in press.), and produced the following figures (***Table 2.2***):

Table 2.1b- Estimations of forest cover in Madagascar in 1994

Formation	**Area in hectares**
Evergreen forest	5,532,800
Dry forest	4,118,300
Complex Secondary forest	7,199,100
Mangrove	453,000
TOTAL	17,303,200

Source: Joint Research Center, 1999 in (J.M. Dufils in Stiassny, M. & Sparks, J., in press.)

2.1.5.3 Distribution

Deciduous forest formations are scattered in the western part of Madagascar and near the west coast. Dense humid forests are found in the East, and remain the currently most abundant forests in Madagascar. Dense humid forests include the mid-altitude rainforest of the Central Domain and along the eastern escarpment and low altitude forests (including littoral and Sambirano formations).
Other less abundant humid forest formations, such as the sclerophyllous forests or the sclerophyllous montane formations, are found in the Central Domain. Overall, 10 major forest blocks remain in Madagascar. (***Figure 2.1c***; see Annex 5)
Four of the most important forests are located in the east. Two major dry dense and mangrove forest blocks exist in the northwest. Two blocks of dry forests are located in the southwest.
The last two remaining forest blocks are found in the southeast of the island (dry dense and secondary forests).

2.1.6 Trends in Management

2.1.6.1 Historical overview

Historically, the forests of Madagascar have been cleared by humans on a massive scale to make way for agriculture, pasture and wildlife hunted for food, probably causing or hastening the extinction of numerous species of large fauna (giant lemurs, elephant birds, pigmy hippo etc.). Awareness of the conservation value of forests was first officially recognized by Andriananponimerina the king of Madagascar in the 1780s, who passed a law banning the cutting of forests within the kingdom of Imerina.

At the local level, there is evidence that certain communities living in or close to forests have endeavored to conserve forests and their resources. Examples include the Mikea people of the southwest and the Bara living around Zombitse national park, also in the southwest. There are also numerous examples of local taboos (*fady*) that ban the hunting or harming of certain species such as lemurs, tortoises etc. However, in areas where it is possible to grow rice, or where there is a tradition of extensive cattle raising, the tendency has been to clear forest, and most large edible species are still hunted throughout most of their ranges.

Following colonization by France in 1896, two phenomena emerged. On the one hand, there was extensive natural history research that led to the creation of the first protected areas and wildlife conservation laws from the 1920s onwards. On the other hand, natural forests were quite extensively logged for valuable timber and plantations established using introduced pine and eucalyptus. Forestry policy was essentially one of production, while conservation was primarily for science. Nonetheless, both approaches required the accurate mapping of forest such that the extent of Madagascar's forest estate became known.

Global concern over the loss of forests and wildlife only began to manifest itself in the 1960s. In 1968 Madagascar signed the Algiers convention on the conservation of Nature and Natural Resources, which provided a framework for creating protected areas that is still used today. This stimulated the creation of new reserves but did little to change the forestry policy, which was still one of production through logging and plantations. During the socialist period 1974-1980 there was little further change.

Major changes finally came in the early 1980s when Madagascar opened to western influence and began negotiations with the IMF for structural adjustment loans. There was a massive increase in the level of biological and conservation research by US and other institutions that has helped to provide baseline information and capacity for rational management of forests and biodiversity. Perhaps the key contributions of the research have been to show:

1. Madagascar's unique terrestrial biodiversity is essentially restricted to natural forests;
2. Madagascar's biodiversity is both more globally important and more threatened than had been realized;
3. The precise location of remaining biodiversity (which permitted setting science-based priorities for conservation);
4. That most of the biodiversity is outside the protected areas network;
5. That conservation of biodiversity cannot be dissociated from human development, especially in predominantly rural Madagascar.

The research has also developed and refined techniques for monitoring changes in forest cover and biodiversity loss, providing the means for evaluating the impacts of conservation action on biodiversity.

In parallel, major advances have been made in approaches to *management* of forest and biodiversity resources.

Prior to the beginning of the national environmental action plan (NEAP), advances were made primarily at the central level of management. A major national congress on Madagascar's conservation was organized by WWF in 1984. Decision-makers became more aware of the issues, leading to improvements in the management of certain protected areas and better control of trade in endangered species (a revised list of protected species was legislated in 1988, Decree 88.243). Deliberations at the national level led to the promulgation of Madagascar's Charter for the Environment (*Charte de l'Environnement*, Law 90-033) that laid the basis for the NEAP and enshrined the principle of conservation of the environment hand in hand with human development.

2.1.6.2 Current legislation and policy

Madagascar's legislation on biodiversity is based on the following bodies of law – forestry laws, wildlife laws (which have been promulgated under forestry law since the 1930s), direct application of international conventions and national environmental law (notably the Environmental Charter of 19990 (law 90-033). Forest legislation is summarized in ***Table 2.1c***.

In 1997, the forestry legislation was revised (law 97-017), and in 1998, a decree (98-782) defining the terms and conditions of forest exploitation was promulgated.

Table 2.1c- Forestry legislation

Issues	Principles
Hunting	• Hunting is allowed on all public or private state properties, except in areas where it is explicitly prohibited (*article 6 and 25* ***edict #60-126 of October 3, 1960****).* • Individuals must get a permit from the district forestry officer (Chef de Cantonnement) (*article 10,* ***decree # 61-093 of 02/16/1961****)* before hunting (this does not apply to local communities' usage rights) (*article 19).* • A special permit for "scientific hunting" can be granted by the Waters and Forests' Ministry in exchange of a fee (*article 15,* ***decree #61-093****)*; this allows the hunting of wild animals (protected or not) in natural reserves, national parks and special reserves, and the possession and export of a limited number of animals within a 4-month period. • The ministry of Waters and Forests can grant commercial hunting permits to kill, trap, carry or sell animals and birds classified as "game" during the fixed hunting period, OR to kill, trap, carry or sell pest animals at any time *(article 18 and 19,* ***decree #69-390 of 09/02/1996****).*
Slash and burn	• Slashing and burning is forbidden within the national forestry domain *(article3,* ***edict #60-127****)* outside that area (on private properties or domanial lands), slashing and burning is also forbidden unless the district forestry officer for the *Fokontany* authorizes it (*article 2,* ***decree #87-143****).* • Temporary or indefinite owners of plots of land can be granted a one year, non-renewable and non-extendable *(article 3,* ***decree #87-143****)* slashing and burning permit, provided the slope of the concerned plots lie between 20-50% and not beyond.
Other types of forest fire	• "Cultivation fires" which burn ligneous vegetation to make way for more land for future agricultural cultivation; allowed without any permit or authorization in areas outside national forestry domain and reforested areas. • "Pasture fires" to clear land for future pasture; allowed in areas outside national forestry domain and reforested areas; requires an authorization (*article 11,* ***decree #87-143****);* a safety area of 20 meters around the area to be burnt must be respected, so should limits (*article 17,* ***decree #87-143****).* • "Wild fires" for no purpose are considered criminal (*article 11,* ***edict #60-127****)* and are not allowed anywhere.
Forest management	• There are four officially-recognized types of forest exploitation (***decree of 1/25/1930***) : use right (*article 31*), cutting permit (*article 16*), exploitation permit (*article 6*) and special exploitation permit (*article 15*). • Classification of forest lands into forestry, pasture and agricultural lands (***edict #62-123 of October 1, 1962***); forestry areas are forbidden to livestock.
Reforestation	• Reforestation is to be carried out in specific reforestation areas (registered by the state specifically for reforestation activities) or on other lands, subjected to the approval of the forestry commission. • Fiscal incentives to encourage reforestation will include state subsidies from the different forestry funds to contribute to land management protection and protection of reforested areas; non-payment of forestry license fees could be another fiscal incentive in exchange of reforestation activities by individuals, communities, etc. • There are five types of reforestation: • industrial reforestation for the production of commercial and fuelwood; • reforestation for ecological conservation and restoration (of dunes, watersheds, soils, etc.) • reforestation for social purposes (education, recreation, etc.) • reforestation for experimentation (with species) • reforestation for direct economic purposes (agriculture, pasture) • A 15-year reforestation plan is established in each forestry district. The plan is implemented through yearly forests programs (***decree #2000-383 of June 19, 2000***)

Source: adapted from ONE, PNUE and ANGAP, 1997

A new forestry policy was elaborated in 1995. ***Table 2.1d*** summarizes its main objectives and strategies.

Table2.1d- The forestry policy

Objectives	Measures and Recommendations
1. Mitigate forest degradation	• Find alternatives to *Tavy* (slash and burn) • Define a fire management measure with local communities • Revise the legislation on fauna and flora management
2. Manage natural resources more efficiently	• Elaborate and launch management plans • Rationalize forest exploitation: attribute plots via public auctions and specifications in order to sustain forestry resources • Internalize the intrinsic value of wood products in the production costs and overall, improve the management of revenues from forest products • Improve professional skills in order to avoid waste
3. Increase forest cover and potentials	• Create incentives for reforestation activities • Guarantee land tenure security to individuals engaging in reforestation activities • Plan reforestation programs according to regional and local needs • Intensify activities related to watershed management
4. Increase and improve the economic performance of the forestry sector	• Reflect the value of forest products in a better way (introduce norms for exploitation, exploit a broader range of products, recycle, produce better quality products) • Facilitate forest products' access to the market • Develop ecotourism

2.1.6.3 The Protected Area System

The first protected areas were created in the 1920s, and there are now 47 protected areas throughout Madagascar, made up of 23 special reserves, 16 national parks and 8 integral natural reserves. These 47 protected areas include 12.8% of Madagascar's remaining total forest cover and are all managed by the National Association for Protected Areas Management (ANGAP).

A key objective of the first five-year phase (EP1) of the National Environmental Action Plan (NEAP) was to implement operations of an urgent nature that included protecting the heritage of *biodiversity in the parks, reserves and gazetted forests*, in conjunction with the *development of the surrounding communities* (USAID, 1997). This was reflected in the launching of a series of Integrated Conservation and Development Projects (ICDPs). At this time, ANGAP tended to be considered as Madagascar's leading agency for biodiversity conservation.

However, at the end of EP1, it became more widely recognized that most of the country's biodiversity was in fact outside protected areas in the classified forests. ANGAP's role thus became more focused on the management of national parks, while the role of the Ministry of Waters and Forests – in charge of the management of all the non-protected areas' forests - was given more importance.

ANGAP's mission is to establish, conserve and manage a national network of parks that are representative of Madagascar's biological diversity. Hence the creation of 6 targeted eco-regions (North, East, Center, West, South and an area including unique isolated habitats). A new protected areas network management strategic plan (known as the "Plan GRAP") was designed for a period of five years (2000-2005) which aims to:

- conserve the ecosystems that are representative of the Malagasy biodiversity and/or of sites of particular importance using an ecoregional approach;
- classify the protected areas in 4 priority levels, 4 being the most demanding in terms of management;
- create new areas;
- optimize the network of protected areas through research and ecological monitoring;
- promote favorable attitudes towards protected areas' conservation;
- promote sustainable development, through eco-tourism.

2.1.6.4 Forests Outside the Protected Area System

There are three categories of forests outside PAs - classified forests, forest reserves and "forêts domaniales" (referring to known but unclassified forests in the territory of Madagascar), all of which fall outside the protected areas system and management rules. These forests' areas represent 87.2% of the island's remaining forest cover and are managed by the Ministry of Water and Forests (Ministère des Eaux et Forets, MEF).

During the second environmental program, the response to the limitations of ICDPs was to promote and "expand conservation and development activities *beyond national parks and reserves* into a *regionalized landscape [ecology] approach* focused on identifying and protecting key biodiversity conservation zones (e.g. *corridors*)." (USAID, 1997).

The specific key objectives under this new landscape approach are to improve governance of the forestry sector, to sustain community-based forest management and overall to promote the regional approach to forest and biodiversity conservation.

2.1.6.5 Community-based management

The first law promoting the management transfer of renewable natural resources to local communities was promulgated in September 1996 (Law 96-025), known as "GELOSE" (Gestion Locale Sécurisée). GELOSE was elaborated in a top-down manner, which has led to difficulties in its application at the field level. GELOSE contracts require facilitation by an official mediator. While this is useful where there are conflicting claims to the resources, such mediation is not generally necessary for simple cases of management transfer.

In February 2000, the government approved the GCF (or "Forest Management Contracts") decree, which transfers the *management of forests to local communities*. The GCF falls under the GELOSE law but puts a specific emphasis on community-based *forest* management according to a simplified procedure. GCF defined clear forest management plans, annual operational plans, and resource accounting instruments, which GELOSE failed to provide. Through training and support programs, GCF insures the improvement of management and negotiation capacities of local communities.

USAID's LDI project has, to date, contributed to the signature of seven GCF contracts in the provinces of Fianarantsoa and Moramanga. Two other contracts are waiting for official approval from the government (A. Abraham, pers. comm.). The USAID-funded WWF/CAF-APN project has contributed to the signature of 13 GCF contracts, for the management of dense humid forests. It is expected that another 13 contracts will be obtained by the end of 2002 (N. Razakamarina, pers. comm.).

Conservation International, through the USAID-funded MIRAY project, has facilitated the negotiation of nine GCF contracts (Amboasary (1), Miarinarivo (1), Port Berger (1) and Moramanga region (6). Eight other contracts are being negotiated - Port Berger (2), Ambilobe (2) and Ambatondrazaka (4) (B. Delaite, pers. comm).

In December 2001, Josserand performed an assessment of community-based natural resource management in Madagascar, with a specific focus on community-based *forest* management on six sites in the provinces of Moramanga and Fianarantsoa. (Josserand, 2001) The report concludes that unless:

1. current legal and policy instruments are reinforced,
2. the capacity of communities, national institutions, NGOs and donor agencies to follow through the management transfer process is improved,

3. the capacity of communities to manage a commercial activity (natural resources providing the goods for such an activity) is increased…

…the current rate of transferring resource management responsibilities to communities will not be sustainable. This raises a key issue about quality – there appears to be tendency to issue as many contracts as possible without regard to the quality of subsequent management.

2.1.6.6 Improved Governance within MEF

The mid-term review of the second environmental program (ONE, 2000) criticized a lack of transparency and efficiency within the Ministry of Water and Forests (MEF), resulting in the imposition of a series of conditions on potential future debt relief. Continued support to MEF for the remainder of EP2 for EP3 are also dependent on compliance with these conditions.

The conditions concern promoting greater transparency, accountability and improved governance in the forestry sector with a special emphasis on:

1. the application and enforcement of decrees defining forest products exploitation in and around sensitive areas, and restricting the export of logs of high value timbers; in this respect, it is required from the government of Madagascar that it commits to effective legal proceedings against offenders; it is also expected that the inter-ministry committee for the environment (CIME) and the national council for the environment (CNE) will actively apply the above decrees at every level, with support from high levels of government;

2. the set up of a transparent system for the issuance of new cutting permits (this condition also applies to the mining and the fishery sectors); permit issuance should be in accordance with a system of checks and balances with the participation of the ministry of the environment, the regional and local authorities and community-based organizations, as required by the MECIE decree and the forest policy;

3. improving the management of the national and regional forestry (FFN and FFR) funds, by ensuring a transparent monitoring of the collection system, establishing a mechanism for disbursing funds at all levels, merger of the AFARB (action en faveur de l'arbre) and FFN/FFR accounts such that they are all used to support sustainable forest management;

4. the creation of independent forest observatories (OSF) at the national and regional levels; these observatories would contribute to the monitoring of forest resources' management and the collection of forest taxes. The IRG/PAGE project funded by USAID is planning to implement a governance program, including the creation of regional forest observatories in two pilot regions (Toamasina and Tolagnaro), as well as the launching of a communication program to inform communities, civil society, etc. of their rights with respect to forestry management.

2.1.6.7 Ecoregional approach

One of the most important lessons learned from EP1 with regard to forest management was that "Conservation and development need to continue to be linked in EP2. The ICDPs, however, were very complex to manage and too costly (when compared to the limited population reached) to be considered sustainable." (USAID, 1997). Building on lessons learned from EP1, USAID's conservation management strategy for EP2 sought, amongst other objectives, to "expand conservation and development activities beyond national parks and reserves into a *regionalized landscape approach* focused on identifying and protecting key biodiversity conservation zones (e.g. [forest] corridors); " (USAID, 1997). The resulting eco-regional, landscape-based approach sought to influence how humans interact with their environment to ensure a sustainable use of natural resources in the broader landscape.

The LDI program was launched in 1998 and set out to promote the sustainable use of natural resources in regions where ecosystems are of a vital importance: Fianarantsoa (Ranomafana-Andringitra corridor and Isalo national park), Moramanga (Mantadia-Zahamena forest corridor), Mahajanga (dry forest) and Antsiranana. In 2001, LDI has assessed the potential contribution of its activities towards reducing slash and burn activities in four pilot zones: two in Fianarantsoa, one in Mahajanga and one in Moramanga. The forests found in the above regions are dense humid primary forests. The assessment yielded the following results (***Table 2.5***):

Table 2.1e- Trends in loss of primary forest due to slash and burn in LDI's priority intervention zones (1990-2001)

Locations	**Number of new slashed and burnt plots**				
	1990-1993	1994-1997	1998-2001		
Andohanisoa (Fianarantsoa)	33	0	7		
Ranomena (Fianarantsoa)	4	11	5		
Belalitra-Ambalamanga (Mahajanga)	14	11	6		
	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001
Ambalavelo (Moramanga)	1	2	3	4	1

Source: adapted from LDI and PACT, 2001.

Overall, LDI has managed to mitigate primary forest degradation through slash and burn activities in the above four pilot zones, located within primary forest areas, appearing to support the regionalized approach.

2.1.6.8 Zoning

During EP2, the zoning of Malagasy forests was identified as a precondition to the launching of a national ecological forest inventory (IEFN), and to facilitate the management of national forests.

The purpose of zoning is to determine the appropriate management mode for different forest blocks, depending on their function (ecological, productive, or regulative). The primary objective of zoning is to delimit forest areas (and other vegetal formations) and describe their status, potential for development, for conservation and for enhancement.

In 2001, the multi-donor committee for NEAP (known as CFE) prescribed the zoning of forests as a priority action for MEF, with the aim to:

- Delimitate zones depending on their physical and ecological status and restrict their management mode in accordance with that status;

- identify zones that are the most appropriate for management transfer under GELOSE; ideally, a total zone of 5 million hectares of natural forest would fall under this category. The immediate objective as of June 2002 is to launch the management transfer of 1.5 million hectares.

Zoning activities were launched. The following results were obtained (***Table 2.1f***):

Table 2.1f- Results yielded by the zoning activities in each province (2001)

Province	**Management Priority**	**Area (ha)**
Antananarivo	Ecology	588,201
	Production	3,929,037
	Ecology and production	2,569,276
Antsiranana		767,998
		225,988
		195,086
Fianarantsoa		645,357
		488,436

Out of the results obtained, it is expected that:

1. a map representing the management mode of every single forest block nationwide will be produced,
2. technical documents including: the criteria allowing for

	Ecology and production	286,321
Mahajanga	Production	1,875,325
	Ecology and production	955,881
	Ecology	677,484
Toamasina	Ecology	1,175,787
	Ecology and regulation	632,161
	Ecology and production	255,970
Toliara	Ecology	2,554,157
	Ecology and production	805,283
	Production	764,994

2.1.7 Linkages with other resources

Forests protect freshwater ecosystems from sedimentation. It is also the case that many wetlands are adjacent to forests; consequently, the maintenance of forest biodiversity is also a condition for the maintenance of wetland biological diversity.

In relation to marine and coastal resources, the existence of forests offers the following advantages:

- greater potential for eco-tourism when the forest is located near a marine or coastal area, such as in Nosy Be (North West) or Toliara (South West);
- reduced risk of coastal plain flooding;
- reduced risk of dune movement and desertification;
- better regulation of water movement to coastal areas, thus favoring the stability and diversity of mangroves;
- protection of marine and coastal ecosystems especially coral reefs, through reduced sedimentation.

Conservation of forests and terrestrial biodiversity may benefit agriculture through improved irrigation management, longer growth season, maintained rainfall, stable local climate and in the sufficient supply of resources needed by farming communities, such as wood and medicinal plants.

2.1.8 Principal Threats

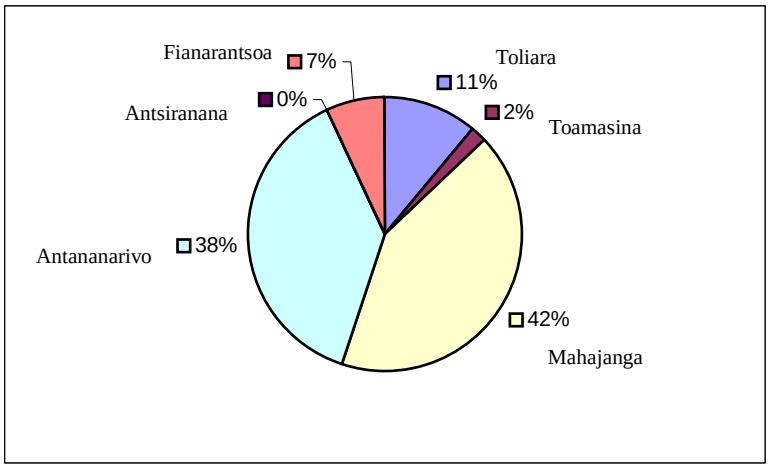
2.1.8.1 Population pressure

A threat that is directly linked to sustained slash and burn and therefore to forest depletion is population pressure. ***Figure 1.2a*** (see Annex 5.5) is a map of population densities in Madagascar. As shown in the figure, the highest densities are found around the long primary forest corridor stretching from the North of Antalaha down to Tolagñaro, in the South of the island. High density rates and a population growth of 2.9% per annum constitute a serious threat to the existence of the remaining dense humid forests.

2.1.8.2 Slash and Burn cultivation (*tavy*)

The sustained practice of slash and burn remains the largest cause of forest cover loss and of all the biodiversity associated with those forests. ***Figure 2.1d*** below shows the rate of slash and burn practices for each province of Madagascar in 1998.

Figure 2.1d- Rates of slash and burn activities by province (1998)



The *tavy* rates (shown in percentage) represent the proportion of burnt forest in relation to the *total remaining forest cover in each province respectively.*
Matching these figures with the forest distribution patterns mentioned above, one can assess that *the forests under the most severe threats from slash and burn are the dense dry forests in the West and the spiny forests of the South.*

Source: adapted from ONE, 1999

There is a false tendency to assume that the Antananarivo province is completely deprived of primary forest. At the frontier between the Antananarivo and the Toamasina provinces, in the east, lies a corridor of low altitude dense humid forest, part of which is included in the Antananarivo province. There are also patches of dense shady forests in the West of the capital; a mixture of forested savannas or high grasslands (*tanety*) characterizes the rest of the province. Data show that rates of loss by slash and burn are higher for smaller fragments (see Fig. 2.6)..

The regeneration of Malagasy forest is a long process (see ***Table 2.1g*** below). The deciduous forest, the Eastern rainforest and the Southern spiny forests take the longest time to regenerate. Because the fallow periods are very short (3 to 5 years at the most), no full regeneration of primary indigenous forest has been reported in Madagascar during the past fifty years (F. Hawkins pers. comm.).

Table 2.1g- Malagasy forest regeneration rates

Forest Type and location	Regeneration rate for a 'new' full forest
Dense humid forest (East)	• 100 years after clear-cutting • growth rate of 0.6 cubic meter /ha/year after selective cutting
Dry deciduous/spiny forest (South/South West)	• infinite (the Swiss forestry project at Kirindy concluded that sustainable harvesting of wood was impossible)
Dense dry forest (West)	• unknown for after clear-cutting • growth rate of 0.4 cubic meter/ha/year after selective cutting (all species lumped together)
Littoral forest (North West)	• 100 years after clear-cutting • 60 years after selective cutting
Mangroves	• unknown; however observation indicates it to be rapid and growth rates of 10 cubic meters / ha are reported from Malaysia)

Source: Tom Erdmann (personal communication)

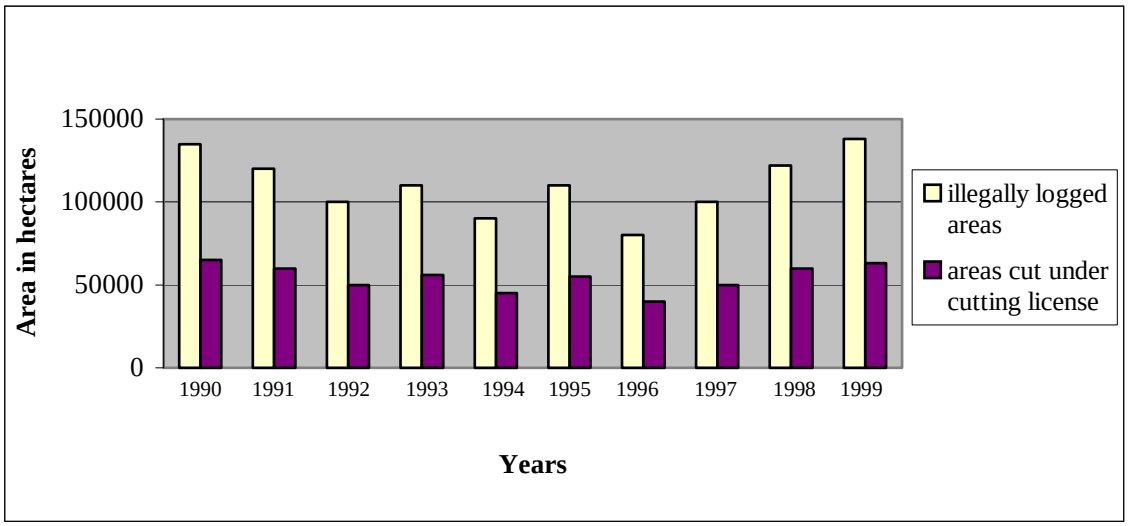
[Note: the above estimations are not the result of rigorous scientific measurements. They are approximate estimations by T. Erdmann, technical advisor to the WWF forestry support unit project; mangrove estimates are from A. Cooke.]

Fire has different sorts of impacts depending on the type of forest. In Madagascar, it tends to be more devastating in mid altitude forests, and dry forests on karstic sub-strata. More recent statistics indicate that 97% of the total burnt area lies within rangelands, 2% in reforested areas and 1% in primary forest. The area of reforestation was just 4638 hectares in 1998/1999 (Service Technique Direction Générale des Eaux et Forêts in INSTAT 2001), compared with around 1.3 million ha of burnt land (INSTAT, 2001), and 33,291 hectares of cut forests (Service de la Conservation de la Biodiversité in INSTAT 2001).

2.1.8.3 Logging

Logging, both legal and illegal, is the second cause of forest degradation and of loss of precious wood species in particular. Legal commercial logging has been identified as a minor cause of forest depletion, even though the rate of extraction has steadily increased over the past few years, reaching 2.3% of total forest loss per annum in 1998. Legal logging accounts for an average 30% of total wood extraction in Madagascar (Ramamonjisoa 2000). In 1999, about 65,000 hectares under cutting license were harvested, 40% of which was located in the Toamasina province, which hosts some of the biologically richest forest. In the same year, 135,000 hectares of forest were illegally logged (MEF in CI and DEF, 2000). The figure below shows the discrepancy between the amount of wood harvested legally and illegally between 1990 and 1999 (***Fig. 2.1e***). In practice, loggers log around the concession before logging the concession itself, always able subsequently to claim that the peripheral logging was a copycat activity. Forest mapping technology is entirely inadequate to enable district chiefs to verify whether the concession is operating within bounds and in any event only a small inducement is required to prevent reports of infractions.

Figure 2.1e Estimated logged areas in Madagascar 1990 to 1999



Source: Service de la Valorisation Economique: MEF (1999); estimated by Ramamonjisoa, 2000

2.1.8.4 Hunting

Hunting constitutes another form of threat to the forests of Madagascar, especially to their biodiversity. Lemurs are the most affected, especially those in the North East. Studies indicate that hunting affects lemurs in two main ways: by reducing their population and by altering their behavior. Hunting constitutes a major threat to the endemic species of Madagascar. Hunting risks becoming an increasingly severe source of pressure on primates' habitats and diversity (F. Hawkins, pers. comm.).

2.1.8.5 Exploitation of species for the wildlife trade

Madagascar ratified the Convention on the International Trade of Endangered Species in 1975 (edict 75-014 and decrees 77-246 and 83-108). Export quotas are tools used by CITES parties to monitor and regulate trade in species listed on the CITES Appendices.

Under Appendix I (trade forbidden except for research purposes) Madagascar has listed all the lemurs, the dugong, ploughshare and radiated tortoise, sea turtles, whales, the boa and *Acanthropus sp*. snakes, short-tailed albatros, peregrin falcon, an owl and the red tree frog and selected species of flora (pachypodium and aloes).

Under Appendix II Madagascar has listed (controlled trade according to quotas) selected carnivores (including fossa), all raptors and owls, flamingoes, Bernier's teal, Psicatttiformes, all other terrestrial tortoises, the freshwater turtle *Erymnochelys madagascariensis*, all day geckoes, all chameleons, the coelacanth, nile crocodile and golden tree frog *Mantella aurantiaca*. For the flora, Madagascar has listed all aloes not in App. I, all cacti, tree ferms, cycads, Didiereacea, Dicksonaceae, *Ceropegia spp*., *Euphorbia spp*., all orchids, *Chrysalidocarpus spp*., and the three cornered palm (*Neodypsis decaryi*). The lists are far from complete although officially Madagascar considers itself bound to enforce CITES lists irrespective of whether they have been declared under national law.

Madagascar did not deliver an export quota for Appendix II reptile species until 1999, when it was fixed at 2000 animals for all eight species (see ***Table 2.1h***).

In November 1994, the Standing CITES Animals committee made recommendations for suspension of exports of specific species from a series of countries including Madagascar for 1995. These species were day geckos (*Phelsuma)* and chameleons (*Chameleo*) , except *P. laticauda, P.lineata, P. madagascariensis, P. quadriocellata, C. lateralis, C. oustaleti, C. pardalis* and *C. verrocosus*. The Committee also recommended that the Management Authority of Madagascar should:

1. regularly submit copies of exports permits that it issues to the [CITES] Secretariat;
2. regularly submit copies of export permits that do not indicate the species involved in the consignment;
3. implement a system to verify the identification of specimens of *Chameleo* and *Phelsuma* species in consignments before they are exported; and,
4. inform the Secretariat of the biological basis for determining that exports of specimens of these species will not be detrimental to their survival (Information document by the United States to the 17th Meeting of the CITES Animals Committee, 2001; unpublished).

It appears that the export of Malagasy wild animal species resumed in 1996 and that despite the above set of recommendations, Madagascar significantly exceeded the export quotas for six of these lizard species in 1999. "For…(*Furcifer pardalis*), [global] exports of wild caught specimens were reported at 6683, 334% of the 1999 quota. United States imports of *F. Pardalis* totaled 5034 specimens in 1999, 252% of the export quota reported, making the United States by far the largest importer of the species in that year." (Information document by the United States to the 17th Meeting of the CITES Animals Committee, 2001; unpublished)

The United States study also evaluated the import of some live tortoises and freshwater turtles (*Pyxis arachnoides, P.planicauda* and *Erymnochelys madagascariensis*) from Madagascar in 2000 (see ***table 2.1h*** below).

Table 2.1h Net U.S. Trade (Imports) of Tortoises and Turtles From Madagascar: Year 2000 Quota

Species	Export quota in 2000	US Imports under 2000 quota	US Imports as a percentage of export quota
Pyxis arachnoides	1,000*	1,764	176.4%
Pyxis planicauda	800*	911	113.8%
Erymnochelys madagascariensis	25	62	248.0%

(*) Export quota originally reported was for 25 live specimens (Notification 2000/035) and later raised (Notification 2000/053).

Source: information document by the United States to the 17th Meeting of the CITES Animals Committee, 2001

Exceeding the export quotas is cause for concern considering that the two last species in the above table have been ranked by IUCN as "endangered". *Pyxis arachnoids* is considered a vulnerable

species by IUCN standards, meaning that it faces a high risk of extinction in the wild in the medium-term future.

Despite export of mahogany and other precious wood species from the Masoala peninsula and the Makira forest (North East), the trade in wildlife floral species has been an issue of lesser concern within CITES (G. Overton pers. comm.), and data on the current situation are not available.

Table 2.1i- Net Trade (Imports) of live reptiles from Madagascar

SPECIES	**1996**	**1997**	**1998**	**1999***	**Average Global (U.S.) Imports 1996-99**	**Global (U.S.) Imports as a Percentage of 1999 Export Quotas**
	Global (U.S.) Imports	*Global (U.S.) Imports*	*Global (U.S.) Imports*	*Global (U.S.) Imports*		
Furcifer (=Chameleo) lateralis	14,079 (9,378)	11,691 (6,010)	25,189 (6,094)	4,026 (2,365)	13,746 (5,961)	201.3% (118.2%)
Furcifer (=Chameleo) oustaleti	2,204 (1,190)	1,891 (578)	3,918 (599)	598 (334)	2,152 (675)	29.9% (16.7%)
Furcifer (=Chameleo) pardalis	13,725 (8,815)	11,309 (6,855)	34,472 (10,142)	6,683 (5,034)	16,547 (7,711)	334.1% (251.7%)
Furcifer (=Chameleo) verrucosus	1,084 (374)	1,469 (470)	2,639 (338)	709 (260)	1,488 (360)	35.4% (13.0%)
Phelsuma laticauda	18,313 (7,815)	12,809 (5,602)	29,742 (7,375)	5,121 (2,666)	16,496 (5,864)	256.0% (133.3%)
Phelsuma lineata	20,168 (10,494)	15,581 (7,869)	32,242 (9,652)	5,803 (3,210)	18,448 (7,806)	290.1% (160.5%)
Phelsuma madagascariensis	19,752 (9,453)	13,827 (5,469)	24,476 (6,156)	4,654 (2,637)[1]	15,677 (5,928)	232.7% (131.8%)
Phelsuma quadriocellata	19,267 (8,493)	14,073 (7,012)	28,162 (6,277)	4,703 (2,278)	16,551 (6,015)	235.1% (113.9%)

(*) Madagascar reported an export quota of 2,000 live specimens in 1999 for these eight species.

2.1.8.6 Mining

Intensive gem mining has contributed to the destruction of relatively large forest areas, especially in the North and the South West. . In the North (Ankarana), mining which started in 1996, has resulted in a 10% loss of forest (the Special Forest Reserve of Ankarana is 18000ha). Interviewed informants have highlighted that the percentage forest loss by mining is small, although impacts may be permanent, due to the associated earthworks.

Legislation requires that the potential mining company prepare an environmental impact assessment before a mining permit is awarded. However, this requirement has not prevented illicit mining around and even within forests. An assessment of the situation in Ilakaka (South West) and Zombitse, even though lacking quantitative data, has revealed that the small illegal mining areas that are the most environmentally destructive because they are intensively exploited and are uncontrolled.

2.1.9 Potential Impacts of threats

The potential short-term (within the next five years) impacts of the above threats on the state of Malagasy biodiversity have been identified as the following:

- A loss of about 10 to 20% of the remaining lowland rainforest and of its genetic diversity of plants and invertebrates;
- A loss of 10 to 20% of the remaining deciduous forest.

The potential long-term (within the next ten to thirty years) impacts are:

- The possible extinction of low-altitude rainforest vertebrates, the extinction of plants and invertebrate species having already taken place;
- Some localized endemics in western forest might pass the point of no return in the wild (Giant Jumping Rat, Flat-tailed tortoise, Blue-eyed Lemur);
- The loss of all low-altitude forest apart from one or two heavily protected reserves;
- The extinction of 10 to 50 locally endemic low-altitude rainforest reptiles and amphibians and of 1 or 2 species of bird;
- The loss of 90% of western deciduous forest outside one or two heavily protected reserves;
- The extinction of 1 to 2 species of bird, 2 or 3 species of primates, 5 to 10 species of reptile and amphibian, unknown numbers of plant and invertebrate species, in the western forests.

2.1.10 Indicated responses

Since the major threat to forests is land clearing for agricultural activities, urgent required measures to eradicate that practice could be:

- Community-based management of natural resources should be sustained;
- promotion of agricultural intensification *away from forest blocks* or/and
- promotion of agro-ecolocigal techniques in agricultural production to help reduce forest loss;
- the promotion of industrial development in cities to encourage migration of labor away from forests;
- Convert classified forests or/and forestry reserves (all currently managed by the Ministry of Waters and Forests, the MEF) into biodiversity forestry reserves (RFB); in exchange for annual payments from a Biodiversity Fund, the MEF would commits itself to the conservation of the RFB. The annual payments need to reflect the opportunity costs of the use of the natural resources. Funding sources remain to be identified;

- implementation of trade controls on hardwoods, including obligatory certification of sustainable harvesting;
- intensive reforestation programs supported by environmental education and awareness-raising activities;
- promotion of the sustainable use of forest products (e.g. essential) to the benefit of local communities.

Broader activities that would help mitigate forest depletion include:

- improvement of forest sector governance, especially institutional development within the Ministry of Waters and Forests;
- Assistance to the forestry industry to make it more competitive and sustainable;
- promotion of [environmental] education;
- improvement and enforcement of mining legislation;
- enforcement of legal texts such as the MECIE decree (99-954 of December 1999) that requires that all forest exploitation (including mining activities) of more than 150 hectares should comply to an environmental impact assessment;
- support to local pilot forestry projects;
- conservation contracts for forest management (e.g. Durbin, 2001);
- carbon sequestration schemes.

Table 2.1j- Summary of threats on and opportunities for the conservation of forests and terrestrial biodiversity

Habitat	Principal threats	Extent and degree of threats	Indicated remedial measures
Dense humid forest	1. Population pressure	• critical around Antananarivo, South of Fianarantsoa, North of Toamasina • relatively severe on all of the East coast	• promote [environmental] education • promote smaller families • promote industrial development in cities to encourage migration away from forests
	2. *Tavy* and bush fires	• Antanarivo has the second highest tavy rates	• promote agricultural intensification away from remaining forest, in the West of the province • promote agro-ecological and soil conservation techniques • apply pastureland legislation • extend (as opposed to intensify) cattle rearing
	3. Logging	• Legal logging accounts for 30% of total extracted wood in Madagascar • Legal and illegal logging activities important in Toamasina, Fianarantsoa provinces	• assist forest industry to make it more competitive (increase commercial returns of forest management) • promote the sustainable use of forest products and community-based natural resource management
	4. Trade in endangered species	• For some highly endangered species, export numbers are well over 100% of the agreed quota	• create trade control on hard woods • Support national CITES authority, customs etc… • Create a fee and/royalty system for exploration
Dense dry forest	1. *Tavy* and bush fires	• Highest *tavy* rates found in Mahajanga; Toliara is third highest	• Promote short-cycle industrial crops (sugar cane; oleaginous crops: cotton, groundnuts; rice) with applied irrigation systems • Encourage the grazing of big and small ruminants with improved grazing management systems • Promote improved agricultural machinery • Encourage and support community-based forest management
	2. Mining	• Critical in Ankarana (North West) • Relatively controlled in Isalo	• Improve and enforce mining legislation (Code Minier) and EIA regulations (MECIE decree)
	3. Logging	• Mahajanga has the fourth highest rate for logging; minor problem compared to slash and burn	• See recommendations for dense humid forests
Spiny forest	1. *Tavy* and bush fires	• Toliara has the third highest slash and burnt rate, out of the six provinces	• Promote short-cycle industrial crops (sugar cane; oleaginous crops: cotton, groundnuts; rice) with applied irrigation systems • Encourage the grazing of big and small ruminants with improved grazing management systems • Promote improved agricultural machinery
	2. Population pressure	• Induced by mining activities; no accurate number available	
Littoral forest	1. Logging	• critical for mangroves; harvested for fuelwood consumption essentially	• assist forest industry to make it more competitive (increase commercial returns of forest management) • promote the sustainable use of forest products and community-based natural resource management
	2. Over exploitation of wild species	• the only habitat where the ploughshare tortoise (IUCN endangered status) is found ; no CITES data available on the export of this species	• create trade control on hard woods • Impose a fee and/or royalties system on exploration • Support national CITES authority, customs etc…

2.2 Aquatic Ecosystems

2.2.1 Freshwater ecosystems and wetlands

Note: this section excludes mangroves, which are dealt with in the section on Marine and Coastal ecosystems.

2.2.1.1 Biophysical setting

Madagascar straddles two major climatic systems. Eastern Madagascar lies in the tropical rainforest belt while south western Madagascar lies in the belt of dry climate that runs across the southern Indian Ocean from Australia to Southern Africa. Thus, within one country annual rainfall varies from over 4000 mm in the north east (Masoala, Mananara) to less than 100 mm in the south west. This large range in rainfall together with variations in physical relief and geology, generate a diversity of freshwater and wetland ecosystems.

2.2.1.2 Type and location

Table 2.2.1a- Different types, location and conservation status of freshwater and wetland ecosystems in Madagascar.

Habitat type	Location	Biodiversity importance	Remarks
I. Water courses (rivers and streams)	Throughout island	Various	Any human interference affects entire downstream ecosystem; under-represented in PA system
Large rivers	Largest rivers in west	Low importance (for aquatic species)	Unsuitable to aquatic life because of turbidity; riparian (gallery) forests important for terrestrial fauna esp. in SW
Small rivers and streams	Mainly in central highlands and on eastern escarpment	Important in remote upland forested regions; much local endemism in east	Remote rivers and upper reaches less affected by sediment and exotic species.
Underwater rivers (in calcareous formations)	South west	Important for endemic blind fish	Little known; low species diversity & productivity
II. Wetlands (lakes, lagoons, ponds, marshes, floodplains, manmade wetlands)	Distributed throughout island, especially in west	Western wetlands the most important, especially for birds. Overall endemism of 30%	High diversity of habitats; under-represented in PA system
Continental lakes: Tectonic Plains lakes Volcanic Barrage Littoral lakes: Freshwater Alkaline	 Mainly in highlands West – Kinkony, Ihotry Manombolomaty lakes Nosy Be Mainly in west E, e.g. Pangalanes canal SW, e.g. Lac Tsinamampetsotsa	 Important / vulnerable Important /vulnerable Important / vulnerable Can be important for birds Low species diversity Low species diversity (Ramsar site)	 e.g. Lac Alaotra Western Malagasy wetlands (covered in GEF proposal) Sanctuaries for endemic fish Man created habitat Acid; low nutrient levels Hypersaline
Lagoons (linked to sea)	E and SE – e.g. Anony	Low species diversity	Saline or hypersaline
Marshes	Lake and river fringes, mainly in west	Moderate species diversity; seasonally important cover for birds	Subject to variable hydrological conditions
Peat swamp	Highlands	??	??
Flood plains	Western sedimentary plain, e.g. Tsiribihinina	Moderate importance	Comparatively little studied owing to difficulty of access
Man-made wetlands	Throughout inhabited areas; especially large in west	Moderate importance for birds	Tend to support few species in abundance
Reservoirs (including lakes)	Highlands (town water supplies, lakes for hydro- and other uses)	Low importance	e.g. Lake Mantasoa, lakes near the capital
Irrigation plains and rice paddies	Highlands and western areas	Moderate importance in west for birds	e.g. Marovoay area – important for waterbirds
Fish farms (freshwater)	Dispersed throughout Madagascar	Moderate importance for some birds	Support species such as Malagasy kingfisher

2.2.1.3 Importance of freshwater ecosystems and wetlands for biological diversity

Madagascar's freshwater and wetland ecosystems are of exceptional importance for biodiversity in view of the high numbers of aquatic species and high levels of endemism, particularly in relation to fishes, other freshwater aquatic fauna and the dependence on wetlands of certain endemic birds and global populations of migratory birds. The biodiversity of freshwater and wetland ecosystems is severely threatened, particularly the freshwater fishes. However, the comparative lack of information on these systems represents a major impediment to management and conservation of freshwater and wetland ecosystems.

Of the 92 endemic species of fresh water fishes known to date (of which 141 species are known in total), about 45 are threatened, 20 endangered and 9 extinct or likely to soon become extinct (Stiassny & Sparks in press). The disappearance of endemic fish species from wetland areas or lakes is a widely reported phenomenon (e.g. Watson 1993 at page 26 for the principal lakes in the Manombolo-maty complex) although not systematically evaluated.

The majority of intact freshwater ecosystems occur within or close to remaining areas of primary forest. Thus, much of Madagascar's freshwater and forest biodiversity share a common fate (Stiassny & Sparks in press). The volcanic lakes of Mont Passot, Nosy Be island, north west of Madagascar, and some lakes on Ile Ste Marie (east Madagascar) have so far escaped the introduction of exotic species and are of critical importance for the conservation of certain fish species (CAMP, 2001).

Wetlands in general exhibit a lower level of endemism for birds than forests 30% as opposed to 70% for forests (Langrand & Wilmé 1993). Madagascar's wetlands in fact contain one primate taxon, 16 waterbird species and at least 43 fish species that are found nowhere else in the world.

Western Malagasy wetlands have been identified as an endemic bird area by BirdLife International, as they are the unique habitat of one critically endangered (Madagascar Fish Eagle), two endangered (Sakalava rail; Madagascar teal), two vulnerable (Humblot's heron and Madagascar plover) and one unevaluated but probably critically endangered (Madagascar Sacred Ibis) species of bird. Western Malagasy wetlands also support several globally significant migratory bird populations (ZICOMA 1999). The presence of these species and the immediate and considerable threats to them, places the Western Malagasy Endemic Bird Area in the highest priority BirdLife category ('critical') for conservation action, making them one of the most important wetland conservation priorities in the world.

For given taxonomic groups of freshwater fauna, Madagascar is often rich in species as compared with Africa. For example, Madagascar has more than 500 species of aquatic insects of the family Trichoptera (caddis flies) whereas middle-Africa has around 200. For the Philopotamidae, 90 species are known from Madagascar, whereas just 15 have been reported for Southern Africa (Gibon, 2000). Levels of endemism are also high – only one of 144 species of mayflies (Ephemeroptera) is not endemic (Elouard & Oliarinony). Further such examples can be expected, and are due to the high diversity of aquatic environments and degree of isolation amongst Madagascar's freshwater ecosystems, especially on the eastern escarpment

For the fishes, the indigenous Madagascar fish fauna is as species-rich as would be expected from the island's size, with 141 species and 91 endemic species, many of which have highly localized distributions (Stiassny & Sparks in press).

Certain elements of the freshwater fauna show altitudinal variation (e.g. the Philopotamid insects). Thus, species at lower altitudes are especially threatened since the effects of disturbance to water courses are cumulative. The aquatic insect fauna of the eastern escarpment also shows a high degree of micro-endemism i.e. species have very small ranges. In the west species are fewer in number but

more widespread. In the west some species are restricted to the middle reaches of rivers, where hydrological conditions are more constant (Gibon, 2000).

2.2.1.4 Economic importance and potential

At the global level, wetlands provide ecosystem services valued at $14,785/ha/yr, greater than for any other component of the biosphere by a very large margin. Lakes and rivers come next with $8498, followed by coastal zones ($4052) and tropical forest ($2007). (Constanza, et al 1997).

In Madagascar, wetlands and freshwater ecosystems are important for several economic sectors:

- Supply of drinking water
- Agriculture
- Industrial development (suitable for evacuation of effluents, source of water for processes
- Energy production (hydropower, cooling water, etc.)
- Fishing

Fishing in wetlands can be a lucrative activity for local people. Fishermen on the lakes of the Manombolomaty complex in western Madagascar were in 1995 earning $1500 annually or 7.5 times the then national average (Watson 1997). Such fisheries are principally based on exotic species, mostly tilapia.

However, with the recognized saturation of suitable rice growing land in the highlands, the prime economic importance of wetlands (and therefore posing the greatest threat to their integrity) lies in their potential for conversion to agriculture.

2.2.1.5 Trends in biophysical condition, productivity, abundance and distribution

2.2.1.5.1 Water courses

Rivers and streams are threatened by soil erosion in most areas. Erosion of the soil makes the water turbid and unsuitable for most of the native freshwater fauna and flora. While there exist some estimates of soil loss rates (ONE 1999), and flow rates of Madagascar's rivers have been partially documented (IRD 1999), there have been no systematic studies of the transport of sediments by Madagascar's rivers. Thus, the means do not yet exist to quantify the turbidity problem.

The ecosystems of rivers and streams are vulnerable to any upstream interference. Essentially only the upper reaches of rivers in preserved forest areas remain intact. In a recent review, it has been estimated that up to 9 freshwater species may have gone extinct, while 20 are critically endangered and about 45 threatened with extinction (Stiassny & Sparks in press).

2.2.1.5.2 Lakes

Madagascar's principal tectonic lake is Lake Alaotra in the northern part of the central highlands, with an area of 22,000 ha and some 20,000 ha of marshes. In flooding conditions the lakes can extend to 800 km^2. The lake has been used to irrigate 117,000 ha of rice paddies. Severe sedimentation from hill burning combined with overfishing, agricultural run-off, acidification (Pidgeon, 1996) and the introduction of exotic species have altered the lake's ecosystem, resulting in a massive reduction in habitat for species such as the Alaotra gentle lemur, two rare birds (Madagascar pochard, Madagascar grebe) and for unknown numbers of aquatic species. The population of Aloatra gentle lemurs has declined from 10000 in 1990 to 3000 in 2001. The pochard has not been seen since 1991. Sedimentation has led to drainage problems on the cultivated plains, and fisheries yields declined from around 3000 tones in 1990 to just 700 tones in 2000 (DWCT 2001).

Madagascar's principal plains lakes lie in the western sedimentary plain, the major lakes being Kinkony and Ihotry. The plains lakes and surrounding marshes are threatened by conversion to agriculture, pasture, bush fires, overfishing and introduced exotic species. Volcanic lakes are typically deep and steep sided. The principal threats are over-fishing and the introduction of exotic species.

2.2.1.6 Trends in management

2.2.1.6.1 Historical overview

Historically Madagascar's freshwater systems and wetlands have not been "managed", other than to develop them for the usual range of uses – navigation, irrigation, conversion to agriculture and direct harvesting for various resources (including hunting and fishing). In more recent years freshwater systems and wetlands have been used for the supply of drinking water, large-scale irrigation schemes, industrial development and in energy production.

With the exception of management for a civic purpose (drinking water, irrigation schemes, energy production), use of wetlands has been on an open access basis. As part of the public natural domain under law 60-009, the possibilities of private or community ownership have been limited. Due to a lack of official awareness, no measures have been taken to limit the introduction of alien species – indeed many such introductions have been quite deliberate, with devastating effect on indigenous fauna (Sparks & Stiassny in press).

Awareness of the biological importance and ecological vulnerability of freshwater systems and wetlands has come much later than for other ecosystems. Thus, there are still no examples of protected freshwater or wetland ecosystem in Madagascar, while protected forests have existed since the 1920's and three marine protected have been created since 1968. While international awareness raising of freshwater and wetland ecosystems has highlighted their importance for birds and for ecological goods and services, awareness of the unique conservation importance of Madagascar's freshwater and wetland habitats has been long to emerge through research. Even the designation of wetlands in 1995 as "sensitive zones" for the purposes of EIA legislation derived more from the recognized importance of wetlands for ecological goods and services than from the specific importance of Madagascar wetlands for unique biodiversity.

Legal protection of hunted freshwater species has lagged behind the more prominent terrestrial species. The freshwater turtle, *Erymnochelys madagascariensis*, has been protected only since 1988. The crocodile has been protected since 1988 (it was formerly classed as a pest). No freshwater fish species is protected (although it may be doubted that such protection would serve any useful purpose given they are most threatened by introduced species).

The designation of wetlands as sensitive zones was the first significant legal step towards their legal protection in Madagascar. The subsequent ratification by Madagascar of the Ramsar convention is undoubtedly the most important step so far. The actions and research of the Peregrine Fund wetlands project and the ZICOMA bird conservation project have help to define the issues, and the proposed wetlands conservation project of a consortium of organizations led by BirdLife International will be the first of its kind. Finally, the recent CAMP workshop at Lake Mantasoa in March 2001 highlighted the plight of freshwater fauna.

2.2.1.6.2 Legislation and policy

Prior to ratification of the Ramsar convention by Law, there was no coherent specific legislation or policy in relation to freshwater systems and wetlands. Lakes and rivers and their banks are legally part of the public domain, discouraging any forms of limited access. Fisheries texts impose rules about net mesh size for freshwater as well as marine fishing. Certain water birds and one freshwater turtle are protected under wildlife protection laws.

Ratification of the Ramsar Convention on Wetlands represents the most significant legal and policy step for Madagascar, since it obliges Madagascar to designate specific sites under the convention which must reach international standards of protection while undertaking generally to manage wetlands according to wise use criteria.

2.2.1.6.3 "Wise use" of wetlands

Wetlands have long been recognized as areas where strict conservation is often neither necessary nor feasible. Instead, wetlands, later followed by coastal zones, are promoted as sites for "wise use" of resources. The emphasis has been on the maintenance of general ecosystem processes, in order to ensure the continued provision by wetlands of important environmental "goods and services" valued by surrounding communities (such as fish, wood, reeds, waterways and paddy fields).

2.2.1.6.4 Community-based management

Thus, wetlands projects in Madagascar have been promoting since the early 1990's community-based management using customary rules or *dina* to manage wetlands (e.g. Watson 1993). The new draft law on community-based management of natural resources (Law 96-025 known as "GELOSE" was well received by the wetlands conservation groups (e.g. Watson 1997) although is considered by some to be overly complex, preferring a return to dina. However, GELOSE offers, through an accompanying land inventory procedure ("Securisation Foncière Relative") a degree of protection to the land over which resources are managed. Dina can be especially useful to cover large areas under occupation by many different groups. Thus, at Lac Alaotra, a large dina or "*dina-be*" was established in 1998 to close the fishery for 2 months every year to facilitate stock recovery.

A GEF project has been proposed to conserve Western Malagasy Wetlands – Lower Mangoky, Lower Mahavavy, Besalampy, Soahanina region, Complex Manambolomaty – using community-based management (BirdLife International 2001).

2.2.1.6.5 Designation of Ramsar sites and other legal measures

Madagascar signed the Ramsar Convention in December 1998 and has since been ratified. A national Ramsar Convention committee has been created known as CONARAMS of which 50% of members are NGOs. Two sites have been designated by Madagascar as Ramsar sites – Lac Tsinamampetsotsa and Lac Alaotra. Designation of sites obliges Madagascar to conserve and manage the sites in accordance with Ramsar Convention objectives.

Under Environmental Impact Assessment legislation, wetlands have been designated "sensitive zones". The definition adopted excludes marine areas, estuaries, permanent rivers, temporary rivers and artificial wetlands (rice paddies etc.).

2.2.1.7 Linkages with forests and terrestrial biodiversity

The state of preservation of freshwater systems and wetlands is closely linked to that of the adjacent or upstream terrestrial habitats. Fully intact freshwater systems and wetlands are found only in remote, upland, forested areas. Conversely, certain types of forest are associated with freshwater systems and wetlands although the links are less marked.

The conclusion of the CAMP workshop was that conservation of forests is essential in order to conserve freshwater and wetland ecosystems while the reverse is not the case. This adds justification to a program that focuses principally on forest conservation.

2.2.1.8 Principal threats and indicated responses

The principal threats to non-marine aquatic ecosystems (water courses, lakes and wetlands) are:

- Sedimentation from soil erosion due to deforestation.
- Introduction of exotic species (plants and/or fish species)
- Conversion of wetland habitats to agriculture
- Over-harvesting of natural resources

In addition, drying of the climate may be a threat to western wetlands (Burney 1993).

The indicated actions are:

- Reduce forest loss and soil erosion;
- Place lakes and wetlands under "wise use" community-based management;
- Take urgent parallel measures to prevent the extinction of endangered fishes.

Specific recommendations of CAMP 2001 (primarily aimed at conserving endangered fishes) were:

- Establish a freshwater ecosystems conservation program, focused on fishes, based in Madagascar's priority region for endemic fishes (the north west)
- Create new protected areas specifically for aquatic ecosystems at Mont Passot, Nosy Be, and the Nosivolo river at Maralambo;
- Develop a new corps of freshwater ecosystem specialists as a long term corpos of people to assure
- fish conservation;
- As an *ex-situ* measure, a program should be launched to encourage the introduction of Malagasy rarities into the aquarium fish trade.

2.2.2 Marine and Coastal Ecosystems

2.2.2.1 Biophysical setting

Madagascar lies in the tropical and subtropical marine region of the Western Indian Ocean. Spanning almost 14° of latitude, mean open water surface water temperatures range between 22° and 28° C, with minimum temperatures in August and maximum temperatures in February (Cooke et al, 2000). The extreme south of Madagascar is affected by nutrient rich, cold waters rising from the south. Madagascar's marine and coastal environments may be split into two basic zones – East and West. ***Figure 2.2.2a*** (see Annex 5.5) illustrates the principal current patterns and ***Fig 2.2.2b*** (see Annex 5.5) illustrates the location of zones of nutrient enrichment of Madagascar's coastal seas.

2.2.2.1.1 East

The steeply shelving eastern continental margin lies in the path of the powerful, westbound, Southern Equatorial Current (SEC) which splits into northbound and southbound branches at latitude 17° S (off Cap Est). The shear forces of the SEC have helped to maintain the east coast's rectilinear character. The east coast is also subject to the SE trade winds, heavy wave action and a narrow tidal range (max. 1 m). The sediment outputs of Madagascar's short eastern rivers are swept away and only a narrow, sandy, coastal plane has developed. Mangroves are virtually absent and coral reefs have only developed where the separation of the northbound and southbound currents provides partial protection from the current and wave action. The warm waters of the SEC are deficient in nutrients, resulting in relatively low levels of biological productivity in eastern waters, except in areas of nutrient enrichment through upwelling (off the Baie d'Antongil in the NE and Fort Dauphin in the SE).

2.2.2.1.2 West

By contrast, the protected, mainly shallow-shelving, western continental margin, fed by Madagascar's largest rivers, and with large tidal range (3-5 m), has supported the development of extensive estuarine, intertidal and shallow water marine ecosystems as well as a wide coastal sedimentary plane with relatively rich alluvial soils. Affected by the SE trade winds in the south and the monsoon in the north, with moderate daily onshore/offshore breezes, conditions are favorable for fishing and other marine activities. Zones of high biological productivity occur around river mouths and in areas of upwelling (off Maintirano in the NW and Toliara in the SW). Thus, it is on the west coast that one finds the greatest abundance of accessible marine and coastal natural resources.

2.2.2.2 Pelagic and open ocean waters

Pelagic waters refer to those overlying the continental shelf, or about 117,000 km^2 of shelf seas in the case of Madagascar. Due to input from rivers and higher seabed to surface transfer, pelagic waters are generally richer in nutrients than oceanic waters. Biological resources are concentrated in surface waters and near the seabed, or around features such as islands and submerged banks and shoals.

Madagascar's pelagic habitats are ecologically important for many marine species, some of which migrate to shallow water at certain times of year (e.g. sharks, lobsters, turtles). Still largely unexplored, the deeper pelagic waters and the seabed are likely to harbor considerable economically valuable resources such as green lobster, deepwater shrimp and snapper.

Open ocean waters refer to those beyond continental seas. Generally relatively empty of life, they are nonetheless important for certain fast swimming species such as tuna that are able to forage over large sea areas, and as migratory routes for large species such as whales and sea turtles. Oceanic surface currents carry the larval forms of most sedentary species, so serve as links between marine ecoregions.

2.2.2.3 Mangroves, coral reefs and islands

Figure 2.2.2c (see Annex 5.5) shows the distribution of mangroves and coral reefs along Madagascar's coasts

2.2.2.3.1 Mangroves

Madagascar possesses over 425,000 ha of tidal marshes, of which an estimated 327,000 ha are covered by mangrove forest (Kiener 1972, Lebigre 1990, IEFN 199X). Mangroves thus represent about 2.4% of Madagascar's total forest cover of 13.5 million ha. Mangroves are overwhelmingly (98%) concentrated along the west coast, mostly (70%) in large stands of over 500 ha at river mouths

between latitudes of 13° and 21° S. In addition there are numerous small but nonetheless ecologically important stands in other areas, notably the south west.

Mangroves provide important environmental services through stabilizing sediments and regulating water flow, as well as providing feeding and breeding areas for many species. Mangroves support critical life-cycle stages of several commercial fishery species, notably penaeid shrimps which constitute Madagascar's most important industrial fishery (12.000 t worth $93 million annually in 2000). Shrimp catches correlate positively with adjacent mangrove area (Lhomme, 2000). Mangroves are the preferred setting for the installation of large shrimp farms, currently amounting to 1200 ha (Instat, 2001). (Madagascar's western mangroves contain many open, treeless areas, known as *tannes*, permitting the construction of large ponds with little or no mangrove tree loss.). The total area of tannes is 50,000 ha (Instat, 2001), with at least 10,000 ha suitable for pond construction (1,200 ha farmed in 2000). Thus, mangroves underpin Madagascar's existing and future shrimp industry.

Mangroves are also important to local populations as a source of wood for construction or fuel, especially close to major towns where mangroves have become degraded. However, due to their capacity for rapid regeneration, certain mangroves offer a potential sustainable source of wood fuel for cities such as Mahajanga, provided they are well managed. Finally, the rapid carbon sequestration rates of mangroves are of interest in carbon credit schemes under the Kyoto Protocol.

2.2.2.3.2 Coral reefs

Madagascar has an estimated 3000 km of coral reef formations distributed along most of the west coast and along the northern section of the east coast. These may be classed as submerged coral banks and shoals (about 1500 km), distributed mainly along the north western and western shelf edge, and emergent fringing and barrier reefs (about 1500 km), mainly in the north west, south west and north east (Gabrié et al 2000, Cooke et al 2000).

Coral reefs provide important environmental services such as productive fishing grounds, coastal defense and suitable environments for tourism development. Most of Madagascar's estimated annual inshore finfish catch of 50,000 tons comes from coral reef areas. Coral reefs protect the shore from cyclones, facilitating development of the shoreline and protecting investments. Madagascar's two major coastal tourism areas (Nosy Be and Toliara) depend on coral reefs.

2.2.2.3.3 Islands

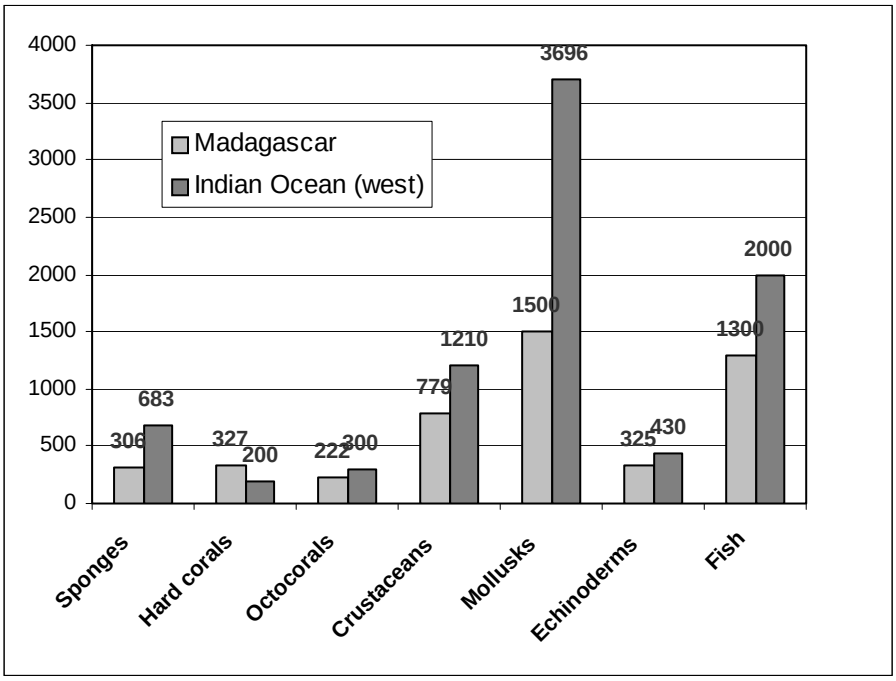
Several islands are important as nesting sanctuaries for sea turtles and sea birds. Many islands are used as seasonal bases for traditional fishermen. Certain islands already make an important contribution to tourism and many have potential in this area (DEC 2001). Islands and submerged coral reefs help to keep shipping away from fragile coastal habitats.

2.2.2.4 Importance for biodiversity of marine and coastal ecosystems

Tropical marine ecosystems, especially coral reefs, support a vast diversity of organisms. Since most marine organisms are dispersed as planktonic larvae across large distances, endemism is uncommon below the regional level, with only a handful of marine species endemic to Madagascar so far recorded. The larger marine species, such as large fish, marine mammals and reptiles, tend to be migratory. Madagascar has just one endemic species of shark (Cooke et al 2001).

Nonetheless, Madagascar is important for marine biodiversity at the regional level because of its large oceanic sea area (the EEZ includes 1,023,000 km^2 of ocean), extensive continental shelf seas (117,000 km^2), a long coastline (5000 km), numerous small islands and large latitudinal range (14°), providing a greater diversity of coastal and marine habitats than any other western Indian Ocean country. Intertidal and shallow water habitats along the west coast, in particular, cover large areas. Recent

reviews of the available literature indicate that Madagascar harbors an average 75% of known species of shallow water marine macrofauna for the Western Indian Ocean (Richmond 2001; Cooke et al, in press) (***Figure 2.2.2 d***).



Coral reefs are among the most biologically diverse marine ecosystems. Madagascar's coral reefs support a minimum of 6000 species of macrofauna, probably closer to 10,000 species (Gabrié et al 2000, Cooke et al, in press). The biological diversity of Madagascar's mangroves has been little studied, although diversity and species composition are comparable to mangroves of Eastern Africa.

Madagascar is regionally important as feeding or breeding grounds for migratory marine megafauna of conservation concern, notably whales and dolphins, the dugong, sea turtles (5 species), tuna (at least 6 species), large teleost fish (sailfish, marlin, swordfish), sharks (at least 56 species) and rays (notably the increasingly rare sawfish *Pristis sp.*) (Cooke et al 2001).

Prevailing current systems connect Madagascar with its East African neighbors and the Comoros Islands. Madagascar is likely to emerge as an important country for marine biodiversity within the context of large marine ecosystem (LME) management through international co-operation.

In terms of terrestrial species, coastal ecosystems have a lesser importance for biodiversity than inland ecosystems, since many coastal species possess marine forms of dispersal and are thus regionally distributed. It has been estimated that Madagascar's littoral vegetal formations comprise about 21% of native endemic species, the remainder being common to the Western Indian Ocean (Bernacsek 1992). However, locally levels of endemism can still be very high; for example the dune vegetation of the south west comprises over 90% of endemic species.

2.2.2.5 Economic importance and potential

At the global level, coastal ecosystems generate ecosystem services of a relatively high value ($4052/ha/yr), which may be compared with open ocean ($252), wetlands ($14,785), lakes and rivers ($8498) and tropical forest ($2007) (Constanza et al, 1997).

In Madagascar, marine and coastal ecosystems make a major economic contribution through fisheries, aquaculture, timber extraction (mangroves) and tourism, while coastal lands are important for

agriculture and urban development. It has been estimated that marine and coastal areas contribute 50% of national economic wealth (ONE 2001).

Marine capture fisheries in 2000 amounted to about 90,000 tons, with exports valued at $130 million (or 23% of all exports), placing fisheries on a level similar to tourism as an earner of revenues. The total fisheries sector (including continental fisheries) employed some 80,000 people and contributed 7-8% to GDP in 2000. The government of Madagascar considers marine fisheries, along with tourism and mining, to be a strategic sector for national economic development (Instat, 2001).

The most valuable fisheries export by far was wild caught shrimp, with exports of 12,180 tons valued at $93 million in 2000, or 71% of the total value of fisheries exports. The high importance of shrimp is in part due to the under-taxing, underreporting or poaching of other valuable resources, such as tuna and bill fish (marlin, sailfish, swordfish). Considerable improvements in fisheries governance and surveillance are required to secure efficient exploitation of these resources.

Potential sustainable marine fisheries yields have been estimated at about 270,000 tons per year (based on a yield of 23% of estimated standing stocks) (Andrianaivojaona et al, 1992), indicating that current levels of exploitation are running at just one third of potential. However, much of the remaining potential lies in stocks that are of uncertain size and extent or uneconomic to exploit. Readily exploited high value resources such as shrimp, lobster, sea cucumbers and sharks are already exploited at or beyond sustainable levels. The potential yields of tuna and bill fish stocks remain uncertain, despite substantial research investments.

Aquaculture in Madagascar is currently limited to penaeid shrimp, sea weeds and the planktonic brine shrimp (*Artemia sp*.) (used as a food source for hatchling penaeid shrimps). Shrimp farming is growing steadily, with 5 farms covering 1,200 ha producing 4,500 tons in 2000 (Instat, 2001). Culture of sea cucumbers and certain mollusks is still at the experimental stage. Brine shrimp farming is limited to Ifaty, Toliara, although highly efficient.

2.2.2.6 Trends in biophysical condition, productivity, abundance and distribution

2.2.2.6.1 Pelagic living resources

Available information on the state of pelagic resources is limited to the results of acoustic surveys from 1983 (Anon 1983) and subsequent catch data for stocks of interest to industrial fisheries, notably of tuna, other large commercial fish and deepwater and shallow water shrimp.

Tuna fishery data for the WIO indicate that catches continue to rise with increased fishing effort, suggesting that the fisheries still operate within sustainable levels and that the ecosystem is functioning well enough to maintain stocks (Pianet, 1998). No specific assessment has been made of stocks within the Malagasy EEZ. Annual catches of tuna in the Malagasy EEZ have been consistently reported as around 10,000 tons since about 1990, although are unofficially estimated to be closer to 18,000 tons.

Concern has been expressed in relation to vulnerable pelagic species, notably sharks, which are taken as by catch by industrial long-line vessels (e.g. Cooke et al in press). Tuna stocks are relatively resilient, due to tuna's rapid growth rate and reproductive mechanism. However, important gaps still exist in knowledge about the ecology of tuna stocks in the WIO.

Experience of the EU-funded fisheries surveillance program indicates that tuna and other industrial licensed catches within the Malagasy EEZ are under-reported by as much as 40%. Unlicensed catches go entirely unreported. The breadth and reliability of data should improve as the surveillance program progresses and permanent mechanisms for monitoring are put in place.

The shrimp fishery has been studied in much more detail. The shrimp trawler fleet has grown steadily since the late 1960's, reaching 70 vessels in 2000. Since the fleet achieved about 45 vessels, yields have varied around an average of about 10,000 tons, good years correlating with high rainfall (Lhomme, 2000). The fishery is generally considered to be running at maximum capacity in most areas, with evidence of excessive take-off undersize shrimp in some areas. The major concerns with the industrial shrimp fishery are the large by-catch of finfish, the incidental capture of turtles and sharks. The ecological impacts of bottom trawling have not been studied.

2.2.2.6.2 Coral reefs

The most significant studies to date concern the coral barrier reef of Toliara, for which biophysical data exist from the 1960's through to the present day. During this period local artisanal fisheries have proliferated, along with other resource uses such as mangrove cutting. Comparative studies of the reef over 30 years (Vasseur et al, 2000) indicate:

- 50% reduction in the number of coral reef fish species associated with the reef;
- 10% reduction in area of active reef growth with a corresponding increase of the sandy areas;
- 50% reduction in the time required for observers to cross the reef along a transect line (due to loss of surface complexity);
- 1% increase in suspended sediments in the reef lagoon;
- 35% of the reef top degraded annually by reef gleaners.

Observers have also noted the disappearance of the characteristic line of boulders along the reef front that increase effective reef height (Vasseur, 1997). A fisheries study in 1992 indicated that the annual extraction of fish from around the reef was 12 tones, considered to be well beyond sustainable levels for a coral reef fishery, and only made possible by recruitment of stocks from surrounding, less pressured, areas (Laroche &Ramanarivo 1995).

The above are the only reliable, quantitative, data on large scale biophysical change available for a Madagascar coral reef. The Toliara reefs are is widely considered to be the most degraded. Reefs around Nosy Be have also declined considerably in diversity (Labouthe & Maharavo undated).

Recent surveys of reefs in the north east (Masoala, Mananara), north west (Sahamalaza, Nosy Hara) and the south west (Ifaty) provide usable baselines for future monitoring of biophysical change in those areas (e.g. Randrianamantsoa & Brand 2000, McClanahan & Obura 1998, Maharavo, Randrianamantsoa & Brand 2001).

A pilot reef monitoring program initiated by a regional environment program of the Indian Ocean Commission ("PRE-COI"), is being continued with follow-on financing from GEF until 2004. The program has carried out transects at several sites. Results appear to indicate improvements at two sites in the north west, especially in one protected area, but declines at sites affected by coral bleaching in 1998 (NE, SW) (Maharavo 2000). The sampling effort was insufficient to provide statistically significant indications of change. A preliminary study of Landsat 7 images indicates that satellite imagery may be useful for monitoring Malagasy coral reefs with substantial reef flats (Barde 2001).

2.2.2.6.3 Mangroves

The mangroves of Madagascar have been described and mapped in some detail by Kiener (1972) and Lebigre (1990). For those mangroves that were mapped in detail (e.g. the mangroves of Toliara described in Lebigre 1997), these studies can provide a very useful base line for monitoring biophysical change.

Local degradation of mangroves has been well documented only for the Toliara region (Lebigre 1997, WWF 1993), although there are numerous examples of mangrove degradation or even destruction near to urban areas, for example at Nosy Be.

There is some evidence of mangrove evolution in response to the transport of sediment in rivers. In particular, "old growth" biologically diverse mangrove has disappeared while pioneer mangroves have been established on new banks of sediment (Be-Totozafy 1994). Thus, there are indications of a decline in mangrove "quality" due to sedimentation.

2.2.2.7 Trends in management of marine and coastal resources

2.2.2.7.1 Historical overview

Prior to colonial times, there was essentially no conscious management of marine and coastal resources (although certain customs and traditions may have influenced patterns of exploitation).

Following colonization, the first fisheries legislation was introduced to regulate the commercial exploitation of high value marine species (whales, sea cucumbers, sea turtles, pearl oysters, lobster, sponges) and to provide basic controls on ordinary fishing (minimum mesh sizes). Most of these early regulations are still in force today (Beurrier 1982).

With the general acceptance of the 200-mile Exclusive Economic Zone, developing countries such as Madagascar received support to evaluate their marine resources. FAO's estimates of sustainable yields of Madagascar's fisheries from the early 1980's (Anon 1983) indicated a maximum sustainable yield (MSY) for all stocks of around 300,000 tones per annum (Andrianaivojaona et al 1992) which at the time was around five times the actual yields. This has encouraged the view that stocks are not in danger of over-exploitation and a policy of developing fisheries as rapidly as possible, especially "under-exploited stocks".

The above views have begun to change. At the national level, recognized declines in catch per unit effort of shrimp, and a decline in the catches of lobster have highlighted the need for restraint. At the local level, resources have become highly depleted in certain areas of intense fishing pressure, especially around Toliara, and for high value resources such as sea cucumbers, certain mollusks and sharks. While fishers have responded through diversification and range extension, the first examples of conflict over marine resources have emerged. Scientists and conservationists have added to the concerns by highlighting local species declines and ecological degradation (e.g. Vasseur et al 1988, Vasseur 1997, Gabrié et al 2000).

2.2.2.7.2 Current legislation and policy

Legislation relevant to marine and coastal ecosystems comprises fisheries legislation, protected species, forestry texts relating to mangroves, decrees and orders creating marine and coastal protected areas, EIA legislation and miscellaneous texts concerned with regulation of extraction of the public domain (e.g. beach sand, corals).

Fisheries legislation is based on an original decree of 1922, under which most technical regulations have been passed. The recent fisheries edict (law 93-022) that defines the overall management regime for fisheries, stipulates in particular that fishing is no longer a free activity but one that can be made subject to licensing and includes a power to create fishing reserves. The law also provides that fisheries should be managed according to principles of ecological sustainability. A sustainable fisheries strategy was commissioned by the Ministry for Fisheries (Orgasys 1997). However, the draft strategy has never been approved or applied.

The legislation for the protection of marine species derives from four principal texts:

- Decree 61-096 (under Ordinance 60-126) which provides for the protection of certain fauna including whales and dugong;

- Ordinance 75-014, implementing CITES, and subsequent decrees (77-246 and 83-108) which implement CITES Annexes I, II & III;

- Decree 88-243, which extends the list of totally protected species under 60-096 to include (probably) all sea turtles including the leatherback;

- Ordinance 93-022, the fisheries code, which totally protects marine mammals.

In addition, there are numerous older regulations, mainly passed under the fisheries decree of 5 June 1922 or the Code Maritime of 1966, regulating the exploitation of whales, dugongs, turtles, lobsters, pearl oysters, ornamental shells, shells for button making, sponges, edible oysters, sea cucumbers, and algae.

Whereas Law 70-004 approved ratification of the Alger Convention of 1968 for the Conservation of Nature and Natural Resources, which lists dugongs and sea turtles among other protected species, Madagascar has never passed specific implementing legislation, (although it has followed the convention in creating protected areas).

As mentioned, sea turtles are listed as protected species in the Alger Convention of 1968 but Madagascar has not passed specific legislation thereunder. Sea turtles are listed in Ordinance 75-014 as CITES Appendix 1 species, but this only regulates international trade. Decree 88-243 appears to provide that all sea turtles are fully protected (and specifically lists the leatherback *Dermochelys coriacea*) but creates confusion by classing sea turtles with a freshwater species (*Erymnochelys madagascariensis*). Sea turtles also enjoy partial protection under two obscure ministerial orders (*arrêtés*) from 1923.

Madagascar has not included all CITES-listed species in implementing legislation. Decree 77-276 lists in Appendix 1 dugong, cetaceans and sea turtles, while placing the coelacanth (which is unprotected under domestic law) in Appendix 2. Hard corals (Annex 2 species) are absent from implementing texts and permits for the export of corals have in fact been awarded by the Direction des Eaux et Forêts (DEF) in the recent past without prior impact assessment. CITES-listed gastropod species subject to trade in Madagascar are also absent from implementing texts.

Mangrove forests are part of the national forests domain and come under forestry legislation. Few specific texts exist in relation to mangroves, although in certain areas they have been the subject of forestry concessions and cutting permits (notably in the Province of Mahajanga). To date, no specific policy exists in relation to mangroves, although they are included under the broad definition of wetlands under the Ramsar convention. At least one protected area exists with a significant area of mangrove (national park of Baie de Bali) with others proposed (notably mangroves of the estuary of the Manombolo river).

Mangroves, coral reefs and small islands are all classed as “sensitive zones” under EIA legislation (Arrêté No.4355/97 of 13 May 1997) with the result that EIA is automatic for investment projects that potentially impact these ecosystems.

Decree 64-291 regulates the delimitation, use, and conservation of the “domaine public naturel” (which includes beaches, intertidal zone, bays, and lagoons connected to the sea). Extractive activities

such as sand mining therefore require a permit. While coral reefs are not expressly included, the law has been treated by certain authorities as applicable to the extraction of corals.

2.2.2.7.3 Marine protected areas (MPAs)

Three protected areas have been legally created that include marine habitats:

- Nosy Tanikely, a small islet close to the island of Nosy Be in the north west, was declared a marine reserve in 1968 by Arrêté 4730 (Journal Officiel 2232, 30 November 1968) of the Ministry of Equipment and Communications – Tanikely is also the subject of a decree by the local authorities;

- Biosphere Reserve of Mananara-Nord, on the northeast coast, gazetted in 1989 (Presidential Decree 89/216). The reserve (a controlled development zone), extends along 50 km of coast and includes two strict conservation zones with national park status – a circular marine zone (1000 ha) centered on the islet of Nosy Atafana, and a much larger terrestrial forest zone;

- Masoala National Park, close to Mananara in the north east, that comprises three marine reserves totaling 10,000 ha of coral reef, lagoon, and open water habitat (Tanjona, Cap Masoala, Tampolo (Presidential decree 97-141).

A community marine reserve also exists at Nosy Ve islet, south of Toliara, created under a customary social convention or *dina* issued in 1999 (Rakotoarison 1999). This has no formal legal status as yet.

The protected areas of Mananara and Masoala were established through direct application of the Algiers Convention of 1968, in common with most of Madagascar's protected areas. The draft law or code on protected areas known as COAP provides for the creation of national marine protected areas.

In 1998 an initiative was launched by UNESCO at the request of the government of Madagascar to assess the potential for creating new coastal "biosphere" reserves. A workshop in November 1998 confirmed the suitability of four sites and subsequent studies resulted in one site being formally accepted (Sahamalaza Peninsular & Radama Islands) and a completed proposal for a second site (Toliara Littoral Zone). The two other potential sites have been the subject of detailed studies (Nosy Hara island complex; Kirindy/Mikea Coast a.k.a Belo-sur-mer) but no proposal as yet.

Additionally, in December 1999, a national initiative was launched by the EMC component of EP2 together with ANGAP (the national protected areas authority) to identify, assess and create new "marine and coastal conservation areas". This has resulted in a national plan of action (which identifies numerous potential sites) and feasibility studies for a site in the south east (Lokaro/Evatraha/Ste. Luce).

Finally, a national inventory of small islands has been conducted which highlights the conservation importance and potential of small islands. Some of these are likely to be proposed as protected areas during EP3.

2.2.2.7.4 Integrated Coastal Zone Management

There has been an increased awareness of the ecological links between different marine and coastal ecosystems and the potential value of an integrated management approach. An assessment financed by USAID pointed out many of the problems (Jain 1996) and a national workshop on coastal zones in 1996 highlighted the value of an integrated approach. These discussions led to the adoption of a marine and coastal component (known as EMC) in Phase 2 of the national environmental action plan (NEAP) which aimed to promote integrated coastal zone management (ICZM).

Studies of the Toliara region by EMC in the course of NEAP Phase 2 confirmed the impacts of upland erosion, land use and mangrove deforestation on the decline of coral reefs and the need for an integrated coast / river basin approach to coastal zone management (CNRE/CNRIT/IHSM 2000). Integrated management plans have been developed for fisheries, mangrove use and tourism for Toliara and Nosy Be (Ocean Consultant 2000).

Increased awareness of the problems at the local level and the effective absence of state authorities have encouraged user groups to take the initiative in managing marine resources. The EMC component of NEAP has exploited this tendency with a resulting proliferation in the use of customary social conventions (*dina*) for resource management, typically accompanied by a formal request to government under the "GELOSE" legislation for a contract to manage the resources.

In addition to the enforcement of size limits on capture and banning the use of destructive fishing methods (poison etc.), the value of "no-take" zones, protected areas or sanctuaries as a powerful and simple tool for maintenance of stocks is taking hold and is being applied in several areas. The protection and restoration of degraded mangroves has also been attempted on a pilot scale as a means for maintaining ecosystem processes in support of fisheries.

At the national level, a policy orientation document on sustainable development of coastal areas has been published by ONE through the EMC program, and advocates the integrated approach for Madagascar's coastal zones (ONE 2001a). Regional and national workshops have been held using the document as a basis for discussion and have yielded a series of recommendations, under which national co-ordination of CZM would rest with the Ministry responsible for Environment, while regional implementation would be the responsibility of the autonomous provinces (ONE 2001b).

Considerable doubt remains about the future of ICZM given the subsequent absorption of the Ministry for Environment into the broader ministry of Transport, Tourism, Environment and Forests and persisting questions surrounding the autonomous provinces in the currently political crisis. In principle, the greater integration of ministries should favor ICZM, while the autonomy of provinces should also facilitate the establishment of regional ICZM schemes.

2.2.2.7.5 Industrial fisheries management

Marine living resources are the responsibility of the Ministry for Fisheries and Marine Resources (MPRH), which is primarily concerned with industrial fisheries that generate hard currency. Initiatives for better management have to date come from the operators and their donor partners rather than from the government. Collected revenues are small in relation to the value of catches.

The principal tuna fishery is a purse-seine fishery operating in the northern waters of Madagascar's EEZ during the first half of the year comprising about 45 Spanish and French vessels. Catches are mainly skipkack (69%) and yellowfin (25%) tuna, of which an estimated 10,000 tones is typically attributed to Madagascar's EEZ (unofficially estimated to be closer to 18,000 tones). The EU financed fisheries surveillance program under MPRH is promoting the installation of transmitters on vessels and fuller catch reporting.

The other fishery is a long line fishery, comprising some 110 licensed vessels from Japan, Korea and the EU operating year round throughout Madagascar's EEZ. Unfortunately, catch reporting requirements are not enforced by MPRH. The fishery is thus essentially unmanaged. Based on an average capacity per vessel of 750 tones spending a good part of the year within Madagascar's EEZ, the catch from Madagascar's EEZ is estimated to be at least at 50,000 tones, comprising mainly tuna, bill fish and sharks. Limited data collected in the early 1990's indicate that sharks make up 6-10% of the catch (Cooke 1997).

Management of the industrial shrimp fishery, on the other hand, has made major strides in recent years, largely through the efforts of the industry itself. Following establishment in 1994 of an

association of industrial fishing companies known as GAPCM (*Groupement d'Armateurs de Pêche aux Crevettes de Madagascar*, recently renamed *Groupement d'Aquaculteurs et des Pêcheurs de Crevette de Madagascar*), the industry has voluntarily accepted management measures including a zoning plan, permit system and satellite tracking of vessels and has pro-actively promoted scientific research and other supports to management of the fishery.

A moratorium has been called on the award of further licenses fixing the number at around 70 trawlers. Key sustainability issues to be addressed are the by-catch of sea turtles in trawls and the conflict between industrial trawlers and small scale fishers over access to the disputed 2-mile inshore fishing limit. In order to address these problems the GAPCM with MPRH has developed a program with financing from the French Development Agency (Agence Française de Développement or "AFD") to put in place special shrimp fishery management and development areas (Zones d'Aménagement Concerté" or "ZAC") which will promote co-existence between industrial and small-scale fishers (CEASM 2000). The same program also has funds to help operators install turtle excluders, although one of the larger operators has already done so with its own financing.

2.2.2.7.6 Industrial fisheries surveillance

An EU-funded fisheries surveillance program has recently been established as a condition of the tuna-fishing agreements between the EU and Madagascar. The program aims to set up a permanent surveillance system and includes:

- Establishment of a permanent dedicated marine surveillance unit free of political control;
- Central satellite tracking of all tuna and shrimp industrial vessels;
- Periodic aerial and marine surveillance missions, with arrest and seizure of infringing vessels (deterrent function);
- Generalized policing of fisheries texts, from fishing activities through to export trade, retail outlets and restaurants;
- International co-operation on the governance of fisheries, especially for tuna and other oceanic fisheries.

The program has already had considerable success in satellite tracking, evaluation of the extent of poaching and in making arrests of industrial fishing vessels. Establishment of an independent surveillance agency remains one of the major challenges.

2.2.2.7.7 Community based management of small scale fisheries

Until recently small scale fisheries and other coastal resources such as mangroves have been exploited on an open access basis. This is beginning to change in areas where pressures are high or resources are especially valuable. Methods of access control range from unilateral action by an established user group to fully negotiated access arrangements. Thus, in recent years there have been numerous examples of locally declared taboos (*fady*) and of customary social agreements (*dina*) that regulate access to resources (e.g. Rakotoarison 1999). Within the framework of NEAP, regional integrated resource management plans have been negotiated, although await application (e.g. Ocean Consultant 2000). Initiatives are underway to integrate such resource management plans into regional ICAM schemes.

2.2.2.7.8 Trade monitoring and regulation

While not expressly aimed at resource conservation, the monitoring and control of domestic and international trade in marine products generates data, notably for high value species such as sea cucumbers, lobsters, crabs, sharks and turtles, that could be useful for conservation and management. Monitoring of marine produce is conducted at the levels of provincial production, health and sanitary regulations, hard currency control and international customs.

2.2.2.8 Principal threats and indicated responses

The principal threats to marine and coastal ecosystems and their degree of severity are summarized in ***Table 2.2.2a***.

The most serious threats are considered to be:

1. insufficiently regulated industrial fishing, especially by licensed and unlicensed long line vessels
2. unregulated exploitation of high value resources such as sea cucumbers and sharks' fins
3. sedimentation of mangroves and coral reefs as a result of upland soil erosion
4. over-fishing and resource degradation in densely populated coastal areas

The principal indicated responses to the identified threats are:

1. improved governance of the fisheries sector (the problems are in many respects analogous to those of the forest sector)
2. introduction of soil conservation practices, especially on upland areas draining into the lower reaches of the larger rivers
3. establish community-based resource management and integrated coastal area management in densely populated coastal areas, applying an integrated coastal / river-basin approach

Table 2.2.2a – Threats to marine and coastal ecosystems

Ecosystem	Principal threats	Extent and degree of threats	Indicated remedial measures
Pelagic and coastal seas	1. Industrial purse seine and longline fishing (including unlicensed fishing) 2. Inshore industrial shrimp trawling 3. Artisanal fishing of high value resources (sharks, sea cucumbers)	1. Moderate; all of Madagascar EEZ 2. Locally severe; mainly on west coast, especially in NW 3. Locally severe; near major coastal fishing centers, especially in NW	1. Improved governance and surveillance of tuna and long line fisheries, with international co-operation; 2. Fitting of by-catch excluders (fish, turtles); more research on impacts of bottom trawling and corrective measures 3. Better licensing, surveillance, monitoring and trade controls for high value products; legislation against shark fining
Coral reefs	1. Over-fishing and destructive traditional fishing (poison, drag nets etc.) 2. Excessive reef gleaning (algae, ornamental shells, octopus) 3. Sedimentation from upland and river basin erosion 4. Global warming (coral bleaching, increased cyclone damage) 5. Pollution from urban and agricultural effluents	1. Locally severe; all inshore coral reef areas 2. Ditto 3. Severe on inshore reefs along entire west coast 4. Severe on all coral reefs, especially El Nino years (was bad in 1998 and 2001) 5. Generally minor, locally moderate; densely populated areas	1. Encourage community-based management of small scale fisheries, linked into ICAM in areas of multiple coastal problems 2. Ditto 3. Improved agricultural methods and land use in catchment areas; reduced deforestation and bush fires; reforestation 4. Lobby for enforcement of emissions reductions 5. Improved pollution control and sewage treatment
Mangroves	1. Wood cutting for construction and fuel wood 2. Sedimentation from rivers (upland erosion)	1. Severe around urban centers; otherwise slight 2. Moderate to severe; all west coast mangroves	1. Community-based mangrove management; alternatives to wood use and fuel efficient stoves 2. Improved agricultural methods and land use of catchments / reforestation
Islands	1. Fishermen's camps 2. Guano mining 3. Tourism	1. Severe on many islands in north west, west and south west 2. Moderate to severe on the Barren islands 3. Generally moderate or light; severe on Nosy Tanikely	1. Need for national islands data base, strategy and integration of islands in regional ICZM plans; 2. Adequate EIA and enforcement; 3. Islands strategy, data base and integration into regional ICZM plans

2.3 Agricultural resources

2.3.1 Biophysical setting

The land mass of Madagascar comprises a lozenge-shaped basement of crystalline, mainly metamorphic, pre-Cambrian rocks intruded over large areas by granitic igneous rocks and at scattered locations by volcanic formations (lavas, tuffs) which has been overlain in lowland areas by sedimentary series derived from alluvial deposition or periodic marine incursion over geological time.

In humid conditions, the crystalline and igneous rocks weather into deep tropical ferruginous or ferralitic laterites from which most minerals have been leached, yielding poor, acidic, friable, soils. In dry conditions, laterites do not form, with the result that the crystalline basement is either exposed or overlain by thin mineral soils. Volcanic formations in moist conditions weather into cohesive basic soils rich in magnesium (an essential element for photosynthesis). The sedimentary series yield a variety of soil types, depending on the underlying rock type and environmental conditions.

2.3.2 Types and Location

2.3.2.1 Soils

Ferruginous and ferralitic soils represent almost 70% of the total national area. A further 27% of the national territory is characterized by mineral soils (highlands, western watershed and the far south). The remainder comprises calcimorphic, halomorphic (saline), and hydromorphic (peats) soils.

Ferruginous and ferralitic soils are highly vulnerable to erosion once exposed, as occurs with deforestation. Denudation of ferralitic soils results in the development of grasslands, whose soils are critically prone to hydrological erosion. Erosion results in the creation of *lavaka*, literally "holes", such as those along the western side of the high plateau. (The term "lavaka" is now used internationally to describe this type of erosion, which is found in parts of Africa and Asia.) *Lavaka* formations and the resulting landslides cause siltation of crop fields (rice and others). *Lavaka* continuously deepen and during that evolution, water and organic matters from the top of the hillside are collected at the bottom, allowing for new vegetation to develop. Undisturbed, the phenomenon can lead to the creation of gallery forest.

Uncontrolled disturbances such as frequent fires and agricultural practices without biological or mechanical anti-erosion measures further increase the vulnerability of ferralitic soils to erosion. Intense water turbidity and coarse-grained sediment loads on most rivers on the western side of Madagascar are visible proof of the effects of erosion. The impacts are significant for downstream alluvial plain agriculture.

There are intrinsic as well as anthropogenic threats to soils, the most important agricultural resource. The intrinsic nature/quality of ferralitic soils is, in itself, a threat to the viability of agriculture. If combined with exogenous sources of pressure such as slash and burn, threats to soils and agricultural land are significantly increased.

2.3.2.2 Agricultural lands

The total agricultural land area in Madagascar is 368,561 km^2, or 62.8% of the island's total area. This agricultural land area consists of:

Arable lands are notably a small percentage of the whole, whereas pastures consist of more than the majority of total land area in Madagascar.

- arable land and
- permanent pasture, grasslands, and savannas (***Figure 2.3a;*** see Annex 5).

Grasslands and savannas in Madagascar occupy 58% of the total area dedicated to agricultural activities (INSTAT, 2001).

Table 2.3a- Estimates of the productivity rates of the main agricultural products over the six provinces in 1999 (tonnes / hectare)

	Antananarivo	Fianarantsoa	Toamasina	Mahajanga	Toliara	Antsiranana
Paddy	2.69	1.90	2.035	2.49	1.51	1.81
Cassava	7.036	7.43	8.58	5.53	6.05	4.96
Maize	0.79	1.13	0.93	1.02	1	1.23
Sweet potato	6.69	6.11	4.58	4.8	4.59	3.94
Coffee	0.34	0.34	0.37	0.31	0.29	0.33

Source: calculated with data from the Service de la Statistique Agricole/DPEE/ Ministère de l'Agriculture

Cassava is the most productive staple crop, with the highlands and the east coast province of Toamasina as main producers. Sweet potato comes second, with the highlands and the south sest (Toliara) as the main producers. Paddy rice comes next, and is mainly produced by the highlands, western and eastern provinces. Rice cultivation is intense in the central highlands, yet yields are still low by global standards (2.69 tonnes / ha). Maize comes fourth, with the northern, eastern and highland provinces as the major producers. Coffee is a low-weight cash crop with similar yields throughout. Most is produced in the eastern side of the island.

2.3.2.3 Livestock

Currently, there are 7 million cattle (compared to 6 million in 1995) in the whole of Madagascar; with little change over the past twenty years. Cattle raising is threatened by the extension of agricultural area, reducing available area for extensive grazing and limiting access to water for drinking. These are the primary causes of stagnation of the livestock sector.

Cattle raising is mainly an extensive activity, requiring periodic grass burning just before rains to generate the desired fresh "green bite". A lack of land tenure rights and a high rate of cattle rustling discourage intensive livestock production, because of the uncertainty about future ownership of pastureland and risk of losing livestock, which is a form of capital in Malagasy culture.

Other events have contributed to the decline in livestock holdings and production.

In 1997, the European community imposed an embargo on the export of Malagasy meat, due to non-compliance to hygiene standards, and probably due to lack of demand. A costly new abattoir subsequently constructed in Antananarivo with EU funding has never operated due to political conflict.

The African porcine pest, known for its devastating effects on pig production, severely hit Madagascar in 1997, and worsened the following year. Data from the Ministry of Livestock reveal that in 1998, 275,000 pigs (32%) out of a total number of 870 000 were lost due to African porcine plague in 1998 (INSTAT, 2001).

Poultry production is currently the most dynamic livestock sector in Madagascar, with 60,000 chicks produced every week; this type of production is increasing in urban peripheries.

Since closure of a World Bank funded livestock program in 1999, there has been no significant program within the Ministry of Livestock to promote the sector, despite the important potential.

2.3.2.3.1 Livestock production opportunities

2.3.2.3.1.1 Tropical humid region

Because of its high humidity, the eastern region is not favorable for livestock production. Cattle reared in the region are imported from the highlands or the south. They are used as draft animals and for cultural ceremonies and rituals. Household extensive poultry production is the predominant for of livestock rearing.

2.3.2.3.1.2 Highlands

The high plateau is the zone of most intensive livestock production. Poultry, pigs and dairy cattle are reared on a small scale (household production), but also on semi-industrial to full industrial scale. The highlands have a major potential for intensification and expansion of livestock production due to market access, financial capital and an abundance of small and industrial agro-industries and agro-processors, as well access to grain and tuber production useful as fodder.

The major limitation to livestock production intensification and expansion is population growth which increases competition for cereals (human vs. animal feeding). Urban growth also encroaches on former pasture. Expanded agricultural production should favor livestock production in the highlands.

2.3.2.3.1.3 Midwest

The open rangelands of the west, with medium to low population densities, offer attractive conditions for livestock production in that region. Before the African Porcine Pest hit the area severely, pig production was another important livestock activity in the Midwest. Unfortunately, due to weak marketing structure and repeated contagious diseases (inadequate vaccination remains the main impediment), the sector's productivity has considerably declined.

2.3.2.3.1.4 Sub-humid west and arid south

The open and vast grasslands of the western and southern region offer an outstanding potential for the production of large and small ruminants. While large ruminant production is currently only orientated towards meat production, small ruminant livestock production offers multi-purpose: meat, dairy and mohair fiber production. Development of ruminant-raising is, however, constrained by two factors: weak or non-existing breeding systems and poor management of grazing which is currently based on free roaming. Additionally, poor grazing practices mean that beef cattle cannot be marketed until the mature age of 5 to 7 years.
Figure 2.3b shows the national livestock holdings for 1999 (see Annex 5.5).

2.3.2.4 Agricultural biodiversity

Agricultural biodiversity (or agridiversity) is a recognized component of biodiversity under the Convention on Biological Diversity. gri-biodiversity or "agridiversity" refers to the diversity of plant and animal varieties and species in actual or potential use in agriculture ("agri-species"), and includes "agroecosystems" and the genetic resources comprised within "agri-species".

Compared to the available area for permanent pastures (see ***Figure 3.1*** above), cattle rearing activities are underdeveloped.

No full inventory or evaluations have yet been conducted of agridiversity in Madagascar. However, the value of Madagascar's agridiversity can be expected to be substantial given the large variations in climate and soil types, encouraging the generation of numerous varieties of economically or genetically useful species. Known examples include a native species of caffeine-free coffee, two wild rice species resistant to the RYMV virus, a native toxic species of sorghum and two wild vines resistant to insect pests.

2.3.2.4.1 Conservation of agribiodiversity

Objective # 3 of the NSSMB under the theme 'Biodiversity Conservation' provides specifically for conservation of the genetic resources of agribiodiversity in accordance with conservation principles.

Objective # 4 of the NSSMB under the theme "reduction of pressures on biodiversity resources" provides for the reduction of risks posed by biotechnology and development of biosecurity. The strategy calls principally for the defense of indigenous agridiversity from threats posed by genetically-modified organisms (GMOs) and from introduced species or pests.

Madagascar is a signatory to the biosecurity protocol under the Biodiversity Convention that requires countries to introduce measures to reduce the risks posed by GMOs. However, no specific measures have yet been put in place. Conversely, there are no specific plans to promote the generation of benefits from innovative uses of indigenous agridiversity, although there have been discussions about conducting a full inventory of Madagascar's agridiversity resources.

Conservation of agridiversity is implicit in the objectives of several environmental and agricultural programs, such as the soil conservation component of NEAP Phase 2, the rural development program (PADR) and various projects supported by bilateral donors in the agricultural field.

The principal institutions in Madagascar concerned with the conservation of agridiversity are the national agricultural and plant breeding institute (FOFIFA) and the more recently established national forestry seed bank or "Silo National des Graines Forestières" (SNGF).

FOFIFA's remit is to conduct research into agricultural techniques and plant varieties, usually working on a project basis with partners. It maintains local seed banks in the course of projects but does not maintain a permanent national agricultural seed collection.

The SNGF has a national network of collection points and aims to conserve useful tree species and varieties. At present the SNGF is mainly focused on varieties of introduced species, but is now beginning to stock samples of indigenous tree species. An advice service is offered to those interested in using the species in question.

2.3.3 Economic importance of agricultural resources

Madagascar has an important potential for more intensive, extensive and diversified sustainable agricultural production. It possesses extensive arable lands, only a small fraction of which is currently exploited. Its assets in terms of diversified ecological zones would be favorable for agricultural diversification. But Madagascar has not so far participated in the "Green Revolution" (which refers essentially to farming with use of fertilizers and pesticides) which partly explains the observed agricultural stagnation.

Agriculture in Madagascar employs 80% of the total labor force, of which 68% of people are the poorest of the poor. About 75% or about two million households derive their livelihood from agriculture also represents 53% of GDP and cash crop production (vanilla, cloves pepper and coffee) accounts for 17% of total exported goods (IMF, 2000).

The rigorously-controlled bio-prospecting of agricultural resources such as some of the seeds guarded by SNGF, could generate substantial revenues, which demonstrates another way in which agricultural resources are economically important.

2.3.4 Trends in biophysical condition and productivity

Figures reveal that overall, agriculture production over the past fifteen years has stagnated or decreased in Madagascar, whether it be with regards to staples or cash crops. The decrease in annual production growth rates is shown in the ***table 2.3c*** below.

Table 2.3c- Madagascar's annual agricultural production growth rates in 1986, 1995 and 2000

Crop	**1986**	**1995**	**2000**
Coffee, green	4.8	-2.9	0
Cotton lint	17	-19.5	-25.8
Cloves	-49.3	-7.1	4
Pepper	1.1	-16.7	-15
Rice, paddy	2.41	3.9	-17.1
Sugar cane	1.8	-3	0.9
Vanilla	-52.9	5	-11.8

Sources: World Bank, World Development Indicators and FAO database

The above declining rates reflect the destructive uses of agricultural resources in Madagascar over the past couple of decades.

Experts from the Ministry of Agriculture identify the following factors as the cause of the stagnation of agricultural productivity:

1. Degraded irrigation infrastructure;
2. Low market prices, resulting in a lack of motivation for farmers to increase cash crop production, hence the prevalence of subsistence agriculture in most of the country;
3. Fragmentation and overexploitation of rice paddy holdings (linked to the land tenure issue).
4. Poor transport and communications infrastructure (roads and information on market prices for instance).

2.3.5 Trends in management and development

2.3.5.1 Historical Overview

Historically, agriculture in Madagascar has been dominated by two main themes. The east of the island and the highlands are characterized by typically Austronesian subsistence agriculture based on rice, cassava, sweet potatoes, pigs and poultry. The west is characterized by extensive cattle raising which owes its origins to Bantu Africa, and which is now widely practiced throughout the island. Both forms of land use have involved the extensive clearing of forest or woodland and cattle-raising involves the annual burning of grassland for pasture. The underlying pattern has been overlain by numerous additional uses, notably those introduced by Europeans before and during colonization, comprising the key cash crops (coffee, vanilla, spices, cashews, ylang ylang), the culture of numerous fruits and vegetables and forestry (both timber felling and forestry plantations). Colonization also saw the introduction of a modern system of land tenure; however, this has been little used in relation to indigenously owned agricultural land where custom and tradition still prevail.

The erosion of soils and the related practices of *tavy* and grassland burning have long been recognized as key problems of land management in Madagascar. Madagascar's first king passed laws to limit deforestation and laws banning the practice of bush fires have been in place since the earliest colonial days. Clearing forest legally requires a permit (while individual, non-commercial, local usage for fuel and construction is permissible under rights of usage or "droits d'usage"). Enforcement has always been a problem and the annual bush fires constitute virtually a cultural tradition, commonly increasing during times of political dissatisfaction. *Tavy*, on the other hand, is driven primarily by the need for land and is most intense in the east where population densities are highest. Research into *tavy* demonstrates that it brings real benefits to those practicing it (BEMA, 2001).

The application of ecological agricultural techniques is still at an early or experimental stage in Madagascar. The growing of leguminous plants in off-season rice paddy is becoming increasingly common as a means of enhancing nitrogen content of the soil, whereas direct sowing in which the soil is no longer ploughed is under trial and yielding very promising results (ANAE, CIRAD, TAFA, 2000). This method maintains the protective crust on the soil, which both limits soil erosion and moisture losses.

2.3.5.2 Current Legislation and Policy

Table 2.3d below is a non-exhaustive overview of the existing legislation texts relating to the management of agricultural resources. Of particular importance are the issues of land tenure, agriculture, livestock, agridiversity and reforestation.

For example, objective #3 of the National Strategy for the Sustainable Management of Biodiversity (NSSMB) under the theme "Reduction of pressures on biodiversity resources" proposes the promotion of livestock-rearing and of short-cycle livestock production as priority actions (Ministère de l'Environnement, 2001).

Table 2.3d-Existing Agriculture-related legislation in Madagascar

Issue	Legislation	Purpose	Major statements
Land tenure	• *Law # 60-004* • *Edict # 62-042* • *Edict # 73-073* • *Edict # 74-022* • Decree # 97-949 • Decree # 98-610	• Establishing the general principles for land tenure management. • Establishes the creation of a rural development exploitation area (Aire de Mise en Valeur Rurale). • Elaborating the basic objectives for the development of rural areas. • Establishes land reforms and the general conditions for land management in rural areas, in the context of *Edict # 73-073*. • Establishes the creation of regional commissions for land security reorganization called "cellule de pilotage foncier". • Instituting the launching of Relative Land Security (Sécurisation Foncière Relative).	• The state owns all non-registered lands. • Any infrastructure building or other improvement activity that would contribute to the economic and social development of the area is allowed. • The State offers assistance to increase agricultural productivity in rural areas by: providing land security to farmers, promoting technical innovation, facilitating the marketing of products, providing insurance and financial assistance in the form of credit or subsidies, promoting the creation of national food-processing firms • Farms located within land management zones (zones d'aménagement foncier), including individual, collective or state farms, must be farmed by their owner/tenant. Sharecropping is forbidden. • The "cellule de pilotage foncier" is an entity within the Ministry for the management of lands and cities; the role of the cellule is to conceive, put into place and supervise/control projects related to the management of land. • Relative Land Security is the procedure consisting of delimiting the land area under which a local community has the management right over renewable natural resources, without that land being registered to that community's name
Pastureland	• *Decree # 61-079*	• Defines places where rules of *Order # 60-127* must be complied to	• Burning licenses for the renewal of pastureland can be granted by relevant authorities, provided climatic conditions allow the burning and that potentially burnt areas lay outside the national forest domain.
Livestock	• No official text yet	• National Strategy for Biodiversity conservation (objective 3 of strategic objective #1)	• Conserve and manage the genetic resources from livestock (create reproduction centers)
Agridiversity	• No official text yet	• National Strategy for Biodiversity conservation	• Continue the identification, the inventory of agridiversity resources Make local varieties and resources known to improve food security

Slashing and Burning	• *Order # 60-127* • *Decree # 61-079* • *Decree # 82-313*	• Distinguishes between three types of fires • Regulates the circumstances under which and places where slashing and burning is authorized • Reinforces decree #60-127 • Establishes pastureland specifications	1. 'cultivation' and 'cleaning' fires for future agricultural cultivation; can be lit without formal approval provided they lie outside the national forestry domain; 2. 'pastureland' fires for the regeneration of vegetation for livestock consumption; requires an authorization; 3. 'wild' fires for no economic purpose; forbidden under ANY circumstance • The area to be slashed need to be clearly delimited and the approval of the chief of the Water and Forests '(MEF) provincial service required before the cutting license is granted; the slope of the area needs to be less than 50%, whether it be covered by vegetation or not. • No further cutting license will be given for areas that have been cut for less than four years (to allow for relative soil and vegetation regeneration). • For potential slashing and burning of state lands, anti-erosion activities must be undertaken within one year. Neighboring forest areas owned by the national forest department must be clearly delimited. • When new forest blocks are classified, the MEF's staff will make sure that some areas for agricultural use by the local community is spared at the edge of those new forest blocks. • The local rural development authority will assess the extent of the area to be burnt for renewal of pasture land vegetation, taking the number of existing cattle and the quality and status of the existing vegetation
Reforestation	• Decree #2000-383 (June 19, 2000)	▪ Defining reforestation rules and procedures	• Reforestation is to be carried out in specific reforestation areas (registered by the state specifically for reforestation activities) or on other lands, provided the approval of the forestry commission (commission forestière) • Fiscal incentives to encourage reforestation will include state subsidies from the different forestry funds to contribute to land management protection and protection of reforested areas; non-payment of forestry license fees could be another fiscal incentives in exchange of reforestation activities by individuals, communities, etc. • There are five types of reforestation: 1. industrial reforestation for the production of commercial and fuelwood; 2. reforestation for ecological conservation and restoration (of dunes, watersheds, soils, etc.) 3. reforestation for social purposes (education, recreation, etc.) 4. reforestation for experimentation (with species) 5. reforestation for direct economic purposes (agriculture, pasture) • A 15-year reforestation plan is established in each district. The plan is carried out through yearly forests programs

The trends in management of agricultural resources vary with the resource, and are summarized in ***table 2.3e*** below.

Table 2.3e- Trends in the management of the main agricultural resources in Madagascar

Resource	**Paddy**	**Other agricultural land**	**Rangelands & tanety**	**Agridiversity**
Conventional management	Annual soil turning, planting, irrigation and harvesting Soil removal for brick making Insignificant soil conditioning Low fertilizer use Low machinery use	Planting with crops such as manioc, maize Planting of vegetables on smaller plots Limited soil conditioning for small plots	Annual burning, often uncontrolled Extensive pasture of cattle (land burned exceeds actual need for pasture by large factor)	Peasant farmers conserve seed, and do some strain selection National silo stores seeds of all key crops but is in decline DEF manages tree plantations of native species Potentially valuable varieties of crops exist such as caffeine-free coffee
Trends	No change yet; production for subsistence prevails PADR proposes intensification, but without specifying the means	Tendency towards diversification, especially vegetables and fruits in highlands Increased use of leguminous plants, especially in agricultural project areas Increasing use of fertilizers for potato cultivation	No significant change yet Annual symbolic reforesting campaigns (*reboisement*) Soil improvement programs proposed (e.g. AFD) A few agro-ecological production pilot projects in the Lac Alaotra region (multiple crops)	Renewed interest in agridiversity (national biodiversity strategy) Growing interest in marketing some products (agri-business) under a specific labeling system Small quantities of fertilizers used in tree nurseries

2.3.5.3 Mini-projects and Watersheds approach

Between the years 1960 and 1983, the Watersheds approach was characterized by:

1. interventions mainly reproduced existing modes of land use;
2. limited variety of interventions (tree planting, pasture, road rehabilitation);
3. erosion control measures exclusively mechanical.

During the above period, concepts such as agroforestry and soil management and restoration were entirely absent. (ANAE, 1996).

At the start of Phase 1 of the NEAP there was established the National Environmental Action Agency (ANAE) with a mission to help conserve soils and reduce erosion.

The experiences of PE1 led to the view that soil conservation should be addressed at the level of the watershed (*bassin versant*) as the appropriate unit for soil conservation at a regional level.

The basis of the ANAE approach was that local populations should manage soil conservation activities. Following participatory rural appraisal at a given site, mini-projects were designed to meet local needs and promote soil conservation. The types of projects included forestry, agro-forestry, pasture, anti-erosion engineering, roads and tracks, water source management, well construction and action-research.

The new ANAE program focused on the management/restoration of watershed in the five ecoregions of Madagascar, depending on the specific needs of each respective region. The expected results under EP2 are:

1. The provision to the forestry sector of material;
2. The full training of rural communities in organizational capacity;
3. The establishment of a planning, coordinating and monitoring system;
4. The actual management and/or restoration of watersheds.

2.3.5.4 Agroecological methods, diversification and agribusiness

In an attempt to reduce anthropogenic pressures on forests and terrestrial biodiversity, the USAID-funded program, LDI, has promoted agricultural intensification and rural income diversification by promoting multiple-uses of agridiversity resources in the Eastern forest corridor. LDI encourages farmers to replace annual crops (rice, manioc and beans), which are usually produced in an unsustainable manner (by use of *tavy*), with perennial tree crops that will prevent soil erosion, maintain/improve soil fertility, and produce sustained/increased yields without further land clearing or fallowing. The LDI Fianarantsoa project proposed the following agricultural diversification and agribusiness techniques:

- An intensive rice production (SRI) system and an improved rice production system (SRA), which consist of improving soil fertility through heavy composting, introducing new varieties of seeds, and using specific water control techniques (SRI in particular allows farmers to make savings on factors of production's costs (labor, 'machinery', seeds and other forms of capital investments);
- Fish production combined with rice production;
- Restoration of denuded, eroded hillsides (*tanety*) with agroforestry (fruit tree production) and vetiver grass plantins. "The rehabilitation of tanety hillsides has commenced in 70% of all [169] villages with the extension of practice such as planting vetiver grasses on contours, planting biomass banks of leguminous shrubs for compost and as a source of pollen for bees, or tree planting for individual and community woodlots." (Freudenberger and Freudenberger, 2000);
- Sustainable harvesting of forests resources for essential oil production.

"In most villages, increases in rice production on small experimental plots have averaged about 20% and in some cases have risen to as much as 70%. […] Approximately 11% of all farmers [approximately 220 in 2000] now grow potatoes as an off-season crop. […] 51% of all farmers now build compost piles." Demand for such agricultural practices and agridiversity techniques is increasing, but funds are limited to expand them beyond the proximity of forests. (Freudenberger and Freudenberger, 2000).

The Swiss Development and Cooperation-funded BEMA projects have also achieved very promising results in the field of agroforestry, which was identified as an advantageous alternative to tavy. Agroforestry is a technique whereby crops are grown under tree or shrub cover; the multiple ecological advantages being soil protection, increased soil fertility, habitat diversification, maintenance of watersheds and carbon sequestration. Agroforestry also offers a more diversified range of consumption and marketing products such as foods and wood.

In Beforona (Toamasina province, Eastern part of Madagascar), farmers have been cultivating banana and coffee using *tanimboly*, an agroforestry technique. However, these *tanimboly* crops were not sufficiently diversified, and rarely included perennial crops, or a sufficient proportion of valuable tree species.

In an attempt to diversify production to include commercial crops, the BEMA project initiated experimental cultivation of ginger under the current *tanimboly* conditions in October 2000, and the development of vegetation already seems promising (Nambena in BEMA, 2001). In the light of these positive results, technicians recommended that crops such as cucumber, zucchini, beans, maize, carrots and chilies be introduced and combined with more diversified tree species. *Crotalaria grahamiana*, *Tithonia diversifolia* and *Tephrosia candida*, for example, are species that would

improve the physical and chemical quality of soils. *Cassia sianea*, on the other hand, produces strong and long-lasting wood, resistant to termites *(ibid.)*.

Improved *tanimboly* techniques will mitigate the following negative aspects: loss of soil fertility, shortages of wood for consumption, lack of diversified sources of revenue for local people. However, for agroforestry initiatives to be fully optimal, innovations need to go beyond diversified cultivation, to include sustainable strategies for marketing products. Of high importance amongst these marketing strategies are the propagation of agroforestry knowledge, facilitating access to seeds after the end of agroforestry projects, such as those supported by BEMA or LDI, and facilitating access to market information through transport infrastructure development.

2.3.5.5 Rural development focus on poverty alleviation

The Malagasy government strategy for poverty alleviation is based upon the participation of the rural poor in the economy through agricultural and rural development, as manifested in the Poverty Reduction Strategy Document (DSRP), the Rural Development Action Plan (PADR), and the Rural Development Support Project (PSDR) (see section 3 of this paper).

2.3.6 Principal threats

2.3.6.1 Threats common to forests

Slash and burn, logging and mining are also threats to agricultural resources, especially to soils. Surveys have shown that before the 1980s, fallow periods were on average around eight years; one decade later, fallow periods had been reduced to two to five years. Such as short period barely allows the vegetation to reach a shrubby stage before land is returned to exploitation. Consequently, the agricultural land under exploitation has a reduced chance of recovering its vital nutrients. Over time, under such practices, degradation in soil texture and soil erosion occur. This phenomenon is visible on the southeast side of the Fianarantsoa province, between the coastal plain and the mid-altitude tropical forest.

Logging and slash and burn also contribute to the degradation of watersheds, water being a vital agricultural resource unfortunately lacking in some areas of Madagascar. In addition to the above-identified direct threats, there are indirect sources of threats to agricultural resources.

2.3.6.2 Land Insecurity

The lack of land tenure or ill-defined property rights discourage agricultural intensification practices as well as the regeneration of natural resources. Traditional agricultural practices such as *tavy*,(encouraged by the lack of well-defined property rights) lead to soil erosion and soil fertility loss. The lack of space for future rice cultivation is a major threat to production (Randriarimanana & Beyrières, pers. comm.)..

2.3.6.3 Lack of disposable cash

The low market price for rice is a disincentive for farmers to invest in factors of production such as labor, machinery or fertilizers. As a consequence, rice paddy fields, which tend to fragmented and small, become overexploited, resulting in soil fertility loss and increased erosion.

A decrease in the quantity and in the quality of agricultural resources has other far reaching consequences of a socio-economic nature, which give way to further migration, further slash and burn and further losses in soil fertility elsewhere.

2.3.7 Indicated responses

In the above threats analysis, soil erosion and loss in soil fertility, induced mainly by tavy,, have been identified as the two major threats to agricultural resources. Indicated responses to these threats are:

- Reforestation and soil conservation/restoration programs - ANAE is already putting a great deal of effort into soil restoration through its activities in watershed management and restoration. These activities include reforestation, forest conservation and soil conservation through improved agricultural methods. (Note that 98% of rice production, 95% of cotton production and 100% of other production such as cassava, maize, potato, sweet potato are dependent on water from watersheds - DEF, 1996);
- Forest conservation programs, for example by way of conservation contracts (Durbin);
- Improved rural education (a sutdy has confirmed the link between education and improved livelihoods through agriculture – Randrianarisoa & Minten 2001);
- Improvements in land tenure and reinforcement of land tenure legislation;
- Promotion of credit facilities that are more advantageous than informal sources of credit;
- Improve agricultural production (agro-ecological techniques, mutli-cropping, facilitate access to fertilizers) and productivity. (Randrianarisoa & Minten 2001 reveal that diversification in high value crops contributes to increased welfare, which would partly solve farmers' lack of liquidity);
- Promote dairy production in mid-Western part of the country;
- Promote rice cultivation using agro-ecological techniques (a project financed by the French Agency for Development developed successful agro-ecological pilot projects in the West and the South West; these trials consisted of multiple crops (rice associated with beans, maize, soy, sorghum) grown under a vegetation cover, in different types of soils, including those abandoned after being burnt (*tanety* in Malagasy), with limited use of fertilizers. Productivity increase obtained from this type of cultivation range from 50 to 200%, depending on the agro-ecological context and the crop. (ANAE, CIRAD, TAFA, 2000);
- Improve communication and transport infrastructure to reduce transaction costs and allow better integration into the market.

Table 2.3f below summarizes the threats to agricultural resources and indicated response to address impacts of those threats.

Table 2.3f -Threats to agricultural resources and indicated responses

Agricultural resource	**Threat**	**Indicated remedial measures**
Soils, lands, water	• Land insecurity • Deforestation leading to soil erosion and loss of fertility • Slash and burn • Climate change (gradual drying of climate in SW)	• Revise land tenure laws and policies • Promote community-based management of resources • Promote the use of agroecological techniques such as those promoted by LDI • Forest conservation and reforestation activities • (see all indicated measures for forests in section II 1) • Soil conservation through improved agricultural methods • Improve and diversify agricultural production (multi-cropping, agroforestry) • Promote agribusiness as a means to diversify sources of revenues • Set up formal rural credit facilities • Improve communication and transport infrastructure • Improve rural education • Monitor impacts • Design climatically adapted methods and crops • Intensify production in appropriate areas • Improve veterinary services • Elaborate, apply and reinforce legislation rules on bioprospecting • Establish a royalties and fees system upon exploration • Create agridiversity species' banks (for seeds, etc.)
Livestock	• Agricultural extension mobilizing pasture land and water sources • Diseases • land insecurity making farmers reluctant to invest in large livestock production	
Agridiversity	• Ill-regulated bio-prospecting • Lack of actual conservation activities	

3 ANALYSIS OF PAST AND CURRENT INITIATIVES

3.1 Historical overview of Madagascar's development

Madagascar was first settled by humans around the 2nd century AD, in scattered settlements along the west coast. Earliest east coast settlements date from the 5th century AD, and the earliest settlements known from the highlands date from the 7th century AD. While settlement has been dominated by Austronesian peoples originating from the Borneo region, Madagascar has also been settled at different times by people of African, Arab, Chinese and European origin, generating considerable ethnic variation across the country.

Although well known to Arab traders since before the 9th century, Madagascar was first visited by Europeans (Portuguese) in the 16th century. Until the end of the 18th century, European settlements were limited to coastal colonies and trading posts (notably in the south west and north east).

The late 18th century saw the rise of the various kingdoms of the central high plateau (Imerina) and the eventual conquest and unification of Madagascar under King Andrianamapoinimerina who established his capital at Antananarivo. Establishment of Madagascar as a nation state attracted European influence through missionaries and adventurers, with more or less equal influence from Britain and France. In the late 19th century Madagascar was colonized by France as part of larger arrangements between Britain and France over possessions in the Western Indian Ocean. France abolished the Malagasy monarchy and other traditional authorities and imposed colonial rule.

Under French colonial rule (1886-1961) Madagascar was managed as a part of the French economy, mainly for the production of cash crops (sisal, vanilla, coffee etc.), minerals and natural resources (timber, fisheries) and other activities such as scientific and cultural research. During the 1st republic (1961-1974) Madagascar remained essentially controlled economically by France, but attained a greater measure of independence following the Christian-socialist revolution of 1974 when Didier Ratsiraka took power and established the Malagasy People's Democratic Republic. There followed a brief period of influence from the Soviet Union and other socialist powers, which was already declining by the end of the 1970's. Madagascar's leadership then turned more to the west, and made its first contacts with the IMF. There followed a flood of interest from international donors and institutions.

3.2 Current initiatives

3.2.1 National Environmental Action Plan (NEAP) and related activities

3.2.1.1 Introduction

Madagascar is unusual in being the object of a coordinated, multi-donor, environment program referred to as the national environmental action plan (NEAP). NEAP is a 15-year program in three 5-year phases known as Environment Program (EP) 1 (1991-1996), EP2 (1997-2002) and EP3 (planned for 2003-2008).

The NEAP is by far the most significant initiative in respect of the environment in Madagascar in recent years representing an investment of more than $450 million over 15 years, employing directly or indirectly thousands of people, affecting the lives of several hundred thousand more and directly intervening in over 25% of Madagascar's 590,000 km^2 land surface. The NEAP has had a substantial leverage effect, encouraging many related activities not formally integrated into the NEAP structure but which pursue similar objectives and which probably represent an additional 50% on the original investment.

NEAP has been a colossal learning experience for all concerned. While the goals and guiding principles have remained unchanged since 1991, increased knowledge and experience have led to significant shifts in perception about how NEAP's goals might best be achieved and the extent to which they are achievable.

3.2.1.2 Genesis of NEAP

Genesis of NEAP began in the early 1980s when the resurgence in biological research, which accompanied renewal of relations with western powers reaffirmed Madagascar as one of the world's top conservation priorities, on the basis of its extraordinary biodiversity and the very high level of threat to that biodiversity. With the assistance of donors, research institutions and NGOs, in 1984 the government adopted a strategy for conservation and for sustainable development,

During the 1980's, much of the development community became convinced of the links between biodiversity loss, poverty and economic development, and the concept arose for a coordinated, integrated program designed to tackle environmental problems within the context of sustainable development. There was thus born the Charter for Environment of 1990 (Law 90-033) which had multiple purposes:

1. to lay down fundamental environmental principles (e.g. duty of all to protect the environment);
2. to present a description of the country's environmental problems and the links between environment and human development;
3. to define the national policy on environment;
4. to establish the NEAP;
5. to define the broad objectives of NEAP and its three 5-year phases while retaining flexibility on the precise objectives and means of achieving them;
6. to define the institutional framework for the environment.

The Charter is not purely a conservation instrument - it stipulates that "environmental action is not solely restricted to the protection and the conservation of natural resources, of rare species or sites. It goes hand in hand with actions towards sustainable socio-economic development."

3.2.1.3 Objectives of the NEAP

NEAP's goal is to "*end the spiral of degradation while reconciling the population with its environment*."

In order to achieve that goal, the NEAP emphasizes the need to change the behavior of people in relation of the environment, in particular on eradicating the practice of tavy as the most serious threat to biodiversity. The Charter specifically advocates the abandonment of the "project approach" in favor of a "program approach" and an end to a "culture of dependence". Finally, the Charter advocates concrete action as the only way to "win the war for conservation and development".

3.2.1.4 Strategy of NEAP

The strategy of NEAP is essentially the same as the national strategy of 1984 with some adjustments and is based upon three tenets:

- A recognition of man's place in the biosphere.
- The need to advance knowledge of the environment and of man's impacts thereon.
- The need to change human behavior in relation to the environment.

The strategy is implemented through the mobilization and participation of the main actors of social, economic and political life with a particular emphasis on communities taking responsibility for the protection and management of their own surroundings. The strategy calls in particular for:

- An integrated approach;
- A long term vision;
- Adopting a beneficiary's perspective;
- Communication and dialogue in place of injunctions;
- Use of methods appropriate to the myriad contexts.

In addition, the strategy sets out sub-strategies for specific sectors: education, watershed management, land tenure, biodiversity protection, ecotourism, improving rural and urban environments, developing tools for management, environmental protection and monitoring and the institutional framework. It then proceeds to define specific regional strategies for Madagascar's principal regions (Central highlands, East, Midwest, West, North and South).

Finally, NEAP's operational sub-strategy is based on:

- *conservation* (i.e. building on existing structures rather than new ones);
- *rehabilitation* (restoration of structures that formerly performed the functions required)
- *innovation* (in cases where the structures with the required functions do not exist).

3.2.1.5 Implementation of NEAP

The three phases of NEAP were conceived as set out in ***Table 3a*** below:

Table 3a- Original objectives of EP1, 2 & 3 (Charter for the Environment)

NEAP Phase	**Main purpose, objectives and orientations**
EP1	NEAP start-up phase, including: • Achieve co-ordination of existing activities • Dynamize existing institutions • Set up institutional frameworks • Set up program financing • Establish program procedures, norms and performance criteria • Put in place the environmental legal framework, notably for EIA • Put in place environmental monitoring mechanisms • Implement program activities • Conduct pilot operations and action research (with a view to EP2)
EP2	Action orientated phase (intensification of actions initiated in EP1): • Concrete action in the areas of biodiversity conservation, soil conservation, cartography and cadastre • Integration of NEAP into the national development plan • Reorientation, reflection and consolidation of actions • Continuing program co-ordination
EP3	Mainstreaming phase (environmental "reflex" to become automatic): • Complete integration of NEAP into the national development plan • Populations, collectives, ministries and NGO's actively implementing techniques of environmental management • State structures systematically applying the environmental concept in sector policies and programs • National plans and programs make environment and conservation a driver for sustainable development

Each phase has been the subject of mid-term or end-of-phase reviews resulting in modification and orientation of objectives and approaches (given below in the description of each phase of NEAP).

3.2.1.6 Environmental Program 1 (EP1 1991-1996)

The two principal objectives of the EP1 were to:

- establish the foundations for environmental management through institution building, studies and human resources development;

- protect biodiversity within national parks, reserves and gazetted forests, along with improving the livelihoods of surrounding communities.

EP1 also focused on mitigating deforestation and erosion of areas where the impact of these would be the most devastating economically. Estimated costs of EP1 were $150 million, with principal funding coming from the World Bank, USAID and other bilateral sources (Holland, Switzerland, UK) and NGOs (especially WWF).

EP1 consisted of seven components:

1. integrated conservation and development projects (ICDPs) for threatened ecosystems);
2. community-based soil conservation, agroforestry, reforesting and watershed management;
3. promotion of land management tools and the set up of a GIS and mapping system;
4. improvement of land security through cadastral operations;
5. promotion of environmental communication, training, education and awareness-raising;
6. environmental research on terrestrial, coastal and marine ecosystems;
7. supporting activities such as institutional capacity-building, elaboration of environmental impact assessment procedures, reinforcement of the environmental database, environmental research, monitoring and evaluation and sectoral policy studies.

3.2.1.6.1 Significant related activities to EP1

Among the significant related activities during EP1 were:

- Madagascar wetlands conservation project (Peregrine Fund);
- Swiss Co-operation forest conservation program at Kirindy, Morondava (CFPF);
- Biodiversity research and institutional support by international organizations including botanic gardens (MBG, RBG Kew), universities (Michigan, Princeton), institutes (ORSTOM), museums (e.g. Chicago);
- Small NGO conservation projects (e.g. Jersey Wildlife Conservation Trust).

3.2.1.6.2 Results and lessons learned from EP1 and related activities

As the program was coming to an end in 1996, an effort was undertaken by the donors, in particular USAID, to help link the learning objectives fundamental to the EP1 program with efforts to design EP2. The most important outcomes of the EP1 experience were:

- The program was too narrowly focused on protected areas; it was recognized that efforts needed to be expanded beyond the present protected areas to add corridors, classified forests, littoral forests, *marine/coastal ecosystems*, and other related landscapes;
- ICDPs were complex to manage and too costly when compared to the limited population reached, to be considered sustainable;
- Modern sectoral environmental policies elaborated by the national office for the environment (ONE) but were not being implemented;
- A foundation (Tany Meva) for the financing of mini-projects was established;
- Having been successful during EP1, community-based activities should be continued and expanded during EP2;

- Sources of pressure and threats to Malagasy biodiversity need to be addressed at both regional and national levels.

3.2.1.7 Environmental Program 2 (EP2 1997-2002)

EP2 was conceived as the piloting phase within the national environmental action plan.

The estimated cost of EP2 has been US $155 million, with principal funding from the World Bank, UNDP, EU, USA, France, Germany, IFAD, Japan, Switzerland, Holland and Norway.

Experience from EP1 generated the following orientations for EP2:

1. expand conservation and development activities beyond national parks and reserves into a *regionalized* landscape approach focused on identifying and protecting key biodiversity conservation zones (e.g. forest corridors);
2. identify key areas for agricultural intensification and economic growth in order to decrease the pressure on natural resources, by addressing the growing agrarian crisis and using the private sector as a catalyst;
3. include a new coastal zone management and marine resources component;
4. integrate environmental activities in the decentralization process and with other sectoral activities in the areas of regional rural development and economic growth.

EP2 comprised the following components:

Direct action components:

- Conservation of protected areas and ecotourism ("CAPE");
- Conservation management of soils and watersheds ("ANAE/Bassins versants");
- Support to regional environmental management and the spatial approach (AGERAS);
- Biodiversity and applied environmental research ("REF/Biodiversité");
- Secured local management of natural resources ("GELOSE")
- Marine and coastal environment ("EMC");
- Multiple-uses of forest ecosystems ("ESFUM").

Cross-cutting component:

- Policies, strategies and information, including EIA ("PSI/MECIE").

Support components:

- Communication and education;
- Program co-ordination (ONE)

Following the mid-term review of EP2 in June 2000 which identified over-complexity as a defect in EP2 design, the above components were reduced to the following:

Table 3b – Revised structure of EP2 (June 2002)

Conservation of protected areas & ecotourism (CAPE)	Unchanged
Multiple-uses of forest ecosystems (ESFUM)	Unchanged
Conservation management of soils	Sub-component watersheds deleted
Support services to environmental management (SAGE)	Integrates AGERAS, GELOSE, EMC and Biodiversity
Policies, instruments & information for environmental management (PIIGE)	Integrates PSI/MECIE and REF
Communication and education	Unchanged

Co-ordination	Unchanged

3.2.1.7.1 Related activities to EP2

A full assessment of activities related to EP2 has not been conducted. It is, however, clear that numerous activities were encouraged or influenced by EP2 and contributed to the same overall objectives.

Among the significant related activities during EP2 were:

- USAID's Landscape Development Initiative (LDI) project that has piloted agricultural intensification, forest management and other means of addressing the threat of tavy;
- Applied research on the links between biodiversity loss and development, especially the "BEMA" program (see below *);
- NGO conservation projects (e.g. Durrell Wildlife Conservation Trust) that have developed promising conservation approaches;
- The national wetlands initiative (based on a consortium of organizations) which resulted in ratification of the Ramsar convention and the establishment of a national wetlands committee (CONARAMS) (a project proposal for a national wetlands conservation program is being considered by GEF);
- Environmental programs of QIT Madagascar Minerals (QMM) in relation to titanium mining near Fort Dauphin (SE Madagascar) (this development has in its turn attracted major investment by USAID and others in piloting a regional planning approach);
- Initiative of the Ministry for Industry to establish a legislative framework for industrial pollution;
- Moves by the shrimp fishing industry, led by GAPCM to establish special management zones (known as "ZAC") for shrimp fisheries (discussions under way for a synergy with NEAP actors for the Baie d'Antongil, NE Madagascar).

*The Swiss-funded Ecological Inventory Project ("BEMA") and Ecology Policy and Biodiversity project ("EPB") have conducted applied research on the links between development, biodiversity and slash-and-burn cultivation whose results have been debated in a national workshop (BEMA 2001). These, coupled with results of the USAID funded LDI project constitute the most rigorous assessment of the links between biodiversity loss and rural development and will contribute importantly to program design after EP2.

3.2.1.7.2 Results and lessons learned from EP2 and related activities

As for EP1, EP2 was the subject of annual or more frequent meetings of the committee of donors (CFE), which conducted reviews of progress to date. However, in the case of E2 the mid-way evaluation (conducted in February 2000) was an evaluation of the entire program.

More recently, the preparations for EP3 have necessarily involved an evaluation of the lessons learned during EP2.

3.2.1.8 NEAP mid-term evaluation

The NEAP mid-term evaluation (Feb-May 2000) yielded the following principal conclusions:

Apart from significant results in the case of protected areas (an area especially supported by USAID) and soil conservation, the impacts of NEAP on the ground and for local populations have been quite limited – the goals of the Charter for Environment are still far from being achieved.

The main achievements of NEAP by the year 2000 had been:

1. Improvement of the institutional framework for management of the environment and natural resources;

2. Development of a number of useful tools for environmental management, notably:

- Environmental impact assessment (EIA) through the MECIE legislation (ONE);
- National biodiversity strategy and revised law on intellectual property (ONE);
- A new draft law on protected areas (COAP) and national protected areas plan (PlanGRAP) (ANGAP);
- Modernization of the National Cartographic Institute (FTM), introduction of the land tenure "securitization" mechanism to support transfer of natural resources (SFR), the establishment of a corps of trained environmental-GIS technicians and a start to numerization of the national land register (cadastre);
- Piloting of the regional approach (AGERAS) including conducting regional environmental assessments and establishment of local "structures for concerted action";
- Transfer of management of natural resources through the various mechanisms of GELOSE, GCF (forests) and social conventions (*dina*).

3. The evaluation also identified as positive the ability of NEAP to evolve and noted in particular a shift in soil conservation projects from a local level to a larger scale communal level, the shift in protected areas strategy to an ecoregional approach and the piloting of integrated coastal zone management (ICZM).

The main criticisms of the NEAP were:

- Inadequate communication – the NEAP was failing to communicate accurately or effectively with beneficiaries or between actors;

- The "program approach" has shown advantages and disadvantages but in general the co-ordination of actions has been far superior than would be the case between separate projects – however, much progress was required in defining global indicators (state of environment, socio-economic indicators, biodiversity indicators) essential for impact evaluation.

The particular operational problems identified were:

- Obstacles to synergy between the different program components;
- Excessive complexity of procedures;
- Lack of co-ordination between NEAP and other national programs (poverty alleviation, rural development)

3.2.1.8.1 Key findings of the mid-term review in relation to specific program themes

3.2.1.8.1.1 Forests

- Governance remains a major impediment and donors made the improvement of governance a pre-condition of further support to ESFUM and the watershed components;
- revenues of the National Forestry Fund (FFN) must be doubled and the management performance of FFN needs improvement;
- a monitoring system has to be put in place to stop illegal forest exploitation on the East Coast (Toamasina) and in the North;
- no logging licenses should be granted by the Ministry of Waters and Forests for priority forest blocks until further validated management plans are elaborated and applied;
- the management capacity of decentralized forestry offices needs improvement.

3.2.1.8.1.2 Marine and coastal ecosystems

- The committee for marine and coastal protected areas must elaborate an action plan and feasibility studies for the creation four other marine and coastal protected areas
- Micro-projects and community-based management activities should be launched on 6 pilot sites;
- Overall strategy of the marine and coastal environment component of PE2 will be clarified for the improvement of transparency

3.2.1.8.2 Further EP2 evaluation in the context of EP3 planning

The annual donor-government review process for November-December 2001generated additional recommendations in the areas of:

- Persistent problems of governance in the forestry sector (a series of pre-conditions were imposed on future EP financing);
- Financial management – clarification required for the remainder of EP2 and the transition persion between EP2 and EP3;
- Restructuring of ONE – the proposed restructuring based on the revised components of SAGE and PIIGE should continue, with SAGE to be established as an autonomous body to become independent of ONE (that would retain the PIIGE function);
- Global indicators of tavy and biodiversity must be defined.

Note: Towards the end of EP2 significant data became available on rates of deforestation that confirm significantly lower rates of deforestation in protected areas and classified forests than in non-classified areas, confirming at least that protected status confers a conservation advantage. A USAID-sponsored study has also demonstrated lower than average rates of forest loss in forest corridor regions where USAID has been intervening through the LDI project (Hawkins & Horning 2001). However, the study did not consider the broader question of whether NEAP interventions as a whole were having an impact. (For further details see the section on forests).

3.2.1.9 Environmental Program 3 (EP3 2003-2008)

EP3 is the “mainstreaming” phase of the Malagasy NEAP. It is intended by the end of EP3 that environmental considerations become systemic and that the environmental “reflex” becomes automatic at all levels in society. Indications of the mid-term review are that these ambitious objectives will not be achieved in full by end PE3 while there is clearly much positive achievement to build from.

Key lessons emerging from NEAP that are adopted in the EP3 approach are:

- The need to address development and conservation at the local and regional level in a fully integrated manner;
- The need for a fully coordinated, coherent, program approach (EP2 possessed many of the ills of the project approach despite best intentions);
- The critical need to develop real capacity within communities to manage resources (simple transfer of authority to manage is not enough).

The proposed strategy for EP3 intervention is based on:

1. Adopting a results-based approach based on a single, coherent, logical framework, in place of the component / institution-based approach of EP2 – in theory this should render EP3 a more open, inclusive but coherent program than EP2 and encourage a greater degree of synergy between actors;

2. The program will operate at the national level (for addressing national issues such as bush fires) while focusing field interventions at the level of zones of known priority for biodiversity (ZPIs);

3. Development planning and integration of the environmental dimension – NEAP would intervene primarily in the context of rural development, providing environmental input to PADR within ZPIs;

4. The guiding principles of intervention will be participation, subsidiarity, a regional and/or communal approach, a gender differentiated approach and empowerment.

The overall goal of EP3 will be to "conserve and derive benefits from natural resources for sustainable growth and improved quality of life". (This goal by implication includes the alleviation of poverty).

The strategic objectives of EP3 are:

- Sustainable management of natural resources by communities in priority zones;
- Promote sustainable management of natural resources at the national level.

The specific objectives of EP3 are the following:

- integrated development approaches adopted by the population (focusing on ZPIs);
- the potentialities of forest ecosystems are realized;
- conservation and enhancement of Madagascar's vulnerable ecosystems;
- the potentialities of marine and coastal ecosystems are managed sustainably;
- a positive change in behavior in relation to the environment is observed;
- mechanisms in place for sustainable financing of natural resources management and conservation.

The expected results at the end of that third phase of the NEAP are that local communities from the priority intervention zones will have assimilated all renewable resources and biodiversity management techniques and principles, and that sustainable management of natural resources will be initiated at the national level.

The adoption of the regional (GTDR; see section on Rural Development Support Plan) and communal approach is expected to contribute greatly to the achievement of the two above results.

In relation to forests in particular, the EP3 seeks to:

- slow the forest degradation process (through the creation of new conservation sites and the support to farmers' associations in bush fire and slash and burn control);
- manage forests in a rational manner through management transfers (this is where the role of rural development working groups (GTDR) is fundamental)
- bring about a future increase in forest cover and improve the national capacity in storing carbon (the main mechanism proposed for the achievement of this result are the creation of more Reforestation Reserves (RFR);
- strengthen the forestry administration through the set up of an information and communications system, monitoring and evaluation of forest management activities, capacity-building of participants in forest management.

The reinforcement of the link between rural development support and conservation is the most striking feature of the EP3. NEAP will thus be working mostly alongside PADR.

3.2.2 Political decentralization

Since the early 1990's Madagascar has been undergoing a process of decentralization. This is a complex, politicized, matter and many aspects remain unclear. Decentralization potentially has important consequences for environmental management in Madagascar.

The idea of political decentralization gained support from the early 1980's and was enshrined in the new constitution voted by referendum in 1992. The constitution called for "effective decentralization" based on the central state devolving administrative powers to regions and communes. Law 97-004 defined the powers of the regions and communes, although implementation only proceeded with the communes (each of which is led by an elected mayor).

Following re-election of President Ratsiraka in 1996, the constitution was revised in 1998 to introduce the new concept of the state of Madagascar as comprising the nation and six "autonomous" provinces. Laws were then passed to define the powers and roles of the autonomous provinces (Laws 2000-016 and 2000-017). Elections were held to appoint colleges of electors and elections held to appoint provincial governors in 2001.

Under the constitution, the state is responsible for international relations, justice, defense, national security, strategic resources, monetary matters, privatization of state enterprises and the guarantee of human liberties. The autonomous provinces are competent concerning the administration of the regions and communes, provincial administrative offices, police, markets, and public services of provincial interest.

The establishment of autonomous provinces is widely seen as a political device of the regime to facilitate presidential control of the country through division and indeed as running contrary to the original vision for decentralization. Supposing that the current political crisis ends in establishment of a new regime, the status of autonomous provinces may be revised or even abolished.

3.2.2.1 Impacts of decentralization on environment

Decentralization has the potential for positive impacts on environment, in promoting more regional and locally-based management. The existence of autonomous provinces, however, may prove to be a threat or hindrance to regional and local management since the provincial administrations have authority over communes and regions.

Between the provincial and national levels there is a risk of conflict resulting in a breakdown of rational management. Thus, provincial governors may be tempted to sell fishing or logging licenses against the wishes of central government, or the government may sell licenses for provincial resources. Such conflicts could have serious environmental consequences.

Between the provincial and the local and regional levels there is a risk that the provincial authorities will use their powers to "re-centralize" management to the provincial level, even sweeping aside all that has been achieved in developing local will and capacity to manage natural resources.

USAID and other agencies have strongly supported the emergence of the commune as the optimal level of intervention for locally-based resource management, with the communal development plan as the principal instrument for development and environment at the local level.

The inter-communal law should facilitate environmental management at the regional level, in the absence of any official regional administrative level (the regions as defined under 94-007 have yet to be put in place).

Nevertheless, there are risks associated with working at the communal level. The leaders of communes are elected politicians (mayors) who are linked through the national association of mayors. As long as the majority of mayors remain members of one political party, communes will be vulnerable to political interference.

3.2.2.2 Opportunities in view of decentralization

Opportunities under decentralization comprise 1) promoting desirable aspects of decentralization; 2) taking measures to compensate for the threats posed by decentralization.

One key opportunity of decentralization has been seized, namely the elaboration and passing of the GELOSE law. Many different actors have sought to apply GELOSE or simply to take the management of natural resources into their own hands through the customary law system (*dina*).

Another opportunity, which has also been seized by donors and agencies, is to use decentralization to promote environmental management at the communal level. Empowerment of communes is also a strategic measure to discourage future political interference by provincial governors.

In general, USAID and other agencies have made full use of the opportunities offered by decentralization. The great challenge is now to provide the decentralized agencies with the capacity to manage their resources correctly.

3.2.3 Structural Adjustment

Structural adjustment constitutes the grand framework for macro-economic development in Madagascar.

The first structural adjustment loan (CAS1) was negotiated with the IMF in 1984 and operated until 1991 when the process was interrupted by a period of political instability. Negotiations resumed in 1994 and agreement on CAS2 was reached in March 1997. CAS2 funding came on stream during 1997.

Structural Adjustment in Madagascar is directed from the Technical Secretariat for Adjustment (Secrétariat Technique d'Ajustement) of the Prime Minister's office. The STA has published progress reports on Structural Adjustment (e.g. STA 1999).

The essential objective of structural adjustment is to bring about rapid and sustainable economic development through adjustment of the institutions, laws and policies that affect economic activity. A major emphasis is placed on market liberalization to facilitate economic growth. Measures are included to ensure that economic development is socially equitable and ecologically sustainable. Indeed, some of such measures are now an express condition of HIPC-II (see below) and are specified in the Strategy Document on Poverty Reduction (DSRP) (Government of Madagascar 2001).

Madagascar's structural adjustment program has pushed through reforms in the following areas:

- Taxation and fiscal policy
- Monetary and financial sector
- Privatization of public industries
- Foreign exchange and payments
- Market liberalization

The program has had considerable positive economic impacts. Liberalization has encouraged a 750% increase in the level of private investment between 1995 and 2000, which now represents 8% of GDP. Debt servicing costs were reduced by 50% by the year 2000. Economic growth in 2000 was 4.8% and

expected to be over 5% in 2001. Economic growth overtook population growth in 1998 or 1999. (A substantial dip can however be expected in 2002 because of the current political crisis.)

The reforms are also considered to have had reasonable success in terms to key social indicators, such as:

- Percentage of children not attending school reduced from 50% in 1993 to below 30% in 1999
- Illiteracy reduced from 56.6% of adults in 1993 to 48.7% in 1999
- Poverty index reduced from 73.3% in 1993 to 71.3% in 1999

However, performance on social indicators has been markedly inferior to performance on economic ones, indicating that many of the benefits of economic growth are not reaching the poorer population sectors, notably the rural poor. As had been highlighted in earlier assessments of the private sector, only about 5% of the work force are active in the modern private sector while 9 out of 10 Malagasy remain in the informal sector (e.g. Coopers & Lybrand 1991).

The above findings led to the renewed emphasis on poverty reduction and the participation of the rural poor in the national economy, as manifested in the DSRP and PADR/PSDR, as well as in existing programs (e.g. NEAP).

3.2.3.1 Environmental impacts of structural adjustment

No specific assessment has been conducted of existing or potential impacts of Structural Adjustment on environmental indicators, while this has been the subject of much debate in international environmental circles since the mid-1980's. The environmentalist argument is that structural adjustment along free market lines, without mitigating measures, can be expected to accelerate rates of forest loss.

The available evidence from Madagascar, based mainly on local studies (Freudenberger and Freudenberger, 2000) tends to suggest that at the local level forest and biodiversity loss will rise with economic growth unless mitigating action is taken. This is primarily because increased prosperity enables wealthier individuals to hire labor for land clearance. While it is difficult to extrapolate from the micro- to macro-levels, there are no examples of any studies that show increased prosperity to have *reduced* deforestation rates.

The expectation that increased prosperity will cause increased rates of deforestation is echoed by the environmental evaluation of the PADR, which predicts that rural development will increase deforestation rates, necessitating a broad array of mitigation measures to counteract this tendency (CNRE 2001). A fuller analysis of the effects of prosperity on deforestation is given below in relation to the poverty reductions strategy (DSRP).

3.2.3.2 Opportunities under structural adjustment

In general, structural adjustment represents an opportunity for a whole range of measures intended to mitigate against the environmental impacts of economic growth and free market forces. Lobbying can help to ensure that such measures are imposed as conditions on structural adjustment, thus providing greater assurance of government for environmental programs. Such lobbying has already had a considerable impact in Madagascar.

At a specific level, opportunities exist in relation to specific adjustment measures (see below under HIPC, DSRP, PADR etc.)

3.2.4 Enhanced Highly Indebted Poor Countries debt relief initiative (HIPC-II)

The HIPC initiative was launched by the World Bank and the IMF in 1996 as the first comprehensive effort to eliminate unsustainable debt in the world's poorest heavily indebted countries. To mark the millennium, the initiative was broadened ("enhanced") in October 1999. An enhanced debt relief package was issued for Madagascar by IDA/IMF in December 2000.

Under HIPC-II Madagascar will benefit from a package of debt relief worth US$ 1.5 million (or US$ 0.8 million in Net Present Value) subject to certain key conditions:

1. Continued commitment of Madagascar to the structural adjustment program;

2. Completion and satisfactory implementation of a fully participatory Poverty Reduction Strategic Paper (i.e. the Document Stratégique de Réduction de la Pauvreté or DSRP);

3. Implementation of an agreed set of measures in the context of the DSRP, including key areas of governance, environment, institutional reform, social services delivery (health, education) and road maintenance;

4. Confirmation of the participation of other creditors in the debt relief program.

3.2.4.1 Links between HIPC and environment

The required environmental measures under 3.above include the implementation of a public and transparent information system on granting of licenses (beneficiary list, geographical zone, amount) in the mining, forestry and fishing sectors, the list to be published biannually.

In relation to NEAP, the World Bank, supported by the other donors, has imposed a series of specific pre-conditions for continued financing of the NEAP, in the area of forestry sector governance, namely:

Definition of working modalities for the National Forestry Fund (*Fonds Forestier National* or "FFN"), Regional Forestry Funds (*Fonds Forestiers Régionaux* or "FFR");

Publication of permits for forestry exploitation (while lists have been published during 2001 they did not meet the full requirements of transparency);

Precise reporting on the status of permits awarded under CITES (in view of Madagascar's having exceeded CITES quotas by massive margins) including reorganization the CITES authority and requiring all permits to be signed by the Minister;

Implementation of a series of detailed conditions with regard to governance in the forestry sector (set out in CFE 2001).

The above additional conditions, although not expressly tied to HIPC, may be regarded as having that effect since they elaborate upon conditions within HIPC-II.

Implementation of the HIPC-II would have substantial beneficial impact on Madagascar. Debt servicing costs as a percentage of government revenues would be reduced from 25% today to as little as 10% in 2004. There are thus very strong political and economic incentives to meet the environmental and other conditions imposed.

3.2.4.2 Impacts of HIPC on environment

Fulfillment of the environmental conditions of HIPC should have a positive environmental impact in the areas of forestry governance and trade in endangered species. Unless conditions are further revised,

an opportunity may be lost in relation to the marine resources sector, where there are also severe governance problems, on at least the same scale as the forestry sector.

3.2.4.3 Opportunities under HIPC-II

Opportunities exist to assist the Government of Madagascar in the fulfillment of environmental conditions under HIPC-II, especially in the areas of natural resources governance. Such assistance could be made conditional upon engagement by GOM in other pro-environment measures that may go beyond the obligations of GOM under HIPC or other programs.

3.2.5 Poverty Reduction Strategy

3.2.5.1 Origins

The strategy document for poverty reduction (*Document Stratégique de Réduction de la Pauvreté* or "DSRP") (Republic of Madagascar 2001) was prepared pursuant to conditions imposed by IDA/IMF in the Highly Indebted Poor Countries debt relief initiative (HIPC-II) (IDA/IMF 2000). The DSRP is essentially an integrated economic and social development plan, in which poverty reduction is the central objective. The DSRP has become the reference instrument for other national programs (rural development, environment etc.).

3.2.5.2 Principal elements

The DSRP supersedes an earlier Framework Document on Economic Policy (*Document Cadre de Politique Economique* - DCPE) adopted in September 1996 and revised in June 1999 (DCPE for 1999-2001). The DCPE was also focused on poverty reduction but did not meet other requirements imposed by HIPC-II, in particular as regards participation. The DSRP may now be considered as Madagascar's principal economic policy instrument.

The goal of DSRP is to halve the proportion of the population living below the poverty line (from 70% to 35%) by 2015.

The DSRP comprises three principal axes of intervention:

1. Improve national economic performance through participation of the poor;
2. Develop essential social services (education, health, drinking water) and enlarge the social security net to reach the most vulnerable;
3. Develop an institutional and policy framework that favors economic growth and poverty reduction, reinforce capacities to improve governance and optimize the interface between the administration and the administered.

Axis 1 integrates Madagascar's macro-economic policy which seeks strong non-inflational economic growth of around 5% based on attracting a high level of investment coupled with rigorous management of public finances, with an effective fiscal pressure of 12.8% of GDP by 2003.

Participation of the rural poor in economic growth under Axis 1 is to be provided through implementation of the Support to Rural Development Plan (*Plan d'Appui au Développement Rural* or PADR), a nation-wide program, of which the principal activities will be financed by the Rural Sector Support Program (*Program de Soutien au Développement Rural* or PSDR), funded from a credit of about $US 100 million from the World Bank. The PSDR seeks sustained economic growth of 4% within the rural sector, slightly below the desired national average of 5%. This is a "daunting challenge" for a sector that has been in overall decline in recent years (World Bank 2002).

Axes 2 & 3 comprise for the most part measures already foreseen within structural adjustment.

3.2.5.3 Links between DSRP and the environment

Under Axis 1, environment is addressed in relation to rural development in two respects: 1) the need for sustainable management of natural resources and 2) the need for urgent parallel measures to conserve vanishing biodiversity that cannot await progress on rural development. Conservation of biological diversity is specifically recognized as important for maintenance of the general environment and environmental services. (Mention is also made of the 50% of park entry fees that are used for development projects in villages adjacent to protected areas, which may be regarded as a direct benefit from biodiversity conservation and a contributor to local poverty reduction.)

Under Axis 2, environmental quality for human populations is addressed in relation to health, drinking water and urban pollution.

While sustainable management of natural resources is specifically included in PADR and PSDR, measures to conserve biological diversity are not. These may be considered important gaps in PADR/PSDR. (A further gap is the omission of marine and coastal ecosystems from PADR/PSDR).

The absence of any stronger link between DSRP/PADR/PSDR and biodiversity conservation (or indeed any specific link between DSRP and NEAP) is perhaps a lost opportunity. However, NEAP donors (including USAID) and actors have helped to remedy this shortcoming through framing the objectives of Phase 3 of NEAP around poverty reduction and rural development, thus promoting integration between NEAP and DSRP/PADR/PSDR.

3.2.5.4 Potential environmental impacts of DSRP

The DSRP has not been specifically assessed for potential environmental impacts. The Bruntland report (WCED 1987) promulgated the view that environmental degradation is largely driven by poverty. It would follow that measures to reduce poverty should reduce environmental degradation. However, there is also a body of literature that supports the opposite view (for example, most of forest loss in Brazil has been caused by the ranching business).

A recent assessment of developing countries around the world shows that poverty is not a good predictor of environmental degradation, while there are associations between environmental degradation and high populations of rural poor and between environmental degradation and a lack of agricultural diversification (Perrings 1998). For Madagascar, it has been argued that the country's unique agro-ecological diversity should confer an important competitive advantage in an increasingly uniform globalized context (von Nieukoop, pers. comm.). Capitalizing on this potential should help to reduce rural poverty and conserve biodiversity.

3.2.5.5 Opportunities under DSRP

There is a general opportunity to complement DSRP with measures that mitigate against potential negative environmental impacts of DSRP or improve DSRP's environmental performance. This would suggest working at the same levels as DSRP, from the policy level down to direct support to rural enterprise.

Opportunities also exist to complement the PADR and PSDR with measures that will support ecologically sustainable rural development, such as eco-certification of agricultural products, ecotourism and other rurally-based environmental enterprise that promotes biodiversity conservation.

3.2.6 Rural Development Support Plan (PADR), including PSDR and PDR

In an attempt to redress its economy, Madagascar is undertaking a series of structural adjustment measures. In this context, the framework document of economic policy (Document Cadre de Politique Economique, DCPE) was revised in 1999. The DCPE stipulates that the agricultural and rural

development strategy (PSDR) should be reinforced by a rural development action plan (PADR) stretching over a period of five years. The latter was institutionalized through the decree 99-022 in January 1999.

The PADR is a conceptual, a defining and orientation policy framework for all rural development strategies and programs in Madagascar. The main objectives and orientations of the PADR are to:

- achieve food security
- contribute to economic development
- reduce poverty and improve rural livelihoods
- promote the sustainable management of natural resources
- promote training and information in an effort to improve agricultural production in rural areas.

Moreover, five sub-themes to the above objectives have been identified.

- Ensuring the good management of rural areas through institutional reforms. This basically consists of put into place legal structures that favor of rural development.
- Promote private sector partnerships in an attempt to modernize rural
- production systems, diversify production and export products and develop some sustainable financing mechanisms for rural areas
- Increase and promote agricultural production through optimal use and
- sustainable management of resources and infrastructures (use of appropriate techniques, organization of producers, improved management techniques)
- Ensure sufficient food supplies for all regions (improvement of transport infrastructure, community barns, etc…)
- Improve social services infrastructures and facilitate access to them (drinking, water, clinics, schools, improved housing).

For operational purposes, Madagascar has been divided into 20 agro-ecological regions and rural development working groups (GTDR) were appointed in each of these regions. Each GTDR consists of farmers' groups, private sector people, decentralized authorities, projects and programs working in the region (NGOs included), decentralized rural development ministry offices. The GTDR are key elements in the regional approach of the PADR. The functions of the GTDR include:

- conduct an inventory of projects and programs in their region,
- create a communication/monitoring network with these projects and programs,
- assess the needs of the region in terms of rural development and give these needs priority in the context of a regional development program (PRDR),
- identify activities and projects needed for the launching of PRDR, which can be submitted to donors for financial support and included in the public investment program (PIP), or put into operation by the private sector.

A series of projects and programs operate under the PADR. Among them, the World Bank-funded support to rural sector development project (PSDR) and the Swiss-funded rural development program (PDR). Before the PADR was implemented, it was required that an environmental assessment of it be carried out. The results of that assessment were complied in a three-volume document:

- Volume 1 presents the environmental context (EP2) in which the PADR will be operating; the environmental context of the EP2 is being described throughout the present assessment, and we will avoid repetition.

- Volume 2 assesses which sub-sectors of the rural development program will need substantial investment into; six key problematic areas were identified:
  1. degradation of natural resources and habitats,

2. access to water,
3. soil degradation,
4. land insecurity,
5. poor management of natural resources,
6. decision-making that is too centralized.

3.2.6.1 The Rural Sector Development Project (PSDR)

The PSDR responds to the World Bank's interest in promoting more innovative approaches to rural development in favor of economic growth and poverty reduction. The Bank's rural strategy for Madagascar seeks to be "comprehensive, poverty-focused, with support for demand-driven projects implemented through decentralized and more efficient mechanisms." (World Bank, 2001) The PSDR aims to encourage farmers to participate more actively in decision-making and financial contributions towards implementation. PSDR will focus on three major objectives:

- the improvement of the economic and institutional enabling environment through an assessment of the impact on the poor of import taxes and VAT on agricultural inputs, a review of the regulatory and legal framework for the private sector, and most important, the strengthening of institutional arrangements at the national, provincial levels and in the PADR's intervention regions;
- the promotion of partnerships in rural development with the private commercial and non-profit sectors;
- the promotion of sustainable growth of agricultural productivity and reduction of rural poverty. The creation of an Agricultural Productivity Fund for the support of technology generation and dissemination is proposed.

3.2.6.2 The Rural Development Program (PDR)

Initiated in 2001, the PDR is 28-billion FMG Swiss program aiming at reducing poverty and at improving the livelihoods of rural people in three key agricultural areas of Madagascar. To achieve that general objective, the PDR sets out to:

- strengthen the organizational capacities of rural people;
- increase rural households' revenues through increased productivity, the sustainable management of production systems, improved access to markets;
- support local communities in their efforts towards social services' improvement;
- integrate rural communities into the market through better communication and access to information.

The originality in this program is that it is very much based on decentralization in decision-making by the rural communities, which makes it an empowering approach. In the PDR context, private and public institutions provide services to rural communities through contracts.

3.2.7 Climate Change Convention program

3.2.7.1 Introduction

The Framework Convention on Climate Change (FCCC) provides a framework for international co-operation in the reduction of greenhouse gas emissions and managing the impacts of climate change.

Madagascar signed the FCCC in 1992 and ratified in December 1998. Unofficially, Madagascar intends to sign and ratify the controversial Kyoto Protocol and has a strong wish to participate as a host country in the Clean Development Mechanism.

In September 2000 a GEF-funded project administered by UNDP and UNOPS and under the Ministry of Environment was launched to enable Madagascar to prepare its first communication to the CCC (Project MAG 99 G31), with funding of $350,000 over 2 years. This project should culminate in a national plan of action in November 2002.

As a first stage, an inventory has been conducted of greenhouse gas sources and sinks in Madagascar (currently in draft form). Because of the low degree of industrialization, principal emissions are from the agricultural sector and in particular from forest clearance and bush fires.

Following a preliminary review of Madagascar's vulnerability to climate change effects, the national CCC project opted to evaluate five sectors for potential impacts and adaptation measures – forests, coastal zones, agriculture, water resources and public health. Reports in these sectors are currently near to completion. It is noteworthy that the energy sector has been omitted in this review, since this was considered more a domain for measures in mitigation.

3.2.7.2 Impacts of climate change in Madagascar

Analysis of meteorological data since the early 1900's indicates that average temperatures have increased by 1° Celsius over the last 100 years, while overall precipitation has not changed significantly. However, there have been considerable variations in patterns of rainfall (seasons, distribution) that remain to be fully investigated. As an example, rainfall over Madagascar's most important offshore island, Nosy Be, has reduced by about 30% since 1960, possibly due to deforestation. There is also evidence of climatic anomalies in the south of Madagascar causing droughts that can be linked to perturbations in oceanic currents (Jury et al. 1995; Reason & Lutjeharms 1998).

There is global recognition that climate change may be linked to an observed increase in the frequency of El Nino events in recent years. In association with these events, Madagascar suffered severe bleaching of its coral reefs (in most areas except the North West) in 1998 and 2001.

Studies are underway as regards sea level rise through a collaboration between the Institute of Marine science in Toliara and the University of Marseille. There are concerns that degraded coral reefs, such as the Grand Récif of Toliara, will fail to keep pace with sea level rise, thus leaving the coastline less protected from wave action. Other impacts of sea level rise will include increased coastal erosion in areas already affected (Tomasina, Morondava) and the potential loss of mangroves, important for the reproductive cycle of penaeid shrimps (Madagascar's major fisheries export). Indeed, Madagascar can expect to lose large areas of valuable intertidal habitat along its western coasts as well as a decline in the area of viable coral reefs.

3.2.7.3 Elements of the CCC program

The current CCC program aims to develop a national plan of action under the CCC, to be prepared in the near future and presented officially in November 2002.

It is premature to predict the contents of such a plan, but activities that can be envisioned include:

- Reinforcement of Madagascar's program in forest conservation and reforestation, including in Madagascar's mangrove areas, under the Kyoto mechanism;
- Reinforcement of coastal zone management measures to take account of sea level rise, sea temperature rise and increased impacts of cyclones;
- Developments in agriculture that take account of climate change;
- Measures in the water sector to ensure continued security in water supplies:
- Research and other measures in the health sector in order to be prepared for the effects of warming (e.g. increased incidence of malaria to cooler areas; greater problems of infantile dehydration etc.).

3.2.7.4 Opportunities under FCCC

In general, opportunities exist to support Madagascar's responses to climate change, in the five sectors identified and other sectors as appropriate.

With regard to the Kyoto protocol, it is acknowledged that USAID interventions in this area may be limited in view of its current stance in relation to the protocol.

Within or without Kyoto, opportunities exist to support private sector development of energy production, including artisanal wood production from community-managed forests. Links exist between forests, watershed protection and options for hydro-power.

Within Kyoto, opportunities exist for the implementation of the Clean Development Mechanism and in particular putting in place a favorable environment for carbon credit transactions.

3.2.8 Sectoral policies and programs affecting key resources and their management

3.2.8.1 Forestry

The first national forest policy was adopted in 1985; it had been elaborated in accordance to the economic priorities of the time (improve the balance of payments and achieve food security). However, that forest policy did not lead to a reduction in forest degradation or to the optimal use of forest resources. Major institutional issues were also unresolved.

As new economic priorities were defined under the successive structural adjustment programs, a new forestry policy (POLFOR) was adopted 1995, on which the national forestry plan (PDFN) is based. This policy evolves around four main interlinked objectives:

1. End the forest degradation process by:

- supporting alternative practices (to *Tavy)* in rural areas,
- contributing to bush fire management and control,
- preserving forest heritage and ecological balance

2. Improve the management of forestry resources through:

- the elaboration of forestry resources' management plans,
- the rational exploitation of forestry resources,
- the reorganization of the revenue generation system of the sector,

3. Increase the forest cover and its potential by:

- promote reforesting activities,
- insure land security for those who reforest,
- reforest according to regional and local needs,
- intensify activities related to watershed management.

4. Improve the forestry sector's economic performance through:

- the promotion of forest products,
- the improvement of the functioning of marketing networks,
- the promotion of ecotourism. (IEFN, 1996)

Four technical offices are in charge of putting each of the above activities into operation.

3.2.8.2 Fisheries

Fisheries sector policies and programs are notable for a relative lack of consideration for sustainability.

In the early 1980's surveys by FAO estimated that Madagascar's various fisheries stocks could sustain an off-take of around 330,000 tons annually, based on a generalized model for estimating sustainable yield as a fraction (23%) of the standing stock biomass (Andrianaivojaona et al 1992). Since total estimated exploitation was then only around 60,000 tons, the perception arose that stocks were in no immediate danger of over-exploitation. Fisheries policy thus aimed to increase production, particularly of "under-exploited" stocks.

In the early 1990's, Madagascar's fisheries legislation was revised. In keeping with greater global awareness of the need for sustainability, the law (93-022) stipulates that fisheries and aquaculture should be conducted in an ecologically sustainable manner. In 1996, the Ministry for Fisheries commissioned the preparation of a strategy for ecologically sustainable fisheries (Orgasys, 1997) but this was never adopted. It has, however, issued a code of conduct for aquaculture to be promulgated as a national law. In essence, the policy of increasing production has remained and the Ministry for Fisheries has been active to promote fisheries as the fastest growing primary sector generating substantial hard currency revenues.

To date, the fisheries ministry has been primarily concerned with the development of industrial fisheries for tuna and shrimp, for other high value products such as lobster and sea cucumber and for shrimp farming, but has undertaken few measures to ensure the sustainability of these activities. Thus, there has been no enforcement of catch reporting requirements for tuna fisheries, the official catch for Madagascar's EEZ being reported as exactly 10,000 tones for most of the last 10 years. In relation to shrimp, the ministry has actively encouraged the use of non-selective gears by requiring trawlers to land a minimum quantity of fish by-catch (for free distribution to local communities) and has declined to introduce turtle excluder devices on the ground that the EU does not require it. Sea cucumber fishing is allowed to continue uncontrolled, and permits have been awarded to semi-industrial operations that illegally use scuba gear (with many diving accidents).

Donors, on the other hand, have shown particular interest in developing the traditional fishing sector for reasons of food security and poverty reduction. Thus, FAO, with UNDP funding, has implemented a substantial traditional fisheries development project at two levels – 1) national level monitoring for traditional fisheries and 2) local level support to fisheries development (focusing on techniques of treatment and marketing). FAO is currently preparing, with financing from the African Development Bank, a major traditional fisheries development program for the entire coast between Toalagnaro (in the south east) and Maintirano (in the north west). A proposal exists to set up a collaboration between EP3 of NEAP and PADIL in priority coastal areas (as designated by NEAP in grounds of marine and coastal biodiversity) where a strong emphasis would be placed on achieving sustainability in small-scale fisheries.

The private sector and donors have also been seeking to improve sustainability of the industrial fisheries sector. Thus, the association of shrimp fishing and aquaculture operators (GAPCM) has supported establishment of a national shrimp fisheries research program to monitor stocks and has pushed for the introduction of a new economic monitoring unit for improved efficiency. Research has shown that the shrimp fishery is exploited close to its sustainable limits and a moratorium has been called on the award of new licenses. In a new program being launched, GAPCM with financing from the French Development Agency (AFD) will seek to promote special shrimp fishing management zones and the introduction of selective trawls.

In the context of structural adjustment, the World Bank has funded the development of a revised non-arbitrary permit system for shrimp fishing. This should increase official revenues substantially permitting their reinvestment in better management.

The EU has financed a new fisheries surveillance program that has been arresting illegal and unlicensed vessels and policing the sale of undersize products. All shrimp and tuna vessels are now tracked by satellite and infractions recorded and regulations enforced. The EU project plans to help establish a permanent and autonomous fisheries surveillance agency.

Major improvements are still required, especially in the less formal commercial sectors such as sea-cucumber fishing (now practiced on an industrial scale without any controls), shark fishing (mainly artisanal) and fishing for ornamental shells. On the positive side, efforts are being made to improve the management of lobster fisheries through a system of community-based management using the GELOSE law (96-025). ICZM, typically integrating "no-take zones" and local enforcement of fisheries regulations, shows considerable promise as a vehicle for promoting sustainability of small-scale fisheries, although ICZM policies and instruments are not yet in place.

3.2.8.3 Agriculture

The agricultural sectoral policies evolve around four main objectives:

- Improve rural livelihoods through the increase of farmers' revenues (diversified, intensified and better-quality production, more substitution and export crops, conservation and improvement of cultivated lands' fertility);
- Improve productivity by rehabilitating currently existing irrigation networks and infrastructures, making beneficiaries participate, establish community infrastructures;
- Open markets up by creating a favorable environment for farmers' organizations, by enabling rural finance transactions;
- Enhance resources' value
- Protect the environment

Regional and inter-regional offices (decentralized structures) have been created to put the above objectives into practice.

3.2.8.4 Energy

The structural adjustment program includes the following measures relevant to the energy sector:

- Privatize the petroleum sector (break-up and sale of national petroleum company SOLIMA and of the national energy distribution company JIRAMA)
- Improve the efficiency of the petroleum sector and the electricity sector
- Adopt an energy policy that is ecologically sustainable with the promotion of alternative energies in order to preserve forest resources
- Revise existing legislation on making investments compatible with the environment (including energy projects)

Objectives no. 3 and 4 are found within the environmental objective of structural adjustment (ecologically sustainable development).

Reform of the energy sector is the responsibility of the Ministry of Energy and Mines. Phase 1 of the Energy Project (1998-2001) included a pilot operation in Mahajanga, a large coastal town. There were three major conclusions:

1. the energy sector needs to be liberalized while the national electricity distribution company JIRAMA should exploit and maintain the existing state infrastructure (power lines etc.);
2. Alternative energy sources, including renewables, should be promoted throughout Madagascar according to context (generators, hydropower, biogas, wind, wood, solar);
3. In light of the Mahajanga experience, the large demand for energy from wood should be met through tree plantation management, including using GELOSE for local management. (PSDR specifically includes funds for wood fuel plantation development, including mangrove management as a wood fuel source.)

3.2.8.5 Mines

The structural adjustment program, with regards to the mining sector set out to enhance the potential of the mining sector. To reach that overall objective, the following sectoral policies were carried out in 1999:

- Prepare and publish decrees (such as the law #99-022) supporting the application of the new mining code (Law #95-016 of September 1995, delimiting authorized mining sites, defining mining, mining permits, the rules for obtaining them)
- Adopt a law on investments of more than US $200 millions
- Process at least 80% of the mining permits at central Mining Cadastre Bureau,
- Make OMNIS (institution for the promotion of the mining sector, as well as a geological information bureau) operational.

An interministerial order on environmental regulation within the mining sector was elaborated and published and adopted in 2000. The creation of the Mining Cadastre Bureau was planned for May 2000.

3.2.8.6 Transport

In the context of economic readjustment, the transport sector was identified as a tool in reducing poverty and a field of opportunity for the direct application of economic liberalization. It is expected that the transport sector will lead to an increase in overall production, the development of tourism and a facilitated access to mining resources (CNRE, 1999).

The figure below represents the current transport infrastructure that exists in Madagascar. The Transport Sectoral Program (PST) determines the transport sectoral policies, which aim at:

- Restructuring the sector,
- Promoting the implication of the private sector through decreased state intervention in planning, legislating and monitoring of the sector's activities,
- Improving planning and accounting,
- Increasing the sector's financing abilities to maintain infrastructures; this includes the set up of a cost recovery system for the sector,
- Involving the targeted communities.

The PST will be implemented in four phases, in accordance with an Adjustable Program Lending system; here is what the four phases will deal with:

- restructuring the sector by rehabilitating and maintaining the priority transport network in good conditions, with a specific attention to port and river infrastructures;
- rehabilitating the secondary roads and the railway;
- create or improve secondary RURAL roads including 'communal' and village roads;
- ensuring good maintenance of overall road and port infrastructures. (CNRE, 1999)

3.2.8.7 Population

Sectoral population policies are inspired by the National Population Policy, which dates back from December 1990, and is supported by the Law #90-030.
The overall objectives of that policy are to:

1. Eliminate social, political and economic constraints to the well being of the Malagasy people who are key protagonists in the development process;
2. Reduce the morbidity and mortality rates, especially of mothers and children;
3. Reduce the fertility rates, so that the exponential population growth (in relation to economic growth) is halted.

For each of the above overall objectives, strategic objectives were elaborated.

The promotion of education and the fulfillment of basic needs (by provision of food, shelter, clothing, employment, health, etc.) is a priority strategic objective for general objective 1 above.

Reach a life expectancy of 60 years, and reduce child mortality rate from the current 120 per 1000 to 70 per 1000, is the strategic objective under general objective 2.

For general objective 3, facilitating access to affordable family planning, providing each Fivondronampokotany (district) with a specialized family planning service, and reach a 2% per annum population increase rate by the year 2000. The latter objective has not been reached, because, according to the World Health Organization, the population increase rate in 2000 was 2.9%. (OMS, 2001). The above population policies go hand in hand with health sectoral policies.

3.2.8.8 Health

The structural adjustment program includes the following measures relevant to the health sector:

- increase real per capita public expenditure, especially on the sector's operational costs;
- allocate funds to sanitary districts, based on efficiency criteria;
- redistribute human resources evenly across the country; this includes the hiring of more paramedical staff, and the assistance in providing better-quality health services;
- finalize the framework for cost recovery in basic health center and elaborate a similar framework for hospitals;
- ensure that the system is financially autonomous;
- help SALAMA become financially independent by ensuring that the benefits generated through the marketing of products are directly reinvested in SALAMA's activities.

3.2.9 Impacts of past events and current initiatives

The preceding analysis of past events and current initiatives has highlighted the following impacts:

- *The National Environmental Action plan Phases 1 & 2* have made substantial progress in achievement of its specific objectives, but the mid-term review indicated that the program had had little impact so far on the behaviour of populations or on the overall rate of environmental degradation. Data emerging subsequently have been more promising, suggesting that deforestation in protected areas and classified forests is substantially lower than in unprotected areas, but still significant (0.6% or greater) and also that rates have been lower in areas where USAID's LDI projects have been promoting agricultural intensification. As yet, there is no evidence that such impacts would be sustainable once funding ceases to flow. Further extension of the national protected areas network is required if a representative sample of Madagascar's biodiversity is to be conserved. Limited progress has so far been made with sustainable financing of environmental management and conservation.

- *Political decentralization* has greatly facilitated the development of decentralized tools for environmental management and transfer of management to the local level through specific legislation such as GELOSE but also through conferring a general "legitimacy" to decentralized forms of management, such as *dina*, even where those mechanisms may not yet enjoy full legal recognition. However, considerable confusion remains over the status of the autonomous provinces which may even threaten existing initiatives at both the national and local levels through concentrating too much power with the provincial governors.

- *Structural adjustment* has definitely promoted economic growth but with most of the impact on the secondary and tertiary economic sectors, mainly based in cities, and with relatively little impact on the primary sectors of production such as agriculture. Furthermore, few benefits trickle down to the rural poor who thus continue to depend on subsistence agriculture including *tavy*. The links between poverty and environmental degradation is still poorly understood although local evidence suggests that improved prosperity in rural areas may actually accelerate deforestation by generating cash to pay for labor.

- *The HIPC debt relief initiative* will undoubtedly assist the Malagasy government in achieving its development goals, adding to the benefits of structural adjustment while not having significant further impact on the rural sector.

- *The poverty reduction strategy (DSRP)* and the rural development plan (PADR) provide the framework for mobilizing rural development although success will depend much on the response of rural communities to the opportunities presented and that of the private sector seeking partnerships with those communities. There is a risk that the PADR will become overly administrative, delivering limited economic impacts, or that its economic success will increase deforestation.

- *Activities under the Climate Change Convention* are at an early stage and are having no current impact on the environment. However, in the future, Madagascar's participation in the convention and the Clean Development Mechanism may ultimately free up funding for forest conservation and plantation programs that would have a positive environmental impact and guaranteed of sustainable financing, depending on how the Kyoto protocol and international carbon markets evolve.

- *Sector policies* are now mostly taking account of the environment, although in reality there remain major governance problems to be resolved, especially in forests and fisheries. Integration of forests into the environment ministry promises to facilitate the shift from a production to a conservation orientation and a rationalization of the forestry sector. Agricultural policy is effectively the PADR (referred to above). Population is a key area since slowing population growth, as well as other measures, is critical if deforestation rates are to be reduced to sustainable levels. Transport policy may need to take account of the impact of roads on deforestation. Energy policy is evolving in the light of environmental considerations.

3.2.10 Specific lessons learned from interventions

The presentation of present and past initiatives identifies some key lessons learned from each initiative. The purpose of this section is to relate the lessons learned to the priorities of Sections 117-119 of the Foreign Assistance Act.

We cannot pretend in an assessment of this kind to achieve the in depth analysis that lying behind academic research. However, we have endeavored to extract from documents reviewed and from interviews with experts some of the key lessons. ***Table 3c*** presents the results of our review.

At a glance through the table, the following key lessons stand out:

- Planning horizons and expectations should be realistic – while 5 years is a useful planning unit, this should be within the context of a longer time frame of 10-20 years;

- Where USAID is engaging its own contractors working in parallel with national programs, there is a risk of overlap and even competition – such initiatives may not be "cooperative" as required by the FAA;

- Conversely, USAID should have the full trust of national partners and be sure to be consistent with its own message – in particular it should support national structures whose creation it has sought or encouraged;

- Scientific research is a critical foundation to conservation action – initiatives should not be launched on mere hypotheses; more could be done to disseminate and exploit scientific research;

- In NEAP there has been an excessive tendency towards the project approach, which typically favoring short-term impacts over long term goals – this approach is an impediment to working a higher policy levels and also creates a culture of dependency;

- Initiatives to promote community-based natural resources management (CBMNR) should strive for quality not quantity – in the long run only real successes will be replicated;

- The regional/landscape approach needs to be truly regional – where the regional actors are in fact concentrated around a biodiversity hotspot, the approach resembles that of the ICDPs of EP1;

- Training should prioritize producing entire peer groups of professionals – individual bursaries or in service training are less beneficial; at the same time, a high level of training is essential at the policy levels of government;

- If research is to be supported, a strong emphasis should be placed on information sharing between research activities and disseminating and exploiting the results.

Table 3.c– Presentation of lessons learned in Madagascar in relation to FAA priorities

FAA priority	**Lessons learned**	**Initiatives from which lessons learned (examples)**
Involves an element of leadership from the US or from US institutions	• Greater co-ordination between US institutions would enhance US leadership role	• Numerous projects of US institutions (MBG, Duke, Stony Brook, Chicago, Smithsonian, AMNH, WCS, Calif. Acad. Sci, Michigan etc.
Interventions that are cooperative in nature	• Avoid situations where agency's contractors are in competition with national partner institutions; • Agency must adopt planning horizons and expectations appropriate to the local context (e.g. 10-20 years in case of Madagascar); • Support institutions whose creation it has sought or encouraged.	• LDI and PACT (with ONE / AGERAS) • Tany Meva (environmental trust foundation) • CNE, CIME
Conservation and management of tropical forests	• Slash and burn is a much greater threat than logging at present; • Agro-forestry alone will not be enough to reduce or stop slash and burn; • Logging activities should be managed over a long cycle (> 50 years); • Must have scientific baseline data on status and distribution of forests; • Governance is the common denominator to all problems and solutions; • The numerous conditions for viable community-based management must be satisfied (see text); • Key conditions for CBNRM are equal access to information and reliability of spatial information, especially for defining land areas and rights; • An atmosphere of trust between community and government is critical for devolved forest management to communities; • Good policy is not enough to get field level implementation and vice versa; • The principal constraints to community-based forest management are socio-organisational; • Interventions should be at a level where problems are readily perceived – particpatory appraisals should be conducted before defining the structures; • Top-down regional forest management schemes are unlikely to work – transfers to local communities offer a higher chance of success; • It is an error to rush through resource management contracts too fast; • The GELOSE process is unnecessarily complex for the transfer of forests from state to community management.	• Dette Nature WWF / MEF • Dette Nature; EFSUM • Pilot forestry management projects evaluation (Hagen 2001). • Jousserant 2001
Offer employment and income alternatives to those who	• Alternative incomes may help beneficiaries to employ additional labour for deforestation and thus serve a contrary purpose;	• Ranomafana program

otherwise would cause destruction and loss of forests	• The links between poverty and forest loss are still poorly understood – no adequate analysis has yet been done; • Sustainable harvesting of in-forest products will not generate enough revenue as an alternative to clearing – only sustainable extraction of timber offers the potential for adequate revenues (and then only in humid forests); • Communities are generally ill-equipped for resource management of a financial or commercial nature; • Emphasis should be placed on piloting high-quality CBNRM rather than expanding the number of cases.	• Jousserand 2001
Help identify and implement alternatives to colonising forested areas	• Development of alternatives for some resource users will not discourage forest colonisation for others; • Need for a truly regional approach – should avoid a concentration of actors around a protected area.	• Freudenberger study • AGERAS
Support training programs, educational efforts and institutional strengthening	• Educational efforts require a long term commitment; • Capacity reinforcement is the key need if regional and local institutions are to manage resources successfully.	• WWF Environmental education program; • AGERAS, LDI.
Help end slash and burn cultivation by supporting stable farming practices	• Supporting stable farming practices may not alone be enough - in particular the need for land is not addressed; • Slash and burn is strongly entrenched and may have real advantages for those involved.	• Biosphere of Mananara-Nord; • Projet BEMA.
Help conserve forests which have not yet been degraded	• Virtually no forest in Madagascar is unaffected by humans; • Conservation of forests requires collaboration with the authority controlling the majority of such forests (forests ministry or directorate); • Scientific research is essential for ascertaining the state of forests.	• MBG research program; • NEAP - EP1 and EFSUM (EP2); • Kew – Paris Museum GIS project, WWF bioinventories.
Support projects to conserve forest watersheds and rehabilitate those that have been deforested	• Watershed argument can be difficult to implant in farming communities; • Rehabilitation of watersheds does not appear a realistic option (better to begin with agro-ecologcial soil improvement).	• ICDPs experience (Montagne d'Ambre, Adohahela…); • Re-afforestation program (areas re-wooded very small)
Support training, research and other actions that lead to more environmentally sound practices of forest use	• In service training is less useful than long term training; • Better to have a blocks of people with the same training than individuals with numerous different specialisations; • PhDs are less useful than Masters' level training; • Research is critically needed on endemic forest trees for possible	• ANGAP, ZICOMA, WWF Ecology Training Program, MBG training program. • Dette Nature (WWF / MEF)

	sustainable harvesting.	
Support research to expand knowledge of tropical forests and identify alternatives to their destructive use	• Information sharing between research projects is essential; • Training of national experts should emphasise "hands-on" experience; • Bioprospecting or sustainable use of forest products are not promising options.	• WWF biodiversity inventories program; • Dette Nature (MEF / WWF); • Study for WWF
Help developing countries identify tropical forest ecosystems and species in need of conservation and establish and maintain appropriate protected areas	• Scientific research is essential for identifying conservation priorities and the establishment a protected areas network; • Bio-inventories have a critical role to play; • Study methods must be compatible (e.g. as regards forest cover indicators); • Integrated Conservation and Development Projects (ICDPs) were excessively costly and too closely linked to protected areas – some actually encouraged degradation; • Most biodiversity is outside the PA network, which is not fully representative of Madagascar's biodiversity.	• RBG Kew / Paris Museum GIS project; • WWF inventories program; • Biodiversity indicator project (NEAP); • AGERAS – regional approach to conservation of forest corridors • Madagascar ICDPs 1990-1995; ICDP review study; • RBG Kew / Paris Muesum GIS project; IEFN

4 Opportunities and entry points for USAID/Madagascar

The purpose of this section is to identify opportunities and entry points for USAID/Madagascar efforts under the new ISP that will positively influence the conservation of tropical forests and biodiversity and improve environmental management.

Identification of the opportunities and entry points was achieved through the following steps:

1. Present the results of the threats analysis into a single integrated table in order to facilitate identification of linkages between resources (***Table 4a***);
2. Based on the analysis of threats to key resources determine the *a priori* optimal results areas for USAID interventions (***Table 4b***);
3. Take into account the analysis of the impacts of past events and current initiatives on Madagascar's development trajectory (***Table 3c***);
4. Analyze the legal requirements of the FAA;
5. Take into account the activities of other donors (***Tables 4.c to 4e***);
6. Take account of the views of environmental experts in Madagascar (**Table 4e**);
7. Make concluding recommendations on the opportunities and entry points (**Table 4f**).

4.1 Integrated threats analysis

The threats to different resources are presented in ***Table 4a***.

Table 4a Summary of the threats and indicated responses for each type of resource

Resource	Threats	Indicated responses
Forests and terrestrial biodiversity	• Slash and burn agriculture (*tavy*) • Illegal or poorly regulated logging • Annual burning of grasslands • Over-harvesting of resources • Climate change (gradual drying of west & south west)	• Agricultural intensification • [Environmental] education • Promote development in cities to encourage migration away from forests • Trade controls on hardwoods • Intensification of livestock raising • Improved forest sector governance (permit system, CITES) • Promote community-based management of harvestable resources. • Promote smaller families • Promote agricultural intensification AWAY FROM FOREST BLOCKS • Support local pilot forestry projects (conservation contracts, etc…) • Promote agro-ecological and soil conservation techniques • Create biodiversity forestry reserves • Promote reforestation activities • Promote the sustainable use of forest products and community-based management • Apply pasture legislation • Improve and enforce mining legislation (CODE MINIER) and EIA legislation (MECIE)
Freshwater systems and wetlands	• Sedimentation from soil erosion due to deforestation. • Introduction of exotic species (plants and/or fish species) • Conversion of wetlands to agriculture • Over-harvesting of natural resources • Climate change	• Urgent measures to conserve habitats of endangered fishes • Measures to reduce soil erosion (forest conservation, reforestation, improved agriculture) • Intensification of agriculture • Promote “wise use” community-based management for wetlands and lakes • Promote smaller families
Marine and coastal ecosystems	• Insufficiently regulated industrial fishing, especially by licensed and unlicensed long line vessels • unregulated exploitation of high value resources such as sea cucumbers and sharks’ fins • sedimentation of mangroves and coral reefs as a result of upland soil erosion • over-fishing and resource degradation in densely populated coastal areas	• Improve governance of the fisheries sector • Promote soil conservation practices in watersheds • Promote community-based resource management • Promote integrated coastal area management in densely populated coastal areas, using an integrated coastal / river-basin approach • Promote smaller families

	• Climate change (rising sea temperatures).	
Agricultural resources	• Soil erosion • Decline in soil fertility • Lack of disposable finance • High rural populations • Climate change (desertification in south, cyclones in east, more variable rainfall patterns…)	• Improve agricultural production and productivity • Improve education • Soil conservation through improved agricultural methods (e.g. direct sowing, multi-cropping) • Promote smaller families • Revise land tenure laws and policies • Forest conservation and reforestation activities • Improve and diversify agricultural production (multi-cropping, etc…) • Set up formal rural credit facilities • Improve communication and transport infrastructure • Monitor impacts • Design climatically adapted methods and crops.

4.2 Optimal results areas

Identification of optimal results areas was based on the following assumptions:

1. Any remedial response indicated by the threats analysis constitutes a potential "results area" for action, whether for USAID or other operators;
2. Results areas selected by USAID should reflect the priorities of FAA and other recognised guidelines applicable to USAID, notably the priority accorded to tropical forests;
3. Preference should be given to results areas that build on USAID's existing strengths;
4. Results areas should compliment those of other actors and avoid duplication.

Applying the above criteria to the list of indicated responses generated in the threats assessment, a table was prepared in which are highlighted *a priori* optimal results areas for USAID (***Table 4b***). The following optimal results areas are indicated:

1. Promote smaller families;
2. Establishment and maintenance of a representative system of protected areas;
3. Promote agricultural intensification away from forest areas;
4. Promote agro-ecological soil conservation techniques;
5. Assist the forestry industry to make it more efficient, competitive and sustainable;
6. Support the national CITES authority (currently the ministry responsible for forests);
7. Strengthen the institutions within the forests authority;
8. Encourage and support community based forest management;
9. Establish a freshwater ecosystems conservation program focussed on fishes;
10. Create new protected areas specifically for freshwater ecosystems;
11. Protect and rehabilitate watersheds;
12. Improve and diversify agricultural production (multi-cropping etc.);
13. Diversify sources of revenues through agribusiness.

It may be noted that protected areas and agricultural intensification away from forests appear to offer the maximum return on investment since forest conservation is one of the key ways to help conserve aquatic ecosystems and protect agriculture. Agricultural intensification and diversification probably offer the best opportunities for poverty reduction that is the principal goal of the Government of Madagascar and all donors.

Table 4b – Threats to resources and indicated optimal results areas

Resource	Threat	Indicated Responses / optimal results areas for USAID	Explanation / justification
Forests	Population growth	**F1B** - promote smaller families.	F1B – USAID has existing population program
	Tavy (slash & burn)	**F2A** - Establish and maintain representative protected areas **F2B** - promote urban/industrial development to draw people away from forests; **F2C** - promote agricultural intensification away from remaining forest, **F2D** - promote environmental education.	F2A – FAA priority area; USAID strength F2B – macroeconomic issue not within USAID domain F2C – USAID has project experience in this area (LDI) F2D – not a USAID strength
	Grassland & bush fires	**F3A** - promote agro-ecological and soil conservation techniques; **F3B** - apply pastureland legislation; **F3C** - intensify cattle rearing. **F3D** – environmental education	F3A – USAID has project experience in this area F3B – government role F3C – other donors involved F3D – not a USAID strength
	Logging	**F4A –** Establish and maintain representative protected areas; **F4B** - assist forest industry to make it more efficient and competitive; **F4C** - promote the sustainable use of forest products **F4D** – support implementation of trade controls on hard woods.	F4A – FAA priority, USAID strength F4B – FAA priority area; US has expertise to offer (US Foresty service). F4C – not a promising area F4D – forest sector governance issue, US CITES expertise.
	Exploitation of endangered species	**F5A** – Establish and maintain representative protected areas **F5B** – Support national CITES authority, customs etc…; **F5C** – Create a fee and/royalty system for exploitation; **F5D** – Strengthen the institutions within forests authority.	F5A – FAA priority; USAID strength F5B – US exposed CITES non-enforcement; has expertise. F5D – FAA priority areas – institutional strengthening, with expertise to offer in CITES implementation.
	Mining	**F6A** – Establish and enforce protected areas **F6B** – Encourage and support community-based forest management; **F6C** - Enhance and enforce mining legislation (Mining Code) and EIA regulations (MECIE decree).	F6A – FAA priority; USAID strength F6B – USAID has expertise in this area F6C – USAID has already provided substantial assistance (through KEPEM and PAGE projects); World Bank is supporting mining code
Wetlands & freshwater ecosystems	Sedimentation from soil erosion due to deforestation. Conversion of wetland habitats to agriculture Over-harvesting of natural resources Introduction of exotic species (plants and/or fish species)	**W1** - Reduce forest loss and soil erosion (see measures above). **W2** - Place lakes and wetlands under "wise use" community-based management or in protected areas. **W3** – Ditto **W4A** – Establish a freshwater ecosystems conservation program, focused on fishes, based in Madagascar's priority region for endemic fishes (the north west); **W4B** – Create new protected areas specifically for aquatic ecosystems at Mont Passot, Nosy Be, and the Nosivolo river at Maralambo; **W4C** – Develop a new cadre of freshwater ecosystem specialists as a long term corps of people to assure fish conservation; **W4D** - As an *ex-situ* measure, a program should be launched to encourage the introduction of Malagasy rarities into the aquarium fish trade.	W1 – forest & soil conservation will help freshwater & aquatic ecosystems W2 & 3 – other donors potentially involved (GEF) W4A–D – US institutions have renowned expertise in freshwater conservation – USAID could promote support from US institutions in this area. W4C – USAID could support the creation of new aquatic protected areas, typically integrated with terrestrial ones
Marine & coastal ecosystems	Sedimentation from upland and river basin erosion Industrial purse seine and long-line	**M1** – Forest and soil conservation measures (see above) **M2** - Improved governance and surveillance of tuna and long line fisheries, with	M1 – measure already indicated for forests & soils M2 – other donors already involved (EU, France)

	fishing (including unlicensed fishing) Inshore industrial shrimp trawling Artisanal fishing of high value resources (sharks, sea cucumbers) Over-fishing and destructive traditional fishing (reef gleaning, poison, drag nets etc.) Climate change (coral bleaching, cyclone damage Pollution from urban and agricultural effluents Mangrove cutting for construction and fuel wood Fishermen's island camps, guano mining, island tourism Coastal tourism	international co-operation. **M3** – Improved governance, fitting of by-catch excluders (fish, turtles); more research on impacts of bottom trawling and corrective measures. **M4A** – Improved licensing, surveillance, monitoring and trade controls for high value products; legislation against shark finning. **M4B** – establish marine & coastal protected areas **M5** - Encourage community-based management of small scale fisheries, linked into ICAM in areas of multiple coastal problems. **M6** - Lobby for enforcement of emissions reductions. **M7** - Improved pollution monitoring, control and effluent treatment. **M8** - Community-based mangrove management; alternatives to wood use and fuel efficient stoves. **M9** - Need for national islands data base, strategy and integration of islands in regional ICZM plans; island protected areas **M10** - Adequate EIA and enforcement.	 M3 – other donor involved (French Development Agency – AFD) M4A – US has special experience in relation to shark finning – possible one-off intervention. M4B – other donors investing, esp. NGOs M5 – other donors involved (African Development Bank, UNDP & FAO) M6 – not indicated so long as US not party to Kyoto M7 – other donors active (UNDP); not a USAID strength area for Madagascar; M8 – important US expertise in this area – potential promotion of support from US institutions M9 – already supported (UNDP) M10 – USAID has already considerably supported this sector (KEPEM project)
Agriculture	Tenure insecurity Deforestation (erosion, loss of soil fertility, degraded watersheds) Lack of disposable cash Climate change	**A1A** - Revise and apply land and tenure laws and policies. **A1B** - Reinforce community-based management . **A2A** – Protection or rehabilitation of watersheds **A2B** – Promote agro-ecological and soil conservation techniques; **A3A** - Improve and diversify agricultural production (multi-cropping, etc…). **A3B** - Set up formal rural credit facilities; **A3C** - Improve communication and transport infrastructure; **A3D** - Improve education, especially primary education; **A3E** - Diversify sources of revenues through agribusiness. **A4A** - Monitor impacts of threats and adapt techniques according to changing conditions; **A4B** - Design climatically adapted methods and crops.	A1A – other donors in this area (e.g. France) A1B – already indicated above A2A – can be achieved through protected areas A2B – USAID has project experience in this area A3A – USAID has project experience in this area A3B – not an FAA priority – other donors present A3C – not FAA priority – other donors present A3D – not a USAID strength; other donors present A3E – intervention in the area of eco-labelling and a Madagascar label. A4A – Madagascar's climate change response not yet defined. A4B – Impacts of climate change on agriculture not yet established

4.3 Analysis of legal requirements under the FAA

Section 117 of the Foreign Assistance Act of 1961 as amended provides that environmental degradation threatens to undermine "efforts to meet basic human needs, sustained economic growth, and to prevent international tension and conflict". It is therefore in the economic and security interest of the US to 1) provide leadership in re-assessing natural resource policies and 2) collaborate with developing countries to achieve environmentally sound development. In particular, proposed programs should be subjected to an environmental assessment process.

Section 118 notes the particular importance of tropical forests and tree cover to developing countries and that forest loss causes *inter alia* loss of productive wetlands, siltation of lakes, extinction of plant and animal species, reduced capacity for food production, loss of genetic resources and can result in desertification.

Accordingly, in giving assistance the President has to place high priority on "conservation and management of tropical forests" and should prioritize projects that "offer employment and income alternatives to those who otherwise would cause destruction and loss of forests", and which "help developing countries identify and implement alternatives to colonizing forested areas."

Other emphasized priorities (Section 118 c) (4) – (11)) are:

- Support training programs, educational efforts and institutional strengthening;
- Help end slash and burn cultivation by supporting stable farming practices;
- Help conserve forests which have not yet been degraded;
- Support projects to conserve forest watersheds and rehabilitate those that have been deforested;
- Support training, research and other actions that lead to more environmentally sound practices of forest use;
- Support research to expand knowledge of tropical forests and identify alternatives to their destructive use;
- Help developing countries identify tropical forest ecosystems and species in need of conservation and establish and maintain appropriate protected areas;
- Engage in efforts to increase the awareness of the US government and other agencies and donors of the immediate and long term value of tropical forests.

With particular regard to the present ETOA, each country plan prepared by USAID should include "an analysis of –

1. the actions necessary in that country to achieve conservation and sustainable management of tropical forests, and
2. the extent to which the actions proposed for support…meet the needs identified" (s. 119, FAA)..

The purpose of this ETOA is to facilitate the preparation of such an analysis.

In order to fully respect the orientation and priorities of the above legal requirements, the present ETOA has:

- Given priority to an assessment of the status and causes of degradation and loss of tropical forests;
- With regard to other resources, given particular consideration to key resources whose status and development is causally linked to the degradation of tropical forests (aquatic ecosystems, agricultural resources);
- In identifying opportunities and entry points for USAID, given full consideration of the orientations and priorities identified in Sections 117-119 of the Foreign Assistance Act.

As regards opportunities and entry points for USAID, particular consideration will be given to those that:

- involve an element of leadership from the US or US institutions
- are cooperative in nature
- prioritize conservation and management of tropical forests
- offer employment and income alternatives to those who otherwise would cause destruction and loss of forests
- help identify and implement alternatives to colonizing forested areas
- observe the priorities of Section 118 c) (4)-(11) noted above.

4.4 Interventions of other donors

Evolution of international aid over the years 1997 to 2000 is shown in Figure 4.3 below. The high figure for 1997 is due to debt cancellation of $248.5 million by France and re-activation in the same year of agreements with Bretton Woods institutions. The general picture is of aid averaging around $350 million per year.

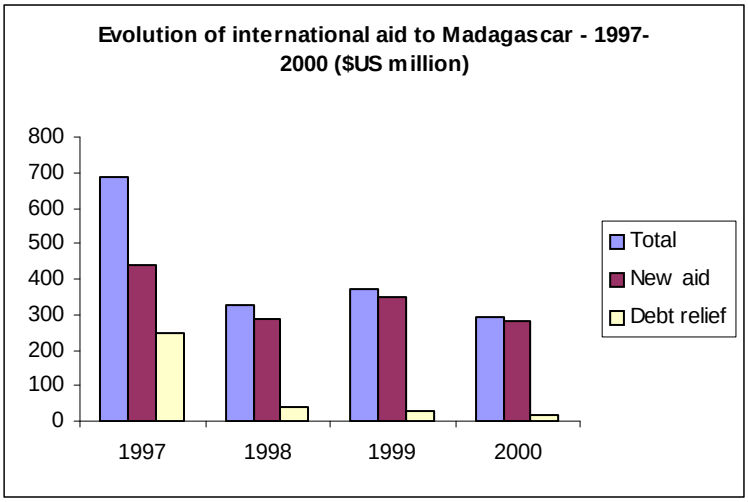


Figure 4.1 Evolution of international aid to Madagascar 1997-2000

Table 4c presents the partition of aid between donor classes. About 60% of all aid is from multilateral donors, and 40% from bilaterals. Surprisingly, NGOs account for only around 1% of all aid. In part this may be due to a lack of reporting on NGO investments. NGOs are nonetheless disproportionately important as a source of operational experience in environmental management, which is invaluable for informing project design and policy.

Table 4c-Partition of aid between donor classes – 1997-2000

Year	**1997**		**1998**		**1999**		**2000**	
Donor class	$	%	$	%	$	%	$	%
Multilateral	257097	37.36	188388	57.72	194989	52.06	190346	64.47
Bilateral	429257	62.37	135341	41.47	175220	46.78	101585	34.41
NGOs	1865	0.27	2640	0.81	4362	1.16	3317	1.12

Evolution of capital investment (i.e. excluding technical assistance) by sector is presented in ***Table 4d*** below. Aid to agriculture, forestry and fisheries and natural resources accounts for around one third of investment aid to Madagascar, reflecting the major importance of these sectors to donors. Aid specific to natural resources (of which 85-90% relates to environment) increased over the period from 6% in

1997 to 16% in 2000 reflecting an upturn in donor's perception of the importance of environment to national development.

Table 4d- Evolution of aid by sector 1997-2000

Sector (UNDP classification)	**1997**	**%**	**1998**	**%**	**1999**	**%**	**2000**	**%**
Agriculture, forestry & fisheries	36403	18.69	40582	20.45	35928	16.18	22183	17.26
Natural resources (inc. environment)	11890	6.10	17500	8.82	21853	9.84	20889	16.26
Regional development	19974	10.15	22639	11.41	26645	12.00	18870	14.69
Health	29882	15.28	25188	12.69	23338	10.51	15109	11.76
Transport	39158	20.10	34899	17.59	38172	17.19	12113	9.43
Energy	2528	1.30	5528	2.79	13349	6.01	9976	7.76
Social development	16744	8.59	19431	9.79	26662	12.00	9966	7.76
Enhancement of human resources	12335	6.39	12870	6.49	15461	6.96	4937	3.84
Communications	8286	4.25	1017	0.51	2968	1.34	4192	3.26
Disaster preparedness	175	0.09	29	0.01	1280	0.58	3290	2.56
Industry	5748	2.95	9396	4.74	7505	3.38	2954	2.30
Administration of development	674	0.35	1678	0.85	2279	1.09	2496	1.94
Economic management	4842	2.49	4663	2.35	3212	1.45	1520	1.18
Humanitarian aid	61	0.03	146	0.07	0.00	0.00	0	0.00
International commerce	4331	2.22	2769	1.40	2049	0.92	0	0.00
Domestic commerce	2088	1.07	81	0.04	1399	0.63	0	0.00
TOTAL	**194520**	**100.00**	**198418**	**100.00**	**222102**	**100.00**	**128494**	**100.00**

Aid from the 10 principal donors for 1999 and 2000 is presented in ***Table 4e***. The US ranks as the 4th largest donor at 7.38% and the largest bilateral after France, Madagascar's former colonial power. USAID stands out as a focused environmental donor, while the other major donors have more mixed portfolios. The World Bank and UNDP are the other major environmental donors. World Bank funding comes as part of a structural loan. UNDP funding comprises grants from GEF and from UNDP's own sources.

Table 4e – Aid from the 10 principal donors 1999-2000

Rank	**Donor**	**Aid 99-00 ($US million)**	**% of total**	Principal areas of investment
1	IDA (World Bank)	168788	25.20	Structural adjustment (privatization, financial markets); Sector programs (mines, agriculture, health, education); Social conditions (micro-finance, water, food security); Community development (FIDA); environment (NEAP); Governance (public services); Reinforcement of private sector.
2	France	154886	23.12	French co-operation: Annual debt relief, bursaries, food aid, education, health, agriculture, community & urban development, governance (judicial system, commune management, decentralized co-operation); social development (youth training etc.). AFD (France Development Agency): structural adjustment (scheduling of external debt, modernization of customs); public sector (airports, irrigation, improved agricultural methods & new products, management of Antananarivo plain and water & electricity networks), reform of postal service, privatization of petroleum sector; private sector investment (lending money to companies in mobile telephones, aquaculture, fisheries, transport, shipping repairs & micro-finance). French technical institutions: research in health, agriculture & development.
3	FED (Europe)	105424	15.74	National program (PIN) – transport (roads, airports); rural development (training, rural credit and equipment); health & education. Regional program (PIR) – promoting trade with countries of WIO region. Export stabilization (STABEX) – intensification of key export products (vanilla, coffee, litchis); conformity with international norms; institutional support to concerned public services.
4	USA	49450	7.38	Support to environmental sector (biodiversity, environmental management). Health (family planning, with accent on institutional capacity building). Poverty reduction (mainly through improved participation of poor in development). Food aid (mini-projects in agriculture, health &education). Emergency relief after cyclones.
5	IMF	46360	6.92	Strictly limited to assistance with balance of payments.
6	Germany	20086	3.00	Regional focus on Mahajanga (rice farming, health centers, family planning, water supplies, biodiversity conservation, implementation of forestry policy). Installation of port equipment.
7	Japan	18540	2.77	Agriculture – equipment to improve production; Education – construction of schools; Health – rehabilitation of Mahajanga hospital. Sector support programs (fisheries *inter alia*); Food aid.
8	China	15870	2.37	Roads and housing; Health (doctors & medicines)
9	UNICEF	14431	2.15	Health (public, maternal & infantile) & nutrition (mainly iodine deficiency); Education (mainly primary); Water & sanitation (infrastructure, behavior change, legal framework); Children (poorest families); IEC; Planning & social statistics (communication, monitoring).
10	UNDP	13878	2.07	Poverty reduction – agriculture, livestock & fisheries for enhanced livelihoods; health, education & water (micro-projects); revenue generation (micro-credit); plans & strategies. Governance – support to decentralization (capacity reinforcement of civil society & rural communes); economic management (facilitating reflection, analyses, capacity reinforcement, development media); private sector development (support programs, statistics). Environment (support to EP2) – regionalized management & spatial approach (AGERAS); biodiversity & product sector approach; marine & coastal environment (policies & strategies, reinforcement of community structures).
TOTAL		**607702**	**90.73**	

The above analysis reflects a diversity of priorities on the part of donors, with USAID as the leading bilateral donor in the environmental sphere. USAID's other program sectors (health, poverty reduction, food aid, disaster relief) are supported in some way by most of the other major donors. Governance and rural development figure highly for most donors.

The substantial presence of UNDP and the World Bank in the environmental sphere points to the importance of co-ordinating efforts with those donors. Such co-ordination is achieved principally through the multi-donor committee on environment for NEAP. This co-ordinating mechanism and USA's pre-eminent position as an environmental donor, place the USA in a good position to "provide leadership in reassessing natural resource policies" and "increase the awareness of…other agencies and donors of the immediate and long term value of tropical forests" as required by sections 117 and 118 of the FAA.

4.5 Recommendations of environmental experts

The analysis of past events and current initiatives and interviews with experts generated a series of lessons learned that have been presented above (***Table 3c***). Perhaps the most important starting point is to underline that in identifying entry-points it is necessary to:

1. Identify the activities required;
2. Consider by whom those activities should be carried out;
3. Decide how the activities are to be financed.

Identification of the activities alone is insufficient since the mechanisms are fundamental to sustainability. In particular, the analysis of current initiatives has shown that a collaborative program approach, despite its problems, offers a "far superior" degree of co-ordination than the project approach, which also "encourages a culture of dependence" and is an obstacle to long term institutional building.

One of the major concerns expressed during the mid-term review process of NEAP was the lack of vision or strategy for ensuring sustainability after NEAP. Some progress has since been made towards a strategy for sustainable financing but it is still not clear how, following the "mainstreaming" phase (EP3) environmental management will be sustained.

In order to ensure that readers should have the benefit of the informed views of experts actually working in Madagascar, experts consulted (most of whom were familiar with USAID programs) were routinely asked for their opinion on the appropriate entry points for USAID. The views expressed have been collated and presented in ***Table 4.f*** for consideration: The opinions expressed demonstrate a diversity of viewpoints and potential scenarios.

Table 4.f- Recommendations of experts consulted:

Theme	**Recommendations**
On USAID's role:	• USAID's primary role should be to use its influence to "open doors" for other organizations to come in and help the conservation effort. • USAID should promote enabling conditions (e.g. harmonization of laws on foundations, on carbon transactions etc.) rather than be directly investing in projects. • USAID should actively promote the intervention of US technical institutions (US Forestry Service, academies, research institutes, universities etc.).
Program strategy	• USAID has so far supported primarily at the technical level (ANGAP, ONE) – it should work further upstream at higher institutional and political levels (CNE, CIME etc.). • USAID should consider the opportunities to work with sector ministries and the private sector, i.e. outside the traditional environmental "sector". • USAID should have a more explicit mission for Madagascar and should communicate

	that mission; it should work to longer time horizons (min, 10-20 years).
Program design	• Proceed through the steps: 1. What activities should be funded? 2. Who with / how to implement the activities? 3. How should funds be channeled?
Biodiversity in general	• Biodiversity should be seen as capital that generates many benefits - potential program theme would be "Helping Madagascar to conserve its biodiversity capital" • Continue to support efforts to advance understanding of the links between poverty and biodiversity loss • Support continued bio-inventories (especially via US institutions)
Forests	• Invest in reforms to forestry governance • Work more with the forestry sector authorities and private sector logging companies and their associations in the area of sustainable forestry • Support pilot community forestry management projects aiming for high quality results • Support the creation of a trust fund for forest management • Support the establishment of a National Office of Forest Management • Support a long term collaboration between MEF and US Forestry Service on sustainable forestry • Support the creation of a well trained corps of community forestry management agents (Hagen 2001)
Aquatic systems	• Support initiatives that integrate management of aquatic and forest systems (wetlands, coastal zone)
Agriculture	• Support the development of eco-labelling of Malagasy export products (vanilla, coffee etc…) or "fresh-marks" (e.g. litchis) • Support the creation of an agri-products label for Madagascar • Support application of the "home gardens" land use intensification system propounded by BEMA
Governance & management	• Focus efforts on developing capacity in local structures to manage resources
Sustainable financing	• USAID should invest in developing a clear strategic vision on sustainable financing – with a vision in place there would be major potential for intervention
Climate change	• Support implementation of the clean development mechanism in Madagascar (primarily through establishing enabling conditions) • Support reforestation schemes for carbon sequestration and forest conservation as carbon reservoirs

4.6 Recommended opportunities and entry points

The preceding analysis indicates that USAID interventions should be governed by the following guiding principles:

- USAID/Madagascar should have a clearly articulated long-term vision for its mission in relation to environment and development in Madagascar;
- USAID should function mainly as a strategic facilitator and avoid involvement in short term results-orientated projects;
- USAID support should be co-operative in nature (as indicated by s.117 of FAA) with national partners, rather than be based on parallel intervention;
- By opening doors for support by US institutions USAID can help promote US leadership in the tropical forests arena (as required by the FAA);
- In general, USAID should work further "upstream" than it has and with sector ministries.

In relation to results areas, recommended entry points are presented in concluding ***Table 4.7*** below. These are to be regarded as indicated entry points and do not attempt to take into account logistical

considerations such as might apply to integration with other USAID program areas, funding and personnel which are the domain of the ISP planning process itself.

Table 4g- Recommended entry points in relation to identified optimal results areas

Optimal result area	**Recommended entry points**
1. Promote smaller families	• Family planning to be fully integrated with forest conservation interventions
2. Establish & maintain a representative system of protected areas	• Sustainable financing (develop SF strategy, support trust fund(s) and other measures, enabling conditions for carbon market transactions) • Extension of PA network to be more fully representative • Promote supportive research on forests (especially US institutions) • Promote new voluntary protected areas
3. Promote agricultural intensification away from forest areas	• Promote technology transfer from US institutions • Promote agricultural intensification initiatives • Ensure full integration of initiatives into regional development frameworks • Promote adequate monitoring of impacts on soils & biodiversity
4. Promote agro-ecological soil conservation techniques	• To be integrated with agricultural intensification
5. Assist forestry industry to become efficient, competitive and ecologically sustainable	• Promote support from US Forestry Service NB: Activity design to take account of s.118(14A), (15B & C)
6. Support the national CITES authority	• Promote institutional reinforcement based on US expertise in CITES
7. Strengthen forestry institutions	• Support improved governance in forestry sector • Establish a new National Forestry Management Office
8. Encourage and support community based forest management	• Procure training of a new corps of community-based forestry management cadres • Focus piloting efforts on strategic plantations of new forest
9. Establish a freshwater ecosystems conservation program	• Promote establishment of such a program • Promote collaboration between US and Malagasy institutions in freshwater conservation
10. Create new protected areas for freshwater ecosystems	• Promote extension of PA network to freshwater and wetland systems
11. Protect and rehabilitate watersheds	• Promote plantations for carbon sequestration that also provide strategic new watersheds for agriculture, reduce soil erosion and conserve freshwater & wetland systems (e.g. around Lac Alaotra)
12. Improve and diversify agricultural production	• Set up co-operation(s) with national partners (at central, regional and local levels) • Co-ordinate actions fully with PADR / PSDR • Promote transfer of (US) agricultural technology • Develop a sustainable financing strategy for agricultural development (possible trust fund for ecological agriculture)
13. Diversify sources of revenues through agribusiness	• Promote a Madagascar agri-label, eco-labels and fresh-labels • Promote “fair trade” links with US markets • Actively promote US-Madagascar partnerships under AGOA

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Bart MINTEN, Cornell University

Gregory OVERTON, Natural Resource Specialist, USAID Madagascar

Martien Van NIEUWKOOP, World Bank

Jean-Paul PADDACK, Program Director Madagascar/Indian Ocean, WWF

Adèle RAHELIMIHAJANDRALAMBO, Environmental Information-Monitoring and Evaluation Specialist, USAID

Bienvenu RAJAONSON, World Bank

Lantosoa RAMAROJAONA, EIA Supervisor, Coordinator of ICPDs, WWF

Harison RANDRIARIMANANA, Advisor to the Ministry, Ministry of Agriculture

Vololoniaina RASOARIMANANA, National Coordinator of AGERAS, ONE/SAGE

Ndranto RAZAKAMANARINA, Forestry Specialist, Natural Resources Office, USAID/ Madagascar

David SOROKO, USAID

Philippe THOMAS, Assistant technique, Ministère de l'Elevage

5.3 Endangered and protected species

In accordance with CITES regulations, the export of all faunal and floral species from the list below is forbidden except for:

1. the animal species raised in captivity by licensed individuals,
2. plants that are artificially reproduced by licensed horticulturists,
3. animal and plants listed in Annex II of CITES, which are not on the verge of extinction

APPENDIX I

Fauna

All Malagasy lemurs	Gidro, Hira, Sifaka, Akomba, etc
Dugong dugon	the Dugong, Lambohara, Lambondriaka
Testudo yniphora	Angonoka
Testudo radiata	Radiated tortoise, sokatra, sokaky
All Chelonians	including sea turtles (fanonjato, fano)
Dermochelys coriacea	Leatherback turtle
Acrantophis spp	Do
Sanzinia madagascariensis	Mandotra
Diomedea albatrus	Short-tailed albatross
Falco peregrinus	Peregrin falcon, Voromahery
Tyto soumagnei	Torotoroka, Vorondolo
Baleina sp	Whales
Dyscophus antongilii	Red frog from Antongil

Flora

Pachypodium ambongense
Pachypodium baronii
Pachypodium decaryi

Aloe haworthioides
Aloe alfredii
Aloe helenae
Aloe bakeri
Aloe laeta
Aloe bellatula
Aloe parallelifolia
Aloe calcairophila
Aloe parwula
Aloe compressa
Aloe versicolor
Aloe delphinensis
Aloe rauhii
Aloe decoingsii
Aloe suzannae

Euphorbia ambovombensis
Euphorbia cremersii
Euphorbia cylindrifolia
Euphorbia decaryi
Euphorbia francoisii
Euphorbia moratii
Euphorbia parvicyathophora
Euphorbia quartziticola
Euphorbia tulearensis

APPENDIX II

Fauna

Cryptoprocta ferox	Fosa
Eupleres goudotii	Fanaloka
Fossa fossa	Tambotsodina
All Phoenocopteridae	all pink flamingoes, Sama, Samaka
Anas bernieri	Bernier's teal, Manamolotra
Sarkidiornis melanotos	Arosy, Anogongo
All Falconforms	All diurnal raptors, Voromahery, Hitsikitsika, etc.
All Strigiform	All nocturnal raptors Tararaka, Vorondolo, etc.
All Pscittaciforms	All parakeets and budgerigars: Boeaza, Koakio, etc.
All Testudinae	All other terrestrial tortoises
Erymnochelys madagascariensis	
Phelsuma spp	All green lizards, Kitsatsaka, Antsatsaka
Chameleo spp	All chameleons, Tana, Tanalahy
Latimeria chalumnae	Coelacanth
Crocodylus niloticus	Crocodile, Mamba, Voay
Mantella aurantiaca	

Flora

Pachypodium
All other *Aloe* species (than those listed in Annex I)
All *Cactaeae* species
All *Cyatheaceae* species
All *Cycadaceae* species, all *Cycas* palm trees
All *Didiereaceae* species
All *Dicksoniacea* species
Ceropegia spp
All other *Euphorbia* (than those listed in Annex I)
All species of orchids
Chrysalidocarpus decipiens like Hovotra and Manavozona
Neodypsis decaryi

Only the Direction des Eaux et Forêts, manager of Madagascar's CITES engagements, is allowed to ensue authorizations for the export the Annex II species.

The above lists were extracted from the "Monographie Nationale sur la Biodiversité" (PNUE, ONE, ANGAP, 1995).

5.4 Authors' biographical data

Andrew Cooke (International Technical Assistance)

Aged 45, qualified as zoologist (Cambridge 1978), lawyer (London 1984) and recently in coastal zone management (MSc Newcastle, 1994), Andrew Cooke is a British environmental specialist with 10 years' of experience working in Madagascar. His most recent assignment (September 1998 to December 2001, under contract to FAO) has been to act as technical adviser to the National Environment Office (ONE) in relation to the marine and coastal component (EMC) of Phase 2 of NEAP. During this time, following recommendations for a more integrated approach, the EMC component was progressively fused with other program components, resulting in a rich cross-fertilization of experience in the areas of regional planning, coastal management, community management of natural resources and the management of biodiversity.

Andrew has had overall responsibility for delivery of the ETOA, while focusing principally on the sections on aquatic ecosystems, analysis of past and current initiatives and opportunities and entry points for USAID and contributing to most other sections.

Valerie Rabesahala (Local Environmental Policy Analyst)

Aged 26, a graduate in social anthropology and development (University of Sussex 1999) with post-graduate training in applied environmental economics (MSc, Imperial College London 2000), Valerie Rabesahala is a Malagasy and French environmental consultant with 3 years' experience working on environmental policy issues in Madagascar. Valerie's most recent assignments have included consultancies in sustainable financing mechanisms, gender relations in agricultural production and rural credit systems.

Fluent in French, English and Malagasy, with considerable recent research experience and extensive contacts in the environmental sphere in Madagascar, Valerie focused mainly on the sections on forests and agriculture while contributing to the sections on past and current initiatives and opportunities and entry points for USAID.