

PN-ABS-788

12/1 9/26/81

Winrock International Environmental Alliance

Environmental & Natural Resources Policy & Training Project



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The Office of Environment and Natural Resources of the Bureau for Global Programs, Field Support, and Research of the U.S. Agency for International Development sponsors the Environmental and Natural Resources Policy and Training (EPAT) Project. The Winrock International Environmental Alliance has responsibility for EPAT's applied research and technical assistance activities.

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PN-ABS-788

Delivery Order No. 22
Project No. 656-0510 under 936-5555
Contract No. DHR-5555-Q-00-1085-00

**Environmental Issues Relevant
to the Preparation of USAID/Mozambique's
Country Program Strategic Plan**

August 1994

**Prepared for
USAID/Mozambique
U.S. Agency for International Development**

by

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Preface

As is often the case in short-term consulting assignments, the team was faced with the task of gathering and assimilating a vast amount of information from many diverse and physically dispersed institutions. The cooperation of many people made this task much easier than it otherwise would have been. At USAID/Mozambique, Julie Born, Charles North, Robin Mason, and Cheryl McCarthy provided clear guidance on what the mission needed and helped the team stay focused on its task. Rod de Vletter and Christine de Voest of the World Bank's mission in Mozambique provided the team with a detailed overview of donor activity related to environmental issues in the country. Bernardo Ferraz and Martin Whiteside provided an orientation to the agencies of the Government of Mozambique with particular environmental responsibilities. All of the people contacted were helpful, but the team wishes to acknowledge the particular assistance received from the people mentioned above.

List of Acronyms

AAC	Annual Allowable Cut
ADB	African Development Bank
BSP	Biodiversity Support Program (USAID)
CAMPFIRE	Communal Area Management Project for Indigenous Resources
CENACARTA	<i>Centro Nacional de Cartografia e Teledeteccção</i> (National Remote Sensing and Cartography Centre)
CNA	<i>Comissão Nacional do Meio Ambiente</i> (National Commission for the Environment)
CPSP	Country Program Strategic Plan
DANIDA	Danish International Development Agency
DAP	<i>Direcção Administrativo das Pescas</i> (Department of Fisheries Administration)
DINAGECA	<i>Direcção Nacional de Geografia e Cadastro</i> (National Directorate of Geography and Mapping)
DNFFB	<i>Direcção Nacional de Florestas e Fauna Bravia</i> (National Directorate of Forestry and Wildlife)
EC	European Community
EMEMP	Environmental Monitoring, Evaluation, and Mitigation Plan
E/NRM	Environmental and natural resources management
FINNIDA	Finnish International Development Agency
FAO	Food and Agriculture Organization
FRELIMO	<i>Frente de Libertação de Moçambique</i> (Mozambique Liberation Front)
GEF	Global Environment Facility
GIS	Geographic Information System
GPS	Global Positioning System
GRM	Government of the Republic of Mozambique
IIP	<i>Instituto de Investigação Pesqueira</i> (Fisheries Research Institute)
INIA	<i>Instituto Nacional de Investigação Agronómica</i> (National Institute of Agronomic Research)
INDER	<i>Instituto Nacional de Desenvolvimento Rural</i> (National Institute of Rural Development)
IUCN	International Union for the Conservation of Nature
LTC	Land Tenure Center, University of Wisconsin
METEOSAT	Meteorological Satellite
MINAG	Ministry of Agriculture
NEMP	National Environmental Management Plan
NGO	Nongovernmental Organization
NORAD	Norwegian Agency for Cooperation for Development
NPA	Nonproject assistance
NTFP	Nontimber forest products
PEA	Programmatic Environmental Assessment

PROL	<i>Programa de Reabilitação de Organizações Locais</i> (Local Organization Rehabilitation Program)
PVO	Private Voluntary Organization
RENAMO	<i>Resistência Nacional Moçambicano</i> (Mozambican National Resistance)
SADC	Southern African Development Community
SEHA	<i>Serviço de Hidrografia e Aguas</i> (Hydrographic and Water Service)
SPOT	Systeme Probatoire d'Observation de la Terre
SPP	<i>Serviço Provincial Pesqueiro</i> (Provincial Fisheries Service)
UEM	University Eduardo Mondlane
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNOHAC	United Nations Office for Humanitarian Assistance Coordination
USAID	U.S. Agency for International Development
WWF	World Wildlife Fund

Executive Summary

This report responds to USAID/Mozambique's request for assistance in completing an assessment of the country's natural and environment resources for the preparation of a Country Program Strategic Plan (CPSP). As outlined in the Statement of Work, the report addresses four major issues:

- (1) the status of these resources in Mozambique, emphasizing the conservation and management of biological diversity and tropical forests;
- (2) shortcomings in the knowledge and management of these resources;
- (3) the efforts of other donors and nongovernmental organizations to address problems associated with potential damage to these resources; and
- (4) recommendations for potential actions or justifications for inaction.

Section 117(b) of the Foreign Assistance Act directs the president to make "Special efforts...to maintain and where possible to restore the land, vegetation, water, wildlife, and other resources upon which depend economic growth and human well-being, especially of the poor." Compliance requires USAID to "prepare and take fully into account an environmental assessment of any proposed program or project...significantly affecting the environment of any foreign country." Sections 118 and 119, respectively, place particular importance on the conservation and sustainable management of tropical forests and preservation of biological diversity. The two sections require USAID to analyze: (1) what is required to achieve these objectives; and (2) the extent to which actions USAID proposes contribute to their achievement in any country strategy statements or plans. In addition to these sections, this assessment is consistent with the objectives of the Development Fund for Africa and USAID's new strategy for sustainable development. This report thus seeks to support USAID/Mozambique in considering natural and environmental resource issues as it prepares its CPSP in light of these requirements and opportunities.

USAID/Mozambique has defined three focus areas around which it is developing its CPSP. These include:

- (1) Income, including the general issue of supporting increased incomes for rural families through the promotion of a range of productive activities;
- (2) Social services, which includes the grave needs facing Mozambique in the areas of health and sanitation, the provision of safe drinking water, and access to primary education; and
- (3) Democracy and governance, including consideration of the role of government, particularly in the context of decentralization efforts underway in Mozambique, the role of law,

the role of the individual in society, associations through which people participate in political processes, and communications.

USAID/Mozambique continues to develop its thinking on what are the key issues to address in each of these focus areas. Thus, the characterizations of them presented here, which are derived from interviews with mission personnel, should be regarded as tentative. This report seeks to assist the mission in developing its thinking about what it hopes to accomplish in each area in light of environmental issues.

The environmental problems that USAID/Mozambique must address as it moves from its transition program focusing on postwar relief, rehabilitation, and resettlement are deeply rooted in Mozambique's colonial experience. Recent events have exacerbated these historical problems. The severity of the problems since independence often obscures how deeply rooted the underlying problems are. Nonetheless, it is also important to remember that the population distribution, infrastructural facilities, and the productive activities they supported not only did not promote Mozambique's economic development but rested on social relations that were inimical to the well-being of most Mozambicans.

Thus, to the extent that relief and rehabilitation efforts pave the way for patterns of economic development that result in improved living conditions for significant portions of Mozambique's population, these efforts do so not by replacing structures that have been destroyed during the previous decade, but by laying the basis for a fundamentally different social and institutional organization of production. Production oriented to serving this new purpose will necessarily imply new patterns of land use and access. This raises several issues:

(1) One cannot assume to understand the environmental implications of repairing or replacing a road, bridge, or other structure based on how it was used in the past; its place in a reorganized production system will be different.

(2) Commonly made distinctions between relief and development are valid only to a limited extent because decisions about where and how relief efforts take place have fundamental implications for the kind of development that will occur and the ways in which land and other resources will be used.

(3) Promoting patterns of land use that promote sustainable resource use and are responsive to legislative and regulatory mandates regarding biological diversity and tropical forests will require an effective framework of government institutions and organizations in the private sector to define and administer land access and tenure rights and to promote sustainable patterns of land use.

USAID/Mozambique faces a complex situation in deciding its relative support for governmental versus nongovernmental institutions. The report recognizes the mission's reticence to devote scarce resources to state agencies when past history suggests their relative ineffectiveness. At the same time, however, the Government of Mozambique and other donors

are attempting to improve the state's capacity to manage Mozambique's natural resources effectively.

To the extent that activities designed under the CPSP are not covered by the Programmatic Environmental Assessment of the transition program, some income-generating activities may require specific supplemental or entirely separate environmental assessments. It will also be desirable to consider a process-oriented monitoring approach (as opposed to a static monitoring system based on periodic surveys) as an integral part of project design and implementation. Such a system will permit USAID/Mozambique to detect unanticipated or indirect environmental impacts as they emerge and to take prompt corrective action.

Individual environmental assessments are not expected to be necessary for most of USAID's activities that are contemplated in the area of social services. Nonetheless, the uncertainties about population movement and the practices that can be expected to characterize newly established or re-established production systems suggest that the scope and location of activities involving the construction of facilities should be considered carefully. The impacts on population movements of creating or rehabilitating facilities as well as patterns and levels of water use should be monitored. USAID/Mozambique may wish to consider planning and implementing activities involving the construction of facilities in coordination with income-generating activities.

The kinds of political participation promoted under the CPSP's democracy-and-governance focus area will be critically important in shaping how natural resources are utilized. This report thus suggests that activities to support government structures, grassroots organizations, or interest groups in the private sector be analyzed from social and institutional perspectives in light of their implications for promoting the kind of participation in resource allocation and management that will contribute to environmental conservation and sound natural resource management.

The elaboration of this CPSP comes at a time in Mozambique's history when donors, nongovernmental organizations, and the Government of Mozambique have what may be a unique opportunity to implement a combination of policies, programs, and projects that address a substantial portion of the environmental issues confronting the country. As a result of the war-related disruption of productive activities that formerly placed pressure on tropical forests, these resources have recovered in some areas of the country. There is considerably less certainty about the extent to which wildlife has recovered; much of the available evidence suggests that it has not. Nonetheless, legislation currently being drafted or considered in areas related to government decentralization, land access and tenure, and environmental policy and regulation offer the possibility of creating incentives for local people to manage resources in conserving ways and empower them to do so. There is widespread recognition of the opportunities that the current situation offers and of the undesirable consequences that will result from failure to take advantage of them.

The three focus areas defined by USAID/Mozambique all have the potential for making significant contributions to the conservation and sustained management of tropical forests and wildlife resources. The income focus will have the greatest number of direct impacts on how local populations use natural resources. By focusing on income, USAID/Mozambique has identified an important issue shaping patterns of land use; rural families who are experiencing absolute or relative income declines often turn to extensive and destructive patterns of land use to compensate. Increasing incomes is an essential element of promoting effective management of natural and environmental resources, but it is not sufficient. In this regard, the strategic coordination of the provision of health and sanitation services and primary education, and the promotion of democratic participation in how resources are allocated and used can contribute to creating the broader conditions required for increases in income to translate into environmentally sound resource management.

I. Introduction

A. The Assignment

This report responds to USAID/Mozambique's request for assistance in completing an assessment of the country's natural and environment resources for the preparation of a Country Program Strategic Plan (CPSP). As outlined in the Statement of Work (see Appendix 1), the report addresses four major issues:

- (1) the status of these resources in Mozambique, emphasizing the conservation and management of biological diversity and tropical forests;
- (2) shortcomings in the knowledge and management of these resources;
- (3) the efforts of other donors and nongovernmental organizations (NGOs) to address problems associated with potential damage to these resources; and
- (4) recommendations for potential actions or justifications for inaction.

While emphasizing biological diversity and tropical forests, the Statement of Work charges the team with addressing these issues in relation to five topical areas: (1) soil and land resources; (2) water resources; (3) vegetative cover; (4) wildlife/biodiversity; and (5) nonrenewable resources.

This report is based on information gathered during interviews in mid-1994 with people knowledgeable about environmental issues in Mozambique, a review of relevant reports and other documentation, and limited field visits. The team conducted over 50 interviews, with staff of USAID/Mozambique, representatives of other donor agencies concerned with environmental issues in the country, representatives of government agencies with environmental responsibilities, and representatives of national and international NGOs and private voluntary organizations (PVOs), grassroots organizations, and other institutions concerned with environmental issues. A list of individuals interviewed and their institutional affiliations is appended (Appendix 2). It is useful to emphasize as well that the recent Programmatic Environmental Assessment (Russell et al. 1993) in Mozambique addressed several of the same issues discussed in this report.

The team reviewed comprehensively the reports and documents addressing environmental issues in Mozambique. The team did not read all of the material that has been generated in recent years, but the team did cover a significant portion of the writing that informs current efforts by donors, NGOs, and the government to address environmental issues. In addition to the references, a partial list of the documents reviewed is appended (Appendix 3).

The team devoted little time to field visits outside of Maputo. The Statement of Work did not provide for field-based research. This decision reflected USAID/Mozambique's concern

that the report focus on the implications of the environmental mandates included in Sections 117-119 of the Foreign Assistance Act for the development of the CPSP for 1996-2001, rather than on the environmental implications of specific activities or programs that the mission may be considering. Two team members did travel to Beira, where they attempted to glean insights for the CPSP from the experiences of Food for the Hungry International in the areas of agricultural production support and extension, and Africare, in the areas of water supply and sanitation.

B. Background Considerations

The environmental and natural resource problems that USAID/Mozambique must address as it moves from its transition program focusing on postwar relief, rehabilitation, and resettlement are deeply rooted in Mozambique's colonial experience. Recent events, most particularly the impacts of civil war, drought, structural adjustment, and some ill-conceived postindependence social and economic policies, have exacerbated these historical problems.

The two features of Mozambique's colonial experience that most directly shape population distribution and the organization of production in rural areas are the slave trade and the interrelated policies of taxation and forced labor that the Portuguese imposed. While slaves had been a significant portion of the commerce through east African ports for centuries, slaves replaced ivory as the region's most important export during the 19th century. The slave trade was particularly important in the northern portion of Mozambique, where it was controlled by Swahili traders and Portuguese *prazeiros*, who worked in collusion with local leaders, who exercised authority over the interior.¹ As the slave trade intensified through most of the 19th century in response to growing international demands for labor, the nature of the commerce shifted from one based on trade and negotiation to one based on raiding and conquest. As late as 1890, slaves continued to be the most important export from northern Mozambican ports, and, after 1890, thousands of people were forcibly shipped as *corvée* labor to the cocoa plantations of São Tomé. More than one million people were exported from Mozambique as slaves during the 19th century (Isaacman and Isaacman 1983:17-18). Oral histories document slavery continuing until as late as 1912 (Hanlon 1984:16).

The slave trade had far-reaching social and economic consequences for rural production and resource management, which subsequent events have reinforced and deepened. These include the depopulation of many interior areas, either as a result of the populations being sold into slavery or of their movement to areas near the coastal ports where they could live in relative

¹ The *prazeiros* were Portuguese subjects, most of whom originally came from Portugal, who had received Crown land grants. Over the years, the weakness of the Portuguese presence for most of the colonial period, the economic ties they developed with African traders and political authorities, and their cultural and racial Africanization, combined so that the *prazeiros* did not necessarily define their interests as coincident with those of Portugal. Maintaining private armies, they came to constitute local powers in their own rights, which Portugal alternately tolerated and courted, as it sought to exercise its power over the colony through them. The definitive subjugation of the *prazeiros* was a central element of Portugal's consolidation of control, in response to the Great Powers' rejection of its historic claim over the region, at the Congress of Berlin, in 1894-95.

safety. The wholesale population movement also disrupted regional economic integration, making trade among interior regions difficult or impossible and causing many local food products to become uneconomical to produce as an outcome of decreased demand and price distortions. The so-called traditional division of labor by gender in agriculture is at least in part an artifact of the slave trade. Men tended to be exported and women to be held in bondage as the major labor force for agriculture and as producers of new slaves.

Portuguese taxation and forced labor policies also profoundly influenced the organization of production and patterns of land use in rural areas. Portugal lacked the resources to export fixed capital to develop its extractive industries in Mozambique, so the colony's profitability depended on the control and mobilization of bound labor. Various taxes were imposed to force rural people to work to earn the money needed to satisfy the obligations the colonial state imposed. Wage rates in Mozambique were so low, however, that it was difficult for most families to earn enough to pay the taxes. Thus, many families earned the money they needed by sending male members to work in the mines and plantations of South Africa and Rhodesia, where wages were 200-300 percent higher than in Mozambique (Isaacman and Isaacman 1983:33). The Portuguese government sought payment for the resulting loss of its nationals, which came in the form of direct payments to the government for workers, and in the form of agreements whereby South Africa and Rhodesia financed the construction of rail lines and port facilities, and directed a percentage of exports and imports to the ports of Beira and Lourenço Marques, which is now Maputo.

The widespread use of forced labor was important in keeping wage rates low. Originating in earlier institutions for extracting labor tribute, *chibalo* was incorporated into the Portuguese labor code in 1899, and remained formally in force in one form or another until 1961.² Under the law, local authorities could oblige people they considered to be "idle" to provide plantation labor for sugar, tea, sisal, rice, and cotton production, work in road and railroad construction, provide domestic service, and so forth. Wages paid were approximately 10 percent of the wages paid to free workers, and workers were subject to considerable physical abuse. The provisioning of laborers to European planters, merchants, factory owners and the like, in exchange for gifts and favors, was an important source of income for many local authorities through the colonial period.

The coercive labor arrangements imposed during the colonial period and maintained through independence have fundamentally influenced the relatively low overall population density, the concentration of population in coastal areas, local variations in land access and tenure, low levels of agricultural productivity, particularly regarding food crops, and the ways that gender and class relations organize rural production. Broader legacies of colonial rule, reflected in extreme levels of poverty, critical sanitation and health problems, massive illiteracy,

² The ending of the legal basis for forced labor did not necessarily alter the power relations on which the practice rested. People continued to be coerced to work for wages that were well below market rates until and, indeed, after independence.

and a small cadre of professionals undermine Mozambicans' capacity to address the environmental issues confronting them (Africa Watch 1992:11-14; Dolny 1985:214-223; Hanlon 1984:95-99; Isaacman and Isaacman 1983:53-59; Saul 1985:36-48). The government of the *Frente de Libertação de Moçambique* (FRELIMO, Mozambique Liberation Front) attempted to reorganize production to overcome the problems that colonialism left behind. Nonetheless, some of FRELIMO's efforts were ill-conceived and poorly executed, so they did not contribute to development, and, in some cases, made conditions worse. Even sound efforts to promote institutional arrangements and production practices that would benefit the country's rural population were curtailed by the war with the *Resistência Nacional Moçambicano* (RENAMO, Mozambican National Resistance). Thus, the fundamental obstacles to a development process that will benefit rural communities in Mozambique have their origins in how rural labor and infrastructure were organized to serve colonial ends.

The severity of the problems that Mozambique has faced since independence often obscures how deeply rooted the underlying problems are. As individuals and agencies attempt to assist Mozambique's recovery from the combined effects of the natural and human-made disasters that have characterized the postindependence period, it is easy to define goals and objectives in terms of a return to "normalcy" that, in fact, never existed. Certainly, no one would argue with the need to repair the damage done since independence. Nonetheless, it is also important to remember that the population distribution, infrastructure, and the productive activities they supported not only did not promote Mozambique's economic development but rested on social relations that were inimical to the well-being of most Mozambicans.

Thus, to the extent that relief and rehabilitation efforts pave the way for patterns of economic development that result in improved living conditions for significant portions of Mozambique's population, these efforts do so not by replacing structures that have been destroyed during the previous decade, but by laying the basis for a fundamentally different social and institutional organization of production. Production controlled by local people free to pursue their own best interests will necessarily imply new patterns of land use and access. This raises several issues. First, one cannot assume to understand the environmental implications of repairing or replacing a road, bridge, or other structure based on how it was used in the past; its place in a reorganized production system will be different.

Second, commonly made distinctions between relief and development are valid only to a limited extent. Decisions about where and how relief efforts take place have fundamental implications for the kind of development that will occur and the ways in which land and other resources will be used. Relief and rehabilitation efforts will create opportunities and constraints for distinct approaches to development and resource management. In particular, because production is being reoriented to different ends, rehabilitation and development efforts have the opportunity to redefine production relations that once contributed to conflicts among users of different rural resources (e.g., farmers and groups interested in protecting wildlife).

Third, taking advantage of these opportunities will require an effective framework of government institutions and grassroots organizations to define and administer land access and

tenure rights and to promote sustainable patterns of resource use. The goal is to create a strong, locally based constituency for conserving or exploiting natural resources in a sustainable manner by creating institutional arrangements that encourage broad participation in decision making about: (1) resource management and allocation; and (2) how the revenues that accrue from disparate productive activities will be shared. Such an integrated approach to local resource management will require systematic consideration of the interrelations among several issues, including:

- (1) the extent to which local leaders and institutional structures represent the interests of the populations in whose name they act;
- (2) the physical and administrative location of legal authority and responsibility for allocating and managing land and natural resources; and
- (3) the relative ability of different interests to influence how natural resources are actually used.

C. Issues to be Addressed

Section 117 of the Foreign Assistance Act directs the president to make "special efforts... to maintain and where possible to restore the land, vegetation, water, wildlife, and other resources upon which depend economic growth and human well-being, especially of the poor." Compliance requires preparing and taking fully into account an environmental assessment of "...any proposed program or project...significantly affecting the environment of any foreign country" (Section 117). Sections 118 and 119, respectively, place particular importance on the conservation and sustainable management of tropical forests and the preservation of biological diversity. The sections require USAID to analyze, in any country strategy statements or plans, what is required to achieve these objectives and the extent to which actions the agency proposes contribute to their achievement.

In addition to Sections 117-119 of the Foreign Assistance Act, attention to Mozambique's natural and environmental resources is consistent with the objectives of the Development Fund for Africa (DFA) and USAID's new approach to sustainable development. Since the DFA's inception and congressional approval in late 1987, USAID has sought to "help the poor majority of men and women in sub-Saharan Africa to participate in a process of long-term development through economic growth that is equitable, participatory, environmentally sustainable, and self-reliant" (Section 496(c)(1) of the Foreign Assistance Act of 1961, as Amended).

Similarly, in *Strategies for Sustainable Development*, the agency articulated a new strategic vision with two significant environmental goals: (1) reducing long-term threats to global environmental problems, including the loss of biological diversity; and (2) promoting "sustainable economic growth locally, nationally, and regionally by addressing environmental, economic, and development practices that impede development and are unsustainable" (USAID

1994: 13). To achieve these goals, USAID now requires all of its country strategies to include assessments of:

- (1) "agricultural, industrial, and natural resource management practices that play a central role in environmental degradation"; and
- (2) "public policies and institutions to protect the environment."

In short, the present report supports USAID/Mozambique in considering relevant environmental issues as it prepares its CPSP in light of these requirements and opportunities.

USAID/Mozambique has defined three focus areas around which it is developing its CPSP. These include:

- (1) Income, including the general issue of supporting increased incomes for rural families through the promotion of a range of productive activities.
- (2) Social services, which includes addressing the grave needs facing Mozambique in the areas of health and sanitation and the provision of safe drinking water, and in providing access to primary education; and
- (3) Democracy and governance, including consideration of the role of government, particularly in the context of decentralization efforts underway in Mozambique, the role of law, the role of the individual in society, associations through which people participate in social, economic, and political processes.

USAID/Mozambique continues to develop its thinking on what are the key issues to address in each of these focus areas. Thus, the characterizations of them presented here, which are derived from interviews with mission personnel, should be regarded as tentative. This report seeks to assist the mission in developing its thinking about what it hopes to accomplish in each area in light of environmental issues.

1. Increasing Incomes

The team concurs with the mission's assessment that the promotion of productive activities to increase incomes is the focus area that raises the most immediate environmental issues. To date, most thinking in this area has assigned a prominent place to promoting agriculture and agriculturally related activities. These pose potential threats to areas of tropical forests, wildlife, and their habitats. Such threats are associated with the direct impacts of expanding crop and livestock production or secondary impacts, like the diversion of water resources for farming or agricultural runoff on downstream habitats and resources. Similarly, the rehabilitation or construction of roads and other infrastructure to improve trade and transport can encourage people to settle in greater concentrations than an area can support or can

inadvertently promote productive activities that exceed the capacity of the land and natural resource base to support them.

Several factors complicate efforts to anticipate the environmental impacts of agriculture or other productive activities intended to increase incomes in Mozambique. At a national level, the massive displacement of people--estimated to be four or five million people, or 25-30 percent of Mozambique's population--as a result of war, drought, and famine, have disrupted farming communities and left in doubt legitimate ownership of abandoned land. The rehabilitation efforts of USAID/Mozambique and other donors focus on assisting people to return home and to undertake productive activities there. It is unclear under what conditions, or even whether, many will choose to do so. Significant numbers may elect to remain where they are or pursue a livelihood in new areas where opportunities are perceived to be greater. This makes it difficult to make sound assumptions about the number of people that reside in an area or may be expected to reside there in the near future, in relation to available land, water, and other resources. This, in turn, makes it difficult to assess how particular productive activities can be expected to affect these resources, even over short time periods.

Regional and local social dynamics play important roles in determining the environmental impact that a particular productive activity will have. A critical issue to bear in mind is the centrality of women's work in rural production. A gender-based division of labor is an organizing principle of production throughout Mozambique. This situation must be considered in light of local and regional complexities in any activity that attempts to modify rural production systems. Among the factors that shape what constitutes women's work and roles as resource managers in particular contexts are:

(1) the role that the slave trade and forced labor had in defining the traditional division of labor in many areas;

(2) local and regional variations in rules of inheritance and descent (e.g., patrilineal or matrilineal), which are fundamental in defining local concepts regarding rights of land access and use; and

(3) differential opportunities and wage rates for men and women in nonagricultural sectors and the relation between on- and off-farm income with regard to its source, the amounts of each earned, the form in which each is earned (e.g., cash or in-kind), and the kinds of access and control that men and women have over each.

Any modifications in rural production systems will have immediate and profound impacts on gender relations in regard to work and long-term implications for the position of women in rural society. Also, because gender is a major axis around which the allocation of labor resources is organized, the impacts of changes in rural production systems on women's work have important implications for how land is used.

As a result of these considerations, the team concludes that, to the extent it is determined that activities designed under the CPSP are not covered by the Programmatic Environmental Assessment (PEA) of the transition program (Russell et al. 1993), some income-generating activities may require specific supplemental or entirely separate environmental assessments.³ It will also be important to provide for a process-oriented monitoring approach (as opposed to a static monitoring system based on periodic surveys) as an integral part of project design and implementation. Such a system will permit USAID/Mozambique to detect unanticipated or indirect environmental impacts as they emerge and to take prompt corrective action.

2. Social Services

As understood by the team, the direct environmental impacts of the missions focus on social services and infrastructure focus should be modest. In general, improved health and sanitation facilities reduce the negative impacts that people have on the physical environment. Improved primary education increases the possibilities for educating people about environmental issues and should contribute to improvements in the quality of participation in institutions that influence how land and natural resources are used.

There may be significant indirect impacts associated with activities that provide facilities like schools, health posts, and wells or potable water systems. The creation of such facilities frequently is a factor in attracting people or in encouraging them to settle densely in the surrounding area. There is considerable anecdotal evidence in Mozambique suggesting that relative availability of water, education, and health care is an important factor for many dislocated people as they make decisions about whether to return to rural areas (e.g., Alexander 1994: 22,25,28).

In addition, water available for drinking and sanitation can be used for other purposes like farming and gardening. This can alter production systems in ways that have negative environmental implications or result in the water resource itself being taxed beyond what was anticipated in the design of the original activity as a result of being used in greater quantities than expected or because unanticipated uses can have consequences like increases in agricultural runoff.

Individual environmental assessments are not expected to be necessary for most of the activities contemplated under this focus area. Nonetheless, the uncertainties about population movement and the practices that can be expected to characterize newly established or re-established production systems suggest that the scope and location of activities involving the

³ The PEA is consistent with a key tenet of the Development Fund for Africa, which is that sustainable, broad-based economic development is dependent on responsible stewardship of natural resources. In turn, responsible stewardship requires environmentally sound design and implementation. All USAID development projects should result in positive outcomes. If such projects are not designed and implemented according to rigorous environmental standards, however, negative outcomes can result. To address such possibilities, USAID's Bureau for Africa is placing increasing reliance on environmental monitoring, evaluation, and mitigation plans (EMEMPs) (Hecht 1994).

construction of facilities should be considered carefully. The impacts on population movements of creating or rehabilitating facilities and patterns and levels of water use should be monitored. USAID/Mozambique may wish to consider planning and implementing activities involving the construction of facilities in coordination with income-generating activities. The provision of health, sanitation, and educational facilities can contribute to promoting sustained economic development. In addition, strategically concentrating support for income-earning opportunities and such facilities can provide powerful incentives for people not to move into environmentally sensitive areas. Such concentration would also facilitate monitoring the impacts of USAID/Mozambique's overall program.

3. Democracy and Governance

With its emphasis on strengthening institutions and processes associated with democratic governance, the democracy-and-governance focus does not presently contemplate activities that would have direct environmental impacts. In this respect, environmental assessments of the activities to be supported under this focus area would probably not be useful or appropriate. In contrast, however, there may be indirect and undesirable environmental consequences over the longer term due to policy reforms and nonproject assistance. Under such circumstances, consideration of the utility of creating an EMEMP (see chapter 5) may be appropriate.

Despite this situation, how institutions define and control access to productive resources is of central importance in shaping how land and other resources are used. This point has been amply documented and argued with respect to agriculture in Mozambique as a result of research that the Land Tenure Center (e.g., Myers and Tanner 1992a, 1992b; Myers and West 1992) conducted for USAID/Mozambique. Focusing on the Chokwe Irrigation Scheme, this research demonstrates that insecure property rights discourage people from adopting practices that contribute to sustainable agricultural production over the medium and long term and can create incentives for practices that are actively destructive.

Wynter (1993/4) extends this argument in two directions by: (1) going beyond the management of soil and water resources in agriculture to consider the management of more complex ecosystems; and (2) considering how political institutions and processes promote environmental conservation and sustainable resource management to the extent that they permit people to participate in defining and regulating access to and use of the resources upon which they depend to earn a living. Research conducted in other countries (e.g., Blaikie and Brookfield, eds. 1987; Painter and Durham, eds. 1994; Unasyuva 1993/4) supports and extends Wynter's argument. The research overwhelmingly suggests that how production is organized, in terms of the overall institutional framework that shapes, defines, and regulates access to resources and distributes the revenues associated with their exploitation, is the single most important issue shaping how land and other resources are used.

Thus, the kinds of political participation promoted under the CPSP's democracy-and-governance focus will be critically important in shaping how natural resources are utilized. This report thus suggests that activities to support government structures, grassroots organizations,

or interest groups in the private sector be analyzed from social and institutional perspectives in light of their implications for promoting the kind of participation in resource allocation and management that will contribute to environmental conservation and sound natural resource management. Coordinating activities in this area with activities intended to improve social services and increase incomes will improve substantially the chances that USAID/Mozambique's program will actively contribute to conservation of Mozambique's biodiversity and sustainable management of its tropical forest resources.

II. Policy and Institutional Issues

A. Introduction

This section discusses policy and institutional factors relevant to environmental issues in the CPSP at three levels:

- (1) planning, policies, and legislation affecting the sustainable management of natural resources;
- (2) management, administration, and organizational issues that pose opportunities and constraints for implementing environmental and natural resource activities; and
- (3) economic and financial issues that can influence the kinds of incentives that people and institutions have to participate in environmental and natural resource activities.

B. Planning, Policy, and Legislation

1. Policy Issues

Several policy issues are particularly important as donors, NGOs, and the Government of Mozambique attempt to define a coherent approach to the environmental and natural resource issues confronting Mozambique. These include:

- (1) the need to strike an appropriate balance between meeting immediate needs and defining and addressing long-term conservation and development priorities;
- (2) promoting institutional arrangements, in both the public and private sectors, that encourage effective local management of natural resources and provide production incentives that are consistent with environmental and natural resource goals; and
- (3) appropriate combinations of institutions to fund, plan, and implement environmental and natural resource activities that reflect the country's needs and the institutional capacity to meet them.

2. Immediate Needs and Long-term Priorities

How to strike a balance between meeting critical immediate needs and addressing long-term conservation and development issues is a question that confronts donors and the Government of Mozambique alike. For USAID/Mozambique, the issue is manifested in the difficulty that many of those interviewed expressed in shifting their focus from the relief-and-rehabilitation orientation of the current transition program to thinking strategically about what the mission's program will attempt to accomplish between 1996 and 2001. World Bank officials express similar sentiments in trying to organize their projects around a coherent approach to

supporting sustainable development, even as immediate needs associated with current projects impose themselves. The difficulty that donors face is understandable in light of the massive current needs confronting Mozambique, but it is important that the donors put their houses in order soon. If they do not, an issue that they find bewildering will be insurmountable for the Government of Mozambique, which is responsible for defining the country's environmental and natural resource agenda. The difficulty is that Government of Mozambique's dependence on donor funds severely limits its ability to seize the initiative on the issue.

The case of the National Commission for the Environment (*Comissão Nacional do Meio Ambiente*, or CNA) is instructive. Created in 1992 to formulate environmental policy, act as a regulatory agency to enforce environmental policy, and facilitate coordination among ministries regarding environmental matters that cut across sectoral lines, the CNA's role in formulating environmental policy found concrete expression in drafting the National Environmental Management Plan (NEMP). The CNA was also involved with the development of a national environmental law, which Mozambique's legislative body, the Assembly of the Republic, will consider. The CNA has received support from the United Nations Development Programme (UNDP) for hiring staff, monitoring the disbursement of funds, and backstopping. Other donors recognized the need for the CNA and its role as a policy maker and coordinator and were supportive of its creation. Donors have tended to support the CNA as a project-implementing agency, however, and the CNA's activities have become substantially project driven as a result. Project implementation has at times competed with efforts to develop a coherent environmental program that reflects the CNA's original policy formulation and coordination mission (Milagre 1992: 3; Quan, Sibandu, and de Santana Afonso 1994: 5, passim).⁴

One must be careful not to oversimplify. Some would argue, for example, that the CNA has been unmindful of its mission and has portrayed itself as a project-implementing agency in an active pursuit of donor support. Others would point out that, given the government's limited resources, the CNA must market itself aggressively and secure support if it is to survive and have the opportunity to fulfill its mission. Still others interpret the CNA's role as an implementor of projects as reflecting bureaucratic struggles and interpersonal rivalries within the government. Some donors suggest that they prefer to tie their support to project-level outputs until the CNA demonstrates its administrative capacity. Some would like greater clarity regarding what the CNA's function in the government ultimately will be before they commit to supporting its policy-making role. The World Bank encouraged this clarity by insisting that the CNA complete a draft of the NEMP by June 30, 1994. With a complete draft of the NEMP in hand, the CNA's functions and the environmental responsibilities and capabilities of the sectoral ministries should emerge from the discussions that will take place during Phase II, which will lead to the final version of the document.

⁴ At least some of the projects include salaries that are significantly higher than those that the government pays, thus creating incentives for key personnel of the CNA to assign themselves to projects, rather than remaining in the positions they were hired to fill (Quan, Sibandu, and de Santana Afonso 1994:2-3).

It is also true, however, that donors have sent mixed signals regarding their willingness to support the CNA's policy-making and coordination mission. No donor has begun to think strategically about conservation and development in Mozambique. Several are sponsoring interesting and potentially important pilot projects, with the CNA or other government agencies, which explore alternatives for managing a range of natural resources with significant local participation.⁵ To date, however, no donor is supporting the creation of the institutional linkages and mechanisms that would permit the lessons from a successful pilot project to become part of a national approach to conservation and development.

To the extent that donors are unable or disinclined to commit resources to government agencies, there are opportunities to support NGOs and PVOs in their efforts to assume more active roles in the management of Mozambique's natural resources. It is surely the case that government serves a necessary and useful function, but not all environmental expertise is located in the halls of government ministries. USAID's support of NGOs and PVOs, both indigenous and international, would contribute to the goals of the Development Fund for Africa, which seeks to stimulate local involvement in the implementation of every project that has a local focus in sub-Saharan Africa. USAID's (1994) *Strategies for Sustainable Development* is similarly supportive of the active involvement of communities and NGOs in decisions affecting the environment as long as it includes close coordination and communication with host governments.

At present, however, the CNA's case stands out because of the central role it is to fill in supporting strategic thinking about environment and development issues. Agencies of sectoral ministries with environmental responsibilities have had similar experiences. For example, the *Direcção Nacional de Florestas e Fauna Bravia* (DNFFB), of the Ministry of Agriculture, is working on several pilot projects that can offer important lessons in forest and wildlife management as components of a multiple-resource production system that also includes agriculture. One such project is the Transborder National Park project, on Mozambique's border with Swaziland. The Global Environment Facility (GEF) sponsors the project.⁶ The Ford Foundation sponsors another activity involving community-based forest management in Tete province. A third involves developing community-based approaches to forest and wildlife management as part of a rehabilitation plan for the Gorongosa National Park, which is receiving sponsorship from the European Community (EC) and the International Union for the Conservation of Nature (IUCN). At the same time, the DNFFB is responsible for administering timber concessions throughout the country, but the directorate lacks the provincial-level personnel, park guards, uniforms and equipment for the guards, vehicles, and gasoline needed to implement this task effectively. To date, donor support for the DNFFB has remained project-focused, and no donor has assumed responsibility for helping the DNFFB strengthen its capacity at the subnational level to protect and manage the bulk of Mozambique's forest resources, which are located outside of parks and protected areas.

⁵ Appendix 4 summarizes donor's and lenders' environmental activities in Mozambique.

⁶ The project will eventually affect areas of Mozambique's borders with South Africa and Zimbabwe as well.

A partial solution may lie in the new decentralization law, which the Ministry of State Administration is currently drafting. The drafters of this law are contemplating the possibility that a portion of the revenues that state agencies generate, as in the case of timber license fees that the DNFFB collects, will remain with the agencies that collect them, to support their operations, and in the affected localities to support resource management and service provision. To date, however, the DNFFB's participation in the process of drafting the decentralization law has been minimal, despite the fact that its staff has been asked to participate. Key DNFFB personnel have had little time to participate because they are preoccupied responding to their donors' wishes to place forest-sector conservation and development projects in a directorate whose administrative capacity is limited. Emphasis on administering pilot projects leaves the DNFFB little opportunity to focus on activities central to the long-term health of the forest sector.

Similar situations exist in all ministries with responsibilities for conservation or natural resource management. The Ministry of Tourism, for example, is reported not to have a single four-wheel drive vehicle. All of the donors with whom the team spoke are aware of such problems, at least in the context of the agencies with which they work. To date, however, no donor has made a commitment to work to strengthen those agencies.⁷ The need is particularly critical at the provincial and district levels where the lack of resources and institutional weakness are greatest. Similarly, it is at these levels that agencies must interact with PVOs and NGOs, interest groups and associations, and local communities if decentralization and local management of resources are to become a reality.

3. Defining an Organizational Base for Rural Production

Establishing an organizational base for production that encourages conservation and sustainable resource management is essential for protecting Mozambique's tropical forest and wildlife resources. The Land Tenure Center's (LTC) research identifies security of possession as a critical issue in shaping how land and natural resources are used. The LTC's researchers recommended several measures that affect how agricultural production is organized to encourage rural people to be conserving (Myers and Tanner 1992a: 31-32, 1992b: 7-8). Some of the most pertinent recommendations relate to:

- (1) promoting equitable access to land and water;
- (2) clarifying the status of land rights that have been distributed;
- (3) establishing a national body with local representation to define procedures for future land allocation, determine future land policy and legislation, and advise on land conflict resolution;

⁷ Donors have many reasons for not doing so. These include limited resources, other needs and priorities, concerns about the government's ability to sustain institutions after donor support ends, and a lack of confidence in some ministries.

(4) replacing the distinction between private and family-sector holdings with a broader classification system based on holding size and management type; and

(5) developing marketable land-use rights to encourage investment in sustainable management and environmental protection.

The team agrees with the thrust of these recommendations and supports their implementation as an important element of promoting sustainable use of agricultural land. The team also suggests that USAID/Mozambique consider these recommendations as a starting point for thinking about the kinds of conditions that would promote a locally based approach to managing natural resources. Many of the issues raised with regard to the sustainable management of agricultural lands are applicable, either directly or with minor modification, to the management of natural resources generally. Applying these recommendations within a broader, multiple-resource-use framework would offer several advantages:

(1) Incorporating the management of resources like trees and wildlife with the management of agricultural systems would contribute to weakening the opposition that has existed in the past between farmers and those interested in the exploitation of other resources.

(2) Incorporating additional resources into the production systems of rural people would create additional income-earning opportunities for rural families.

(3) Creating an integrated structure through which local populations manage land and other resources would consolidate an institutional base for making decisions about using resources that permits local people to participate in making decisions in areas like allocating land among competing uses.

Integrating agriculture with other resource management activities would also facilitate the consideration and response to the factors that affect land use. The team is in general agreement with the LTC's findings about the importance of secure rights of possession as an important factor in promoting sustainable land use, but it is an assertion that must be contextualized. In Central America, for example, the creation of mechanisms to insure the security of landholdings encouraged many people to invest in land. People with more money often bought out those with less. Those who purchased land frequently managed it well. In contrast, a substantial portion of those who sold land moved into areas unsuitable for agriculture, cleared forested areas, and began to farm. In addition, factors like returns to unwaged family labor arising from a combination of on- and off-farm activities have been shown to be a critical variable in shaping patterns of land use in many areas.

The LTC's findings provide a useful starting point for the consideration of how local institutional structures and political processes, like those to be addressed under USAID/Mozambique's democracy-and-governance focus, and sources and levels of income, to be addressed under the income focus, are part of a single set of issues, which shape how land

and resources are used. These issues must be addressed in order for the CPSP activities to have a positive impact on Mozambique's tropical forests and wildlife.

Another important issue in organizing locally controlled structures is the definition of appropriate vertical linkages with central government authorities and horizontal linkages across geographic spaces (e.g., Alexander 1994: 28). Returning to the issue of security of land possession, for example, Borges (1993: 6-8) points out that true security for individuals and local management structures comes through these linkages and not in spite of them. On the one hand, this underscores the importance of strengthening regional and provincial offices of relevant central government ministries as part of any effort to support local resource management. On the other hand, the definition of linkages points to the importance of considering local structures (including those in the nongovernmental sector) in a regional context that includes access to markets and urban services and the implications of productive activities implemented in one area for resource users in another (e.g., the implications irrigation for wildlife and people dependent on the same water resource downstream).

Such considerations are not inconsistent with any plans discussed with other donors or USAID/Mozambique. The considerations do suggest areas that require attention as planning progresses. In the case of other donors, for example, the team has already noted the tendency to think in terms of pilot projects, with no clear plan for how these address the need for developing institutional capabilities or how the lessons learned from a pilot project might be translated into action on a broader scale. In the case of USAID/Mozambique, the team noticed a tendency to think of local management issues in terms of the creation and strengthening of rural enterprises. It is important to remember that the enterprise structure excels in maximizing the efficiency of a particular productive activity (e.g., farming). Nonetheless, enterprises are not necessarily the most skilled at making decisions that require balancing the need for economic efficiency with the resource requirements of other enterprises or with community interests that are not directly translatable into net revenue. Such decisions need to be made by local institutions, in which rural agricultural enterprises would certainly participate, either individually or collectively. Other sectors of local populations, with interests in resources like forests, wildlife, and fisheries, also need to participate. Through its focus on democracy and governance, USAID/Mozambique can make an important contribution to locally controlled and sustainable natural resource management by considering how to promote fora for broadly based participation in decisions about the allocation and use of resources by different interest groups.

The focus areas of income and democracy and governance can be linked profitably. The income focus suggests the importance of people having economic incentives to use rural resources sustainably. The democracy-and-governance focus seeks to influence the political processes and institutions that affect how resources are allocated at the local level in the interest of promoting broad, democratic participation. These are the elements of a community-based approach to managing multiple resources (e.g., trees and wildlife, along with agriculture). Some of the pilot projects that promote community management of multiple resources will offer useful experiences suggesting how such an approach might work in Mozambique as the mission prepares its CPSP. There is a wealth of experience in other countries upon which to draw. It

may be profitable for the working groups to think collaboratively about community resource management issues in light of some of these experiences as they develop the CPSP's focus areas.

4. Defining Implementing Agencies to Support Rural Production

As noted earlier, due to the weakness of state agencies, many donors rely heavily on international NGOs to implement activities. The degree to which this reflects an explicit decision not to work with the national government varies, as do donors' commitments to building the institutional capacity of indigenous institutions in the name of sustainability. The single greatest impact on behalf of conserving Mozambique's tropical forests and biodiversity resources that a donor might have would be to improve the capacity of those state agencies responsible for managing different resources to implement their mandates. Of particular importance is the need to strengthen state agencies at the provincial level and to increase the resources they have available to implement their duties in the rural areas of their respective provinces. Such support could include equipment, training to improve the technical and administrative capacities of provincial and district level officials, and support for reorganization and reform processes, like decentralization. These items would increase the ability of state agencies to generate and retain operating funds through mechanisms like the sale of timber and safari licenses.

Support for state agencies that emphasizes revenue generation and retention and strengthens technical and administrative capacities at the subnational level would have positive impacts on Mozambique's ability to manage its tropical forest and biodiversity resources. Such an effort would improve the government's capacity to grant and administer licenses to exploit natural resources (e.g., timber, hunting, fishing, mineral exploration, and mining licenses) in a more rational way. There is presently considerable confusion in the granting of licenses. There are cases in which licenses for different, incompatible uses (e.g., forestry and mining) have been granted for areas that overlap. While the law establishes an order of precedence for competing claims (e.g., mining takes precedence over all other uses; forestry takes precedence over farming), the absence of national government agencies below the provincial level means that the law is not enforced. One consequence is that party that can muster the strongest presence exploits the resources. Similarly, the government is unable to enforce the provisions of the licenses that are granted. For example, a forestry license that the DNFFB grants specifies that a licensee may harvest a given volume of a certain variety from a defined area, but the directorate does not have the resources to monitor operations and insure that the terms of the license are respected.⁸

⁸ These general problems are complicated in some areas because RENAMO has granted timber concessions in areas it controls, with the expectation that licensees would contribute a portion of the revenues to the movement, which is now a registered political party. Not only were these licenses granted without regard to environmental concerns or national land-use policies, they were a source of conflict with some local RENAMO "administrators," who wished to participate in the granting of licenses in areas under their control (e.g., *Noticias* 1994:3). Such areas will require a concerted effort by the post-election government, local authorities, licensees, and local populations to sort matters out in a way that is politically acceptable and environmentally responsible.

Despite its highly centralized formal structure, the state does not have an effective presence at the provincial and community levels. This poses a problem for those seeking to promote strong locally based institutions that would make decisions about the allocation and use of natural resources, within a broader framework of local politics and government. While one may be opposed, with good reason, to the central government monopolizing decision-making authority, the government's capacity to manifest an effective presence at the local level is important to provide minimal guarantees of security to local investors and resource users. To the extent that donors and the government succeed in creating conditions that favor the organization of community-based institutions to manage multiple resources, close coordination with government agencies (and interested NGOs and PVOs) will be required to address local management arrangements and integrate what will necessarily be diverse local practices with regard to access to markets, services, and infrastructure at a regional level.

Donors will also need to consider more carefully with which state agencies, if any, it is appropriate for them to work, given the conservation and resource management goals they are trying to achieve. Present practice tends to be to "adopt" a state agency to implement portions of a pilot project. Thus, as described above, for example, the CNA is the lead implementing agency in some projects, while the DNFFB is in others. The role that each plays does not necessarily correspond to the role formally assigned to it. For example, the CNA was not created to be an implementing agency. Coordination among agencies with responsibilities relevant to the pilot projects ranges from superficial to nonexistent. To some extent, one can blame the problem on capriciousness and donors wanting to establish a claim on "their" people and agencies. Once more, however, the underlying problem has to do with the dearth of technically qualified people and institutional capacity to address environmental issues. This is complicated because the ministries' sectoral responsibilities are fragmented along lines that do not reflect an appropriate division of labor for addressing environmental problems. The legislative and planning processes (described below) are partially addressing this problem. At this writing, the final results of these processes remain to be seen. They will, however, provide donors with a framework for addressing the policy issues that have been discussed here.

C. Legislative Processes

The Government of Mozambique is currently engaged in a comprehensive effort to define a national development agenda, which may bear fruit following the elections in October 1994. This involves several legislative initiatives to create the legal framework for that agenda and a number of planning exercises, which anticipate and are attempting to facilitate the implementation of the new laws. In spite of the importance of the elections and the legislative initiatives, the processes will not lead to immediate policy or legislative action. Nonetheless, the processes will lay the foundation for changes to follow. The legislative issues of particular relevance to the management of natural and environmental resources are discussed in this section, and the planning processes below.

Currently pending legislation, which will shape the context in which donors make their policies affecting natural and environmental resources include:

- (1) the draft national environment law;
- (2) the draft decentralization law;
- (3) modifications and clarifications to the national land law; and
- (4) a draft national water law.

Each of these is discussed below. In addition, however, pending revisions to the commercial and investment codes also have the potential to affect the use and management of Mozambique's resources.

1. Draft National Environmental Law

The CNA has prepared a draft environmental law (CNA 1994a), one of the tasks the Council of Ministers envisioned when it created the CNA in 1992. The draft law:

- (1) empowers the CNA to be a coordinating agency on environmental matters;
- (2) tasks the CNA to coordinate with the sectoral ministries to promote environmentally sound resource use;
- (3) requires the CNA to report annually to the Assembly of the Republic on the state of the environment;
- (4) grants the CNA authority to define environmental standards and regulations and to require environmental impact assessments; and
- (5) makes the CNA responsible for enforcement of environmental standards and regulations, in coordination with the relevant ministries and local or national authorities.

The authority to oversee the use of natural resources remains with the ministries and local and national authorities. The law thus provides donors with guidance regarding the appropriate mechanism for achieving intersectoral coordination and the appropriate state agencies with which to work in implementing activities involving actual exploitation of natural resources.

2. Decentralization

The Ministry of State Administration is currently drafting legislation that will decentralize governmental authority to subnational units. The drafting is being done in consultation with sectoral ministries. As noted earlier with regard to the DNFFB, it is not clear whether the quality of participation is always what it should be in light of the extent to which an agency might be affected.

Decentralization will promote local decision making and control over natural resources by granting greater power to provincial and municipal authorities, and greater authority to provincial-level offices of the central government.⁹ An integral part of this devolution of authority will be provisions in the law defining the rights of local and municipal authorities to raise revenues for their own administration and for development activities they wish to implement. Similarly, ministries responsible for levying user fees, licenses, and so forth will be allowed to retain a greater portion of the resulting revenues and use them to support their own programs. Provincial offices of national ministries reportedly will also be able to retain a greater portion of the fees they collect in their jurisdictions.

Decentralization will provide donors with a greater definition of the options for working with local government authorities. It will also allow donors to target support to the provincial level of central government ministries in support of geographically defined projects and programs and have a reasonable expectation that resources invested in strengthening government institutions in an area will be utilized in that area. The combination of better definition and allocation of power to local government authorities and greater decentralization of power in central government agencies should facilitate donors' efforts to support local institutions and support central government agencies in being responsive to them. These opportunities should not necessarily preclude consideration of increased reliance on or strengthening of NGOs and PVOs, particularly when they can demonstrate a comparative advantage.

3. Modifications to the National Land Law

A general land law, which the People's Assembly approved in 1979, currently regulates land use in Mozambique. Implementing regulations guiding the law's application were promulgated by decree in 1987. An important aspect of current government efforts to define overall development objectives is the divestiture of state farms and the privatization of parastatals. Through divestiture the government seeks to rid itself of enterprises that are a major drain on its financial resources. The sale may also permit the recovery of some of the money invested in the state farms through the sale of possession rights. The government seeks to promote private commercial agriculture and strengthen the land rights of family farms. The government also hopes that divestiture will ultimately result in greater agricultural productivity and create conditions that will bring about improved rural living standards. However desirable divestiture may be, one should recognize that it raises the possibility of additional environmental risks. As an example, commercialization of agriculture elsewhere in Africa has brought with it increased reliance of fertilizers and pesticides. Unfortunately, the use of pesticides in sub-Saharan Africa is not always as environmentally safe or rational as it might otherwise be.

Under the general direction of the Ministry of Agriculture, the government created an ad hoc land commission to study what revisions are needed in the current land law to clarify

⁹ A draft law of municipalities has been completed and is currently before the Council of Ministers for consideration.

possession rights and to encourage investment. The intent is to create a clear land policy that includes transparent allocation procedures among disparate categories of users and a mechanism for settling land disputes that all interested parties accept as legitimate. A crucial element in this intent is to clarify all locally recognized land rights based on so-called traditional authority, and local patterns of descent and inheritance (e.g., patrilineal or matrilineal), and their relation to formal national law regarding land.

It remains unclear exactly how the revisions being contemplated will be reflected in modifications to the existing law. Some people feel that the law will have to be modified substantially, particularly in regard to the kinds of guarantees that private investors will require of their possession rights and the kinds of local entities to be recognized as landholding units. Others feel that the existing law regarding land is less the problem than is the lack of definition regarding the local institutions that can hold land rights and the weakness of the provincial-level national government entities. Under this interpretation, the institutional "gap" must be addressed or other mechanisms found to address the problem.

4. National Water Law

The Council of Ministers has accepted a draft national water law, which will be presented to the Assembly of the Republic for consideration. The team was unable to obtain a copy of the draft law to review prior to the preparation of this report. The law's purpose is to facilitate the management of water resources on the basis of water catchment areas rather than according to the diverse ways that water is used, which forms the basis of a highly fragmented distribution of responsibility among multiple ministries for the management of water resources. Passage of a meaningful law should contribute significantly to the ability of the state and donors to promote institutional coordination in conserving and managing water resources.

D. Planning Processes

In addition to each ministries' consultative relations with the Ministry of State Administration in the drafting of the decentralization law, the former have been charged with developing a five-year strategic plan, which indicates priorities and goals for the period and the means whereby each ministry proposes to meet them. The strategic plans are to consider anticipated limits on resources and reflect the modes of operation that will characterize each ministry as a result of decentralization.

Within the strategic planning process, several activities are underway that will directly affect how government agencies will approach natural resource and environmental issues. One is the Ministry of Agriculture's "Pre-Program," which is being implemented with the UNDP's support. The Pre-Program seeks to promote improved coordination among the Ministry's different units in the interest of reducing duplication of effort and in creating mechanisms for addressing issues that cut across disciplinary and sectoral lines.

This effort responds to several concerns of the Government of Mozambique and donors. First, the Pre-Program is an effort to make government agencies better able to respond to locally generated demands for services; less duplication of effort and better coordination should mean more resources for supporting action at the local level. Second, the Pre-Program anticipates the need to translate the lessons learned from pilot projects in environmental conservation and natural resource management into a general approach to land management in environmentally sensitive areas throughout the country. Many of these projects, such as those being implemented in the areas of Marrromeu or the Gorongosa National Park, are based on notions of working at a local level with rural families in the management of multiple resources (e.g., farming, forestry, wildlife). This will require the Ministry of Agriculture to treat the resources of an area in an integrated way, rather than permitting sectoral agencies to focus exclusively on the natural resources of interest to a single sector. Finally, the expectation is that better coordination and less duplication of effort will improve how donor funds are used by reducing the incidence of different government agencies implementing projects and programs that overlap, or are operating at cross purposes (Milagre 1993: 3-4, 5-6).

The Pre-Program is currently being implemented in eight districts, located in different areas of the country. It focuses on improving institutional capacity in four major areas: (1) land evaluation for land-use planning; (2) research and extension to increase the production of basic foodstuffs and promote agroforestry in rural production systems; (3) interagency coordination and training of personnel; and (4) information management. The Government of Mozambique and the UNDP intend that this will provide a base of information and experience upon which to base the drafting of a five-year development strategy for the country as a whole, which reflects the concerns noted above.

As part of the Ministry of Agriculture's strategic planning process, the DNFFB has identified the completion of an inventory of forest resources and an assessment of the forest biomass as priority activities that will permit it to promote the sustainable exploitation of forests. A reliable forest inventory will permit the ministry to grant timber licenses on a more rational basis.¹⁰ The inventory will also define appropriate reforestation plans to be tied to a transition from the granting of licenses to the granting of timber concessions. The biomass study, which is discussed in greater detail in the next chapter, will facilitate work with farmers to incorporate fuelwood into their production systems, permitting the calculation of sustainable extraction rates. How each ministry addresses these kinds of issues will shape the kind of presence that central government agencies will have in different areas of the country and their capacity to interact in constructive ways with local resource users.

As part of the CNA's decentralization planning, the commission has defined a structure whereby it will operate out of three regional centers, in Nampula, Chimoio, and Xai-Xai (see Figure 1). Each regional center will concentrate on a specific set of issues that are of particular importance there and that affect other areas of the country. Nampula will be responsible for

¹⁰ The granting of licenses will not necessarily ensure that they are monitored properly, and this will be an issue of importance if the management of the country's forests is to be improved.

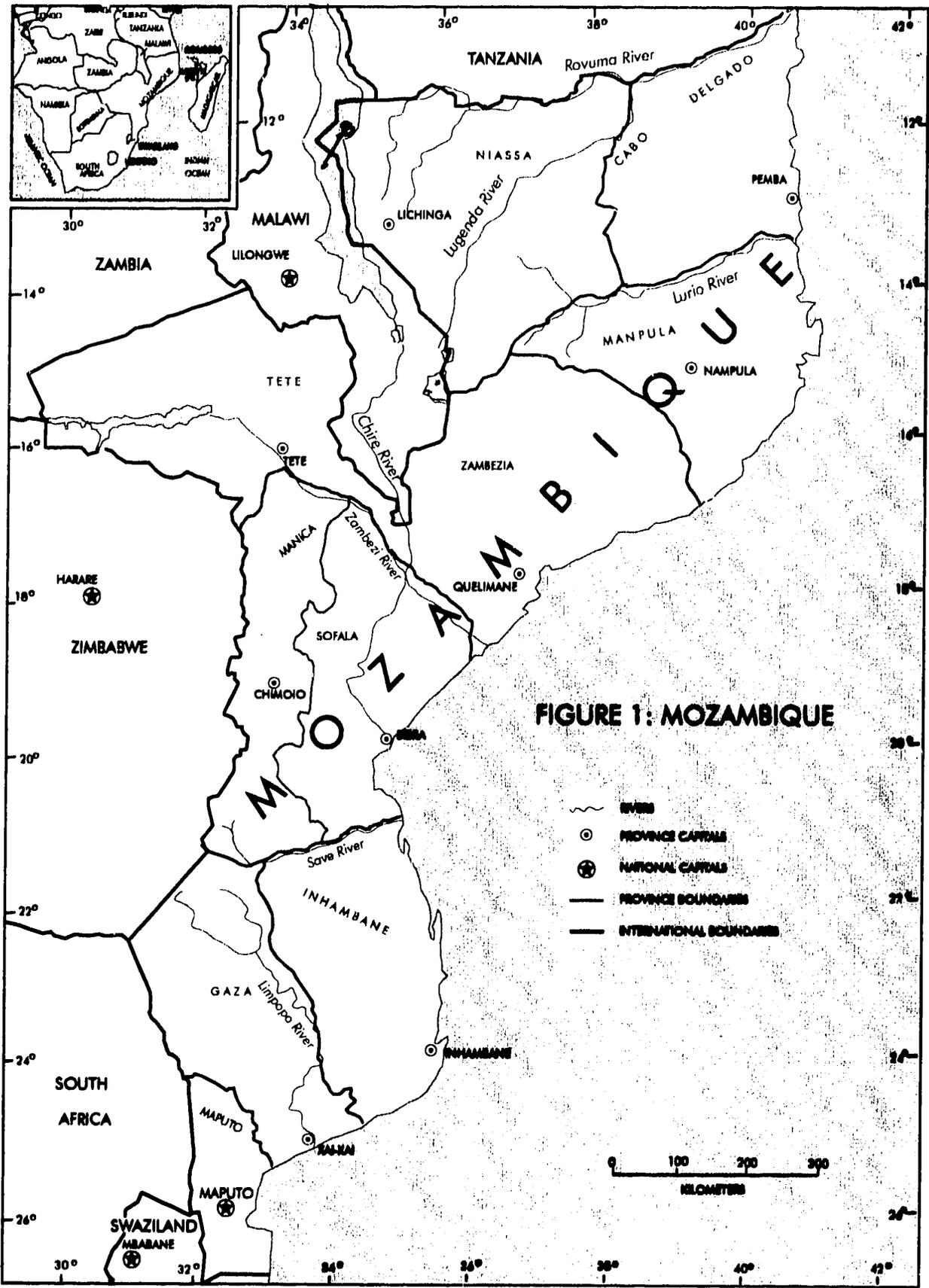


FIGURE 1: MOZAMBIQUE

work on the urban environment and community involvement in environmental issues; Chimoio will concentrate on settlement/resettlement issues and rural production systems; the center in Xai-Xai will focus on coastal zone management. The regional structure represents the CNA's attempt to decentralize and shift its focus away from Maputo while recognizing that it will not have the resources to establish a permanent presence in each provincial capital.

Despite these efforts, the most important planning exercise involving environmental issues is the elaboration of the NEMP. As already discussed, the World Bank informed the government that it had until June 30, 1994, to complete a draft NEMP. Failure to do so could have resulted in the suspension of funding for World Bank projects and led the Bank to impose its Country Environmental Strategy Paper, an internal document currently being written, as the basis for addressing environmental issues associated with its projects. The CNA completed a draft NEMP in May 1994 (CNA 1994b), and the Council of Ministers approved further circulation of the draft. The draft was then circulated throughout the Government of Mozambique for comment, and, as this report is being written, the comments are being incorporated into a revised version to be presented to the Bank in compliance with its requirement.

Presentation of the draft document to the Bank marks the beginning of Phase II in the NEMP planning process, which formally began on July 1, 1994. This phase is envisioned as a consultative process, which will be used to discuss the NEMP and the environmental issues it attempts to address in all of Mozambique's provinces through a series of public meetings. The CNA also hopes to discuss the draft NEMP with donors in light of the technical expertise they bring to bear and their funding priorities. The goal is to produce an enriched final document, which will serve as an environmental master plan, by the end of 1994.

The draft NEMP is a comprehensive planning document, divided into six sections:

- (1) an overview of the environmental situation in Mozambique, including a general prioritization of environmental problems and general recommendations for addressing them;
- (2) a discussion of the legal, social, economic, political, institutional, and financial issues to be addressed in implementing an environmental management plan;
- (3) three sections dealing with environmental management and natural resource issues in rural areas, coastal zones, and urban areas; and
- (4) a discussion of environmental education issues.

In each of the six sections, the NEMP lists actions to be taken and the mechanisms whereby those actions may be taken. It proposes a division of labor among the sectoral ministries and defines a coordinating role for the CNA. The division of labor proposed assumes a decentralized administrative structure, whereby the provincial-level offices will have the authority and resources to work together. On the one hand, this is consistent with what donors

say they want as well as with what the government is planning to do. On the other hand, there are to date no solid commitments of funding to support the necessary decentralization or the programmatic activities called for in the NEMP.¹¹

The NEMP's major technical limitation is that its definition of priority areas as coastal zones, urban areas, and rural areas does not provide for the intersectoral coordination required to address natural and environmental resource issues. The NEMP does not, for example, provide a useful frame of reference for assessing or addressing the impact of inland agricultural activities (covered under the discussion of rural areas) on coastal resources due to the diversion of water or agricultural runoff. The management of rural fuelwood and water resources in response to growing urban demand poses a similar kind of problem about which the draft NEMP offers little guidance. These should be areas of continuing discussion as the draft document is discussed and revised during Phase II of the NEMP approval process, which is taking place between July 1, 1994, and the end of the 1994.

E. Organization, Administration, and Management Issues

1. Organizational and Administrative Issues

As outlined in the draft environmental law and the NEMP, donor coordination on environmental issues is the CNA's responsibility. The agency has responsibility for setting environmental standards and determining when an environmental impact assessment (EIA) is required. Donors would coordinate with the CNA in deciding what activities in their respective programs require individual EIAs and the expertise required to address the environmental issues the activity raises.

The CNA is also the appropriate agency through which to plan intersectoral coordination in projects and programs involving the exploitation or management of resources under the jurisdiction of various ministries (e.g., inland fish, forests, and agriculture). The CNA is also the appropriate agency through which to address appropriate linkages between local entities (e.g., municipal governments, community organizations, private enterprises) and central government agencies. Under the draft environmental law and the NEMP, the sectoral ministries are the appropriate state entities through which to implement projects. It remains to be seen how the CNA will work with the sectoral ministry offices located at the subnational level at its three regional offices.

As noted previously, some donors have relied heavily on NGOs for project implementation because of the institutional weakness of many government agencies. Under the draft environmental law and the NEMP, the CNA will determine when an activity requires an EIA.

¹¹ The various conservation and resource management projects that donors have funded are consistent with and supportive of NEMP's objectives. To date, however, there is no overall program or policy support.

Most donor activity to date has a geographically specific, project focus. Several of these projects address issues of community or local management of multiple resources. It is not clear, however, how the lessons that should be learned from these experiences will inform the actions of responsible government agencies or be incorporated into the country's environmental policies. This is in part an artifact of the uncertainty surrounding what will be the final outcome of legislative processes addressing such issues as decentralization and land tenure (discussed above), which makes it difficult to anticipate what will be the extent of central government authority and the division of labor among government agencies and community organizations.

Donors could strengthen local structures for managing natural resources, support the capacity of central government agencies at the subnational level to work effectively with those structures, and promote improved intersectoral coordination by taking an integrated, regional approach to environment and development issues. This approach would involve the definition of a coherent production region (e.g., a section of a river basin or a market center and its hinterland), and then the development of community-based structures to manage the range of resources found there. Thus, for example, production would be based not only on agriculture but could also include forestry, fishing, and managing wildlife for hunting, depending on the resource endowment of the area in question. The diversified resource base would offer more income-earning possibilities for families. At the same time, because the enterprises would be based on communities rather than households, the opportunities to secure the credit needed to finance different activities adequately would be enhanced.

2. Management Issues

Current implementation arrangements for activities being conducted under USAID/Mozambique's transition program do not provide for appropriate monitoring of socioeconomic processes that shape land use. This does not mean that the mission is devoting insufficient attention to monitoring; indeed, the mission has invested considerable effort in data collection and analysis. Mission staff accept the importance of monitoring, but the process of gathering and analyzing information while concurrently attending to project implementation responsibilities is difficult for USAID/Mozambique and NGOs alike. In addition, while the information gathered is often detailed, it is also often regarded as disappointing in the extent to which it answers questions that the mission and NGOs raise about the impacts and implications of what they do.

The mission may wish to consider a process-oriented approach to monitoring. Such an approach would define development objectives to which it hopes an activity will contribute, and then frame hypotheses about what one would expect to occur over the life of an activity if processes consistent with the development objective were in effect. These hypotheses would be supported or refuted by indicators about which information would be gathered continuously over the life of the activity. The indicators would be simple enough so that the implementation staff could gather the information as part of its regular duties. Alternatively, a small monitoring unit that might service more than one activity could perform this function.

To the extent that analysis reveals that the indicators suggest that the hypotheses based on the development objective are not valid, highly focused, systematic studies would be used to understand better the meaning of the information being gathered. This approach is different than using periodic surveys because it allows for more frequent gathering of data and for gathering qualitative data that permits a better understanding of the social and economic processes that generate particular situations. Periodic surveys, regardless of how frequently conducted, represent snapshots of a situation at a particular moment, and the process responsible for generating that situation must be inferred.

This kind of approach would offer several advantages. First, it would be easier for USAID/Mozambique and NGOs or other implementing agencies to use. The design and implementation of surveys intended to demonstrate project impact is costly and imposes heavy demands on staff time. The approach suggested here would reduce the level of effort required to monitor impacts.

Second, the approach would offer data that are of higher quality than those currently being collected in two ways. The kinds of data gathered in this type of exercise are particularly well suited for understanding how and why changes take place in particular ways. This is critical for addressing issues like changes in women's productive roles, or land-use practices as a result of changing production techniques. Likewise, the quantitative data resulting from this kind of monitoring system would be stronger than those presently being collected, in the sense of their ability to support statistical inference and provide systematic, rather than anecdotal, evidence of changes related to the goals of an activity. This obtains because surveys would be based on the analysis of data gathered on a day-to-day basis and be problem-focused by definition. As a result, populations to be studied and samples of those populations can be defined more precisely, and questions can be more sharply focused.

Under such a system, it might be necessary for USAID/Mozambique to support an external monitoring unit to conduct continuing data analysis and design and conduct more detailed studies when these are deemed necessary. The monitoring unit should be a Mozambican institution, which, depending on its capabilities, might require some technical support in getting the monitoring system designed and started. The goal would be for the institution to become relatively self-sufficient in a short time.¹²

F. Establishing Appropriate Incentives

A critical issue for promoting conservation and sustainable management of natural resources involves the creation of appropriate incentives. USAID/Mozambique's focus on income is appropriate as a starting point for addressing environmental issues because the levels and sources of people's incomes shape how they use natural resources. It is important to remember, however, that increasing per capita income does not indicate that people have been given an incentive to use resources sustainably. Indeed, rising incomes are often associated with

¹² Further attention to the processes and means of monitoring are given more explicit attention in chapter 5.

the opposite, indicating expanded production and accelerated appropriation and transformation of natural resources.

At the same time, people who do not share in the increased incomes, and as a result become relatively or absolutely poorer, often become more destructive in their production practices. This can be a direct result of certain kinds of economic growth, as, for example, when resources formerly open to everyone are privatized and become unavailable to people who had depended on them. Similarly, people experiencing declining incomes, whose access to labor and capital is limited, often become more extensive in their use of land, clearing forested areas and cultivating on slopes not well suited for farming. In this way, people attempt to offset income shortfalls by increasing gross production.

Changes in income will affect patterns of land use. The crucial issue is how access to productive resources is defined and regulated and how the resulting income is distributed. This raises several questions relevant to the elaboration of the CPSP. First, for people to have an interest in conserving resources like tropical forests and wildlife, they need to participate in decision making regarding the management of these resources and share in the revenues that result from managing them well. Dividing participation in productive activities by sectors (e.g., fishing, forestry, agriculture, etc.) creates conflicts as people compete to use interrelated resources for different purposes. Such activity increases the probability that tropical forests and biodiversity will be depleted. At the same time, access to multiple resources offers greater opportunities to earn income and greater economic security. People have more options for responding to opportunities and adversity.

Second, because the requirements for utilizing different resources are different, in terms of the investments required, the kinds of markets to which one must have access, and the kinds of management expertise needed, organizing production systems around the use of multiple resources involves an institutional base in which entire communities, or significant portions of them, participate. Effective interaction of community institutions with central government agencies and private sector entrepreneurs is crucial. Particularly in areas where tropical forests are located or that are characterized by high levels of biodiversity, the institutional approach to organizing an environmentally responsible income-generating activity is at least as important as defining the activity itself. This suggests that some of the activities implemented under the CPSP's income focus would benefit from coordination (as distinct from integration) with some activities carried out under the themes that focus on social services and democracy and governance.

As has been discussed, there are a number of pilot projects that donors sponsor that attempt to promote community-resource management, particularly in association with efforts to rehabilitate and manage protected areas. These should yield a number of lessons and, probably, models for implementation that USAID might consider as it identifies activities to be implemented under the new CPSP. Community management is not necessarily tied to protected areas, but offers an alternative for managing resources that do not lie within their boundaries. In this regard, it is an appropriate framework for pursuing general rural development goals.

III. Vegetative Cover

A. Introduction

This chapter provides a spatial context for the discussions of natural resource policy and biological diversity and attempts to establish linkages between human impacts and the environmental conditions of Mozambique as reflected in the vegetative cover. After providing some background on Mozambique's physical geography, a discussion is presented on land classification to provide the full framework for the discussion of vegetation that follows. The two succeeding parts deal with impacts on the vegetative cover and a discussion of current development activities and approaches that contribute positively to stewardship and sustainable management of renewable natural resources.

Vegetative cover represents a dynamic environmental indicator and provides a spatial framework within which to assess natural resource management and the condition of Mozambique's environment. Monitoring of changes in vegetative cover can readily be done on a national scale using satellite imagery and geographic information systems, which are discussed in chapter 5.

1. Physical Geography

Mozambique has a total area of approximately 784,000 km², about the size of Texas (see Figure 1). From north to south the country is 2,500 km long and 250-300 km wide. Predominantly tropical, it embraces a latitudinal band between 11 and 27° South.

a. Topography

Topographically, Mozambique can be divided into four physiographic zones.

(1) A coastal Zone, extending from the Tanzanian border to the Save River and including nearly all of the territory south of that river. Near the Tropic of Capricorn, the coastal zone reaches a maximum width of about 340 km. Approximately 42 percent of Mozambique is within the Coastal Zone. General elevations are less than 200 m above sea level.

(2) A middle Plateau Zone, occupying higher elevations north of the Save River and extending westerly in the Zambezi River Valley. The range of elevation is 200-500 m.

(3) A northern Plateau Zone, also referred to as the Planalto Moçambicano, covering parts of Niassa, Cabo Delgado, and Zambézia provinces. Elevations are in the 500-1,000 m range.

(4) A western Highland Zone, which is not continuous because it is interrupted by portions of Malawi and Zimbabwe. In the western portion of Niassa Province it is locally known as the Planalto de Lichinga, in Tete Province as the Planalto de Angonia and the Planalto

de Morávia, and in Manica Province as the Planalto de Chimoio. Elevations are in excess of 1,000 m.

b. Climate

Two gradients are important determinants of Mozambique's major climatic and ecological zones. One is the temperature gradient from the tropical north to the subtropical south; the other is topographic, from the coastal plain to the western uplands.

Three distinct climatic regions can be identified. The northern region, from the Zambezi River to the Tanzanian border, falls within the East African Monsoonal system with its associated high rainfall on the coast. It has a well-defined rainy season from November/December to March/April. The central region extends from the Zambezi River to the Save River and is influenced by the Indian Ocean Subtropical anticyclonic system of the southeast trade wind zone. Both systems overlap between Beira and Pemba where rainfall is high. The highest annual averages of rainfall in Mozambique are recorded in upper Zambézia (Gove 1994). The southern climatic region, south of the Save River, has a rainy season best described as unpredictable and irregular; long dry periods often occur. Along the coast, average annual rainfall is 800-1,000 mm. Moving westward, it diminishes to 600-800 mm and drops to 400-600 mm in the interior portions of Gaza and Inhambane provinces.

Both the monsoon and the Indian Ocean anticyclonic system result in occasional severe storms along the Mozambican coast. In the past ten years, two of these storms, "Demoina" in the Maputo region and "Nadia" in Nampula, have resulted in catastrophic flooding and destruction.

2. Biogeographic Factors

Due to Mozambique's diversity of topography, elevation and latitudinal range, the country has a variety of ecosystems ranging from coastal wetlands to Afrotropical forests. Africa, including Madagascar, comprises the large biogeographical unit known as the Afrotropical Realm. For purposes of conservation, the Afrotropical Realm has been classified and mapped according to its vegetation characteristics. It is instructive to place Mozambique within its larger biogeographical context to promote thinking about the environment and its natural resources in terms of habitats that seldom coincide with highly artificial political boundaries.

In descending order of area, Mozambique is a part of four of the continent's 20 biogeographic units. The following information is summarized from the IUCN (1986).

The Zambezian Unit (IUCN Unit II) includes all of Zambia, Malawi, and Zimbabwe, about two-thirds of Angola, inland portions of southern Tanzania and Mozambique, and smaller areas in Botswana, Zaire's Shaba Province, northern Namibia, and the Transvaal of South Africa. This region is the largest biogeographic unit in the Afrotropical Realm and also is

believed to have the most diversified flora represented in the broadest range of vegetation types. Woodland is the most characteristic form of vegetation, with three major woodland types: miombo, mopane, and undifferentiated. At least 8,500 species of flowering plants occur in this region; the endemism rate is estimated to be 54 percent.

The Zanzibar-Inhambane Unit (IUCN Unit XIII) is a regional mosaic that consists of the coastal belt of comparatively moister habitats extending from southern Somalia, including Kenya and Tanzania, and Mozambique as far south as the Limpopo River. Dominant natural vegetation of the unit is lowland rain forest and transition forest, but much of the region is now a mosaic of agriculture and secondary wooded grasslands. A few patches of relict forest remain in higher and steeper sites. Botanically, the Zanzibar-Inhambane Unit has a moderately rich flora of about 3,000 species of flowering plants. The endemism rate of forest trees is 48 percent.

The Tongaland-Pondoland Unit (IUCN Unit XV) is also a regional mosaic, consisting of the portion of Mozambique south of the Limpopo River, Swaziland, and parts of Natal, Transvaal, and eastern Cape Province of South Africa. The original natural vegetation of this unit was evergreen forest, but this has been modified to a complex mosaic of forest, scrub forest, bushland, and agriculture. This unit also has about 3,000 species of plants. More than 40 percent of the larger woody species are endemic, but the proportion of other endemic species is believed to be less.

The Afromontane Unit (IUCN Unit VIII) includes small isolated patches of forest in the higher elevations of mountains, generally above 1,500 m, in both East Africa and West Africa (Cameroon). These patches share common characteristics of high diversity and endemism. Mozambique has such limited areas of this type of vegetation that they cannot be shown on the IUCN's small-scale maps.

3. Mozambique's Vegetative Cover

The general status of the environment in Mozambique can be considered in terms of the conditions that exist over the entire country with respect to its vegetative cover. In a narrow botanical sense, vegetative cover refers to the natural vegetation that is present or would potentially be present if human factors had not affected patterns. Such vegetation is a product of the natural processes influenced by climate and soil conditions. Vegetation that has reached a state of relative equilibrium with its environment is commonly referred to as climax vegetation (e.g., tropical rain forest), which will persist and replace itself as long as conditions remain stable. Disturbance to the climax vegetation occurs as a product of a number of natural processes (e.g., tree falls producing gaps) with recovery over time to reestablishment of the climax species.

For development purposes, consideration of natural or climax vegetation is important because it provides data on the potential for biomass production on an annual basis and for total

standing biomass.¹³ Although biomass includes both plants and animals, plants account for nearly all biomass in most areas.

Another development-related reason for making reference to natural vegetation is to situate particular commercial species, timber or other, within a specific habitat. Natural resource management, if it is to be successful and sustainable, must be related to the conditions in nature where the species are found and have evolved. Habitat protection is likewise the key to protecting biodiversity in areas of high endemism.

Taking a broader approach, the patterns of natural vegetation as well as vegetation associated in whatever way with human activities can be combined to provide an overall picture of patterns and conditions. These are readily visible on the ground and through aerial photographs and remote-sensing imagery.

Vegetative cover reflects the most tangible evidence of the environmental conditions of a particular area. By inference, natural vegetation reveals information on soil conditions and of climate when such data are unavailable. Natural vegetation also disclose the physical habitats that are present upon which animal species depend for survival but do not provide direct data on the presence or absence of particular species. Only through specific ground studies or in the case of large mammals, by aerial surveys, can the status of animal populations be determined.

Through the study of vegetative cover, it is possible to assess in broad spatial terms (i.e., the national or provincial level) the general status of biological diversity and the environmental conditions that exist. Although vegetation associated with human activities cannot substitute in a biological sense for natural vegetation, tree-based production systems in an area where a forest was once present are more environmentally beneficial than if forest land is cleared to establish pasture.

B. Land Classification

The characterization or classification of land is the starting point for an assessment of land capability that can lead directly to a determination of the most environmentally appropriate uses for land. Such use provides maximum sustainable productivity with minimum depletion of resources; it is the keystone to sustainable development. Land classification also furnishes information on vegetative cover. A project under way within the Ministry of Agriculture, in collaboration with University Eduardo Mondlane (UEM), has as its objective to classify forest cover, using Landsat thematic mapping images, at a scale of 1:250,000. The methodology for the Ministry of Agriculture's study is employed in this chapter to facilitate linking the discussion to a classification in use in Mozambique.

¹³ Biomass refers to the total weight, generally expressed as dry weight, of organisms in a particular habitat type.

The hierarchy of land uses developed for the Ministry of Agriculture's study is presented in Table 1 in slightly modified form. Primary classification divides all land use into five major categories: (1) water bodies, lakes, reservoirs and rivers; (2) urban and other areas, which would include all areas where human settlement is dominant as well as industrial and mining areas; (3) barren land where there is no visible vegetative cover; (4) sand dunes that are active and without vegetative cover; and (5) vegetation including natural vegetation and vegetation of whatever type associated with human activities.

Table 1. Ministry of Agriculture's Land-Use Hierarchy

Water bodies	
Urban and other areas	
Barren land	
Sand dunes	
Vegetation	
Natural vegetation	
Woody vegetation	
Forest	
Montane forest	
Closed montane forest	
Partially closed montane forest	
Open montane forest	
Lowland forest	
Closed lowland forest	
Partially closed lowland forest	
Open lowland forest	
Thicket	
Shrub	
Wooded grassland	
Mangrove	
Closed mangrove	
Open mangrove	
Nonwoody vegetation	
Grassland	
Manmade forest (plantations)	
Agriculture and its impact on natural vegetation	
Permanent cropping	
Shifting cultivation	
Long fallow	
Short fallow	

A land classification scheme such as given in Table 1 should not be perceived as static; to a degree it is dynamic and subject to revision as a result of changes associated with human activities or in some cases natural events. For example, land areas can be inundated following dam construction and the filling of an associated reservoir. Periodically flooded areas can be reclaimed through drainage systems that turn them into productive agricultural land. Irrigation projects can transform formerly barren but fertile land into cropland. Sand dunes can bury agriculture fields or themselves receive a vegetative cover through being stabilized by tree or shrub plantings. Natural coastal erosion processes can lead to either increased or decreased land areas in particular locations along the littoral zone. All of these examples refer to relatively small areas when considered on a national scale but can of course have measurable impact at the local level.

C. Vegetation Patterns

This section focuses on the vegetation types of the Land-Use Hierarchy given in Table 1 and establishes a spatial framework for subsequent discussion of major impacts and remedial actions in process or needed in the future to sustain Mozambique's vegetative cover.

1. Natural Vegetation

Mozambique has about 5,500 species of native flowering plants. There are no published lists of threatened plants for Mozambique but based on IUCN records, 195 species may be endemic. Of these, six species are classified as endangered (the highest risk category), five as vulnerable, and 59 as rare. The northern coast is reported to be particularly rich in local endemics (IUCN, 1986).

2. Woody Vegetation

a. Forest

Five types of woody vegetation are recognized in Mozambique (Table 1), with forests (montane and lowland) representing the most important in terms of general natural resources and the environment. Montane forests, by definition, are those occurring above 1,500 m elevation. Found in isolated areas along the western boundary of Mozambique, montane forests are limited in area, discontinuous, and typically occur in areas of steep slopes. The Gorongosa, Chimanimani, Milange, Gurue, Namuli, and Tomasse mountains are examples of areas of montane forest.

Lowland forests range in density of tree cover from closed to open, depending on the canopy density. They contain the country's most desirable timber species. Characterizations of subtypes derive from the dominant tree species present. For example, the genera *Brachystegia* and *Julbernardia* dominate in the wetter miombo woodland; in drier areas the woodland is dominated by *Colophospermum mopane*, the species name furnishing the designation of mopane woodland. Coastal forests have a tree flora in which *Acacia* is quite common, whereas species of *Adina*, *Khaya*, *Diospyros*, and *Erythrophloeum* characterize woodlands or riverine forests.

Data on the amount of forested area (under the classification being employed by the Ministry of Agriculture's study) will not be available until the research is completed in late 1994 or early 1995. Nevertheless, Ribeiro's (1992) data, which follows a slightly different categorization of vegetation types, clearly show that Sofala Province has the largest area of closed denser forests. Extensive areas of less-dense lowland forests occur in Zambézia, Cabo Delgado, Niassa, and Nampula provinces, in descending order of importance. The miombo woodlands, mopane woodlands, coastal forests, and riverine forests are under the greatest pressure for timber harvest because of their greater accessibility due to road construction.

b. Thicket

Thicket is characterized by a dense growth of woody plants reaching a height of 3-7 m, with scattered emergent trees. A reflection of lower rainfall, thicket vegetation is found throughout Mozambique but is dominant in the provinces of Tete and the interior of Gaza. In areas where native forest has been cleared for agriculture and subsequently abandoned, regeneration (second growth) is initially in the form of thicket cover. If left undisturbed for a sufficient number of years, the original forest cover would reestablish itself by natural processes if seed is present in the area. As it is, because there are a number of species that occur in both forest and thicket formations, seed sources should not be an impediment to full recovery from land clearing. *Colophospermum mopane* is an example of a species with a distribution that includes forest and thicket. A species such as this occurs as a tree in wetter areas but as part of the thicket where there is pronounced aridity. Thicket vegetation does not represent a commercial timber resource but is an excellent source of polewood and woodfuels.

c. Shrub

Shrub vegetation is a low form of thicket, and the two types can be found together. Shrub is not as tall as thicket, ranging in height from 50 cm to 3 m. It too can have a few emergent trees. This type of vegetation occurs in areas of poor soils and low rainfall. Shrub vegetation is common throughout Mozambique, with the largest areas found in Tete Province and the Massengir-Massengena area of Gaza. In density, shrub is comparable to thicket, but the smaller stature of its individual plants makes it less usable for polewood, although for it is suitable as a source of woodfuels.

d. Wooded Grassland

Often referred to as savanna, wooded grassland is characterized by the dominance of grasses with trees, thickets, or shrubs occupying about 10 percent of the area. Widespread in Mozambique, wooded grasslands are the predominant vegetation in Niassa and Tete provinces. In some areas, especially in the provinces of Zambézia, Nampula, and Cabo Delgado, the presence of wooded grassland is the result of degradation of forests, thickets, and shrub by shifting cultivation; repeated burning contributes to maintain this vegetation type. Woody species in this vegetation type are shared with forest, thicket, and shrub types. Due to the low amount of woody biomass, wooded grassland is a poor source of wood products in any quantity.

e. Mangrove

Mangrove communities occur in bays, estuaries, protected coastal areas, and near river mouths. Depending on local conditions, mangroves in Mozambique range from low shrubby cover to stands of trees reaching 10 m in height. The provinces of Nampula, Sofala, and Zambézia have the most extensive areas of mangrove. Mangroves are under pressure for woodfuels (mangroves make excellent charcoal) and for construction wood because of their proximity to settlements. Mangroves also form an important part of coastal marine ecosystems. Mangroves provide breeding grounds for shrimp and other marine animals.

3. Nonwoody Vegetation

Nearly pure grasslands support herds of wild animals and, in areas free of tsetse fly, domestic livestock. Grasslands occur naturally under edaphic conditions where seasonal waterlogging precludes the growth of woody species. Grasslands also are created through removal of the woody cover. Such is frequently the case in Zambézia, Nampula, and Maputo provinces. From the standpoint of monitoring vegetation, grasslands pose the most difficulty for either remote sensing, aerial photography, or videography (i.e., use of a video camera flown on a plane at low altitude).¹⁴ It is difficult to distinguish between natural grasslands and agricultural fields in which grains are being cultivated.

4. Manmade Forest

Approximately 42,000 ha of manmade forest exist in Mozambique. They were established to produce timber, construction materials, and woodfuels. The major plantations were made through government efforts beginning in 1978, and are located in the provinces of Manica, Maputo, Sofala, Nampula, and Niassa, within access of major urban markets. Manica Province alone has around 20,000 ha. Species under plantation cultivation are *Pinus* spp. (55 percent), *Eucalyptus* spp. (43 percent), and *Casuarina* spp. (2 percent) (Agostini 1993).

Although plantation forestry has thus far not been an overall commercial success in Mozambique, it can be considered a positive factor in the environment by providing tree cover and habitat in specific areas. Much criticism has been levelled at the establishment of tree

¹⁴ These techniques are discussed in more detail in chapter 5.

plantations in the tropics, especially those containing exotic species, because they do not replicate the quality of habitat found in native vegetation. The comparison is generally made, however, to relatively undisturbed natural vegetation. A more equitable comparison would be between a degraded forest area and a tree plantation; the former receiving no management the latter under full management. Viewed as such, plantations are more readily defensible in environmental terms.

Plantings of trees along the coast, chiefly *Casuarina* spp., in an attempt to stabilize sand dunes, represent another example of manmade forest, albeit in areas too limited to map at a scale of 1:250,000. Nevertheless, such plantings are crucial to environmental stability in certain coastal areas. According to Burley (1989), these plantings have amounted to about 2,000 ha, although they are reportedly being degraded by woodfuel harvesting and other purposes.

5. Agriculture and Its Impact on Natural Vegetation

Considered from the standpoint of natural processes, agriculture is the selective cultivation of certain desirable plant species at the expense of others that are removed from and kept out of the production system to avoid competition for space, soil nutrients, moisture, and sunlight. Agriculture is essential to human well-being, so a certain level of negative impact on natural vegetation from its practices is unavoidable. In Mozambique, most agriculture is more extensive than intensive, a function of the country's stage of economic development. Agriculture thus has a greater impact on the natural vegetation than would be the case in a more developed country with a comparable human population.

6. Permanent Cropping

Permanent cropping consists of those agricultural systems producing perennial crops, be they woody or nonwoody. (Plantation forestry is a form of permanent cropping; it is often treated separately for convenience.) Environmentally, the fact that crops occupy the land for long periods means that soil conditions and the risk of erosion are reduced because soils do not have to be tilled and replanted after each annual crop.

a. Woody Crops

In Mozambique, tree crops represent a small but important percentage of the total vegetative cover. Commercial tree crops are the best example, and the most significant in terms of area is cashew. Estimates place the number of cashew trees in Mozambique at more than 61 million. Using a planting density of 100 trees per ha, this represents about 6,100 km² hectares of land under this crop. Areas of cashew cultivation are in the coastal areas of the provinces of Nampula, Inhambane, Zambézia, Cabo Delgado, and Gaza, in descending order of importance (*Programa de Reposição do Parque Cajulcola*, 1994).

It was not possible to locate data on the area that other tree crops occupy, but production amounts are known. Coconuts represent another tree crop in the coastal zone, especially in

Zambézia and Inhambane provinces. According to FAO (1991) estimates, approximately 420,000 t of coconuts were produced in 1991. Other important tree crops are papaya (44,000 t), citrus (39,000 t), and mangos (32,000 t). Many of the fruit trees contributing to this production are found in household gardens, where they provide other products such as wood and shade for houses and domestic animals.

The green belts surrounding Maputo and Beira have trees, commonly fruit trees, as part of the vegetative cover. In the Maputo metropolitan area alone, a total of some 15,250 ha of land is part of the green belt (Dejene and Olivares 1991). At a national scale, however, this type of tree cover is subsumed into urban land-use categories.

The only other woody crops for which any areal data are available are tea and coffee. Mozambique has some 3,000 ha of tea, concentrated in the highlands of Zambézia Province. An estimated 1,000 ha of coffee are also reported (FAO, 1991).

b. Nonwoody Crops

A few perennial nonwoody crops function as a stabilizing force in the environment. These were, according to either production levels or area, in 1991: bananas (80,000 t), sugarcane (22,000 ha), sisal (6,000 ha), and jute (6,000 ha) (FAO 1991).

Development activities that rehabilitate, maintain, and expand the land area with woody or nonwoody cultivated vegetation cover should be viewed as positive. Such activities occupy small individual areas and seldom can be represented on a national or even provincial map; large monocultural plantations are the exception. Nevertheless, in the aggregate, the activities can cover a fairly significant area and provide an effective measure of environmental stability within an agricultural landscape and the country as a whole.

Detailed studies of the crops mentioned above would contribute useful information in monitoring changes over time.

7. Shifting Cultivation

Shifting cultivation, or slash-and-burn agriculture, can be placed in two primary systems on the basis of intensity of use: short fallow and long fallow. In the Ministry of Agriculture's study, short fallow is defined as land that is left fallow for a short time period (i.e., a few years), with one-third or more of the holding being cropped every year. This pattern is visible from imagery and is a reflection of an intensification of the shifting cultivation system, often as a result of civil strife or land shortages related to increased human populations.

Long fallow is a system of shifting cultivation that refers to plots of land where the fallow period is several to many years in length, allowing for greater regeneration of natural vegetation before repeating the clearing process again. By definition, less than one-third of the

land is used for cropping. Long-fallow, shifting cultivation is an indication that land in a given area is plentiful.

If a continuum is assumed from the long-fallow practices in land-rich areas on the one hand, to intensively cultivated permanent agriculture on the other, short fallow is somewhere at the midpoint between the two. From a development perspective, a trend of decreasing relative areas of land under long fallow can be viewed as positive.

8. Discussion

Mozambique is a large and diverse country undergoing dramatic changes in all sectors. For the long-term well-being of its people, the public and private sectors need to adopt policies and order priorities that emphasize the sustainability of activities that deal with natural resources. The country's two most important activities--agriculture and forestry--have significant environmental impacts associated with them that affect all parts of the nation. To a major degree, the health of the Mozambican environment will influence the future success of its agricultural production and the levels of timber and nontimber products that can be obtained from the woody vegetative cover.

This section has provided a framework by which the status of the environment and the rate and kinds of changes occurring over the short- and long-term can be measured independently and accurately and monitored through assessment of the condition of the vegetative cover. As suggested in the previous chapter, data and information generated by process-oriented surveys of the vegetative cover of Mozambique can provide a means to test hypotheses and practices and point to the need for changes to achieve the aim of sustainability.

D. Major Impacts on the Vegetative Cover

Deforestation has been identified as a major environmental issue in Mozambique, although its effects vary in intensity from place to place. In the 1980s, forest loss was estimated to be about 120,000 ha per year (10,000 ha open forest and 110,000 ha closed forest). This loss represents 0.8 percent per year of Mozambique's total forested area (Sharma 1992). Appendix 5 provides a summary of data on the country's forest sector.

Forest degradation resulting from overuse, overgrazing, and the effects of repeated burning leads to a gradual reduction in woody biomass. Degradation is a much more widespread concern in Mozambique than deforestation, especially in woodland areas. If pressures are reduced, however, partial recovery occurs within a few years. Comparisons between satellite imagery from 1972 and 1990-1991 have revealed that forests had recovered in areas that farmers abandoned because of the war (Agostini 1993).

Several factors contribute to either the degradation or complete removal of vegetative cover in Mozambique. There exists considerable overlap among these factors and, in some

instances, they are sequential, but the issues associated with the mitigation of impacts are typically organized along the lines of the individual topics.

The vegetative cover of a country such as Mozambique is dynamic in terms of its particular quality (i.e., mix of species), quantity (areal extent), and geographic location. Change is a natural and expected phenomenon, manifesting itself most dramatically at the local level but also affecting the overall conditions to be found across the nation.

In appraising general land use, change always needs to be considered as having two facets. For example, clearing land in a primary forest for the purpose of establishing high-yielding production of foodstuffs obviously has a negative impact by destroying forest cover. At the same time, however, such activity has a significant positive impact on a nation's food self-sufficiency and can contribute in a major way to food security.

Changes in land use affecting Mozambique's vegetative cover are driven by the expanding economy that exerts increasing pressure on the renewable natural resource base and by the burgeoning human population, which increases the base of natural resource users. An intimate knowledge of the character of changes in land use in a country such as Mozambique makes possible the weighing of particular shifts in land use to influence change in such a way that it satisfies short-term needs while providing for long-term sustainability.

1. Land Clearing

Land clearing describes the process whereby there is total or nearly total removal of the vegetative cover of an area and the substitution of another type of land use. For discussion purposes, all land clearing not associated with agriculture can be treated together.

Developing countries like Mozambique experience the loss of vegetative cover for reasons linked to economic development and increases in human population. Such losses are unavoidable and should be accepted as being a normal part of the development process. The primary example is urban sprawl, including industrial parks and transportation networks, which requires extensive areas of land. Peri-urban changes in land use can be dynamic, such as Maputo has experienced in the past two decades. Although the end result of land clearing is reached in and around urban areas, clearing is generally a gradual process. Natural forest areas near a city may be cleared initially for agriculture, gradually become more densely populated as additional dwellings are constructed and eventually become an integral part of the urban conglomeration.

Vegetative cover is also lost in mining areas from either open pit operations or mine tailings brought to the surface from shaft mines. Environmental regulations incorporated into modern mining operations to rehabilitate impacted lands can reverse the loss of vegetative cover, but the process is expensive and lengthy inasmuch as there is generally a total loss of soil in addition to vegetation.

A third example of permanent irreversible loss of vegetative cover is in areas inundated by reservoirs. Cahora Bassa Reservoir on the Zambezi River in Tete Province is about 240 km in length and up to 30 km across at its widest point. New hydroelectric projects on the Zambezi and other rivers will result in destruction of considerable areas of natural vegetation.¹⁵

In assessing and monitoring the status of the country's vegetative cover, data need to be collected on the areas impacted by the land-clearing activities discussed here as a separate statistic and reflected in national figures. The more detailed discussion of monitoring in chapter 5 provides several potential sources of such data.

2. Agriculture

About 85 percent of Mozambique's population lives in rural areas. Family farms occupy 90 percent of the cultivated lands, and the agricultural sector employs more than 80 percent of the total national labor force (Dejene and Olivares 1991). Such statistics are key indicators of the level of Mozambican agriculture on the development continuum. Family farms practice forms of shifting cultivation and traditional hoe agriculture with few modern inputs. The most common crops are maize, sorghum, millet, groundnut, cassava, and sweet potato.

Shifting cultivation is an ancient agricultural system. Although maligned by many development practitioners as degrading of and destructive to forests, in areas where extensive areas are available for its practice and long periods (ten or more years) of fallow are the rule, shifting cultivation is a sustainable system. When land pressures increase, however, typically because of greater human populations, farmers are forced to shorten the fallow period to as few as three years. Under such circumstances, shifting cultivation results in negative impacts on the vegetative cover.

Shifting cultivation is common on lands that have only marginal suitability for intensive, fixed agricultural fields. In contrast, extensive systems (for crop production or animal production) in general are better suited to the land resources of marginal areas; therefore, shifting cultivation may be an appropriate land use and should not be totally discouraged.

Agriculture plays a complex role in modifying vegetative cover in Mozambique. In instances such as the establishment of tree plantations as well as monoculture of cashew, coconut, or other fruit trees, the magnitude of the change from forest cover to cultivated tree cover is minimized. When vegetation is cleared for the production of annual crops, however, there is greater risk of a decline in soil fertility and increases in soil erosion.

It needs to be emphasized that agriculture does not necessarily represent a permanent loss of more environmentally desirable vegetative cover. Natural vegetation, especially in the tropics, recolonizes abandoned agricultural fields with amazing speed and, if left undisturbed, will represent good second growth within a number of years. Locally some species can be lost

¹⁵ Further environmental consequences of dams are discussed in Chapter 4.

in the process, failing to become re-established because seed sources are remote. As agriculture intensifies and becomes more productive in Mozambique, some of the more marginal agricultural areas will be abandoned and allowed to revert to natural vegetation.

Monitoring the changes in agricultural land use on a national level can contribute in a significant way to understanding the development processes taking place and provide a measure of the positive and negative effects on vegetative cover.

3. Timber Harvest

Native tropical forests contain hundreds of tree species, but timber harvest, as commonly practiced, focuses on a small number of desirable, commercially valuable species. Selective harvest of only a few trees per unit area is expensive and involves a considerable impact on the forest itself. This obtains because trees brought down with the desired species and the skid-trails and road networks needed to transport logs from forest to market. In large measure, only high-value tropical timber can bear the current costs of harvesting.

Standing commercial tropical timber represents one of Mozambique's most valuable natural resources; it is also a major export commodity and earner of foreign exchange. The Government of Mozambique's handling of this key resource issue is critical because it will both determine the future of the forest sector and establish a precedent for the wise or unwise stewardship of other renewable natural resources. Ribeiro (1992) points out that despite the importance of timber resources within the context of the economy, Mozambique should not be considered to be a forest-rich nation.

Hindering the development of sustainable management of the timber resource is the lack of inventories on which to base the annual allowable cut (AAC). Ribeiro (1992) estimated that the standing volume of natural forests in Mozambique is nearly 78 million m³, but high-value species represent no more than 15 percent of the total existing volume. A conservative estimate of the AAC places it at 340,000 m³, which will not meet future demand for timber (Ribeiro 1992). The major commercial species are given in Table 2.

A solution to the shortfall is to promote secondary species for commercial use in both domestic and export markets. Agostini (1993) mentions that 38 species have been classified as having commercial use, and Bunster (1994) has compiled a detailed catalogue of the physical characteristics of 52 promising species.

It should be pointed out that Mozambique's timber sector has never consumed more 200,000 m³ per year, and in recent years, because of the war, far below that figure. In contrast, there is an installed logging capacity of 372,000 m³ per year (Dejene and Olivares 1991). Without any increase in capacity the AAC would be exceeded if full operating of installed capacity were utilized.

Under current Mozambican law, the DNFFB issues licenses to harvest a fixed quantity of wood of named species. According to Agostini (1993), the stumpage fee is per species and quantity. Stumpage rates in 1992 were low, possibly because they had not been adjusted for inflation. For example, stumpage rates are 20,460 meticaïs per m³ (US\$3.82) for premium species, 10,230 meticaïs (US\$1.91) for first class species, 7,161 meticaïs (US\$1.34) for second class species, 5,151 meticaïs (US\$0.96) for third class species, and 3,069 meticaïs (US\$0.57) per m³ for fourth class species.¹⁶ The extremely low stumpage rate is exemplified by the average market price for first class species of 600,000 to 800,000 meticaïs (or US\$112.15 to 149.53) per m³.

Table 2. Common Commercial Timber of Mozambique

Trade Name	Scientific Name	Main Forest Product
Chanfuta	<i>Azelia quanzensis</i>	sawnwood
Mercrusse	<i>Androstachys johnsonii</i>	parquet
Messassa	<i>Brachystegia spiciformis</i>	sleepers
Messassa Encarnada	<i>Julbernardia globiflora</i>	sawnwood
Panga Panga	<i>Milletia stuhmanii</i>	sawnwood
Pau Rosa	<i>Swartzia madagascariensis</i>	export logs
Pau Preto	<i>Dalbergia melanoxylon</i>	export logs
Umbaua	<i>Khaya nyasica</i>	export logs
Umbila	<i>Pterocarpus angolensis</i>	sawnwood
Tule	<i>Chlorophora excelsa</i>	sawnwood

Source: Ribeiro 1992

Timber harvest of construction materials, largely poles, is also subject to a stumpage tax. Poles with a diameter of 20 cm or more of third and fourth class species are assessed the same rate as given in the previous paragraph. The same materials with a diameter of less than 20 cm amounts to 2,026 meticaïs per stere.¹⁷ No tax is levied on construction materials harvested for domestic use in rural areas.

Due to security problems in areas that RENAMO controls, even the low taxes go uncollected, and there is no DNFFB supervision. Another problem with the present system is that licences do not require a management plan. This problem is discussed below.

Timber harvest can be monitored using videography and other remote sensing imagery, with companies receiving concessions bearing the costs. If sustainable forest management plans

¹⁶ In June 1994, one U.S. dollar was worth approximately 5,350 meticaïs.

¹⁷ A stere is a unit of volume equal to one cubic meter.

are required, implemented, and enforced, the impact of harvesting tropical timber can be kept within acceptable environmental limits. Much more serious is the indirect impact of timber harvest brought about by road construction and the opening of access to previously remote areas of Mozambique.

4. Woodfuel Harvest

Woodfuel harvest differs significantly from timber harvest because it is far less selective in terms of utilizable species. In the Mozambican context, woodfuels represent an important forest product because they account for about 83 percent of the total energy consumption of Mozambique. Moreover, 99 percent of domestic energy comes from fuelwood and charcoal. All woodfuels in Mozambique come from natural sources. Average annual wood demand in urban areas is estimated to be 0.70-0.75 m³ per capita (Russell et al. 1993). The shadow value of woodfuels is over US\$730 million per year (Agostini 1993).

The biomass energy value of native vegetation in Mozambique is not adequately known. Bunster and Karlberg (1988) investigated the characteristics of fuelwood sold commercially in Maputo. Results showed a predominance of *Acacia* spp. and *Strychnos* spp. among the samples. Wood of these species was found to have an average caloric value of 4,816 per gram. An initial field assessment by the DNFFB's Biomass Energy Unit focused on woodfuels in the Limpopo, Beira/Chimoio, and Nampula/Nacala corridors. Calculations revealed that the total biomass energy was 20,000-23,600 t per ha in the three areas studied (Ministry of Agriculture 1993). This preliminary study neither attempted to correlate total biomass energy with native vegetation types nor calculated the amount of woodfuels that could be harvested sustainably per hectare. These issues are to be addressed in the next phase of the research, which is discussed in the next section of this chapter.

In most rural areas of the country, harvesting woodfuels does not seriously impact the natural vegetative cover because human populations are low. For farmers practicing shifting cultivation, woodfuels represent a by-product of land clearing, providing fuelwood or raw material for making charcoal to satisfy their own energy needs and possibly as a cash earner if there exists an accessible market for either fuelwood or charcoal.

Harvesting woodfuels to supply the demands of burgeoning urban areas has created a serious problem of deforestation in and around the major cities of Mozambique. Woodfuels to supply the Maputo market are currently coming from a distance of 60 km or more. Although this circumstance shifts the pressure on the vegetative cover to more rural areas (a negative factor) by increasing the market cost of woodfuels, it sets the stage to make the cultivation of trees for woodfuels closer in more feasible (a positive factor).

Government regulations impose a fee on commercial harvest of woodfuels. In 1992 that amounted to 256 meticals per stere. Rural populations are exempt from the tax when woodfuels are cut for domestic use.

Two solutions may result in lessening the impact on native vegetation for woodfuels. One is the cultivation of fast-growing species in areas in proximity to large urban markets, thereby reducing the pressure on wild sources. The second factor relates to income. As soon as family incomes increase to a moderate level, there will be a tendency to shift to kerosene or bottled gas as the major domestic fuel of choice.

Deforestation associated with woodfuel harvest is a localized phenomenon in Mozambique and lends itself to being monitored by field surveys and by the use of videography and other remote sensing imagery.

5. Nontimber Forest Products

As used here, nontimber forest products (NTFP) refer to the array of products gathered from stands of natural vegetation, with the exception of timber and woodfuels. Included are wild game and fishes. NTFPs include all of the wild products (nuts, fruits, honey, herbs, leaves, medicinal plants, building materials, etc.) that indigenous people originally used with a hunting and gathering culture; NTFPs also represent an important natural resource for agricultural peoples. If conducted on an extensive basis in an otherwise healthy forest, the gathering of NTFPs is sustainable because plant and animal populations can tolerate a moderate level of human predation.

Data on the amount of NTFPs gathered in Mozambique are lacking, as is the case in most developing countries. Direct observation, anecdotal evidence, detailed nutritional studies, and inference from products in the market are major information sources of the various types of NTFPs. Medicinal plants probably represent the most important group of commercial NTFPs, as evidenced by the variety and quantities sold at the Xipamanine Market in Maputo. Such plants are reportedly exported to neighboring countries. Other examples of NTFPs, observed during a field trip outside Beira, include the mafurra tree (*Trichilia emetica*), a multipurpose species that furnishes an oil-rich fruit and has medicinal properties. The mafurra is also widely planted in Mozambique but apparently has never been the object of any scientific improvement. The second example is the native and rather common palm *Hyphaene coriacea*, which is tapped for palm wine, killing the palm in the process.

NTFPs by law are regulated under the same set of regulations established for timber, woodfuels, and construction materials. Currently the rate of tax is 2,026 meticaís (US\$0.38) per ton plus an ad valorem of 10 percent (Agostini 1993). The DNFFB has responsibility for regulating and collecting taxes on NTFPs.

The collection of NTFPs is highly selective, so excessive harvest can degrade a forest over time, making the NTFPs less common than they would normally be. NTFPs represent one of the problematic areas in terms of monitoring vegetative cover. A forest under heavy collecting pressure for its NTFPs would not necessarily appear much different in general from one where sustainable harvest was taking place, neither to the casual observer nor in aerial photographs and other remote-sensing imagery. Field surveys by trained botanists and zoologists

would be necessary to determine the well-being of a forest in terms of its NTFPs. Such research is seldom feasible because of financial constraints, so the only alternative is to ascertain the impact of NTFP harvest by inference from data on quantities exported or sold domestically.

E. Key Development Activities Issues Affecting Vegetative Cover

1. Key Projects and Programs

As already noted, the Ministry of Agriculture's National Directorate of Forestry and Wildlife (DNFFB) administers the forestry sector in Mozambique. The ministry was established in 1967. It is now responsible for two of the three major ongoing activities in Mozambique that relate directly to the future status of the country's vegetative cover and, by extension, to maintaining and protecting the environment. Specifically, these activities include: the agriculture and forestry components of the Ministry of Agriculture's National Pre-Program for Development of the Family Farm Sector, each considered separately, and the CNA's emerging regulatory, monitoring, and coordinating role linked to preparation of the NEMP.

The Pre-Program began in May 1993, with funding from the UNDP, and is due to end in November 1994, just after the scheduled national elections. In addition to core funding, the Pre-Program provides expatriate technical assistance to the ministry. The World Bank and the UNDP are jointly sponsoring the NEMP; the latter organization is providing technical assistance to the CNA for the NEMP's preparation.

2. Pre-Program: Agriculture

Focused on small farmers who represent the great majority of the rural population, and where the need is certainly greatest, the Pre-Program in agriculture is laying the groundwork for a community-based resource management approach within the agricultural sector. The Pre-Program is being implemented in such a way as to include the roles that provincial, district, and local governments are to be play.

The Pre-Program has four major components: (1) land evaluation for purposes of land-use planning; (2) research and extension to improve production of basic foodstuffs and to promote agroforestry; (3) coordination and training; and 4) information management. To define more accurately specific activities to be implemented, research teams are investigating the current agricultural systems in Mozambique with respect to the agroecological and socioeconomic conditions that exist. The results of those field studies will then be used to propose the best means of reaching the objective of sustainable agriculture. Recognizing that other issues also require attention, the Ministry of Agriculture plans to add other components (namely irrigation, rural credit, livestock development, and technology development) to its agenda in the near future.

3. Sustainable Agriculture and the Pre-Program

People involved with agriculture can have a negative impact on Mozambique's vegetative cover through their practices of shifting cultivation, burning, land clearing for permanent fields, livestock raising, the harvest of woodfuel and construction materials, and the gathering of NTFPs. In the search for mitigating actions that can lessen this impact, it must be kept in mind that in almost every case the practice cannot be abandoned readily because small family farmers do not have alternative sources of the products they need to sustain themselves. Some changes to existing practices are feasible as long as the farmers have the wherewithal to adopt new agricultural inputs (e.g., to buy fertilizer or better seed) or the motivation to change farming systems (e.g., to adopt agroforestry).

Technical solutions abound to improve the lot of the small farmer in a developing country such as Mozambique and to move at a steady pace toward sustainable agriculture. The real challenge is socioeconomic. As thinking about agriculture has widened to take into account the environment within which it is practiced, so too has the realization taken hold that the socioeconomic environment is often the principal constraint. The breadth of the approach contained in the Ministry of Agriculture's Pre-Program is indeed encouraging and establishes a plan to achieve sustainable agriculture in Mozambique. This goal will, of course, require the plan's effective implementation over a long period of time. Whether this is possible remains to be seen. As Russell and his colleagues (1993) noted in their programmatic environmental assessment, the Ministry of Agriculture is one of the weaker ministries. During much of Mozambique's recent past, the ministry focused its efforts on state farms and cooperatives at the expense of small-scale farmers.

4. Pre-Program: Forestry

The forest sector represents an integral part of the Pre-Program, and activities are developing apace with those in the agriculture sector. Pre-Program actions are aimed at the drafting of a five-year strategy for forestry in Mozambique. Data gathering is currently underway, and a series of regional meetings is planned to involve provincial- and district-level officials in the process. One of the broad thrusts of the Pre-Program is to set the stage for management of natural forests.

Two forest mapping exercises are in process within the DNFFB. One is to produce 1:1,000,000 scale maps of Mozambique as a means of inventorying the types, extent, and location of forest resources. The maps and accompanying report are in press. The second mapping exercise is being carried out initially in Sofala and Cabo Delgado provinces and entails mapping at a scale of 1:250,000. (The latter is the same mapping project employed and referred to above). Maps at this larger scale will make it possible to design and to monitor forest management plans.

Forest mapping will permit the DNFFB to modify the current system of timber licenses and institute a system of forest concessions that will require forest management plans. New laws and regulations governing timber harvest as part of a forest management plan will assure that the government receives realistic stumpage fees. Forest management is also an inducement to

use a greater number of tropical tree species and to minimize the negative environmental affects of timber harvest on the remaining vegetative cover, soils, and streams.

Another key part of the Pre-Program in forestry involves the work of the Biomass Energy Unit. The preliminary studies referred to above are to be continued to provide essential data on the biomass productivity of particular vegetation types and, more important, the average annual increment of biomass production so that woodfuel harvest can be promoted on a sustainable basis. Nontimber forest products are also included in the Pre-Program in forestry, with special attention being paid to the markets that exist or could be developed for the various products.

The Pre-Program in forestry has as a longer term goal the establishment of a small number of demonstration areas for integrated forest management (of approximately 40,000-50,000 ha in area) that will include extension services and community participation. One of the acknowledged knowledge gaps in this undertaking is the lack of local people trained in social forestry. Wildlife is an integral part of the Pre-Program in forestry, but this topic is discussed in Chapter IV.

Natural forest management is the counterpart of sustainable agriculture in terms of protecting Mozambique's base of natural resources. The national government must play a key role in establishing policies for timber companies and in monitoring their activities over the course of any license or concession because of the character of the timber industry as a major export activity. To date, involvement of local people in timber extraction traditionally has consisted of little more than employment opportunities. Despite this passive role, experience elsewhere in Africa suggests both the possibility and desirability of increased reliance on integrated conservation development projects in which local communities benefit from their wise and sustainable management of local resources (Brown and Wyckoff-Baird 1992). In contrast to this possibility, local people are now directly involved in and control the informal woodfuel harvest and the gathering of NTFPs. Outputs are usually for domestic use or for sale in the local area. Medicinal plants would represent an exception.

The DNFFB's community approach to forest management presents an opportunity to give rural people an enhanced role in deciding how and at what levels forest resources are to be utilized. The forest management approach sets the stage for greater involvement of local residents in timber harvest by having them assume some form of an oversight role in terms of the operations of the timber companies. Promotion of social forestry with respect to woodfuels and NTFPs will contribute to make local communities participants in natural forest management and supplement the integrated approach to agricultural development of small farms.

F. National Environmental Management Program (NEMP)

The draft of the NEMP, which is being circulated for comment at all levels of government and among private organizations until the end of 1994, has as one of its three foci management and utilization of natural resources in rural areas. As such, that section of the NEMP draws together the key issues of agriculture and forestry in the Pre-Program discussed

above and goes further to include other topics. For example, land tenure is discussed in terms of insecure land titles as an impediment to sustainable agriculture. Other topics covered are commercial agriculture, rural infrastructure, and mineral resources.

The NEMP's implementation and the CNA's anticipated monitoring responsibility on a national level means that the CNA will be the primary governmental body to gather, interpret, and disseminate information on the status of Mozambique's environment. If the CNA develops appropriate administrative capacity and moves effectively to fulfill its responsibilities, then it may be possible within a few years to monitor progress in the agriculture and forestry sector as regards environmental impact by using the CNA's resources. This possibility is discussed in greater detail in chapter 5.

G. Sections 117-119 of Foreign Assistance Act and USAID's Environmental Procedures

USAID's current bilateral assistance to Mozambique represents a transition program consisting of activities to address the immediate problems resulting from the war, the drought of the early 1990s, and the process of normalization of the public and private sectors. Actions associated with the transition program relate only indirectly to the environment, tropical forests, and biological diversity, which is the subject of the next chapter. Despite the environmentally peripheral nature of USAID/Mozambique's transition program, USAID still mandates that programs in every sphere of development "must be designed with conscious regard for their impact on the environment and their potential for improving environmental stewardship locally, nationally, regionally, and globally" (USAID 1994: 14).

USAID/Mozambique's transition program can reasonably be judged to be neutral in the sense that it does not involve new roads, water supplies, agricultural areas, or other activities that have the potential for considerable harm to the environment. Nonetheless, the Programmatic Environmental Assessment of the transition program considered that, over the long term, transition activities specifically dealing with roads, water supplies, and agriculture could have the potential to result in a negative impact on biological diversity and forest, land, soil, and water resources (Russell et al. 1993). By arriving at such a conclusion and in accordance with USAID's environmental procedures (i.e., those contained in 22 *Code of Federal Regulations* 216), the PEA team was obligated to recommend that individual activities in these sectors be evaluated and that a subsequent decision be made about the level of environmental review that might be required.

This may be a narrow interpretation of the procedures, which were promulgated with respect to new activities, not the restoration or rehabilitation of facilities or practices that had already been in place and were destroyed by war or natural disaster.¹⁸ Indeed, a positive

¹⁸ For example, Section 216.2(a) of the procedures stipulates that they apply "to all new projects, programs or activities authorized or approved" by USAID and "to substantive amendments or extensions of ongoing projects, programs, or activities." Section 212.2(b) provides that activities involving international disaster assistance and other emergency circumstances are exempt from the agency's environmental procedures.

threshold decision (i.e., a finding that a proposed action will have a significant effect on the environment) would be unusual in the instance of rehabilitation. One can assume, therefore, that most actions associated with restoration or rehabilitation would be given a "negative declaration," indicating that they will not have a significant impact on the environment, at least in terms of USAID's environmental procedures.¹⁹ Furthermore, the PEA also articulated a monitoring process and provided guidance meant to encourage a locally managed environmental review process that would not require review from the Washington-based staff of the Bureau for Africa.

USAID/Mozambique has identified three broad areas for investigation and analysis relevant to the strategic objectives of its CPSP. These are income generation in agriculture and nonagricultural sectors, social services, and democracy and governance. These three areas are discussed below in relation to vegetative cover and the requirements of Sections 117, 118, and 119, and USAID's environmental procedures. The discussion must be hypothetical because specific activities have not yet been defined. Such a circumstance lends itself to suggestions for actions that could contribute to positive impacts on Mozambique's environment and natural resources.

1. Income Generation

It is assumed that these activities in the sectors will be focused almost exclusively on the country's rural areas. Of the three focus areas, income generation is of major concern in relation to the vegetative cover. Specific activities that potentially will be included in a program with an objective of income generation will almost certainly have a direct impact on tropical forests and other woody vegetation. One should be reminded, however, that undesirable environmental are not the sole province of rural areas. The processing of food and timber can be "industrial issues" with undesirable environmental outcomes.

One must appreciate as well that USAID is required to consider both direct impacts and indirect, longer term impacts that may be associated with policy reforms and nonproject assistance (NPA). When NPA is used to achieve reforms of sectoral economic policies affecting long-term development, the Development Fund for Africa requires USAID to protect "long-term environmental interests from possible negative consequences of the reforms" (Section 496(h)(2)(B) of the Foreign Assistance Act of 1961, as Amended). In other words, the lack of reasonably foreseeable direct and short-term environmental impacts should not preclude consideration of less evident, but no less hazardous long-term consequences. Although this point is made in the context of the potential environmental consequences of activities intended to increase incomes and to promote democracy and governance, the logic is no less valid for all activities that USAID/Mozambique may be considering.

¹⁹ In contrast, in *Strategies for Sustainable Development* (USAID 1994:14), the agency commits itself to ensuring that all of its efforts, "whether projects or program-related investments, are environmentally sound. Where necessary, it will require mitigating measures or project redesign."

Moreover, if income generation is dependent on USAID-supported efforts involving tropical forests, USAID/Mozambique must also be cognizant of a statutory limitation on such support. Through Section 533(c)(3) of the Foreign Operations, Export Financing, and Related Programs Appropriations Act of 1991, the U.S. Congress prohibits the expenditure of any appropriated funds "for any program, project or activity" that would "result in any significant loss of tropical forests" or "involve commercial timber extraction in primary tropical forest areas unless an environmental assessment":

- "(i) identifies potential impacts on biological diversity;
- (ii) demonstrates that all timber extraction will be conducted according to an environmentally sound management system which maintains the ecological functions of the natural forest and minimizes impacts on biological diversity; and
- (iii) demonstrates that the activity will contribute to reducing deforestation."

The clear intent of this section is prevent the demise of tropical forests. Consequently, Section 533(c)(3) arguably applies both to the extraction of timber as well as the extraction of NTFPs that is harmful or destructive to these forests.

2. Social Services

Assuming that activities under this category involve only the health and education sectors, there would be no significant, direct impact on the vegetative cover. The point could be raised, however, that if digging wells for potable water becomes a key objective of health activities, the issue of sustainable use of groundwater sources could affect the environmental sector and require consideration of the agency's environmental procedures to determine if an examination of environmental consequences should be required. To continue this line of argument, excessive drawing down of the water table by potable water wells could have a negative impact on more shallow-rooted native vegetation.

3. Democracy and Governance

Policy reform under the rubric of democracy and governance could affect the environmental sector through the promotion of new policies and regulations directed at forestry and agriculture. An example would be legislation that regulated harvest of tropical timber through enactment of a concession arrangement to replace the current practice of granting license to harvest specific types and quantities of timber. Technical assistance in the drafting of new legislation to bring about a policy of sustainable forest management as a requirement of timber harvest would make a significant positive contribution to protecting and maintaining Mozambique's forest cover.

H. USAID/Mozambique's Options

USAID/Mozambique has an opportunity to make a positive contribution to the process of improving the lot of small farmers by working with NGOs to promote agroforestry, natural

forest management, improved soil conservation practices, buffer zone management surrounding protected areas, and other measures that contribute to sustainability and the protection of the natural resource base. At the national level, USAID's support for government agencies may be more problematic, given problems with implementation and concerns about the viability of these agencies absent external support. For example, should USAID, in cooperation with other donors, choose to support the CNA's core activities, such support should be premised on a thorough assessment of its likely effectiveness and a realistic means for linking support with specific accomplishments. In this regard, USAID's experience with policy-based NPA may be particularly relevant. Well-focused and well-managed assistance has the potential to assist the Government of Mozambique to obtain accurate and current data on the state of the environment as well as to monitor changes to determine necessary mitigating actions that might be incorporated into USAID's projects and programs.

Although USAID missions typically (and understandably) focus on issues relevant to a single country, there is no reason to avoid consideration of environmental management in an international context. As this report indicates, international boundaries do not constrain environmental resources. As an illustration, Mozambique shares its biogeographic factors and water resources with several other nations in southern Africa. These nations are likely to have the same concerns as does Mozambique, namely economic development that depends on sustainable uses of natural resources. For this reason, USAID/Mozambique may wish to consider opportunities to encourage the Government of Mozambique to create or join international fora that address shared environmental concerns. Regional coordination and harmonization of environmental planning, policies, and regulations might be considered. Regional standards on the use and management of pesticides might provide an initial area on which to focus. Efforts to achieve regional harmonization are sure to win favor and support from many organizations, including the World Bank, the IUCN, and the Southern African Development Community (SADC), to name a few. USAID's (1994: 15) perspective is to encourage international collaboration on environmental issues among nations, "including ongoing coordination, establishment of priorities, allocation of responsibilities, exchange of techniques, and sharing of technical resources."

IV. Biodiversity: Ecosystems and Their Animal Inhabitants

A. Introduction

This chapter summarizes the published material related to the state of Mozambique's terrestrial wildlife and freshwater and marine ecosystems and indicates where that information is to be found. It also reflects actual or potential impacts on the environment as perceived by key people in the natural resources agencies or organizations that were interviewed. With regard to longer term impacts, the chapter describes the processes that lead to or perpetuate environmental degradation so that the contribution of present activities to any downward spiral can be considered in attempts to manage the behavior of people or the resources themselves.

B. Conserving Biological Diversity

The concept of biological diversity focuses on the objective of conservation of whole systems, not only on individual species.²⁰ This chapter focuses on wildlife and their habitats and on freshwater and marine ecosystems. Biological diversity (or, more commonly, biodiversity) is assessed or measured in various ways, including:

- (1) the number of distinct ecosystems;
- (2) the number of genera of a particular group of organisms per area (e.g., the number of antelope species in Mozambique);
- (3) the number of species of a particular genus per unit area (e.g., the number of species of aloe plants in the province of Maputo);
- (4) the number of races of a particular species found in a given area.

In these measures of biodiversity, the number of individuals of any species is not a factor. In contrast, the number of individuals of a particular species is important:

- (1) to establish the reproductive viability of each population (i.e., whether each species has a population large enough to make inbreeding unnecessary and to produce healthy new generations), and
- (2) to determine, for the management of each species, adequate habitat conditions and sustainable size of animal populations given the size of the habitat.

²⁰ Biological diversity represents the variety and variability among living organisms and the ecological complexes in which they occur (Office of Technology Assessment 1987). Biological diversity can be measured in terms of biomes, ecosystems, species, and genetic varieties (McNeely et al. 1990).

Each way of measuring biodiversity provides an indicator, often called an "index," of an area's relative richness. Biological diversity has become an important indicator of environmental health because human impacts on natural systems tend rapidly to eliminate the most fragile species of an area, reducing its biological diversity. Human impacts can be both direct (such as clear-cutting for timber or fuelwood) or indirect (such as poor siting of industrial or sanitation facilities resulting in outflows that overwhelm adjacent ecosystems).

The biodiversity index is, however, only one tool in conservation. One also needs to look at the interactive dynamics of people in ecosystem and the relation between an area of interest and the ecosystems adjacent to it.

C. Geographic Setting²¹

1. Drainage Systems: Rivers and Estuaries

The majority of the rivers of Southern Africa flow eastward through Mozambique to the Mozambique channel. Approximately 100 rivers descend from the mountains, building and enriching floodplains and creating Africa's largest coastal plain. The rivers also transport sediments that enrich estuaries and inshore marine habitats. Mozambique occupies Africa's largest coastal plain. The largest river in Mozambique, and one of the largest in Africa, is the Zambezi. It drains a catchment area of about 1,250,000 km², which includes the SADC countries. Other major rivers are the Rovuma and Lúrio in the North, the Pungue, Búzi, and Save in the center, and the Limpopo, Incomati, and Maputo in the South. These rivers all rise in neighboring countries and are central to Mozambique's ecological relationship to them because the rivers' flow is arguably the most important input into Mozambique's agriculture and fisheries and a major determinant of wildlife existence and distribution.

The sediment load of rivers contributes to the formation and nutrient replenishment of floodplains, deltas, offshore sand banks, and islands. The soils are uncompacted sands, including riverine and deltaic alluvial soils. Without vegetative cover they are susceptible to erosion. Mangroves are the dominant vegetation at the seaward edge of these areas.

2. Oceanography

In terms of inshore ecosystems and fisheries, the dominant current is the Mozambique Current, which splits from the South Equatorial Current at 12°S and flows south in the Mozambique Channel. The current is strongest (4 knots) between October and February (Gove 1994). This main current induces a countercurrent, which runs northward and is responsible for the northward facing peninsulas and spits such as that of the Machangulu Peninsula (McNae and Kalk 1969). High surface temperatures (26° to 30° C) are observed between February and

²¹ For an excellent introduction to Mozambique's environment, the reader is referred to Grupo de Trabalho Ambiental (1990).

April while lower values (21°C to 27°C) occur between August and September (Sactre and da Silva 1982).

Mozambique has about 2,500 km of marine coastline and an estimated shelf area of 68,300 km² (Gove 1994). The coastal shelf is narrow except for the Sofala Bank in the central region of the country, where it extends for approximately 130 km. The average depth is 200 m. The tides in Mozambique are semidiurnal and have a range of 3 m with a maximum of 5.7 m in Beira. The effect of this tidal prism on the coast is exaggerated by the gently shelving coastal plain, a strip of which, one kilometer or more wide, is exposed each spring (flood) tide.

D. Ecosystems and Associated Fauna

1. Terrestrial

Mozambique's different climatic influences have resulted in wet forests on the uplands parallel to the country's western border, semiarid grasslands south of the Save River, where the rainfall is below 600 millimeters per year, and woodlands and open savanna in the center and north of the country, where forested inselbergs are a feature of the northern Sofala and Nampula Provinces. The plains and woodlands are the natural habitat of once substantial populations of large vertebrates. The most important ones and their estimated numbers in the 1970s are shown in Table 3; more recent information is found in Table 4.

The main concentrations of the animal species listed in Tables 3 and 4 have been legally protected over the past 30 years and managed in several kinds of protected areas, as indicated in Table 5. According to the government's information, approximately 13 percent of Mozambique is under some form of protection (Grupo de Trabalho Ambiental 1990). All harvest of fauna or forests is prohibited in national parks. In all other areas, specific uses are dependent on the type of protection given to the area.

Despite the legal protection, the data in both tables underscore the steep decline in the size of all wildlife populations, undoubtedly due to poaching, the civil war, and the loss of habitat associated with slash-and-burn farming and agricultural extensification. Although the counts for 1993 represent inexact estimates, it is also true that, unlike the rest of Mozambique, the vegetative cover in the Marrromeu Game Reserve (in Sofala Province) has been reduced, and there is less likelihood of under counting the wildlife populations. Therefore, until more reliable counts are available, work in wildlife areas should assume low counts to be correct and proceed in a manner that enhances the chances of the populations of each species to reestablish their prewar numbers.

The Land Law of 1979 established the six categories of protection of fauna and flora, which are indicated in Table 6.

Table 3. Estimates of existing larger animal species (in thousands)

Species	General estimate 1976	Average counts Gorongosa 1972	Average counts Marromeu 1977
Elephant	30	2.5	3.0
Buffalo	200	13.3	46.0
Wildebeest	35	7.0	-
Zebra	35	3.5	11.0
Impala	50	-	-
Waterbuck	70	3.5	27.0
Kudu	70	-	-
Hippopotamus	15	3.4	1.7
Sable	30	0.7	8.0
Nyala	15	-	-
Eland	20	0.5	4.0
Hartebeest	-	0.8	8.0
Reedbuck	-	-	13.0

Source: Agostini 1993

Table 4. Wildlife population estimates in Marromeu Game Reserve (in thousands)

Species	1977*	1979	1993	% Decline 1979-93
Elephant	3.0	0.4	0.3	19
Buffalo	46.0	30.0	6.0	79
Zebra	11.0	2.7	0.1	95
Waterbuck	27.0	45.0	0.4	99
Hippo	1.7	1.7	0.04	99
Sable	8.0	2.0	0.5	97
Hartebeest	8.0	1.4	0.1	99
Reedbuck	13.0	3.5	0.6	82

Source: Agostini 1993

* Same figures as in Table 3 to give an indication of how rough these estimates are.

Table 5. Protected Areas in Mozambique

Province	Protected area	Gazetted	Proposed
Cabo Delgado	Ibo Archipelago		Community management proposed but not yet funded
Gaza	Banhine	National Park	
Inhambane	Pomene Bazaruto Island Zinave	Game Reserve National Park National Park	
Manica	Chimanimani		Transborder park and community
Maputo	Inhaca Island Maputo Reserve	Partial Reserve Special Reserve	National Park
Nampula	Nacala-Mossuril		Community management proposed but not yet funded
Niassa	Niassa Reserve	Forestry Reserve	Community management
Sofala	Gorongosa	National Park	Proposed expansion of park boundary to link it with Marromeu
	Marromeu	Game Reserve	
Tete	Zumbo	Game Reserve	Community management
Zambézia	Gilé	Game Reserve	

Sources: Based on the Lei de Caça [Hunting Law] 1979, the Caça Legislação [Hunting Legislation] 1972, Bandeira et al. 1993, and interviews with representatives of the DNFFB.

Table 6. Categories of Protected Areas

Category	Type of protection	Type of use permitted
National Parks	Total prohibition of hunting and forest exploitation	Tourism
Coutadas (hunting reserves)	Hunting license required	Usually operated by private concessions.
Partial Reserves & Special Reserves	Protection of specific resources	Agriculture and fishing may be permitted
Community management areas	Experimental zones	Usually on frontier with national parks in adjacent countries. Issues and mechanisms for community management to be determined.

Forest Reserves

Sources: Caça Legislação [Hunting Legislation] 1972, the Lei de Caça [Hunting Law] 1978, and interviews with representatives of the DNFFB.

In Mozambique, wildlife specialists and supporters are discussing new approaches for protecting wildlife populations and their habitats. Ideas under consideration include community management to address social issues, game ranching to provide revenue for conservation, and a review of present park boundaries. One idea, which is inappropriate at this time because of the low wildlife counts, involves the hunting of existing stocks. Until the total of each population returns to levels of 1980, however, no hunting of *wild* stock should be authorized. To the extent that hunting is considered or permitted, it should be limited to game ranches in order to preserve the gene pool of wild populations.

There is another equally important point to consider. However desirable it may be to protect large mammals (and protected areas are usually for that purpose), much of Mozambique's biological resources are found outside of protected areas. As Almquist and his colleagues (1993) emphasize: "Little attention has been paid to biodiversity conservation [in sub-Saharan Africa] outside of parks and reserves, even though the vast majority of species on earth are not found within these protected areas." This observation suggests the need to recognize the

need to extend concern for biodiversity beyond protected areas as well as the need to remember the primary purpose of such areas.

2. Freshwater Ecosystems

a. Lakes

Lake Niassa, which forms the frontier between Malawi and the province of Niassa in Mozambique, is the latter's largest lake. It is notable for the high level of endemism of its fish species. Smaller lakes and wetlands occur, among them wetland systems that are included in the Maputo Special Reserve. The largest body of water in Mozambique, however, is the lake created by the Cahora Bassa Dam.

b. Rivers and Dams

The most important dam in Mozambique is Cahora Bassa at Songo on the Zambezi River. Plans for hydroelectricity include several smaller dams on both the river's main channel and on tributaries that enter the Zambezi in Tete Province. The main market for the electricity is South Africa. Although the dam was completed and filled in 1975, it quickly became a casualty of the war. The dam is now being restored. Power lines toppled during the war are now being replaced, and plans for the second phase of hydroelectric development are proceeding.

Dams minimize flooding for human settlements in the floodplain, but flood control is a mixed blessing. Dams in general and Cahora Bassa in particular reduce sediments, nutrients, and annual flooding in the floodplains and estuaries. The environmental role of flooding in estuaries is to:

- (1) decrease salinity, which is a chemical trigger for spawning in some species;
- (2) maintain brackish swamp conditions for mangrove forests;
- (3) transport not only sediments from upstream but also nutrients from the floodplains and mangroves as the floods retreat;
- (4) prevent salt water from intruding upstream, thereby maintaining the highly fertile interface between riverine and marine water in the estuary; and
- (5) contribute nutrients to the inshore ecosystems that support artisanal fisheries.

In a country dominated by floodplains, freshwater systems are inevitably analyzed in relation to their impact on marine coastal ecosystems they influence. Gammelsrød (1992) found that the lack of flood water input into the Zambezi's estuarine system negatively affected the prawn fisheries of the Sofala Bank. He examined temperature, sediment loads, and mangrove distribution and concluded that the critical change in the system was the decreased volume in

freshwater in the spawning seasons of prawns. Gammelsrød recommended a compromise to those responsible for the Cahora Bassa Dam to allow for a greater release of water in the spawning period. In interviews with the directors of the Instituto de Investigação Pesqueira (IIP, Fisheries Research Institute) and the Direcção Administrativo das Pescas (DAP, Department of Fisheries Administration), both implied that it is the decline of mangroves that is affecting the stocks of prawns. The World Bank has just completed a survey of mangrove areas and concluded that the total loss of mangroves in Mozambique since 1980 has not exceeded 3 percent (de Vletter, personal communication, 1994). Accordingly, the government may have to look elsewhere for variables to explain the declining populations of prawns.

Cahora Bassa dam has significant fish stocks of *Tilapia* spp. and *Limnothrissa miodon* spp. "Capenta." Both stocks will support fisheries operations to service a regional market. Artisanal fishermen currently fish *Tilapia*. They dry it and sell it as far away as Manica Province in Mozambique and across the border in Malawi and Zimbabwe. The Government of Mozambique has licensed a Zimbabwean company to fish for *L. miodon* for sale in Zimbabwe. The number of boats the company may use is unlimited, but it will pay a tax on each boat. At present it has two boats. An office of the Serviço Provincial Pesqueiro (SPP, Provincial Fishery Service) has the responsibility for monitoring both fisheries.

Cahora Bassa is the motor for development for Tete Province and surrounding provinces. Cahora Bassa's fish stocks will support a growing provincial fishing economy. The dam's potential for irrigation and the energy from the power plant supports the agricultural and mining sectors.

As projects are designed for Tete Province, Cahora Bassa will be central to those plans. Nonetheless, open-ended concessions for fisheries, such as the present one in Cahora Bassa, may not be to the province's long-term advantage. Equally important, all construction of dams on the main channel of the Zambezi, both above and below Cahora Bassa, should consider downstream effects. With the importance of rivers and dams to Mozambique's future development and with the increased construction of dams in Zimbabwe, the desirability of regional management likewise increases. As suggested in the previous chapter, such a task provides an opportunity for international cooperation, and USAID/Mozambique may wish to encourage regional planning for the management of the Zambezi River system. Wise management will assist in the protection of biodiversity and continued opportunities for the generation of incomes for many fisherfolk.

Other major dams in Mozambique include the Mavuzi, which supplies electricity to Manica and Sofala Provinces, and the Chicamba Real Dam in Manica Province west of Chimoio, which supplies electricity to neighboring areas in the Zimbabwe. Water impounded behind the dams supports small local fisheries, which industry should not ignore in managing impacts for which it is responsible.

During the drought of the early 1990s the Limpopo River ran dry. Dams in Swaziland and South Africa exacerbated the effects of the drought. The single most important

environmental issue for Mozambique in relation to water is the lack of a regional forum for water policy decisions affecting SADC countries that depend on downstream use of water (Grupo de Trabalho Ambiental 1990). The downstream users are not able to define convincingly and support vigorously their economic and environmental arguments. As downstream users of all rivers in Southern Africa, Mozambique must begin to articulate a water policy to protect its rights to water. As suggested above, access to water (and its associated resources) is linked closely to potential increases in incomes. For this reason, USAID/Mozambique may wish to consider support for a study in the next three to five years that examines the country's reliance on international rivers and the costs and benefits of a well-articulated policy on ensuring continued access. In addition, the need for a forum for water policy issues should be recognized in any future discussions of policies affecting Mozambique's coastal zones.

3. Coastal Ecosystems

a. Mangroves

Mangrove swamps are a feature of tropical coasts under riverine influence. Such swamps are one of the ecosystems that form a mosaic along tropical coasts: mangroves in the brackish intertidal zone, sea grasses on the mud flats, and coral reefs in clear, low intertidal and infratidal zones. These three ecosystems are connected by nutrient flows from the mangroves and sea grass beds and by the filtering function of mangroves, which maintain the clear water that coral reefs need. In this relationship, mangroves are key to maintaining the ecosystem's health as well as providing erosion protection for the coast.

Mangrove forests dominate brackish-water coastal swamps in Mozambique. Such forests are found along the entire coast, although to a lesser extent in the far north and the coast between Beira and Inhambane (see Figure 1) (Grupo de Trabalho Ambiental 1990). There are six species of mangroves in the north and four species south of the Incomati. These species are *Sonnerantia alba*, *Rhizophora mucronata*, *Brugeira gymnorhiza*, *Ceriops tagal*, *Avicennia marina*, and *Lumnitzera racemosa*. Other species are strongly associated with the landward edge of the mangrove distribution. The mangroves of Inhaca Island are well known, and the scientific literature on its mangroves forms the basis for understanding the country's mangroves.

Estimates of the total area of mangroves along Mozambique's coasts are subject to considerable disagreement. The disagreements are largely due to the discrepancies in the baseline figures for mangroves in the early 1980s. The total area of mangroves is a contentious issue because the casual observer will note loss of mangrove swamps that has occurred over the last ten years in areas near cities. Nonetheless, because the baseline value for the area in mangroves is questionable, it is impossible to establish the total loss at this time. Recalculation could be done by using a series of aerial photographs from 1957 as the baseline.

One should note, however, that mangrove stands can recover easily, but not always spontaneously. The mangroves of Costa de Sol in Maputo illustrate that seeds are needed for the mangroves to recolonize the area. A mangrove forest does not have a seed bed. Reseeding

depends on a constant supply of seeds from the forest's own heavy production of seeds and by recruitment of seeds from the seaward side of the current. Costa de Sol's mangrove stands will not recuperate until the daily shaving of the branches for firewood ends and until seeds are supplied to reseed the area.

The major reasons for clearing mangroves in Mozambique are for house construction and fuelwood. Peasants in the coastal belt select mangrove timber for house construction. Termites dislike the tannin in some mangrove woods, so structures made of mangrove timbers last longer than those made of other woods. Mangroves are the first forests that fishermen exploit for processing fish products such as sea cucumbers, and mangroves can be used to make charcoal. In other countries with mangrove forests, people clear mangroves to convert the space to other uses, such as rice fields, aquaculture ponds, and housing developments. Except for a few salt ponds, this has apparently not yet begun in Mozambique. Mangrove loss has been noted in the Zambezi estuary around Marromeu, where reduced flooding results in the loss of mangroves loss (Dutton, personal communication, 1994).

Mangroves in Mozambique are not the undisputed management responsibility of any institution. The IIP claims an interest but has no particular expertise. The Ministry of Transport and Communications claims control of the coast inland to a distance of 100 m above the mean high-tide mark. Mangroves are located in this zone, but the Ministry of Transport and Communications does not have a policy on mangrove forests. The DNFFB's management guidelines for mangroves relate only to the protection of stream banks, not to the relation between mangroves and their importance to the fisheries or to the health of coastal ecosystems. This question of institutional duplication, which undermines conservation objective, is discussed below.

Mozambican fishery experts spoke of the dangers to the prawn fisheries if significant portions of the mangroves are degraded or destroyed. The experts will probably be vigilant in ensuring that appropriate assessments are conducted for any activities in or near mangroves. All fishery activities on the coast should take management of mangroves into consideration. At a minimum, the DNFFB should establish the number of large seed trees that must be maintained per hectare as a source of seeds to reseed the forest.

Projects located in estuarine areas may have a more pronounced impact on mangroves than on other forest resources because peasants select mangrove species before terrestrial ones. Methods to ensure reforestation of each species can be incorporated into community management of their resources.

b. Estuaries

Estuaries are the sites of major human population concentrations: Maputo on the estuary of the Matola, Umbeluzi, and Catembe Rivers, Beira on the Pungue and the Búzi, Quelimane on the Zambezi. Harmful land-use practices or poor urban planning can negatively impact these estuaries. Poor sanitation that accompanies rapidly expanding concentrations of population

usually manifests itself in both organic contamination of the estuary and possible eutrophication of nutrient-enriched sites.

Agricultural activity is low within estuaries, but urban areas are the main sources of nutrients and toxins. As soon as agricultural production is reestablished, however, pesticides and fertilizers are likely to find their way into streams and rivers. It is important, therefore, that the use of these agricultural inputs be addressed before they become a significant problem.

In Mozambique most nonmining industrial activities is sited near estuaries. For example, several factories that supply Maputo are sited along the Matola River. The main industries are brewing, cement, food processing, fishing and fish processing, and the production of fertilizer and agricultural equipment. Two recent investigations have made a preliminary inventory of industries and the issues involved. These include a Dutch-supported study of contaminants in the Matola River and a study on sustainable industry that the UNDP supported in the Ministry of Industry. The first study found that there are a number of rivers where factories sited upstream of treatment plants produce certain effluents the plants cannot treat.

In addition to attracting large populations and industry, estuaries are areas of high marine fertility of great importance to inshore fisheries. These include not only prawns but crabs, mollusks, and sea cucumbers. Furthermore, many fish species such as the mullets enter estuarine areas to spawn and are the object of intense artisanal activities during the spawning periods.

A visit to many markets in Mozambique will confirm the existence of a small mollusc and crab fishery. Although this fishery is a small part of the overall fishing economy, it is an extremely important source of revenue for the women fishers and children. They collect crabs, cockles, mussels, and oysters. This fishery is essentially an estuarine/mangrove fishery. Its loss has direct negative consequences for coastal women and, of course, for anyone who depends on these resources either for income or nutrition.

c. Reefs and Associated Flora

A narrow range of tolerance for salinity and temperature fluctuations and the need for relatively transparent water restricts the distribution of coral reefs to areas with these qualities and leads to their disappearance when these conditions deteriorate. Mozambique has coral reefs intermittently from the Ibo Archipelago in the north to Inhaca Island in the south. No coral reefs occur in the immediate vicinity of major estuaries. The reefs are mostly fringing, that is, they begin in the low intertidal and grow outward from there. This means that most coral reefs are accessible from land by foot. Coastal people are familiar with reefs and, in some cases, have fashioned reefs to their own uses such as when they create artificial caves and use them as traps. These coastal residents use reef products for food, cosmetics, ritual purposes, and to construct houses (Wynter 1992, 1993/1994).

Artisanal fishers near reefs such as at Ibo, Inhaca Island, or Inhassoro all exploit species that are dependent on reefs for either food or cover. Such species include groupers and parrot fish as well as the Indian Ocean lobster *Palinurus* spp. Thus, coral reefs are a part of the resource base of communities living on the coast. Men generally exploit the fugitive resources, fish, while women and children exploit the more sedentary resources such as crabs and clams. As population densities increase in the coastal zones, the internal market for coastal products drives a rapid stripping of the easily accessible intertidal resources of edible and nonedible products.

Two reef areas are protected in Mozambique, Bazaruto Island and Inhaca Island.²² Two other reefs have been proposed for protection: Ibo and the Primeiras and Segundas Islands. In the case of Inhaca and Bazaruto, the management objectives include a recognition of the role of the coastal resources in the economies of islanders and the need not to forbid use of the resources but to establish a sustainable level of use. These two protected areas are the first attempts in Mozambique to integrate community needs in the process of park planning.

The single most important issue for the management of reef areas and, therefore, for maintaining their biodiversity is the attraction they hold for tourist development. The environmental challenges of tourism include the obvious and the not so, namely:

- (1) siting tourism facilities to maintain an area's biodiversity and to avoid such problems as coastal erosion and pollution;
- (2) maintaining uncontaminated ground water as the number of residents and tourists increases;
- (3) sharing scarce ground water during construction and during operation and use;
- (4) providing suitable jobs to islanders, which was their reason for wanting the development, instead of bringing in outsiders who may initially be more qualified;
- (5) ensuring that the primary economic benefits of tourism are retained in areas where they generated;
- (6) avoiding the use of fuelwood without adequate reforestation measures by the tourist developers;

²² The importance of Inhacan reefs does not lie in their richness of species nor in their extent or beauty; at best they are small, species-poor versions of the extensive reefs of the north. Inhacan reefs are the southernmost occurring fringing reefs in Africa. They occur in relatively cold water and thus provide an example of reef-forming corals living at the extreme conditions they can withstand. The most interesting aspect of the two main reefs on the island is how different they are. The southernmost reef at Ponta Torres is visibly much poorer in species than that in front of the Barreira Vermelha. Inhaca Island represents the southern end of a distribution of coral that begins in the Red Sea.

- (7) ensuring adequate regulation of tourist activities that can have long-term negative effects such as water skiing on bird nesting sites and unlicensed sport fishing; and
- (8) developing appropriate concessions for tourist developers, which internalize long-term ecological and social and economic impacts.

d. Protected Marine Species: Dugongs and Turtles

The Hunting Law of 1979 (*Lei de Caça 1979*) protects dugongs and sea turtles wherever they are found. Such species are typically endangered throughout most of their oceanic habitats. Unfortunately, the law has never been applied uniformly in Mozambique; the regulation has been enforced only in a few places, such as Pomene, Bazaruto, and Inhaca. Since the 1980s, however, dugongs have been killed in gill nets used by the semi-industrial fishing boats. These gill nets are no longer legal. It is unclear, however, whether viable populations of dugongs exist in Mozambique's coastal waters. Some monitoring and protection of turtle nesting sites is provided on Inhaca Island. Turtles are caught accidentally in gill nets and are actively hunted for meat and their carapaces. Tortoise shell jewelry is sold openly in local markets, including Maputo's main market. For most practical purposes, therefore, the Hunting Law has no salutary effect.

The problems associated with the Hunting Law are illustrative of a far greater problem. The law's relative ineffectiveness is no surprise to those familiar with most laws that attempt to restrict or manage access to desirable natural resources in developing countries. Rarely is it the case in such countries that there are too few laws or regulations. While exceptions to this general rule are easily found, the problems associated with the proper management of biodiversity, tropical forests, and other environmental resources go well beyond inadequate laws. However appropriate the laws may be, enforcement is typically weak or nonexistent. In countries that attempt to regulate the use of natural resources, governments typically find themselves telling people what they should not or cannot do. For people with the wealth to secure alternatives, such restrictions pose few problems. In contrast, those with few or no alternatives are not likely to be persuaded to forego their livelihoods (or their next meal) merely because a distant government has approved a law they cannot read or appreciate. For governments, then, the challenge is to find ways in which people can benefit from wise and sustainable use of their resources. This means that governments should encourage preferred activities rather than discourage undesired activities. Such encouragement is often most effective when it is locally initiated and when people can benefit from their desired behaviors. Again, this approach recommends consideration of integrated conservation development projects, which were discussed in the previous chapter, or the use of appropriate incentives that foster changes in behavior.

E. Issues in Terrestrial Biodiversity Conservation

1. Protecting Wildlife Populations

The DNFFB is trying to develop a strategy to save the remaining populations of wildlife, especially large mammals. It has decided, for example, to send the remaining pair of rhinoceroses in Mozambique to Malawi for the next five to six years in belief that they will have a greater chance of survival under the care of Malawi's National Park Service than in their original habitat.

For the rest of the animal population there are many proposals. There are several proposals for community management mechanisms to address the relation between animals and people. Three projects that are to begin in 1994 include: a) the Zumbo Community Management Project in Tete Province; b) the Niassa Community Management Project in Niassa; and c) a Transfrontier Hunting Reserve and Community Management Project in Maputo Province. The latter project will receive support through the Global Environment Facility.

Other proposals for protected areas are identified in Table 5. Each proposal represents a small contribution to the solution. Personnel at the DNFFB complain, however, that no donor has shown interest in supporting the area the directorate see as crucial, namely training for regulation, planning, and management at all levels and the rebuilding of park infrastructure.

An IUCN team visited Gorongosa National Park in June 1994 to assess the state of the fauna, determine the priority needs for reestablishing protection of the area, and to consider whether to propose an extension of the park's boundaries. Previous training for park rangers was provided at Gorongosa, so "resurrecting" the park is the DNFFB's key to resuscitation of Mozambique's network of protected areas.

To the extent that USAID/Mozambique seeks opportunities to assist in the protection of the country's protected areas, this assessment suggests that USAID/Mozambique may wish to consider the DNFFB's requests for support in park planning. Such support need not be expensive. Working through various NGOs (e.g., the IUCN, the World Wildlife Fund, or The Nature Conservancy), the mission might feasibly commit some resources to facilitate cooperation between the DNFFB and one or more of these groups. At a minimum, for example, the DNFFB arguably needs to develop an institutional capacity to plan and implement a biodiversity conservation strategy. There are many issues to be addressed:

- people/park relationships
- people/wildlife/timber
- local versus national wildlife and forest management
- local versus national collection of revenues
- game ranching
- ecotourism development
- concessions
- implications of regional water management decisions.

At present the DNFFB's six senior members spend much of their time evaluating and promoting new proposals and visiting sites with perspective sources of funding. As suggested

in the previous chapter, the business of forest and park planning is constantly marginalized. The DNFFB's lead staff members are dynamic and capable but overwhelmed. They need an influx of new staff. In particular, the DNFFB needs more ecologists, further training in community-level management, and assistance with long-term planning, management, and regulation of protected areas.

Whatever the form of potential assistance (and whatever its source), there should be some attention to the DNFFB's present orientation toward forests and wildlife. A reasonable case can be made that this orientation does not consider protected areas to be complex institutional entities with social, cultural, economic, and ecological linkages. Moreover, the DNFFB has difficulty in conceptualizing marine parks as a part of its jurisdiction. The agency's present perspective emphasizes large animals rather than protected areas and the ecosystems they represent.

Although USAID/Mozambique does not have a primary emphasis on natural or environmental resources, the mission should recognize the agency's thorough familiarity with the management of these resources in Africa. As an illustration, USAID is presently supporting, both directly and through nongovernmental organizations, park planners in many countries in eastern and southern Africa. In Zimbabwe, USAID is supporting the Communal Area Management Project for Indigenous Resources (CAMPFIRE). In Uganda, USAID is supporting the resurrection of the protected area system through a combination of support to the national park system, NGOs, and PVOs. Such support suggests potential opportunities for collaboration; Mozambican park managers could benefit from study tours in countries in the region that have more advanced park systems. Alternatively, USAID staff or contractors in neighboring countries could be invited to Mozambique to address other needs.

2. Resettlement and Wildlife

Mozambique had the makings of a protected area system in terms of designated protected areas, a rudimentary enforcement system, training programs, and some nature tourism by 1980. With the war-related damage to Gorongosa National Park, however, this system decayed. Many protected areas were insecure for both park personnel as well as the local population, which led to two different effects on the vegetation and the animals. The vegetation and, therefore, the habitat for the animals, recuperated because it had neither grazing pressure or fire from cultivators nor hunters. At the same time, many mammals provided food and revenue for soldiers. The protected areas, therefore, ceased to be areas of refuge for many animals. Consequently, many of the animals that survived this war-related predation are to be found outside the areas designated for their protection.

As people resettle in districts near protected areas, it will be important to remember that animals outside the parks are not a windfall to newly returning refugees and that projects in the vicinity of designated protected areas must work with forestry and wildlife agents to develop appropriate relationships with these resources. It is not a question of no use but of appropriate use that makes economic and ecological sense.

In this regard, CAMPFIRE has demonstrated how villagers can and do participate in conservation of wildlife when they are permitted to share in the proceeds of the sale of hunting licenses. If a tourist hunter buys a hunting license, a villager can share the license fee and also receive the meat, which is of no interest to the visiting hunter. No comparable mechanism for revenue sharing now exists in Mozambique, and this situation is relevant to efforts to increase rural incomes in an environmentally sound manner. The DNFFB presently collects all revenue for parks or forests. The DNFFB intends to develop mechanisms for sharing revenue within the community management projects scheduled to begin in 1994. Should these projects succeed, then they will provide an example of a situation in which attention to environmental issues can improve rural incomes. Other similar possibilities exist and suggest that new programs are not always necessary to achieve new goals. In other words, changes in existing regulations can lead to desired changes in the distribution of incomes. For this reason, the mission should remain alert to such possibilities in other areas of resource management.

3. Cattle and Wildlife

The classic tension between people and parks in East and Southern Africa concerns grazing areas for cattle and wildlife. During Mozambique's civil war, cattle-grazing land became choked with acacia and other woody vegetation. As villagers again acquire cattle the easiest solution to grazing will be to use those areas that are not choked, including wildlife foraging and grazing areas. It will be important for projects that introduce cattle to devote attention to the recuperation of grazing land for each season and to make the necessary investments to upgrade cattle-grazing areas, thus avoiding heightening tensions with wildlife interests for wildlife grazing areas.

F. Issues in Marine Conservation²³

1. Fisheries

Three levels of organization are recognized in Mozambican fisheries: (a) artisanal or small-scale inshore fisheries; (b) semi-industrial (mostly for prawns); and (c) industrial (by mixed Mozambican and foreign companies). The first of these, artisanal fisheries, are licensed and monitored at the provincial level. Over the last ten years there has been a steady increase in the number of boats in this fishery. Although some areas appear to suffer from excessive fishing (e.g., the Bay of Maputo and the Inhassoro coast), the IIP's director does not believe that Mozambique suffers from overfishing. The increase in fishing effort is thought to be a result of the war, but there is no sign of a decline of fishing in areas such as the Bay of Maputo since the peace accord in October 1992.

Provinces sell licenses and monitor the boats of the semi-industrial fishery. These boats must adhere to national regulations regarding the procedures for ensuring quality of the product destined for the international market as well as the level of fishing allowed. Provincial control

²³ Again, the interested reader is referred to the work of the Grupo de Trabalho Ambiental (1990).

of licenses results in closer monitoring of the fishery while the use of national legislation provides uniformity of regulations and access to whatever scientific monitoring the national level is equipped to provide.

The Secretariat of Fisheries licenses the industrial sector. The main products of this fishery are prawns and tuna. This industrial fleet comprises about 70 boats, all of which are licensed to fish beyond the 12-mile limit. Due to the present depressed prices of prawns on the international market, the IIP's director maintains that the Secretariat of State for Fisheries has no interest in increasing the number of boats operating in the industrial fishery. Instead the director argued that the objective is now to exploit a wider variety of the available stocks.

Despite the director's apparent lack of interest in increasing the fishing effort for prawns, it is safe to assume that this is not the last word on this subject. The IIP recently completed an experimental prawn culture project. Results have not been encouraging. This may be due to poor siting of the ponds (in areas contaminated from organic waste or agricultural runoff) or to poor technical design (due to inefficient water filtering systems). A Mozambican from the IIP is presently completing a graduate degree in aquaculture and is expected to return to continue work on this issue.

The long-term environmental concerns in the fishery sector highlight the different approaches of the two organizations the assessment team consulted. The IIP is taking a long-term view of sustainability and is focusing on the decline in mangroves as a nutrient source for prawns. The DAP's staff highlighted its struggles with post-harvest organic contamination of catch for export, especially prawns. The DAP's director noted that the European Union has recently introduced new standards for fish products, which has forced Mozambique to review its procedures for handling of the catch. This director argued that the catch that is frozen at sea on industrial boats has no significant contamination, but the catch of the semi-industrial fishery needs both better procedures and more monitoring to maintain acceptable hygiene levels. The DAP is in the process of developing three regional laboratories to support the monitoring effort.

The DAP's focus on sanitation problems is on maintaining product quality for export. The artisanal fishery, which produces for local consumption, is omitted from this thinking. In addition, the long-term effects of eutrophication appear not to be included on the present thinking on the subject.

The team questioned the directors of the DAP and the IIP about the decentralization process now under discussion in Mozambique. Neither believes this is a pressing issue in their sector since, they argued, the SPP has always been substantially decentralized for the semi-industrial and artisanal fisheries.

In contrast, the IIP's director strongly believes that the deep-sea industrial fishery can be managed adequately only at the national level because it is not possible to divide the resources among coastal provinces. Notwithstanding this situation, the director believes this could be an issue for the future. The Sofala Bank off the coast of Beira is a major area for shrimp fishing.

Consequently, it would not be surprising if the province of Sofala demonstrates an interest in controlling all fishing licenses in the area. Such a move would be consistent with recent declarations (such as those in Maputo's daily newspaper in July 1994) by RENAMO in which it claimed dominion over forest resources on the land it controls.

G. Nonrenewable Resources

Mozambique has commercially important deposits of several minerals including marble, pegamites, tantalum, iron copper, bentonite, and precious and semiprecious stones. It also has important coal fields in Tete Province (Grupo de Trabalho Ambiental 1990). Production at all mines virtually ceased during the war. Since the cessation of the war artisanal mining has been growing rapidly for precious and semiprecious stones and gold in Tete and Manica Provinces. Re-opening of large mines will depend on several factors, including the repair of roads and the clearing of land mines. Natural gas was discovered at the Pande-Búzi field off the coast of Inhambane Province in the 1960s, and commercial extraction began in 1991.

H. Institutional Strengths and Weaknesses for Biodiversity Conservation

1. Training for Biodiversity Conservation

Mozambique suffers a shortage of university graduates, so it is appropriate to consider the implications of this shortage for expertise relevant to natural and environmental resources, especially biological diversity. Most Mozambican biologists receive their first degrees in the Department of Biology at the University Eduardo Mondlane (UEM). The biology course has an annual intake of 25 to 30 students each year. Students in their final year are allowed to choose one of several areas of emphasis for their classes of that year and for the *licenciatura* theses.²⁴ Each year about five students choose ecology. Once these students graduate, most remain at UEM; others pursue postgraduate degrees abroad.

The ecologists on the faculty, in addition to teaching, often consult for international organizations, including the IUCN and the World Bank. These ecologists represent the best source of local information on biological diversity (see, for example, the reports of Bandeira et al. 1993; Gove, 1994). These young ecologists are in a position to assist in the training of medium-level technical people for the protected areas as well as to participate directly in short-term studies.

The DNFFB has not yet accessed this expertise fully, and this is a weakness for the immediate future of biodiversity conservation in the country. The DNFFB has a traditional categorization of its stewardship: foresters for the forest resources and veterinary surgeons for the wildlife. The DNFFB would do well to bring community and systems ecologists into its thinking.

²⁴ The *licenciatura* is a "hybrid" between a senior thesis and a master's thesis.

2. Overlapping Institutional Jurisdictions

The division of responsibilities among different government agencies is discussed in earlier chapters, but it is useful to raise the issue again in the context of a key environmental issue. Although the assessment team did not have sufficient time to assess actual or potential overlaps in all areas involving natural resources, it did examine in some detail those involving management of coastal resources. This assessment found a bewilderingly diverse set of government agencies and offices with responsibility for one aspect or another of the coastal zone, giving rise to the perception of bureaucratic overkill: fourteen government departments control some aspect of the coastal zone (see Appendix 6). The number is alarming because no department or agency seems to acknowledge more than two others that are relevant to its work, and no department seems to function with a broad concept of what the coastal zone and its management involves. For example, the directors of the different fisheries departments were asked what role the CNA has in resolving their coastal zone problems. They said it has none. For the directors of the IIP and the DAP, the Maritime Police (in the Ministry of Transport and Communications) are more relevant for their work than is the CNA. In fact, both directors believe that the Ministry of Transport and Communications is the agency with primary responsibility for issues affecting the coastal zone. It is equally disconcerting to learn that the fourteen departments have never been present at any meeting to discuss a common agenda related to coastal issues. In short, at a time when Mozambique is trying to attract foreign investments, this apparent institutional redundancy is not only bad for conservation, but it is also counterproductive for economic growth and Mozambique's ability to attract support from prospective donors for institutional strengthening.

a. The CNA and Coastal Zone Management

It is undoubtedly this institutional "clutter" and the inertia it generates for coastal zone management that the CNA is mandated to address. Perhaps the greatest contribution that the CNA could make at this juncture would be to look at time- and cost-effective mechanisms to keep the departments with coastal responsibilities informed of each other's activities and the CNA's own activities in regard to integrated management. Effective networking could foster a sense of the responsibility that all coastal agencies share for the coast. Within this group, the CNA could begin to address both the environmental awareness that it proposes to do as well as the development of uniform standards for the zone.

b. The CNA and the DNFFB

The DNFFB is the CNA's strongest ally among all the organizations with responsibility for the environment. The CNA's role is one of supporting the DNFFB as it defines its program. The CNA can be most helpful to the DNFFB in developing the concepts and in seeking responses to the integrative approach to management that it promotes. These concepts will include question of scale, systems approach to management, and ecological and social diversity. Thus, some key points of consideration should include:

(1) recognition that villagers practice integrated management and need security for their approach. They need legal, administrative, and technical support for the wise use of the environmental resources around their villages;

(2) identification of different levels at which management should be integrated--national, provincial, district, and village;

(3) conceptual integration both at the institutional level and at the resource level; and

(4) recognition that villages or districts cannot manage all resources (because they often do not have the ability or authority to do so).

I. Conclusions

At the least, this chapter reveals the considerable paucity of information about the status of biological diversity in Mozambique. Of the information that is available on animals, for example, most of it relates to fish and large mammals at the top of the food chain. Considerably less is known about species lower on the food chain and potentially more important to a clear understanding of the status of the country's biological resources. The absence of any discussion of Mozambique's plant resources is also notable. While there is surely some literature that discusses the country's flora, it does not provide enough information to develop a meaningful portrait of the extent or diversity of these resources.

The relative lack of information on plants and most animals is unfortunate. Tropical areas contain most of the world's biodiversity, and much of this biodiversity remains to be discovered and described scientifically. Other developing nations are rapidly learning that biodiversity offers lucrative offers for both protection and economic gain. In Costa Rica, for example, the government has entered into an agreement with a multinational pharmaceutical firm that is prospecting for "new" substances and genetic materials found only in that country. Madagascar's vast biological diversity has prompted scores of international NGOs and bilateral donors (including USAID) to spend millions of dollars in an effort to protect this diversity. This infusion of external resources, while devoted to biological diversity, has obvious economic benefits for local populations in the form of increased incomes. In this regard it is worth citing the wisdom of Almquist and his colleagues (1993, xi): "To the extent that biodiversity represents an important international as well as national and local resource, Africa's competitive advantage is enhanced not only by the fact that its environment is among the world's richest biologically but also by the fact that it has not yet sacrificed its endowment of these resources."

Although there are surely noneconomic reasons to protect a country's biological heritage, the experience in other countries suggests that further attention to Mozambique's biological diversity is warranted. This is not intended as a recommendation that USAID/Mozambique commit resources to the task, but it is suggestive of future possibilities. It need not be the case that the mission would have to provide resources, but it is in a position to assist Mozambique to explore potential opportunities. USAID's Biodiversity Support Project (BSP) may provide

a means to do so. The BSP has considerable expertise relevant to sub-Saharan Africa and may be willing and able, at little or no cost to the mission, to advance the state of knowledge of Mozambique's biological diversity. Such assistance could involve a range of activities, such as biological surveys or assistance in training of the country's scientists. Likewise, the mission could explore opportunities for collaboration with the Bureau for Africa's centrally funded activities. Many of these activities involve field work in Africa, but the choice of countries is typically dependent on an invitation or expression of interest from the USAID missions in those countries.

Similarly, the external resources devoted to environmental protection can be used to promote a government's improved attention to democracy and public participation. As noted earlier, integrated conservation development projects encourage local participation and engender a sense of political efficacy. People find themselves in control of local environmental resources, and they reap the benefits of good governance. These examples illustrate an important point. To be effective, democracy and governance need a context. Democracy implies public participation, respect for private property, and representation that reflects majority will while protecting minority rights. All of these goals can be addressed through more effective management of Mozambique's biological diversity and the vast untapped potential it represents.

V. Environmental Monitoring

Environments change, and few of these changes are due to donor activities, including those of USAID/Mozambique. Nonetheless, to the extent that any donor has an interest in relating its inputs to desired changes in Mozambique and then discerning whether these changes affect the environment, it will be necessary to monitor the status of the country's natural and environmental resources. Any monitoring can be problematic when changes have multiple and interactive causes. How, for example, can USAID/Mozambique relate efforts to increase rural incomes with possible effects on tropical forests? Is it possible to relate efforts to promote democracy with changes in the status of biodiversity? Statistically and theoretically it is always possible to make such linkages. In practice, however, the task is complex, particularly given the nature of the presumed linkages and the weakness of existing mechanisms to monitor the condition of Mozambique's natural resources.

Despite the difficulties in resolving these issues, they cannot be avoided. Accordingly, the task then is to find a means to identify and develop appropriate monitoring systems while minimizing both the cost and the practical constraints. This chapter attempts to suggest some ways of doing so in Mozambique.

To the extent that USAID/Mozambique is either able to create an effective monitoring system or support a system being developed with the Government of Mozambique, the mission can benefit in several ways. At the least, effective monitoring can help the mission manage its programs, fulfill legal obligations associated with the requirements of USAID's Environmental Procedures, and report on the impact of its programs under the terms of the Development Fund for Africa. In addition, USAID (1994) is supportive of efforts that promote procedures for measuring and monitoring the environmental impacts of economic growth. For these reasons the present assessment includes this chapter, which suggests options for monitoring responsibility; sample designs; data sources and requirements; and tools, methods, and applications.

A. Monitoring Responsibilities

Support of a Mozambican monitoring unit was suggested earlier in this report. Such a unit could advise and assist those with responsibility for monitoring the environmental impacts of activities that USAID funds or supports. Before establishing such a unit, however, the purpose of monitoring should be understood. If the primary purpose is to collect information for USAID, a unit external to USAID/Mozambique could be the most efficient way to gather data. In contrast, if the purpose is to provide data that can assist project implementors in making mid-term corrections, then internal monitoring might be more effective. For example, although monitoring is usually included as a component in agency projects that contractors implement, USAID/Zimbabwe has established and funded a mission information system that provides in-house monitoring of the progress and impact of projects. USAID/Madagascar and USAID/Ethiopia are also considering such an arrangement.

If PVOs continue as important project implementors, USAID/Mozambique should raise the issue of monitoring with them. Although some PVOs have resisted outside monitoring of their USAID-funded efforts, they too are accountable for the environmental consequences of their activities. If USAID/Mozambique's program shifts responsibility for implementation to private contractors, they presumably will monitor their own projects. If USAID/Mozambique decides to fund nonproject assistance (NPA) that has the potential to cause environmental change, the Government of Mozambique would be required to monitor the changes.

Building monitoring capacity within the government will be necessary if the government accepts responsibility for any monitoring. In fact, appropriate assistance (presumably for the CNA's monitoring capabilities discussed in chapter 3) may be desirable when the government's monitoring efforts parallel those of project implementors. Sound resource management, which helps establish a country's economic self-sufficiency, requires monitoring competence. Building such competence into one or more agencies would provide the government an important tool to manage its scarce resources. Having promoted such competence, however, USAID/Mozambique could profit from it by reliance on the government should the mission choose NPA as a programming strategy.

If USAID/Mozambique supports the development of an indigenous monitoring capacity, the mission may have to decide whether to direct its support to a central agency, a single-line ministry, or a ministry in which a central agency coordinates the data aggregation and analysis but in which several line ministries collect and analyze data that relate to their responsibilities. If a clearly defined task is the mandate of a single department or ministry, that agency should implement the institutional capacity to monitor. If, however, several departments or ministries are involved, a coordinated effort would be more effective. If more than one line ministry or department is involved, each would be charged with the responsibility for monitoring domains in which they have their mandate. To the extent that the government assigns responsibility for environmental monitoring to a single agency, then the mission's options may be limited.

Countries that have established central monitoring units generally have found them to be ineffective. The central unit tends to restrict access to data. In addition, the ministries responsible for collecting the data often fail to communicate results to the central unit. In Uganda, for example, the National Environmental Information Centre was ineffective as a stand-alone monitoring unit until it began to function as a hub for data that line ministries collected. Kenya's Department of Remote Sensing and Resource Surveys, which is currently an effective monitoring unit, was for years more interested in gathering rather than sharing data. Both Malawi and Madagascar are establishing monitoring units that are characterized as hub-and-spoke systems; both appear, at an early stage, to provide effective arrangements.

A decentralized hub-and-spoke model is more difficult to establish than one located in a monitoring center. Such a dispersed effort requires building capacity in each institution involved, but this approach can have advantages. When data needs overlap among institutions, there is often a reluctance to share information. Those gathering the data would be more familiar with monitoring techniques in their fields of responsibility rather than with the needs

of their colleagues in other ministries. The use of multiple agencies with responsibility for monitoring may be particularly appropriate when the objective is community management of a multiple-resource base.

If USAID opts for the establishment of new monitoring capabilities, then the DNFFB and the Ministry of Agriculture represent potentially viable locations. Both are critical actors in efforts to increase rural incomes, and both are involved in the Pre-Program, which is discussed in chapters 2 and 3.

Institutional location is an important consideration, and one that USAID/Mozambique should not take lightly. At the same time, however, the mission may also wish to focus attention on the process of monitoring. Faulty monitoring systems will waste scarce resources and be of little use to anyone. For these reasons some attention to process is essential. Although some of the discussion that follows is not written specifically for the Mozambican context, the issues raised should be addressed. Good monitoring requires several fundamental decisions well before any monitoring begins. Poor decisions lead to faulty monitoring systems and, in turn, data whose credibility are questionable. One of the first issues that should be addressed involves sampling--from what units will data be collected and how representative will those sampled be of the population to which one is interested in generalizing?

B. Sampling Designs

Sample design, a potentially complex subject, has the simple objective of making a valid inference about a larger population using a small sample drawn from that population. To ensure unbiased results when samples are used to generalize to populations, the selection of respondents must be random. Such a requirement means that the sample cannot be drawn exclusively from conveniently located households, such as those located along major roads in rural areas, or from administratively convenient agricultural areas. Random sampling and selection is not always possible, but it is the ideal and should be considered in every instance.

Drawing a random sample requires a list of all the sampling units located in the population of interest. These sampling units can be households, forested areas, or types of cultivated areas. Sampling units of households or people are designated as a "list frame." Sampling units that represent land areas are designated as an "area sample frame." As an illustration, an area sampling frame stratifies land areas for types of use and selects a small sample that provides results that can be projected to the larger area. Whether a list frame or an area sample frame is used, the sample size is a function of both the need for precision and the resources available to collect and process the data. The ideal is to collect a small sample so that the survey is inexpensive to conduct, can be processed with minimal resources, and provide the desired precision.²⁵ If all else is equal, precision is a function of sample size. In other words, as sample sizes increase, margins of error decrease and the ability to generalize the findings

²⁵ Where there is bias, *precision* indicates the variance about the expected value; *accuracy* is a measure of variation about the true value being estimated. See Hanson, Hurwitz, and Madow (1953).

from the sample to the population increase. This is an issue of external validity. Similarly, the larger the number of variables, the larger the sample should be to obtain reasonable results. When data are needed on many variables, the sample must be sufficiently large to estimate the most important characteristics with sufficient precision. To control costs, sampling should restrict the number of variables and thus the sample size.

All sampling is prone to two types of errors: a) sampling error, caused by selecting a sample that does not represent the population; and b) nonsampling error, which is due to imprecise data collection or entry. Small samples increase the possibility of sampling error; larger samples increase the possibility of nonsampling errors. Given a choice, it is more important to minimize nonsampling errors because they distort the conclusions that can be drawn from the data (Agricultural Assessments International Corporation 1992). Sampling errors do not affect a survey's internal validity, which relates to the accuracy of the information collected, but do affect the projections to the population from which the sample is drawn.

It is not always possible to develop and select randomly from a sampling frame. The result may be a biased sample. Data collected through nonrandom sampling should not be used to make projections to or generalizations about entire populations or land areas. If it is not possible to utilize a random sample, every effort should be made to include in the selected sample the variability in the population, particularly in regard to the variables that are believed to be important. For example, if 60 percent of a province's population is employed in farming, and that population is the unit to which one wishes to generalize, then approximately 60 percent of the respondents should be employed in farming. Whether a sample is random does not affect the conclusions that can be drawn from monitoring of that sample, assuming that there are no problems with internal validity. In effect, a nonrandom sample is similar to a random sample that has a possibility of a large sampling error.

C. Data Requirements

Unless cost is not a constraint, the variables or indicators selected for inclusion in a survey should be minimized. Consequently, each variable (e.g., such as income, number of species per unit of analysis, or agricultural productivity per hectare) should be assessed to determine whether it is required or simply desired. Proxy variables are often used when the desired indicators are unavailable or difficult to collect. For example, weight of children by age is sometimes used as a proxy for safe drinking water where food availability is not a constraint. The rationale is that water testing for each household would not be feasible. Each indicator or proxy must be capable of being quantified to facilitate statistical analysis. This means that every variable must have (at least two) numeric values, although the numbers do not necessarily represent quantitative differences.²⁶

²⁶ The best example relates to gender. In coding data from surveys, for example, researchers will arbitrarily assign a value of 1 to females and 2 to males. The numbers allow the researchers to make distinctions among respondents and to use the data for purposes of statistical analysis.

Decisions should be made before data collection about which variables will represent desired or anticipated outcomes (i.e., dependent variables) and which will represent presumed explanations for outcomes (i.e., independent variables). Equally important, data collection should be linked to the hypotheses or assumptions used to develop the activity. For USAID/Mozambique, this means that it will be necessary to hypothesize the presumed or expected relation between each of its focus areas and their likely or anticipated environmental consequences, all of which were discussed in the previous chapters. These working hypotheses link inputs and actions (independent variables) to expected results (dependent variables) and help to identify appropriate variables or indicators to be measured. As an illustration, for the focus category "increased rural income," the linkage of the project inputs, such as fertilizer, extension service, and improved seed varieties, should be the variables for which data are collected. The monitoring should assess whether project inputs are available to both men and women, if they are used, whether their use has affected incomes (and, if so, by how much as a proportion of the total change in income), and identify other sources of income. Monitoring might also make an effort to determine whether gains in income are sustainable.

Sustainability, an issue in all projects involving the use of the natural resource base, should be a part of any monitoring program. In Mozambique, farm and forest lands are the main natural resources controlling rural income. Biodiversity can also be a consideration. Sustainable farm income is a function of a number of variables, including erosion and soil fertility. Neither variable is readily measured, so reliance on such proxies as soil type, slope, and land cover can be used in lieu of a direct measures of erosion. Successive yields represent a proxy for soil fertility. Other variables and proxies might be more suitable or readily collectable.

Other concerns in environmental monitoring are forested areas and biodiversity. Forested areas often do not need proxies. The yield of timber from a forested area can be measured without too much difficulty; as noted in chapter 3, however, the yields of nontimber forest products are more difficult to measure. Biodiversity can be monitored either directly or through proxies, which might include changes in the effort to harvest a product, changes in habitat boundaries, disappearance of a common plant or animal, and arrival of alien species (Almquist et al. 1993).

D. Monitoring Tools, Methods, and Applications

Tools that supplement and enhance the use of survey methodology include satellite data, videography, global positioning systems (GPS), and geographic information systems (GIS). These tools, useful by themselves, when combined with traditional survey methods, provide an effective monitoring tool.

Satellite data have been used for monitoring for many years, but their usefulness is now enhanced by a wider range of data choices. Coarse resolution data from the National Oceanic and Atmospheric Administration's Advanced Very High Resolution Radiometer satellite is an inexpensive method of estimating crop vigor and yields; it is the basis for all famine early

warning systems. Where there are no rain gauges, the Meteorological Satellite (METEOSAT) can provide daily estimates of rainfall. Data from the Systeme Probatoire d'Observation de la Terre (SPOT) and Landsat's Multispectral Scanner and its Thematic Mapper can provide increasingly fine resolution information on ground cover.

Videography provides another remote sensing technology. With this technology, the pixel size can be very small and is dependent on the height of the plane and the focal length of the lens. The camera can be fitted with filters that allow selection of different spectral bands. Some cameras have zoom lenses that automatically take extreme close-ups for one frame out a series of wider views.

Videography has been available for several years, but the mass of data collected and the difficulty of correlating what is on the videotape with a reference point on the ground has made it of marginal value. Historically, videography was used primarily as a backup and record of animal surveys. Wide availability of GPS now makes videography more valuable. Filming is integrated with GPS to record and print location data on each frame of the videotape. Detail from the GPS can then be used to match the video frame with the land area it represents.

GIS can integrate spatial data. If data are referenced to a single base map, individual data layers can build an archive of soils, slope, transportation, and other variables. These can be combined with data derived from monitoring. GIS can then be used as an analytic tool. Where monitoring shows different results from the same agricultural practices, the explanation may be in the soils. Lower incomes might be related to distance from markets. Successive monitoring observations can show changes over time in any single variable or combination of variables. These tools can supplement the survey, the basic tool of monitoring. Used correctly, GIS can increase the ease of collecting and analyzing data.

It is important to select monitoring technology carefully. Overemphasis on the high-technology approach is a danger. For small areas, ground-based inventories supported by inexpensive GPS units can do a better job of providing information on the composition of the vegetative cover than can satellites. Subsequent surveys of small areas can detect such changes as encroachment into forested areas. The choice of methodology often depends on the extent of the area to be monitored. For larger areas, satellite data, aerial photography, and videography are the most efficient methods of gathering data.

E. Selected Existing Data and Planned Data Sources

The existing data sources listed below can serve as a guide in the development of USAID/Mozambique's Country Program Strategic Plan. Indeed, many of these sources will not be useful as baseline data for project implementation because of the rapid changes associated with the resettlement of refugees and displaced persons. A more extensive discussion of many of these data is in the preceding report's chapters.

Biodiversity. At least national two surveys have been conducted on Mozambique's wildlife populations, the latest done in 1987. Flying transects were used to collect the data, which are the responsibility of the National Directorate of Forestry and Wildlife. None of the data are archived in a digital database.

Tropical Forests. There are both historical and current assessments of forest cover. A total coverage at 1:1,000,000 based on satellite data dating from 1979 is currently available as a map series at the National Directorate of Geography and Mapping (DINAGECA). Recent map coverage of forests is based on data from Landsat's Thematic Mapper from 1992 and is being prepared at a scale of 1:250,000.

Coastal Zone. Data from the Integrated Study of the Coastal Area of Xai-Xai, the principal city in the Province of Gaza, are available at the CNA. The study evaluated coastal resources and collected data on the natural resource base in Xai-Xai. The study identified the area's major environmental problems. The data are available in digital format in a GIS database. Further work at the CNA will establish a baseline of coastal information at 1:50,000 scale or larger with a view toward developing an environmental monitoring and management plan for portions of the coastal area.

Food Production. The FAO's National Early Warning Project, which is located in the Ministry of Agriculture, provides periodic assessments of food produced during the growing season. The project has adopted a systematic program that monitors the production of the seven principal food crops.

Projection of yields assumes that:

- population estimates can be derived from the 1980 census which has been updated subsequently by migration records for 128 districts;
- size and type of area cultivated, mix of crops, and production can be projected from a small sample taken from an area next to the principal towns of the district;
- METEOSAT data can be used to estimate rainfall when data from rain gauges are unavailable; and
- a water-balance model can project yields based on area planted and moisture availability.

Land Cover and Use. DINAGECA is the center for map production. Mozambique is currently mapped at a scale of 1:250,000. A series of maps at a scale of 1:50,000 is being completed. Most of the data used to construct the maps are from aerial photography that is more than 20 years old. DINAGECA is preparing land-cover maps

at a scale of 1:250,000 for the provinces of Sofala and Zambézia. A limited area of the two provinces will be covered at a scale of 1:50,000. This is the first of a two-phase project that the World Bank will fund under a proposed land-use/land-cover activity. The two provinces are to serve as a pilot project for similar mapping of the country. The purpose is to plan for rural rehabilitation. The major source of the data for mapping will be Landsat's Thematic Mapper. SPOT data will be used in selected areas for increased detail. Data will be available as both black-and-white maps and in digital form in a GIS. Other data layers to be added include those for transportation, administrative districts, hydrography, and principal towns.

Soils and Land Capability. Soil maps at a scale of 1:1,000,000 are available in digital GIS form at the National Institute of Agronomic Research (INIA) and are being printed as map sheets. Land-capability maps at a scale of 1:250,000 include data on soils, soil fertility, and hydrology and are being prepared for three districts. These will be available in digital GIS format and as hard copy.

DINAGECA has also produced soil maps at 1:250,000 for the southern area and biomass maps at 1:250,000 and 1:50,000 for some southern regions.

Social Services. The United Nations Office for Humanitarian Assistance Coordination (UNOHAC) manages the most extensive database on social services in Mozambique. Along with the FAO's food security database, the UNOHAC's database operation employs people throughout the country. The current program is scheduled to end in October 1994, and may die when U.N. operations in Mozambique end. Database variables potentially useful to USAID include:

- Soil fertility
- Family-sector production of maize
- Family-sector production of cassava
- Most cultivated crop by district, 1969
- Most cultivated crop by district, 1992-1993 and 1993-1994
- Current enrollment in primary school
- Road accessibility of district capitals
- Population per primary health care unit
- Network of rural and general hospitals
- Population density
- Markets

F. Environmental Monitoring, Evaluation, and Mitigation Plan (EMEMP)

An EMEMP combines monitoring, evaluation, and mitigation in an effort to address USAID's legal obligations in the DFA to protect long-term environmental interests from the negative policy consequences of policy reforms. Through mid-1994, approximately 25 EMEMPs were being implemented or developed as part of USAID's NPA assistance in sub-

Saharan Africa. The regional environmental officers and the Bureau for Africa help design an EMEMP in cooperation with mission staff.²⁷

If USAID/Mozambique's strategy involves NPA that encourages policy reform with potential environmental implications, an EMEMP will be required. EMEMPs are equally appropriate because of USAID's selection of the environment as a major strategic objective. A well-conceived EMEMP can be used to integrate all monitoring activities in a comprehensive framework. As an illustration, the required information for missions' annual Assessment of Program Impact could be derived from data collected and analyzed through an EMEMP. Implementation of EMEMPs is the host government's responsibility, so substantial efforts are typically required to build suitable institutional capacity within these governments.

G. Integrating Monitoring Needs

Mission programs are not designed in vacuums. The government's involvement and concurrence is implicit in developing and implementing such programs. Both need data on program progress. The mission can establish individual monitoring efforts and can use these for program management or for EMEMPs and can aggregate the data to satisfy reporting requirements.

It is difficult to get data from many ministries in Mozambique. The government would be served best by line ministries and departments that collect and distribute data as part of their mandate to manage their respective portfolios. Such a system could also serve the needs of USAID/Mozambique. There is currently an interesting opportunity to develop such a system. As noted in chapters 2 and 3, the Ministry of Agriculture is developing a Pre-Program, which is assessing the ministry's needs and developing a strategic plan for investments to fulfill those needs.

For this approach to be successful, the Ministry of Agriculture will require monitoring capability to identify changes in areas it is trying to affect. Related efforts to decentralize governmental authority will make establishment and upgrading of provincial and district units of the Ministry of Agriculture a logical step. Although USAID/Mozambique has consciously eschewed any effort to strengthen existing institutional capability within the Government of Mozambique, the mission may wish to consider such an effort as a long-term goal. Such support should be premised on the government's clear understanding and delineation of what roles and responsibilities various ministries should have. This process of categorization and definition would facilitate the mission's efforts to achieve its strategic objectives. Having suggested the potential desirability of such strengthening, it is important to note that it is probably premature in many substantive areas, as much of the discussion in this report suggests.

²⁷ For a thorough discussion of the development and implementation of EMEMPs in four African countries, see Hecht (1994).

H. An Environmental Information System for the NEMP

The CNA is responsible for coordinating the actions that will lead to acceptance of the draft National Environmental Management Plan (NEMP). To have meaningful effect, the plan must identify required actions to ameliorate or reverse the problems identified in the NEMP. This will require some form of environmental information system to locate problem areas and to design mitigation plans. Monitoring will also be required to assess the effect of investments designed for the mitigation efforts.

I. Monitoring for Mission Needs

To develop comprehensive plans to improve rural incomes, it will be useful to know the location and changes in rural settlements and their use of land and other resources. Satellite data can provide overall location of areas settled in relation to roads and other infrastructure. USAID's needs would determine the type of satellite data and the frequency of repetitive coverage. Low-altitude videography can provide ground truth. Video may also be the most efficient way to gather data and possibly the only option in areas of limited or no access.

J. Conclusions

It is unlikely that any monitoring system can unequivocally show that a program is leading to improving people's lives and protecting the environment. Too many variables intervene, and too many other donors are providing parallel support. It is possible, however, to assess whether change is occurring and, if so, its direction. It is also possible to show whether and why agricultural yields are increasing, people's health improving, or incomes rising. Such information can lead to a review of the hypotheses on which assistance is predicated or an adjustment in the implementation strategy. Collecting and using data to track the impact of a program on people and the environment is therefore valuable, although the data cannot prove a clear cause-and-effect relationship between the investments and the program's goal. The monitoring effort's purpose of documenting a change in people's lives while maintaining or improving the natural resource base will impose a discipline on the development assistance effort.

VI. Conclusions

The elaboration of this CPSP comes at a time in Mozambique's history when the Government of Mozambique and donors have what may be a unique opportunity to implement a combination of policies, programs, and projects that address a substantial portion of the environmental issues confronting the country. As a result of the war-related disruption of productive activities that formerly placed pressure on tropical forests, these resources have recovered in some areas of the country. There is considerably less certainty about the extent to which wildlife has recovered; the available evidence suggests that it has not. Nonetheless, legislation currently being drafted or considered in areas related to government decentralization, land access and tenure, and environmental policy and regulation offer the possibility of creating incentives for people to manage resources in conserving ways and empower them to do so. There is widespread recognition among the Government of Mozambique and the donor of the opportunities that the current situation offers, and of the consequences that might result from failure to take advantage of them.

The three focus areas of the CPSP that USAID/Mozambique has defined all have the potential for making significant contributions to the conservation and sustained management of tropical forest and wildlife resources. The income focus will have the greatest number of direct impacts on how local populations use natural resources. By focusing on income, USAID/Mozambique has identified an important issue shaping patterns of land use; rural families who are experiencing absolute or relative income declines often turn to extensive and destructive patterns of land use to compensate. Increasing incomes is an essential element of promoting effective management of natural and environmental resources, but it is not sufficient. In this regard, the strategic coordination of provision of health and sanitation services and primary education, and the promotion of democratic participation and accountability in how resources are allocated and used can contribute to creating the broader conditions required for increases in income to translate into environmentally sound resource management.

Each of the mission's three focus areas has its own priorities, but all raise important issues regarding the environment and natural resource management. As an illustration, the emphasis on supporting democratic political processes at the local level goes to the heart of issues of resource allocation and access and can make an important contribution to creating conditions that favor environmental conservation and sustainable rural production systems. Similarly, the location of essential infrastructure in relation to areas prioritized for promoting productive activities intended to raise rural incomes can have a significant influence on the success of the activities themselves, the impacts the activities have on the environment, and on general patterns of land use in the vicinity in which they are located.

The team appreciates the complexity of trying to coordinate these activities solely on the basis of environmental concerns. The team also recognizes that it would not be desirable to attempt to do so in light of the mission's priorities that each focus area reflects. Nonetheless, the preparation of the CPSP does offer a singular occasion to consider the opportunities that each focus area creates in regard to sound environmental conservation and sustainable production,

particularly when activities in one area have the potential to enhance the environmental impacts of activities being implemented in other areas. Presently, the working groups concentrating on the CPSP's different focus areas are working in relative isolation from one another. The team suggests that the CPSP's planning process include consideration of how coordination of selected activities in each area might strengthen USAID/Mozambique's capacity to address environmental issues assertively.

The team is aware of and understands the mission's reticence to devote its scarce resources to state agencies and its corresponding desire to work at a local level, promoting nongovernmental initiatives. The team believes that this preference is potentially consistent with promoting environmental conservation and sustainable production. At the same time, however, the Government of Mozambique and other donors are attempting to improve the state's capacity to promote these objectives as well. Ultimately, the state's ability to do this will be important in determining whether it can provide the guarantees of security in areas like land rights, rights to compensation for losses incurred as a result of the environmental irresponsibility of others, and so forth, that will be required to promote investment and encourage local initiative.

Therefore, the team urges USAID/Mozambique to be supportive of the efforts of the Government of Mozambique and other donors to improve the performance of state agencies in these kinds of areas. This recommendation emphatically does not mean that the mission should invest large amounts of time and money into strengthening state agencies. Nonetheless, the team believes that USAID can make a positive contribution to environmental conservation and natural resource management concerns by taking an interest in state agencies functioning as well as they can. For example, the team suggests that the mission take an active role in commenting on and urging improvements in the NEMP.

Similarly, while the team does not suggest investing large amounts of money in the CNA, the mission could support efforts to promote the CNA's role in defining informed environmental policy and enforcing responsible environmental regulation. Accordingly, it would be appropriate to involve the CNA in determining what mission projects require environmental assessments and in conducting the assessments. This would, in the team's opinion, contribute to conservation and resource management and have the added benefit of improving understanding among state agencies and the donors working with them of what USAID's assumptions and objectives are. Finally, dependence on the CNA for these tasks is consistent with Section 117 of the Foreign Assistance Act, which encourages cooperation with developing countries to achieve environmentally sound development, the strengthening of their capacity to protect and manage their environment, and reliance on local technical resources in preparing environmental assessment of "any proposed program or project...significantly affecting the environment of any foreign country."

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Appendix 1

USAID/MOZAMBIQUE COUNTRY PROGRAM STRATEGIC PLAN

BACKGROUND ANALYSIS FOR ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT

Statement of Work

I. Introduction

A. Purpose

Technical services are required to assist USAID/Mozambique in completing the environmental and natural resources management (E/NRM) analytical requirements for the preparation of a Country Program Strategic Plan (CPSP) in accordance with current Mission, USAID, and U.S. government guidance and priorities on this subject.

The primary product of this effort shall be a report that identifies and assesses: (1) the status of Mozambique's environmental and natural resources, with particular emphasis given to the conservation and management of biodiversity and tropical forests; (2) shortcomings in the knowledge and management of these resources; (3) efforts of other donors and nongovernmental organizations to address problems associated with potential damage to these resources; and (4) recommendations for potential actions and/or justifications for inaction. Although internal travel within Mozambique may be necessary, this statement of work does not provide for primary, field-based research. The completed report shall address thoroughly the environmental mandates included in sections 117-119 of the Foreign Assistance Act.

B. Strategic Priorities

1. **Mozambique:** Throughout much of the past two decades, Mozambique has suffered the effects of a prolonged civil war. As a result of this conflict, much of the nation's infrastructure was severely damaged or destroyed, rendering most regions of the country inaccessible. An estimated 25 to 30 percent of the population--some 4 to 5 million people--were either displaced to the more secure coastal areas and population centers or became refugees in neighboring lands, especially Malawi. More recently, this tremendous war-induced toll has been exacerbated by the effects of a serious drought experienced in large portions of the country (and the region). Under such circumstances, pursuit of any "normal" long-term development agenda has been difficult, and USAID as well as other donors have been forced to limit development assistance largely to addressing the immediate needs of a society in turmoil.

With the signing in October 1992 of the General Peace Accord and the end of the regional drought, Mozambique is returning to some semblance of normalcy. Hopes are now high that, following the elections scheduled for October 1994, Mozambique will be in a position to start the long process of national reconciliation, reconstruction, and rehabilitation towards a more stable, just, and economically productive society.

The Government of the Republic of Mozambique's (GRM) National Reconstruction Plan envisages moving from short-term rehabilitation to long-term development. The GRM is committed to and is making progress under its economic and social rehabilitation program, but the government does not have a comprehensive framework for linking these objectives with sustainable environmental and natural resources management. This raises the possibility that efforts to rehabilitate the economy could have the unintended result of increasing degradation of these resources, which constitute the life support base and foundation of productivity. In turn, this would lead to resource depletion, further increasing the vulnerability of the poor.

2. **USAID:** USAID's strategic priorities within the E/NRM sector are a reflection of the U.S. Government's commitment to the protection of tropical forests and the conservation of biodiversity. Salient country program analytical requirements in support of these priorities are described in Sections 118 and 119 of the Foreign Assistance Act, respectively. Section 117 explicitly links the economic and security interests of the United States to leadership in natural resources and the environment. Sections 118 and 119 specifically state that:

Each country development strategy statement or other country plan prepared by the Agency for International Development shall include an analysis of (1) the actions necessary in that country to [achieve conservation and sustainable management of tropical forests and conserve biological diversity] and (2) the extent to which the actions proposed for support by the Agency meet the needs thus identified.

The U.S. Government has stipulated that development assistance is to move beyond reviewing development activities for potential environmental impacts to supporting programs that are primarily focussed on natural resources sustainability, and environment and development linkages. The multiple linkages among the environment, population growth, poverty, public health, market, public and nongovernmental institutions, and social culture require a coordinated, geographically specific approach to build on the positive and to break the negative associations between development and the environment.

USAID's strategy for development includes five interrelated areas of concentration: (1) protecting the environment; (2) building democracy; (3) stabilizing world population growth; (4) encouraging broad-based economic growth including protecting human health and supporting sustainable agriculture; and (5) providing humanitarian assistance and aiding postcrisis transitions. Within the E/NRM sector, USAID's strategic priorities are: (1) a reduction in long-term threats to the global environment, particularly loss of biodiversity and climate change; and (2) the promotion of sustainable economic development locally, nationally, and regionally by addressing environmental and economic practices that impede development or are not sustainable.

Country-specific E/NRM issues are addressed to promote the sustainable management and use of the environment and natural resources for long-term economic prosperity and a satisfactory quality of life for all. The critical environmental questions for Africa relate to the underlying productivity of the continent's resource base, as a pivotal element of long-term economic development. For that reason, USAID emphasizes programs that support the sustainability of agriculture, tropical forests, and biodiversity.

3. **USAID/Mozambique:** USAID/Mozambique is currently operating under a 36-month transition program initiated following the signing of the Peace Accord in October 1992. The transition program consists of: (1) emergency assistance in response to the effects of the 1992 drought; (2) support for the peace process (including demobilization, mine clearance, elections, and rural reintegration and rehabilitation); and (3) implementation of the Mission's core development program. The core program includes, inter alia, policy dialogue and research in support of agricultural policy reforms; support for better governance through decentralization; legal sector reform and strengthened civil society; improvements in primary health care delivery and management; private sector import support; commercial food aid; and long- and short-term training.

The Mission is developing a new program strategy for the period FY 1996-2001. Three broad areas have been identified for investigation and analysis for identification of possible strategic objectives. These areas are democracy/governance, social services, and income generation in agricultural and nonagricultural sectors.

II. Statement of Work

A. Topical Areas Requiring Analysis

The analysis shall address the following topical areas:

1. **Soil/Land Resources** to include general geography, topography, classification and condition, such as soil fertility and land use, as they relate to or potentially affect sustainable agriculture;
2. **Water Resources** to include both freshwater and adjacent coastal/estuarine resources;
3. **Vegetative Cover** to include natural and plantation forests (especially tropical forests), grasslands and pastures, agricultural/agroforestry and fallow vegetation, and coastal/wetlands vegetation;
4. **Wildlife/Biodiversity** to include terrestrial, aquatic and coastal/marine fauna, and associated habitats and ecosystems, e.g., protected areas and associated buffer zones, peripheral zones;

5. Nonrenewable Resources to include minerals, fossil fuel and petroleum resources, and other significant resources.

The five areas are listed as discrete topics solely for ease of presentation. In completing the tasks outlined below, the team should not let this arbitrary sectoral framework deter it from identifying and analyzing the significant intersectoral E/NRM issues and relations that exist and must be addressed in completing a thorough sectoral analysis of Mozambique. While "brown" issues, such as industrial pollution, associated environmental liabilities, and urban environmental issues, should not be overlooked, they should not be a significant focus for the analysis. An overview of the status of the environment in Mozambique with particular reference to the five areas listed above will be supplied to the team upon arrival. A bibliography of environmental documents is also available.

B. Tasks

1. Gather and review documentation and information on the five topical areas listed above. Potential sources include documentation obtained from and interviews with knowledgeable Mission staff, GRM officials and advisors, other donor representatives and advisors/consultants, representatives of international, regional and local PVOs and NGOs, local consultants and other private sector representatives, and university staff. This task does not include primary field research or other raw data gathering or collection efforts.

2. To the extent that the available literature and documentation permit, complete an analysis of the information collected and reviewed for each of the five topical areas from the following perspectives:

a. the state of the resource to include sources of supply, distribution, quantity, quality/condition, ecological processes, significant migration patterns, etc.;

b. the uses of the resource to include both planned and sanctioned-use activities as well as illicit exploitations and other significant human-induced or natural pressures affecting the quantity or quality of the resource in question, e.g., indirect effects, climatic variations, etc., with particular attention devoted to differences related to gender and interest/ethnic groups;

c. planning, policies, and legislation (at the national, regional and local level) affecting the sustainable management of the resource in question, including level and extent of government planning efforts, adequacy and appropriateness of salient policies and legislation and any known impact of policies, extent and effectiveness of donor coordination, and effectiveness of monitoring and evaluation and other information collection, management, and use systems; capacity for environmental monitoring and mitigation should be assessed as well;

d. management, administration, and organization to include the capacity and effectiveness of government/parastatal institutions, training and educational institutions, academic and other research interests, PVOs, NGOs, and private sector entities to manage or contribute

to the sustainable management of the resource in question; also include a brief examination of the existing NEAP process in Mozambique;

e. economic considerations to include salient economic or financial incentives affecting the sustainable management of the resource in question;

f. sociocultural considerations to include salient political-social characteristics and institutional structures of the society, including gender-based characteristics, role of land tenure, extent of social cohesion/fragmentation, public health and sanitation considerations, aesthetic considerations, and beliefs, taboos, and other cultural constraints to the sustainable development, adoption, and use of the resource in question, involvement of different population groups, including gender, foreign and local interest groups in the private sector, in resource use, planning management, and organization, and the impact of policies and legislation and technical and economic issues on these groups.

Wherever applicable and salient information is available, planned and projected future GRM decisions or actions affecting the resource in question with respect to each of the above topics should also be considered in the analysis.

3. Based on the results of the analysis completed for the previous task, identify and describe any perceived shortcomings in existing and future efforts to manage the resource(s) in question sustainably, together with an estimation of the relative significance of the issue with respect to the priorities of Sections 117, 118, and 119 of the Foreign Aid Assistance Act, the GRM's National Reconstruction Plan, and USAID/Mozambique's CPSP as described in section I.B., Country Context and USAID Priorities, above.

4. Review relevant ongoing and planned activities by other donors, and international and local PVOs and NGOs, academic and research interests, and private sector entities to identify projects or programs that are intended to assist in the sustainable management of Mozambique's environmental and natural resources and that can be expected to assist in addressing the shortcomings identified in task 3.

5. Briefly recommend and concisely justify potential actions or interventions to address the shortcomings (identified in task 3 but not adequately dealt with per task 4), for promoting the sustainable management or use of Mozambique's environment and natural resources for the Mission's consideration for inclusion in the new program strategy. Particular attention shall be devoted to actions that could complement or otherwise contribute to the sustainable achievement of the planned CPSP goals (towards enhanced human productivity) and strategic objectives, or which would be required to ensure that the other planned Mission activities are achieved in an environmentally sound and sustainable manner.

6. Submit a draft report and, following a brief period for review and comment by the Mission (and others identified by the Mission), a final report documenting the results of the tasks specified above.

The final report shall include a copy of this statement of work, a comprehensive bibliography of all salient literature reviewed in the completion of this work, and a list of all persons contacted during the implementation of this work.

Five copies of the draft report and ten copies of the final report shall be submitted to the Mission. The draft report shall be submitted to the Mission before the team's departure from Mozambique. In addition, the Mission shall also be provided with computer diskettes of the draft and final reports in WordPerfect 5.1 format.

Reports will be completed and submitted in English.

All documents collected by the team in support of the completion of this work (and deemed retainable) will be submitted to, and remain the property of, USAID/Mozambique for future reference and use, unless agreed to otherwise by the Mission.

At the request of Mission staff, the team shall make an oral presentation that discusses the results of the analysis and assessment.

III. Team Qualifications, Experience Criteria, and Terms of Reference

A. Required Expertise and Responsibilities

The core technical assistance services team should include:

1. a natural resource policy analyst/team leader (25 days);
2. a biodiversity/wildlife specialist (27 days);
3. a tropical forestry specialist, with related experience in sustainable agriculture (27 days);
4. a monitoring and evaluation/information systems expert (core-funded, to be coordinated with the Bureau for Africa); and
5. a Mozambican social or natural scientist familiar with the country's environmental and natural resources (25 days).

The natural resource policy analyst/team leader will have primary responsibility for: (a) arranging a team planning meeting (to include appropriate representation from the Bureau for Africa); (b) the activities associated with Tasks 2 c, d, e and 4; (c) preparation of appropriate parts of the reports described in task 6; and (d) ensuring successful completion of all tasks and reports.

As appropriate, the biodiversity/wildlife specialist, the tropical forestry specialist, and the information systems specialist will share responsibility for tasks 1, 2 a, b, and f and complete appropriate portions of the reports described in task 6. These experts must ensure that their analyses (and the portions of the reports for which they are responsible) comprehensively address

the issues and mandates associated with sections 117, 118, and 119 of the Foreign Assistance Act.

The locally hired social or natural scientist will assist in making local arrangements for the expatriate consultants. More important, the Mozambican consultant will provide assistance to the other experts by identifying and locating relevant documentation, arranging appointments, and establishing contacts with local nongovernmental organizations. Depending upon this person's expertise, he or she should contribute in a substantial way to the activities associated with all tasks.

Due to the nature of tasks 3 and 5, all team members will share responsibility for their completion.

B. Qualifications and Experience Criteria

Expatriate team members should:

1. possess graduate-level degrees in their area of expertise or a related discipline;
2. demonstrate professional competence in their respective areas;
3. possess appropriate professional experience within developing countries;
4. have prior regional experience;
5. demonstrate knowledge of and experience with USAID's practices and procedures; and
6. possess strong oral and written communication skills.

Highly desirable is:

7. prior professional experience in Mozambique and the southern Africa region; and
8. prior experience in USAID's CPSP analysis and/or preparation.

The locally hired expert should be familiar with relevant local NGOs and should demonstrate sensitivity to issues of gender as they relate to the sustainable use and management of Mozambique's environmental and natural resources.

Language proficiency in Portuguese, while highly desirable, is not required.

Appendix 2

People Contacted

National Commission for the Environment

Bernardo Ferraz	Director General
Abilio Inguane	Documentation and Information Center
Barbara Leite	Project Manager, National Environmental Management Plan
Francisco T. C. Mabjaia	Head, Department of Environmental Planning and Research and Management
Alfredo Massinga	Director, Mecufi (Cabo Delgado) Sustainable Development Project and Coastal Research Coordinator

Ministry Representatives

Abdul Adamao	National Directorate of Forestry and Wildlife
Simeão Velemo Cambaco	National Directorate of Geography and Mapping
Milagre Cerezilo	National Director, National Directorate of Forestry and Wildlife
Russo da Sa	Director, Provincial Fisheries Services
Imelda da Souza	Director, Fisheries Research Institute
Manuel F. G. Ferrão	National Remote Sensing and Cartography Centre
Jennifer Garvey	Legal Counsel, Director General of Mines
Polly Gaster	Director, Bureau of Public Information
Roberto W. Kachamila	Topographer, Image Analyst, National Remote Sensing and Cartography Centre
Félix Mandhlate	President, National Institute of Rural Development

F.M. Mazuze	Chief, Land and Water Department, National Institute of Agronomic Research
Mike Murphree	Technical Advisor, National Directorate of Forestry and Wildlife
Bartolomeu Soto	National Directorate of Forestry and Wildlife
Carlos Bernabé Zandamela	National Director, National Institute of Agronomic Research
Paulo Francisco Zucula	National Family Sector Agricultural Development Programme

University Eduardo Mondlane

Yussufo Adamo	Lecturer
Salamao Bandeira	Head, Herbarium, Department of Biology
Jaime Bunster	Department of Forestry
Telma Faria	Department of Agronomy and Forest Engineering
Domingos Gove	Department of Biology
Leonel Leite Lopes	Department of Geography
Oswaldo Manso	Department of Forestry
Margarita Mejía	Department of Women's and Gender Studies, Center of African Studies
Abdala Mussa	Department of Agricultural Economics
Inocência Pereira	Department of Geography
Carlos Miguel Ribeiro	Department of Fruit Crops and Agronomy

USAID/Mozambique

Peter Argo	Engineering Officer, outgoing Environmental Officer
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Scott Allen	Mission Economist
Juliet E. G. Born	Program Advisor
Diane Eames*	Private Sector Advisor
Robin Mason	Rural Development Specialist, incoming Environmental Officer
Cheryl McCarthy	Acting Deputy Director
Darrel McIntyre	Agricultural Officer
Charles North	Acting Program Officer
Fernando Paixão*	Agriculture Sector Advisor

USAID/Washington

Walter Knausenburger	Bureau for Africa
Russell Misheloff	Bureau for Global Programs, Field Support, and Research
Tony Pryor	Bureau for Africa

International Donor Community: Mozambique

Klaus Broersma	First Secretary, Embassy of the Netherlands
Sergio Castillo	Chief Technical Advisor, FAO
Roberto Chávez	Resident Representative, World Bank
Alberto Correia Mendes	Data Management Officer, World Food Program
Rod de Vletter	Operations Officer, Environment, World Bank
Christine de Voest	Operations Officer, Agriculture, World Bank
Enzo di Taranto	Information Officer, UNOHAC
Julio P. González-Palmou	Country Representative, FAO

Andrew S. Karlyn	Anthropologist, Doctors without Borders
Eusébia Mata	Program Officer, Norwegian Agency for International Development
Alessandro Palmero	Economic Attaché, European Community
Martin Whiteside	Chief Technical Advisor, UNEP

International Donor Community: Washington, D.C.

Tanya Yudelmann	Mozambique Country Officer, World Bank
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PVOs, NGOs, and Grassroots Organizations: Mozambique

Lisa Bornstein	Consultant, Food for the Hungry International
Fernanda Cabanas	National Director, Agricultural Sector Documentation and Information Center
Buck Deines	Agronomist and Extension Specialist, Food for the Hungry International
Ricardo L. Dueñez	Project Coordinator, Africare
Paul Dutton	World Wildlife Fund
Valeriano Ferrão	Consultant, General Union of Agricultural Cooperatives
Manuel Ginga	Agricultural Technician, Buzi District, Food for the Hungry International
José Manuel de Almeida	Extension Coordinator, Food for the Hungry International
Arminda Prost	Health Worker, Sanitation Project Coordinator, Africare
Niall M. Watson*	Deputy Country Director, Food for the Hungry International

* Participated in meeting with team but not interviewed individually.

Appendix 3

Additional Documents and Materials Reviewed

The following documents and materials represent a partial list of items reviewed during the assessment but not reflected in the text. In addition to these items, the assessment team also reviewed pertinent legislation, government directives, and a considerable amount of "gray literature" available only in Mozambique. For much of the latter, much of it in Portuguese, full citations are not available, so such items are not included.

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Appendix 4

Summary of Donors' and Lenders' Environmental Activities, June 1994

Donor Agency	Implementing Agency(ies)	Topical Issue	Area Affected
Government of Netherlands	INDER and NGOs	Integrated Rural Development; pilot area for Programa de Reabilitação de Organizações Locais (PROL)	Four western districts of Nampula Province
Government of Netherlands	Various ministries	Port management support	Beira: pilot training; Maputo: drainage and sanitation
DANIDA	?	Erosion control	Nampula Province
NORAD/Maputo	CNA	Coastal zone management pilot project	Mekufi, Cabo Deigado Province
NORAD/Maputo	Biology Department, UEM	Coastal zone management research	Inhaca Island, Maputo
NORAD/Maputo	DNFFB	Core institutional support, not including salaries	Maputo Office
NORAD/Maputo	CNA	Workshop to assemble state-of-the-environment studies	National
NORAD/Oslo	CNA	Support for the NEMP	National
NORAD and FINNIDA	?	Soil erosion control	Nacala
European Community	UEM	Rehabilitation study	Ilha de Maçambique
European Community	DNFFB	Training park rangers-includes	National

		jobs for some demobilized troops	
European Community	European NGOs	Water supply and infrastructure	Sofala Province, central Mozambique
European Community	Ministry of Tourism	Physical management master plan for tourism development	Cabo Delgado, Nampula, Inhambane, Gaza, Maputo Provinces
EC, ADB, IUCN	DNFFB, IUCN	Integrated rehabilitation and management plan (EC and IUCN); Implementation of plan (ADB)	Gorongosa National Park and surrounding area
World Bank and EC	CNA, IUCN, WWF	Integrated Coastal Zone Management	Bazaruto Archipelago
World Bank	SEHA	Medium- and large-scale irrigation master plan; may extend to small-scale	National
World Bank	DINAGECA	Land use information system; remote sensing	Zambézia and Sofala Provinces
World Bank	INDER	Support for technical committee on land use; streamline information storage and retrieval	National
World Bank	Ministry of State Administration	Local government strengthening; includes substantial environmental management emphasis (PROL)	National
World Bank	Various	Activities under various projects to implement NEMP; Environmental Support Programme	National
World Bank (GEF)	DNFFB	Transborder national park program; community management of multiple resources	Mozambique borders with Swaziland, South Africa and Zimbabwe

World Bank, UNDP	?	Lacustrine resource management	Lake Niassa
UNDP	CNA	Technical support for the CNA	National
UNDP	Ministry of Agriculture	Pre-Program; pilot program for implementation of strategic plan	National in scope; implemented in eight districts
Government of Australia	DNFFB, IUCN	Wildlife advisor	National
Swedish International Development Agency	CNA	Training local decision makers in sustainable development	National
Government of Japan	CNA	Support for the NEMP; from funds for Environmental Support Programme; not received by CNA as of June 17, 1994	National
Government of Japan	Various	Support for the Environmental Support Programme	National

Appendix 5

Portrait of Mozambique's Forest Sector

1. **Total Forest Area (1980-1985): 15,435,000 ha**

Closed Forest	935,000 ha
Open Forest	14,500,000 ha

Other Wooded Areas

Forest Fallow and Shrubland	42,700,000 ha
Plantations	25,000 ha

Total Forest and Other Wooded Areas 58,160,000 ha

Percent of Total Land 74 %

2. **Deforestation Rate (1980s)**

Total Forest Area	120,000 ha
Percent of Total	0.8 %

Closed Forest	10,000 ha
Open Forest	110,000 ha

3. **Reforestation and Plantations (by 1980)**

Reforestation Average Annual Rate (1980s)	4,000 ha
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Total	24,000 ha
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Hardwood (as % of total)	13 %
Softwood (as % of total)	50 %
Nonindustrial Plantations (as % of total)	38 %

4. Land Use and Change

Land Area	78,000,000 ha
Cropland	
Percent of Land Area	4.0 %
Percent Change 1975-1987	0.3 %
Permanent Pasture	
Percent of Land Area	56.0 %
Percent Change 1975-1987	0.0 %
Forest and Woodlands	
Percent of Land Area	19.0 %
Percent Change 1975-1987	-6.0 %
Other Land	
Percent of Land Area	21.0 %
Percent Change 1975-1987	6.2 %

5. Productive Forest Area (1980-1985)

Total Area	3,800,000 ha
Closed Broad-leaved Forests	
Unmanaged Primary (% of total)	2 %
Unmanaged Logged (% of total)	10 %
Managed	0 %
Open Broad-leaved Forests (% of total)	88 %

6. **Productive Forest Volume (1980)**

Growing Stock

Total (M m ³)	24
Inventory (ms/ha)	60

Closed Broad-leaved Forests

Unmanaged

Undisturbed (% of total)	21 %
Undisturbed (m ³ /ha)	70
Logged (% of total)	79 %
Logged (m ³ /ha)	50

Managed

Percent of Total	0 %
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7. **Protected Forests (1980s)**

National Protected Systems

Number	1
Area	2,000 ha
Percent of Land Area	0 %

Protected Forest

Total Forest Area	375,000 ha
Percent of Total forest	2.4 %
Closed Forest Area	25,000 ha
Percent of Closed Forest	0.2 %

8. Forest Sector Production

Gross Value (1961) US\$202,000,000

Percent Gross Value of GDP (1961)

Forest Sector Total	6.6 %
Forest Industry	0.8 %
Nonindustrial	5.8 %

Gross Value (1989) US\$411,000,000

Forest Sector Total	8.9 %
Forest Industry	0.2 %
Nonindustrial	8.7 %

9. Trade: Forest Products Value

Exports	1980	US\$9,000,000
	1988	US\$3,000,000

Imports	1980	US\$11,000,000
	1988	0

Exports	As a % of Total Exports	1980	3.1 %
		1988	3.0 %
	Growth Rate 1980-1988		-16.1 %

Imports	As a % of Total Exports	1980	1.4 %
		1988	0.1 %
	Growth Rate 1980-1988		-40.9 %

10. Roundwood Production

Total	1980	13,245,000 m3
	1988	16,002,000 m3
Industrial Roundwood as % of Total	1980	7 %
	1988	6 %
Woodfuel as % of Total	1980	93 %
	1988	94 %
Growth Rate		
Total Roundwood	1980-1988	2.4 %
Industrial Roundwood	1980-1988	0.0 %
Woodfuels	1980-1988	2.5 %

11. Roundwood Consumption

Total	1980	13,234,000 m3
	1988	15,996,000 m3
Industrial Roundwood as % of Total	1980	7 %
	1988	6 %
Woodfuel as % of Total	1980	93 %
	1988	94 %
Growth Rate		
Total Roundwood	1980-1988	2.4 %
Industrial Roundwood	1980-1988	0.1 %
Woodfuels	1980-1988	2.5 %

12. Roundwood Exports

Total	1980	11,000 m3
	1988	6,000 m3
Industrial Roundwood as % of Total	1980	100 %
	1988	100 %
Growth Rate		
Total Roundwood	1980-1988	-9.4 %
Industrial Roundwood	1980-1988	-9.4 %

13. Roundwood Imports

(none)

14. Processed Wood Production

Mechanical Wood	1980	67,000 m3
	1988	41,000 m3
Sawnwood as a % of Mechanical Wood	1980	97.0 %
	1988	88.0 %
Growth Rate	1980-1988	-6.5 %
Wood-based Panels as a % of Mechanical Wood	1980	3.0 %
	1988	12.0 %
	Growth Rate	1980-1988
Paper and Paperboard Volume	1980	3,000 MT
	1988	2,000 MT
Growth Rate	1980-1988	-2.2 %

15. Processed Wood Consumption

Mechanical Wood	1980	52,000 m3
	1988	39,000 m3
Sawnwood as a % of Mechanical Wood	1980	88.0 %
	1988	92.0 %
Growth Rate	1980-1988	-2.4 %
Wood-based Panels as a % of Mechanical Wood	1980	12.0 %
	1988	8.0 %
	Growth Rate	1980-1988
Paper and Paperboard Volume	1980	20,000 MT
	1988	3,000 MT
Growth Rate	1980-1988	-25.6 %

16. Processed Wood Exports

Mechanical Wood	1980	20,000 MT
	1988	2,000 MT
Sawnwood as a % of Mechanical Wood	1980	100.0 %
	1988	6.0 %
Growth Rate	1980-1988	-53.1 %
Wood-based Panels as a % of Mechanical Wood		
	1980	0.0 %
	1988	94.0 %
Growth Rate	1980-1988	-2.0 %
Paper and Paperboard	(none)	

17. Processed Wood Imports

Mechanical Wood	1980	4,000 m ³
	1988	0
Sawnwood as a % of Mechanical Wood	(none)	
Wood-based panels as a % of Mechanical Wood		
	1980	100 %
	1988	0 %
Growth Rate	1980-1988	0 %
Paper and Paperboard		
Volume	1980	17,000 MT
	1988	1,000 MT
Growth Rate	1980-1988	-41.5 %

Source: Sharma 1992

Appendix 6
State Agencies with Responsibilities in the Coastal Zone

Institution	Function
Fisheries Research Institute (IIP) (State Secretariat for Fisheries)	Research and monitoring of fish and shellfish stocks and ecology.
State Secretariat for Fisheries	National responsibility for the fishery sector.
Institute for Development of Low-Scale Fisheries (State Secretariat for Fisheries)	Technical assistance to the inshore, small-scale fisheries.
Department of Biological Sciences (University Eduardo Mondlane)	Trains ecologists and fisheries biologists. Administers the Inhaca Island protected area.
National Commission for the Environment (CNA)	Undertakes coastal zone management projects. Has completed a prenational environmental management plan that includes integrated coastal zone management.
National Directorate of Forests and Wildlife (DNFFB)	Manages forests (including mangroves) and protected areas including marine protected areas.
National Directorate for Water (Ministry of Housing and Water)	Regulates the development of water resources including upstream hydroelectric dams and water treatment sites near coastal cities.
National Directorate for Tourism (Ministry of Commerce)	Promotes tourism and grants concessions for tourist development on the coast.
Center for Promotion of Investments (Ministry of Commerce)	Approves plans for investment in the coastal zone including the coastal zone.
National Institute for Hydrography and Navigation (Ministry of Transport and Communications)	Develops and regulates coastal shipping.
Laboratory for Water and Food Hygiene (National Institute for Health)	Monitors bacterial levels in marine products for export and faecal contamination in drinking water.
Maritime Administration (Marine National Directorate, Ministry of Transport and Communications)	Policies the coastal waters and regulates all construction or use of a 100-meter strip above the high water mark.
Institute of Rural Development (INDER)	Provides technical support to small-scale agriculture in the coastal zone.