ICAM in Mozambique Xai-Xai District
Coastal Area Management Strategy

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ABBREVIATIONS

CECX - Xai-Xai City Council

CNA - National Environmental Commission

DINAGECA - National Directorate for Geography and Cadastar

DINATUR - National Directorate of Tourism

DNA - National Directorate for Waters

DNE - National Directorate for Statistics

DNFFB - National Directorate for Forestry and Wildlife

DNP - National Directorate for Planning

DPAP - Provincial Directorate for Agriculture and Fisheries

DPICT - Provincial Directorate for Industry, Commerce and Tourism

EAF - East African Action Programme

EIA - Environmental Impact Assessment

ESA - Environmentally Sensitive Area

FAO - Food and Agriculture Organisation

FRUTISUL - Association of Private Entrepreneurs

GBA-LBA - Global Programme of Action for the Protection of the Marine Environment from Land-based Activities

GIS - Geographic Information Systems

GTA - Environment Working Group

ICAM - Integrated Coastal and Marine Areas Management

ICRC - International Coral Reef Initiative (the Eastern African Phase)

IDPPE - Institute for the Development of Small Scale Fisheries

IIP - Fisheries Research Institute

INAHINA - National Institute for Hydrography and Navigation

INIA - National Institute for Agriculture Research

INPF - National Institute for Physical Planning

IUCN - International Union for Conservation of Nature

MAE - Ministry for State Administration

MICOA - Ministry for Co-ordination of Environmental Affairs

MICTUR - Ministry of Industry, Commerce and Tourism

NCSD - National Council for Sustainable Development

OIM - International Organisation for Migration

PAP/RAC - Priority Actions Programme/ Regional Activity Centre

PSD - Programme Support Document

SAFMAR - Services for Maritime Administration

SIDA - Swedish International Development Co-operation Agency

SPFFB - Provincial Services for Forestry and Wildlife

SPPF - Provincial Services for Physical Planning

SRBL - Sistema de Regadio do Baixa Limpopo

UEM - University Eduardo Mondlane

UNEP - United Nations Environment Programme

WIO - West Indian Ocean

EXECUTIVE SUMMARY

Project EAF/5

The coastal zone between the continental states of Somalia and Mozambique is home for 25 million people. This represents 20% of the total population of continental nations living on 12% of land. Thus, even with declining national population growth rates, there will still be a strong competition for the existing coastal resources. The pressure on coastal resources will increase as more people seek employment opportunities around coastal centres, as well as the right to the unrestricted access to the seashore, the right to coastal renewable resources, and the right to recreational activities.

Management of land-based activities in coastal zones has in turn become one of the most complex management challenges. Given the severity of the coastal zone degradation, and the need for sustainability and effective national regulatory interventions, there is great demand on governments who limited financial resources to act. In many instances, when governments act, the interventions are reactive, weak and, at times, aggravate the problems through sectorial policies that conflict. Policies are implemented as projects, in most cases in the form of sectorial projects with finite life spans. Developed projects may have little or no relation to the programmes implemented earlier. As a result, most governments are littered with half finished but related projects, or finished projects without long-term support or recurrent budgetary provisions. In most cases, local support is also lacking, such as:

- establishing policies that promote and enhance integrated planning and management of coastal areas by integrating the coastal zone into a national, economic and physical process;
- developing and implementing integrated planning and management of coastal area programmes, which address environmental concerns, particularly resources overexploitation, environmental degradation and loss of biodiversity, and emphasise action at the local level.

The project has secured funds from the Swedish International Development Co-operation Agency (SIDA) for the following activities in the Comoros, Kenya, Mozambique and Zanzibar State of the United Republic of Tanzania, namely:

I. Development and implementation of national public awareness strategies, campaigns and material;

II. Development of ICAM strategies for selected pilot sites;

III. Implementation of ICAM Demonstration projects (e.g., fish landing sites, dune restoration, public beach facility improvement);

IV. Development and Implementation of ICAM priority bankable projects identified within ICAM strategies developed.

Project EAF/5 in Mozambique

Mozambique has a surface area of about 800,000 km^2, out of which 44% once being under maritime influence and now forming littoral valleys not higher than 200 m. The coastline is about 2,700 km long, with 42 Districts out of 110 Districts of the country being coastal. About 40% of the Mozambican population lives in coastal Districts, causing a very high pressure over the coastal ecosystems. These ecosystems are, *per se*, very fragile and degradation has already been seen, particularly deforestation,

mangrove depletion, acceleration of erosion, soil salinization and coral destruction.

The Ministry for Co-ordination of Environmental Affairs (MICOA), giving the highest priority to the coastal zone, decided on the elaboration of the coastal zone management programme of Mozambique. The District of Xai-Xai was chosen as a pilot area in May 1995. A working team was formed to work on the Xai-Xai ICAM accompanied by the consultants nominated by the Priority Actions Programme/Regional Activity Centre (PAP/RAC) which was selected by FAO as the executing agency. The tasks of the team include as follows:

1. Coastal Profile of a selected area;
2. Management Strategy for the selected issues;
3. Implementation of a small Demonstration Project;
4. Public Awareness Campaign;
5. National Workshop on the proposed management strategy adoption and implementation.

The Coastal Profile, which preceded the preparation of the Management Strategy, gives a broad identification of physical environment, natural resource base, socio-economic context, physical systems and institutional framework of the region, highlighting the main environmental and development problems and potentials, the major physical processes and development patterns, conflicts between different users, and specific coastal management priorities in the region.

For the purpose of the Xai-Xai Integrated Coastal and Marine Areas Management (ICAM), the coastal area is defined as follows:

- the near-shore sea or coastal water extending several kilometres seaward;
- the coastal dunes belt extending up to ten kilometres landward and along the entire coastline; and
- the Limpopo Lower Valley, up to the Xai-Xai Town.

Main Physical Features

The District of Xai-Xai is located in the Province of Gaza, comprising the area of 1,745 km^2 and representing about 2.73% of the total area of the Province. The District has a central position within the coastal stretch of the Gaza Province. The length of the District's coastline is 67 kilometres.

From a physical point of view, the District's coastal area belongs to the southern Mozambican region, classified as a parabolic dune coast. This coastal region stretches from Ponta do Ouro at the border with South Africa to Bazaruto Island up north. The coastline of this physical region is 850 kilometres long, and represents almost one third of the entire Mozambican coast. The coast is characterised by high parabolic dunes and north-trending capes, and barrier lakes. At some points, particularly in the Xai-Xai segment, these systems attain heights of more than 120 meters and are considered the world's tallest vegetated dunes.

From the functional point of view, the Xai-Xai District is the northern pole of the Incomati-Limpopo region, located in the most important transportation corridor, namely, the National Road Number One, linking the south and the north of the country.

Continental shelf on the Xai-Xai coast is narrower than in the Maputo Bay in the south and on the Inhabame coast in the north. The 100 meters isobath is on average about 15 km far from the shore. The tidal range along the Mozambican coast is the highest at Beira (6.3 m) due to the broad continental shelf in the Sofala Bay. At Xai-Xai, the tidal amplitude is lower, reaching 3.2 meters of the mean high water.

The main physical feature characterising the Xai-Xai District coastal area is a belt of parabolic dunes extending up to ten kilometres landward and along the entire coastline, except a couple of kilometres short break at the Limpopo river mouth. The belt of coastal dunes comprises three main physical entities: a) sandy beaches, open or protected by the beach rock; b) the dune hills, rarely flanked with smaller foredunes;

and c) barrier lakes at the backset of the dune hills.

The Limpopo river basin has a total area of 412,000 km^2 and is shared by Mozambique (19%), South Africa (47%), Botswana (18%) and Zimbabwe (16%). The mean altitude of the whole Limpopo river basin is 840 m. Within the District, the Limpopo river course meanders about 70 kilometres through its lower valley, from the Xai-Xai Town to the sea. The alluvial valley, which is formed within the inland or interior dunes area, has a circular shape with diameter of about 15 kilometres. Before reaching the sea, the river passes through the belt of coastal dunes forming a small estuary only a couple of kilometres wide.

ICAM Goals and Objectives

The process of applying ICAM to particular cultural and natural characteristics of the Mozambican coast, requires identification of a set of the overall goals and strategic objectives that collectively set policies and direct actions, and provide ongoing feedback from all users of the coast. ICAM is not a substitute for sectorial planning/plans, but focuses on the linkages between sectorial activities to achieve more comprehensive goals. The ICAM goals and strategic objectives are the following:

Overall Goals

- to contribute to economic and social conditions of the local population by identifying available resources and development potentials;
- to ensure that natural resources are rationally exploited and equitably divided between generations;
- to preserve ecological integrity through establishing ecologically sustainable limits for resources use;
- to recognise and support a wide range of values: ecological, economic and cultural;
- to encourage private/public partnerships;
- to provide a mechanism for capacity building and planning; and
- to provide a mechanism for collecting, analysing and incorporating data, as well as the ongoing feedback and review.

The Xai-Xai ICAM Strategy Framework

Based on the presented principles, the ICAM Strategy Framework for the Coastal Area of Xai-Xai should depart from the two major policy decisions, namely:

1. Biodiversity protection of naturally the most valuable and environmentally the most sensitive areas of coastal dunes, the Limpopo river and the Baixos de Inhampura Coral Reef, which, if preserved and maintained, would in turn benefit the local population and national treasury on a long-term basis;
2. Sustainable development of environmentally less sensitive, physically and functionally appropriate areas and sites for the development of agriculture, fishery and, particularly tourism, including residential zones and the relevant infrastructure.

Biodiversity Protection

The following biodiversity protection scheme is proposed (see Map 1):

- Managed Resource Protected Area (Terrestrial/Marine-Category VI): the entire coastal belt stretching beyond the District's boundaries, comprising ESAs: a) coastal dunes; b) the Limpopo river; and c) coral reef.

The average width of the coastal dunes belt is about 4.5 kilometres, and the average height of this chain is about 60 meters (the highest peak has 126 meters). Being only a segment of the coastal dunes belt which stretches into the neighbouring Districts (Provinces), the protected area should extend beyond the Xai-Xai District boundaries.

As it is proposed above, the entire coastal dunes ESA should be protected as the Managed Resource Protected Area (Terrestrial/Marine-Category VI). Special protection and conservation requirements should be designed for each of sub-areas (intertidal zone, dune hills, the area behind

the dunes) consequently governing the choice of compatible types of tourism development or other appropriate activity. Consequently, within the segment between the Xai-Xai and Chongoene Beach, the development of housing and tourist accommodation capacities, the related infrastructure and services should be allowed, but planned and controlled. The relevant management proposals for sub-areas (protection, conservation, restoration and regime of the activities), as well as for the entire segment dedicated to tourism development and comprising the elements of all the three sub-areas, are elaborated in more details within the Chapter 2.4.

Within this larger protected area, the following two specially protected areas should be established:

- Habitat/Species Management Area (Category IV): the Limpopo river; and
- Habitat/Species Management Area (Category IV): the Baixos de Inhampura Coral Reef.

The river mouth and its small estuary are a segment of the river course stretching through the area of coastal dunes in the length of about 6 km. Only the western side of the river mouth bears distinct characteristics of the estuary (saltmarsh and mangroves). The area has already been protected (nature or forest reserve) but notable improvements of environmental conditions in the area have not been achieved yet (signs declaring protection of the site have been removed by the local population).

Although small in size, the estuary is not only important as a nursery ground for shrimp and a habitat for mangrove crab, but is presently the only fishing ground (mostly sardines) that can be reached by local fishermen possessing only small engineless canoes. Within the management regime (IV Category) the activity should be allowed in the area, even the creation of a small artisanal fisheries centre is possible, but planned and strictly controlled. Agriculture and felling should be restricted in this area.

The river course, between the Town of Xai-Xai and the sea, meanders through the valley, partially bordered by the dikes built as a protection against flooding. The expected rehabilitation of the dikes, drainage and irrigation system in the Lower Limpopo Valley should be done fully respecting preservation and restoration of the riverine environment dominated by mangrove colonies along the river banks. It is important to avoid pollution of the river discharging the future agricultural runoff outside the river course and estuary. The upstream pollution caused by the Xai-Xai Town urban liquid waste should be eliminated adequately by a proper waste water treatment and disposal.

When applying the precautionary principle, the Baixos de Inhampura Coral Reef should be at least protected as the Habitat/Species Management Area (IUCN Category IV). Later on, if the necessary and envisaged survey of the reef proved its wider biodiversity, the protection category could be raised even to the establishment of a marine national park.

Sustainable Development

Development of agriculture, being essential for subsistence of the local population, should be directed towards the area of the Limpopo Lower Valley and interior dunes. Protection against flooding and restoration of the drainage and irrigation system as part of the integrated watershed management, is a prerequisite for the rehabilitation of agriculture in this area. This project should be designed in a way to preserve natural ecosystem of the Lower Limpopo, particularly mangroves growing along the river banks. Agricultural activities on the coastal dunes should be avoided. Development of agriculture in the valleys behind the coastal dunes can be planned, taking into account importance and vulnerability of the relevant groundwater aquifer.

There are favourable but limited conditions for the development of an artisanal fisheries centre in the Xai-Xai Beach and at the Limpopo river mouth where the fishermen colony already exists. Taking into account all

these advantages and disadvantages, it seems reasonable to propose development of the artisanal fisheries centre at the Limpopo river mouth, if further surveys proved the possibility of entering the river mouth. At the same time, the Xai-Xai Beach seems to be suitable for development of a tourist port, including existence of a small fleet of fishing boats to serve for game fishing and excursions (including visits and diving on the coral reef).

Within the 67 km long coastline of the Xai-Xai District, tourism, residential and relevant infrastructure (roads) development should be confined and concentrated at the places where this activity already exists, namely, in the area between the Xai-Xai and Chongoene Beach. Any development of tourist accommodation capacities outside of this area should be prevented in order to protect the remaining uninhabited and unspoiled environment of the coastal dunes. In such a way, the alteration of natural environment is confined to a relatively small section of the coastal dunes (9 kilometres in length or about 13% of the District's coastline).

The future infrastructure investments should, in general, serve the local population and tourism development. It is important to ensure that the adequate share of costs of infrastructure development will be carried by investors involved in tourism.

Concentration of tourist capacities in this section of the coastal strip will allow rational construction of adequate infrastructure (water supply network, liquid waste treatment and disposal, energy supply, feeder roads, boat landing and mooring facility, etc.).

Development of settlements within the coastal dunes area, should be restricted except within the segment of Xai-Xai to Chongoene Beach. The most appropriate area for this purpose are the interior dunes including the area behind the coastal dunes where a chain of small villages already exists.

The roads should be laid and constructed causing the minimum damage to the fragile dunes morphology and environment, particularly by avoiding the steep slopes and hilltops. In order to satisfy these requirements, the proposed tourist resort (and villages) should be serviced by roads passing through the area behind the coastal dunes and lateral valleys of the coastal dunes (see Map 3). The same principle should be applied to linking the Limpopo mouth with the national road.

Coastal Dunes Management

Conservation and sustainable development of the coastal dune areas is the overall goal. The dune should be in the first instance protected and preserved, and any development opportunities provided should be judiciously used so as not to disrupt its natural characteristics and support system.

Within this general goal, particular objectives are as follows (with reference to Chapter 2):

1. Protection of the entire coastal dunes belt as the Managed Resource Protected Area (Terrestrial/Marine - IUCN Category VI) stretching beyond the District's boundaries, comprising intertidal area, the dune hills and barrier lakes;
2. Restoration of the eroded and deteriorated segments of the coastal dunes area;
3. Sustainable development of environmentally less sensitive, physically and functionally appropriate areas and sites, particularly, the development of tourism, housing and relevant infrastructure in the Xai-Xai to Chongoene coastal dunes segment; and
4. Selective approach in designating the development areas within the Xai-Xai to Chongoene Beach Resort segment.

Limpopo Lower Valley

It should be noted that the Limpopo Lower Valley is only the final and, probably, environmentally the most sensitive segment of the vast Limpopo river basin. Only elaboration of the comprehensive Limpopo watershed management plan, what is an issue of the international co-operation,

could give the answers related to flooding, pollution, salinization, erosion and other basic problems. In lack of this comprehensive plan, only the inputs for biodiversity protection and relatively confined development issues are tackled in the Xai-Xai ICAM Strategy.

Within the comprehensive framework of sustainable development of the Limpopo Lower Valley, two specific goals have outstanding importance, namely:

1. Sustainable development of agriculture, including rehabilitation and construction of the systems for drainage, irrigation, and protection from flooding in the Limpopo Lower Valley;
2. Maintaining the productivity of the Limpopo estuary ecosystem, including:
   - sustainable management of the estuarine resources, and protection of its ecological assets;
   - promotion of uses compatible with conservation and sustainable development objectives.

Baixos de Inhampura Reef

1. The reef is made up of base rock with a very incomplete veneer of coral growth. As such, it is not a coral reef, but rather a coral community. It appears to resemble those reefs to the south of Maputo surveyed by the Oceanographic Institute of South Africa.
2. The mapping of the reef flat indicates that there are three sub-habitat types, but this can only be a preliminary observation as mapping of the reef slopes was not possible.
3. The area appears to be important for turtles, because 5 were seen over a period of 4 hours with a very poor visibility.
4. The reef is very exposed for much of the year and this may be an important factor in trying to develop diving or artisanal fisheries industry.
5. A rapid assessment should be performed before any final recommendations are made on which management option(s) should be considered.

Tourism Development

The coastal area of the Xai-Xai District, offers, among others, the following tourist and recreational development opportunities (see Map 2):

- the space suitable for the development of tourist centres, resort villages and hotels, as already mentioned, between the Xai-Xai and Chongoene Beaches;
- protected lagoons for bathing and snorkelling, and the possibility to develop a small tourist port;
- marine environment suitable for marine sports, such as ocean game fishing, sailing and surfing, diving on the reef;
- bathing, walking and jogging along the distant sandy beaches, and in the area behind the coastal dunes;
- excursions and recreation (canoeing) along the Limpopo river, in the estuary, and on the freshwater lakes (Lake Ualute); and
- developed urban centre, the Town of Xai-Xai, able to support the coastal tourist area with necessary services and infrastructure.

Being part of the coastal dunes protected area of the Xai-Xai to Chongoene Beach, the proposed tourist resort should be developed respecting as much as possible natural and landscape aesthetic values, particularly the dunes' indigenous vegetation and morphology.

Following this principle, the least harmful to the dunes environment and the most suitable for the development of tourist accommodation structures, are small valleys on the seaward side of the coastal dunes. Environmentally the most fragile sections, the steep hill slopes dividing these valleys should be kept undeveloped and indigenous vegetation cherished (see Map).

Situated on the opposite sides of the coastal segment proposed for tourism development, the sites of: a) Xai-Xai Beach;

and b) Chongoene Beach, have prerequisites to become the focal points or centres of the future tourist resort. The Xai-Xai Beach has already developed into a small tourist centre while the Chongoene Beach with the rehabilitation of the existing hotel and development of a new accommodation capacity on the eastern side, could have the similar function within the future resort.

Along the Xai-Xai to Chongoene Beach coastline, several sites, mainly seaward oriented valleys, are designated to accommodate hotels, tourist villages, camping sites, etc. These sites have the following common characteristics and values:

- the highest altitudes are not over 40 meters in order to avoid the unstable steep slopes and visual exposure in the landscape;
- the sites are serviced by roads on the landward side, therefore allowing the attractive seaward side remain undisturbed by traffic (including parking lots) and service activities;
- all the sites are shifted from the shoreline at the distance of about 100 meters to allow the creation of an attractive public space including beaches, foredunes (to be protected), and a promenade with entertainment buildings (cafe', restaurants, etc.).

Artisanal Fisheries Development

The fish catch potential of the Province as a whole is very high and, with the exception of some species, it does not seem to have been fully utilised. The catch estimates for Penaeidae shrimp are approximately 950 tons, for large demersal species (*Sparidae, Serranidae, Lethrinidae*) about 5,100 tons, for small demersal species (*Scianidae, Sphyraenaidae, Mugilidae*, etc.) about 5,400 tons, and for small pelagic species (*Engraulidae and Clupeidae*) about 3,500 tons a year. The small pelagic species are mostly caught between Monte Belo and Ponta Zavora. In the area of mangroves, around the mouth of the Limpopo river, the estimated catch potential of mangrove crab (*Scylla serrata*) is 950 tons per year.

With the development of the capital infrastructure (the national road) and particularly tourism, the conditions for developing fishing activity are slowly improving. The expected future tourism development is going to create the local market particularly interested in the high quality demersal fresh fish to be offered in hotels and restaurants. The new market and the improvement of infrastructure in the area (electricity, feeder roads, boat landing facilities), followed with the growing economic potential of the native population, is going to create the new, favourable environment for the small-scale or artisanal fisheries development.

The summary of the activities to be undertaken in the short term (up to three years), are as follows:

1. Support, facilitation and monitoring of the initial joint ventures between entrepreneurs (experienced foreign and national fishermen) and local fishermen;
2. Construction of the basic infrastructure in the Zongoene and Chilaulene areas (roads, electricity, etc.);
3. Elaboration of the basic studies regarding harbour development in the Limpopo estuary and a basic study relevant to the artisanal fisheries potential; and
4. Improvement of the existing conditions within the Limpopo estuary (marking the pass, small peer construction, installing of modest freezers, etc.) for the development of small-scale fisheries.

Outcomes of the mentioned studies, results of a co-operation between the local population and experienced fishermen, the attained level of tourism development, and relevant market demand, should give a proper scope of the project to be realised in the second phase. If the results were positive, then the programme for the establishment of fisheries centre, including funding proposals, should be elaborated in the second phase.

The summary of the activities to be undertaken within the medium term (up to six years), are as follows:

1. Assessment of market potentials and funding sources;
2. Elaboration of projects for the development of a small harbour; and
3. Elaboration of a programme and projects for the development of a small artisanal fisheries centre in the Limpopo estuary.

Construction of the artisanal fisheries centre, if proved to be viable, and physically and environmentally appropriate, should take place after the studies and projects are completed. In the construction phase, the engagement of governmental institutions would be significant, particularly facilitating in the provision of funds, issuing the building permits, and surveying of construction.

Port Development

In the framework of the given physical conditions of the high energy and unindented District's coastline, and evident opportunities for the development of artisanal and sport fisheries, and particularly tourism, development of a harbour that could provide shelter for small boats is the general goal. Within the expected timely development and given location opportunities, particular objectives are the following:

1. Development of a harbour at the Limpopo estuary with a primary function to accommodate artisanal fisheries boats;
2. Development of a small harbour in the Xai-Xai Beach Lagoon primarily to give shelter for a limited number of small tourist boats.

Recently, the boat launching facility was constructed in the Xai-Xai lagoon, behind the detached beach rock formation. This area, the cove in front of the Halley Tourist Complex, is the only location suitable for a small boat shelter. The cove is narrow, extending about 1 km and fringed by the beach rock and the beach. The beach is surfacially exposed during the mean sea. With tourism development in the Xai-Xai coastal area, mooring facilities should be provided for boats which would be used for game fishing, as well as for bringing tourists offshore for boating. Taking into consideration the size constraint, the boat mooring facilities should be designed in a way that part of this cove could be used for mooring of boats, and part of it for bathing. The section west from the bollard should be used for bathing, pedallo, kayaking, and the other part for berthing and mooring of boats. Depending upon the size of the boats, about 20 normal size boats could safely be moored if the facility were properly designed. During rough seas, these boats would be towed up the beach by the winch safe from wave uprush. In no circumstances any boat should move to the bathing area site.

The site may be developed further for a small harbour with permanent moorings. In fact, this is the only site in the lagoon that in the long run, with growing of tourist capacity, may be developed as a marine centre.

The primary function of the Limpopo estuary harbour is to accommodate small artisanal fishing boats that will develop in the area. The harbour requirements for artisanal fisheries would include a modest marginal quay, and a slip for hauling up crafts for repairs and maintenance in sheltered waters. Artisanal fishing boats are generally shallow draft small crafts which are put out to the sea in the morning and return before dusk. The catch is usually offered for immediate sale, and therefore, a small market place is required. Probably, it is convenient to provide also for a small size freezer.

The proposed harbour development on both sites should be implemented in several phases. It is obvious that these phases should be interlinked and harmonised with tourism and artisanal fisheries development in the area. The most important is the first or preliminary phase being implemented when the presumed inputs to this Management Strategy (such as bathimetry, data on currents and waves, fish stocks,

etc.), were examined through sectorial scientific expertise, studies and projects. It is possible that some of these studies give results, what calls for a significant modification of the proposed harbour development in this Strategy.

The preliminary or planning and design phase, should, among others, include the following basic surveys and expertise:

1. Xai-Xai Beach Lagoon
   - bathymetry and land survey maps of the lagoon and the relevant littoral area;
   - climate, currents and tidal conditions;
   - coastal engineering survey (littoral movement of sand, waves);
   - preliminary project of the harbour including marine and land area;
   - environmental Impact Assessment (EIA) study; and
   - cost estimate and feasibility study.
2. Limpopo River Estuary
   - bathymetry and land survey maps of the river mouth and estuary;
   - climate, currents, hydrodynamic and tidal conditions at the river mouth;
   - coastal engineering survey (littoral movement of sand, waves, feasibility of dredging free channel access through the river mouth);
   - study of a navigation link between the Limpopo estuary mouth and the Xai-Xai Town;
   - survey and estimates of the offshore fish catch and market potentials;
   - development programme defining services and capacity of the artisanal fisheries centre;
   - location selection and a preliminary project of the harbour including marine and land area;
   - environmental Impact Assessment (EIA) study; and
   - cost estimate and feasibility study.

The construction phase should follow planning and design phase. However, having in mind a relatively high cost of the suggested expertise for both potential investments (3% to 6% of the construction costs), and the need for urgent improvement of the existing conditions, particularly in the Xai-Xai Beach lagoon, some minor improvements should be done on the basis of a preliminary coastal engineering expertise. These improvements should be limited in scope and time in order not to become an obstacle for further major investment.

Institutional Strengthening

Some positive steps have been taken towards the protection and sustainable use of natural resources in Mozambique, like establishing of the Ministry for Co-ordination of Environmental Affairs (MICOA). This Ministry has already elaborated the National Environmental Management Programme (NEMP), and environmental legislation, of which the most important environmental "umbrella" law is in the process of approval, is being elaborated.

At the Xai-Xai District level, there is mainly lack of technical human resources for good control and management of natural resources and environment. Besides technical capacity, resources and equipment for the control of sensitive and protected areas, or other areas of concern, are also lacking.

The coastal inter-institutional management group consisting of MICOA, DPAP, DPICT Marine Administration representatives was formed in the course of this ICAM elaboration. Its aim is to guarantee the region's sustainable development through the implementation of a tough discipline on the use of resources. Owing to this group, sectorial pronouncements as regards socio-environmental impact of investment projects, are now being taken into account.

Within MICOA, the department responsible for the coastal area is assisted by an integrated team of professionals, the CZM Unit, and is responsible for all activities related to coastal area management,

including studies, planning, programme management, and co-ordination.

In order to guarantee coherent, uniform and harmonised practices, the process of legislation production is also being undertaken by a multi-sectorial group co-ordinated by MICOA.

In order to develop training, research and monitoring activities on the coast, the establishment of the Coastal Zone Management Centre in Xai-Xai is considered to be of paramount importance.

The general tasks of the Centre are the following:

1. To conduct research, surveys and data collection of the coastal zone, and its management and related issues at the local, provincial and regional level, including the establishment of a data bank;
2. To secure technical assistance to local governments, institutions, organisations;
3. To promote and implement popular awareness campaigns, and to empower the community in the field of natural resources management and sustainable development;
4. To carry out short-term training courses on natural resources management and sustainable development for civil servants, private sector, NGOs and general public;
5. To perform Environmental Impact Assessment (EIA) of activities developing in the region;
6. To promote and implement experimental and demonstrative activities in the field of coastal natural resources management and sustainable development;
7. To support the Provincial Directorate of MICOA in coastal Provinces in the CZM area;
8. To co-ordinate all CZM activities in Mozambique, including shores of the lakes and reservoirs;
9. To co-ordinate the preparation and implementation of the National Coastal Zone Management Programme; and
10. To participate in the preparation of the National Biodiversity Programme.

1 INTRODUCTION

1.1 Background of the Project EAF/5

The nine Eastern African Nations are in different states of both political and economic development. The diversity in the development process in both island and continental states is exemplified by Mauritius and Seychelles at one end, of both political and economic stability with a GNP of $3500 per annum, Comoros/Kenya with $500, and Mozambique with less than $100.

The coastal zone between the continental states of Somalia and Mozambique is home for 25 million people. This represents 20% of the total population of continental nations living on 12% of land.

The main Eastern African coastal cities are experiencing dramatic growths: Dar-es-Salam, 6.7%, Maputo, 7%, and Mombasa, 5% per year. The trends indicate doubling of the population in coastal urban centres by the year 2025.

Thus, even with declining the national population growth rates, there will still be a strong competition for the existing coastal resources. The pressure on coastal resources will increase as more people seek employment opportunities around the coastal centres, as well as the right to the unrestricted access to the sea shore, the right to coastal renewable resources, and the right to recreational activities.

Coastal Area Management in the Eastern African Region

The coastal area management programmes in the Eastern African Nations are implemented within the weak frameworks that poorly coordinate cross-sector activities with little or no reference to the river basins.

Management of land-based activities in coastal zones has in turn become one of the most complex management challenges. Given the severity of a coastal zone degradation and a need for sustainability and effective national regulatory interventions, there is great demand on governments who limited financial resources to act. In many instances, when governments act, the interventions are reactive, weak and, at times, aggravate the problems through sectorial policies that conflict. In most cases, policies are implemented as projects in the form of sectorial projects with finite life spans. Developed projects may have little or no relation to the programmes implemented earlier. As a result, most governments are littered with half finished but related projects, or finished projects without long-term support or recurrent budgetary provisions. In most cases, local support is also lacking.

Institutions

Most institutions have limited financial resources, and a limited pool of experts and managers. Despite limitations, these institutions are mandated to train managers and seek balance between the ever increasing need for economic development and a conflicting demand made on the coastal environment. Since the intensity of the coastal resources use increases, most institutions are unable to cope. Attempts to ensure sustainable capacity of coastal resources are not exceeded without much success. Predictably, the health of coastal resources will decline further before significant reversal in depletion and environmental degradation can be controlled through improved management interventions.

The model to guide development planners from sectorial approach towards multipleuse ecosystems-based mode of

management was proposed by UNEP, FAO, IOC of UNESCO and IUCN for Eastern Africa in 1981. This initiative was further given some impetus by the Governments of the region through policies that called for the development and implementation of the Integrated Coastal Zone Management Programmes, especially in Mozambique, Zanzibar and Seychelles.

In a series of workshops organised at the high level, and sponsored by the World Bank, SIDA/SAREC, UNEP, FAO, namely: the Ministerial Meeting held in Arusha in 1993, and in Seychelles in 1996; Practitioners' Meeting held in Tanga in 1996; and in-country ICAM workshops held in Tanzania, Mozambique, Seychelles and Madagascar, the Governments of the region have further realised the need for ICAM.

Through joint declarations from these meetings, the Governments are, among others, committed to:

- establishing policies that promote and enhance integrated planning and management of coastal areas by integrating the coastal zone into a national, economic and physical process;
- developing and implementing integrated planning and management of coastal area programmes which address environmental concerns, particularly resources overexploitation, environmental degradation and loss of biodiversity, and emphasise action at the local level;
- strengthening management capabilities of relevant agencies, particularly at the local level, for effective management of the overall environment, especially coastal areas;
- implementing and rigorously enforcing effective legislative instruments, and supporting incentives to reduce resources use conflicts, as well as to prevent and control environmental degradation in coastal areas; and
- investing in public education and awareness programmes to create broader and stronger constituency for a proper management of coastal areas.

Objectives

In 1993, the countries of the region agreed to embark on the EAF/5 project. The project is interlinked to other Eastern African Action Plan projects, namely: Eastern African and Marine Environment Resources Database and Atlas (EAF/14), Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GBA-LBA), International Coral Reef Initiative (ICRC) - the Eastern African Phase.

The project's main objective is to enhance management capabilities within relevant governmental agencies, particularly at the regional and local level, aimed at the creation of the effective coastal areas management. The project design recognised the need for the incremental learning-based approach, with the three main properties in the Pilot Phase approach, namely:

- an interactive participatory learning process: Practical on the job exercises provide experiences and comprehensive information base from which the process towards holistic approach to coastal resources management is developed. The process involves design and implementation of demonstration activities;
- a few defined issues, modest finances, attainable objectives, short-term management actions: The process is adaptive enough to reconcile the already conflicting and diverging interests over resources - fisheries, forestry, tourism, etc. in heavily developed sites (e.g., in Kenya - Nyali - Bamburi - Shanzu and in Moroni in the Comoros area), and pro-actively evolving into a management tool that is dynamic to facilitate resources allocation in developing sites (e.g., the Chwákà Bay in Zanzibar and Xai-Xai in Mozambique);
- the process is continuous consisting of distinct phases: The three distinct phases include: the preparatory phase from 1993 to 1995; the planning phase from 1997 to 1998; and the implementation phase after 1999. The phased approach provides the planning teams the

opportunity to consider and reassess programme strategies in the implementation phase. The project has secured funds from SIDA for the following activities in Comoros, Kenya, Mozambique and Zanzibar State of the United Republic of Tanzania, namely:

I. Development and implementation of national public awareness strategies, campaigns and material;

II. Development of ICAM strategies for selected pilot sites;

III. Implementation of ICAM Demonstration projects (e.g., fish landing sites, dune restoration, public beach facility improvement);

IV. Development and Implementation of ICAM priority bankable projects identified within ICAM strategies developed.

1.2 Project EAF/5 in Mozambique

The Ministry for Co-ordination of Environmental Affairs (MICOA), giving the highest priority to the coastal zone, decided on the elaboration of the coastal zone management programme of Mozambique.

Taking this into consideration, UNEP together with FAO, initiated a project entitled "Protection and Management of the Marine and Coastal Areas" at the level of the Eastern African Region (EAF-5) co-ordinated by OCA/PAC (Ocean and Coastal Area/Programme Activity Centre)[1] in Nairobi. This project started by selecting pilot areas in February 1993. A training programme on GIS (Geographic Information Systems) applied to the coastal zone took place in May 1993, followed by more training on the coastal zone emanate in July 1993.

The expected main outputs of ICAM in Mozambique, as specified in the Memorandum of Understanding, are the following:

1. Coastal Profile of a selected area;
2. Management strategy for the selected issues;
3. Implementation of a small Demonstration Project;
4. Public Awareness Campaign;
5. National Workshop on the proposed management strategy adoption and implementation.

The District of Xai-Xai was chosen as a pilot area and in February 1994, the first version of the "Perfil da Area Costeira do Distrito de Xai-Xai" (The Coastal Area Profile of the Xai-Xai District) was elaborated and published in Portuguese. In this profile, some information were outdated or missing, particularly those on marine environments, coastal dunes belt, water resources, and tourism.

In May 1995, a new working team was formed to work on the Xai-Xai ICAM accompanied by the consultants appointed by the Priority Actions Programme/Regional Activity Centre (PAP/RAC) which was selected by FAO as the executing agency. The first mission of the joint team was organised in Maputo and Xai-Xai, in May 1995.

1.3 Definition of the Xai-Xai District Coastal Area

At the beginning of the elaboration of the Coastal Profile, the entire District of Xai-Xai was estimated as the relevant coastal area. With progressing of work, it became evident that for the purpose of the Xai-Xai Integrated Coastal and Marine Areas Management (ICAM) the coastal area should be defined as follows:

- the near-shore sea or coastal water extending several kilometres seaward;
- the coastal dunes belt extending up to ten kilometres landward and along the entire coastline; and
- the Limpopo Lower Valley, up to the Xai-Xai Town.

The terrestrial area of the Xai-Xai District consists of the three basic geographic

[1] Presently UNEP Water Branch

entities, namely: (1) the belt of coastal dunes; (2) the Limpopo river valley; and (3) the area of inland dunes. By all means, the first two entities are a typical physical and socio-economic environment of the coastal area, while the third one, extending beyond the District's boundaries has a deficiency of typical coastal activities in spite of some physical elements of the coastal area.

The near-shore sea and the belt of coastal dunes are fragile environments whose natural resources are constantly being exploited by the local population and visitors. Having in mind that the pressure upon this precious coastal resource will be significantly increased in the future, particularly with the development of tourism, this ICAM was mainly directed towards this area.

The Coastal Profile concerns also the Limpopo river course, influenced by the ocean tide, with saline water intrusion far beyond the Xai-Xai District. Particular attention is paid to the area of the river mouth, and to a small estuary. Since management of the flooding occurring in the Limpopo Lower Valley is a problem far exceeding the scope of this project, it should be elaborated in the framework of an adequate watershed management plan.

Box 1
The Main Geographic Features

Mozambique has a surface area of about 800,000 km^2, out of which 44% once being under the maritime influence and now forming littoral valleys not higher than 200 m. The coastline is about 2,700 km long, with 42 Districts out of 110 Districts of the country being coastal. About 40% of the Mozambican population lives in coastal Districts, causing a very high pressure over coastal ecosystems. These ecosystems are, per se, very fragile and degradation has already been seen, particularly deforestation, mangrove depletion, acceleration of erosion, soil salinization, and coral destruction.

The District of Xai-Xai is located between the latitudes 25°18' South and longitudes 33°19' East in the Province of Gaza, comprising the area of 1,745 km^2, and representing about 2.73% of the total area of the Province. The District has a central position within the coastal stretch of the Gaza Province, bordering on the following Districts:

- the coastal District of Mandhlakazi to the East;
- the coastal District of Bilene-Macia in the West;
- Districts of Chokué and Chibuto in the North; and
- the Indian Ocean in the South.

The length of the District's coastline is 67 kilometres.

According to data estimate[2], the population of Mozambique in 1994 was 16.6 million, with a share of the Gaza Province estimated at about 1,115,000 inhabitants or 7% of the country's population. The District's population was estimated at about 210,000, while the Town of Xai-Xai, the capital of the Province and the District, had about 103,000 inhabitants living in the urban and rural area on 131 square kilometres, all in 1994.

As far as the administrative division of the territory is concerned, the District has been divided into three administrative units (postos administrativos), namely: Zongoene, Chicumbane, and Chongoene.

[2] DNE (National Directorate of Statistics)

Agriculture, being the main activity in the area of inland dunes, has presently a limited impact upon coastal resources. The development of drainage and irrigation schemes, as well as an appropriate land use in this area, were the subject of another project dealing with environmental issues. Also, it should be noted that there is no other significant economic activity in this area exploiting the coastal resources, or having impact upon them. The only serious environmental threat is a municipal liquid waste of the Xai-Xai Town which is being discharged into the Limpopo river. The elaboration of an adequate liquid waste treatment and disposal project should be part of a Master Plan of Xai-Xai, which far exceeds the scope of this ICAM. The above mentioned were the main reasons explaining why this ICAM, particularly when elaborating the management strategy, paid less attention to the area of inland dunes.

1.4 District within the National and Regional Context

Being one of the least developed countries in the world, the Mozambican GDP (Gross Domestic Product) is only 100 US$ per capita, although it could be supposed that the level of the economic development in the Gaza Province is slightly higher. As it can be presumed, agriculture is a predominant economic activity both in the country and in the Province. The figures in Table 1 show distribution of the population within the main economic activities at the country's level.

The share of agriculture in the Xai-Xai District is probably much lower than at the national level due to high percentage of the population living in urban centres (about 60%).

From a physical point of view, the coastal area of the District belongs to the southern Mozambican region, classified as a parabolic dune coast. This coastal region stretches from Ponta do Ouro at the border with South Africa to Bazaruto Island up north (see Map 1). The coastline of this region is 850 kilometres long and represents almost one third of the entire Mozambican coast. The coast is characterised by high parabolic dunes and north-trending capes, and barrier lakes. At some points, particularly in the Xai-Xai segment, these systems attain heights of more than 120 meters and are considered the world's tallest vegetated dunes.

Laterally, the region is crossed by several larger rivers forming alluvial valleys. Although with the largest watershed of 412,000 square kilometres, the Limpopo river does not form a delta mouth, and a typically riverine coastal environment is confined on a relatively small coastal segment.

From a functional point of view, the Xai-Xai District is a segment of the Incomati-Limpopo region, which is, due to the capital of the country Maputo and the vicinity of South Africa, one of the most dynamic regions of Mozambique related to economic activities and movement of the population. Actually, the Xai-Xai District is the northern pole of this region owing to its location in the most important transportation corridor, namely, the National Road Number One, linking the south and the north of the country.

Table 1. Share of the Population within Economic Activities

(Source: National Directorate of Statistics, 1991)

Activity	**%**
Agriculture and Fisheries	82.0
Mining	1.5
Energy Production	0.2
Industry	4.0
Construction	1.0
Transports and Communications	1.6
Commerce	2.7
Financial Services	1.0
Administration	6.0
Total:	**100.0**

The central functions of the Xai-Xai District and the town itself in political, economic and cultural sense, as well as its particular role within provincial and the national context are the result of the following:

- the Xai-Xai Town is not only the capital of the Gaza Province, but is also its political, economic, social and cultural centre;
- owing to its location along the main national road, it has relatively good communications with other Districts and Provinces;
- in comparison with other Districts, it has more social and economic infrastructure, giving it more opportunities for the fast development and growth;
- owing to its central function and capacity to receive and reproduce the given economic and social inputs, it has a priority within the Government policy;
- the District's natural resources base, the Limpopo Valley (irrigation system with a large potential for agriculture and livestock production) and the coastline (tourism and fisheries) being the main assets, are development potential distinguishing it from the majority of other coastal Districts.

Box 2
The Main Physical Features

Continental shelf on the Xai-Xai coast is narrower than in the Maputo Bay in the south and on the Inhabame coast in the north. The 100 meters isobath is on average about 15 km far from the shore. The sea bottom slope is steeper, and a 400 meters isobath is at the distance of 20 to 25 kilometres from the shore.

The salinity is uniform, ranging from 35.33‰ at the surface, and 35‰ at a 400 m depth. The sea water temperature ranges from 27ºC at the ocean surface to 20ºC in the near-shore sea in cold periods. The colour of the water is generally green and clean. However, during the rainy season, some turbidity can be observed due to the exceptional volume of sediments brought by the Limpopo floods.

Although direction of the current in the Mozambican Channel is from the north to the south, the prevailing current along the Xai-Xai coast is in the opposite direction. Therefore, the water and suspended particles from the Limpopo river influence more frequently the coast of the Xai-Xai Beach than Bilene.

The tidal range along the Mozambican coast is the highest at Beira (6.3 m) due to a broad continental shelf at the Sofala bay. At Xai-Xai, the tidal amplitude is lower reaching 3.2 meters of the mean high water.

The main physical feature characterising the Xai-Xai District coastal area is the belt of parabolic dunes extending up to ten kilometres landward and along the entire coastline, except of a couple of kilometres short break at the Limpopo river mouth. The belt of coastal dunes comprises three main physical entities: a) sandy beaches, open or protected by the beach rock; b) the dune hills, rarely flanked with smaller foredunes; and c) barrier lakes at the backset of the dune hills.

The Limpopo river course meanders about 70 kilometres through its lower valley, from the Xai-Xai Town to the sea. The alluvial valley, which is formed within the inland or interior dunes area, has a circular shape with diameter of about 15 kilometres. Before reaching the sea, the river passes through the belt of coastal dunes forming a small estuary only a couple of kilometres wide.

2 ICAM GOALS AND STRATEGY FRAMEWORK

2.1 ICAM Goals and Objectives

The process of applying ICAM to particular cultural and natural characteristics of the Mozambican coast, requires identification of a set of the overall goals and strategic objectives that collectively set policies and direct actions, and provide ongoing feedback from all users of the coast. ICAM is not a substitute for sectorial planning/plans, but focuses on linkages between sectorial activities to achieve more comprehensive goals. The ICAM goals and strategic objectives are the following:

Overall Goals

- to contribute to economic and social conditions of the local population by identifying available resources and development potentials;
- to ensure that natural resources are rationally exploited and equitably divided between generations;
- to preserve ecological integrity through establishing ecologically sustainable limits for resources use;
- to recognise and support a wide range of values: ecological, economic and cultural;
- to encourage private/public partnerships;
- to provide a mechanism for capacity building and planning; and
- to provide a mechanism for collecting, analysing and incorporating data, as well as the ongoing feedback and review.

Strategic Objectives

1. Conservation objectives: creation of protected areas; application of a precautionary principle in development; protection and restoration of important biological areas and species; prevention of ecosystem loss; and supporting of ecosystem rehabilitation.
2. Resources management objectives: preparation and implementation of site-specific and industry-specific management plans; use of research and monitoring in the ICAM and management planning processes; and involvement of stakeholders in the planning process.
3. Education and public awareness objectives: gaining of better understanding by stakeholders and, therefore, giving support to relevant actions; development of appropriate programmes and feedback opportunities for diverse target groups.
4. Research and monitoring objectives: encouragement of environmentally enhancing activities; determination of ecologically sustainable levels of input and change; monitoring of activities application; encouragement of information exchange process; use of areas and activities as a basis for prescription; and evaluation of the ICAM process and management plans.
5. Integrated planning objectives: encouragement of consistency, complementarity, and co-ordination in planning and actions aimed at achievement of conflict resolution and ecologically integrated approaches, respecting on- and off-site areas, as well as transboundary areas; and establishment of a timely review mechanisms.
6. Legislative objectives: creation of streamlined procedures and regulations for enforceable implementation; establishment of means for stakeholders' input, review and amendments regarding boundaries, management goals and

permitted use; respecting of local communities as the most closely affected stakeholders.

ICAM Strategy Principles

Development of the ICAM strategy requires respecting of certain underlying principles that guide the ICAM process over time, and ensure that the coastal and marine environment will continue to provide goods and services on sustainable basis. Such principles are especially important during periods of economic transition in order to ensure that social and economic problems (such as over-population, poverty, etc.) do not justify short-term actions causing environmental degradation which undermines the resource base and hope for a long-term prosperity.

The following principles illustrate how ICAM can facilitate positive integration of sectorial interests, productive co-ordination of institutions, resource compatibility and equity of values between different users:

- development should not degrade the resource base upon which it depends;
- precautionary and anticipatory approach should be used in the case of lack of clarity;
- to strive after achievement of maximum cultural, ecological and economic diversity;
- to maximise uniqueness of products authenticity;
- to prevent short-term benefits from taking priority over long-term costs;
- economic benefits should be reasonably distributed;
- development activities should be based on local value systems;
- direct and indirect economic leakage should be minimised;
- the use of local resources should be maximised to benefit the local people;
- developers should cover all costs of negative impacts;
- development should be implemented within regulatory framework.

The approach towards realisation of sustainable development of the coastal area of Mozambique requires a strategy to be developed bringing together coastal issues and problems, the ICAM methodology, goals and objectives, and the ICAM principles into a cohesive strategy that will guide the scope, scale, and siting of development and conservation activities. This will lay foundations for all proposals presented in chapters that will follow. These proposals will be based on the following criteria:

Biodiversity and Environmental Protection

Given the important role of the coastal and marine habitats, biodiversity and environmental protection should be considered first, and then, the level of development the area could withstand, should be determined. It is essential to account for the upstream impacts, as well as for impacts of the adjacent activities. Criteria for the establishment of "environmentally sensitive areas" (ESAs) should be conducted first, allocating thereafter different ranges of protected areas. This should be done in the form of an overall coastal biodiversity strategy that takes into account the role of the existing and potential pollution loads. It is important to prevent the process of privatisation and tendency to create small development areas from the inhibiting large-scale areas needed for the dunes and wetland management and conservation.

Tourism and Conservation

Tourism is increasingly recognised as an important source of foreign exchange. Given a relatively good health of natural environments, the environmentally-based tourism, being not only sensitive to coastal and marine habitats, but also enhancing their quality, is the most compatible development option for the Xai-Xai coastal area. Tourism should be organised in specific clusters offering a range of interventions that enhance the environment and provide a variety of economic

opportunities to local communities. The integrity of the coastal marine environment, the dunes hillside ecology and aesthetics, should be maintained.

Protected areas (nature reserves, marine reserves, scenic landscapes) are focal points that could attract people, therefore funds, to both local communities and national treasuries. Linking tourism with nature conservation, through the establishment of the protected areas, provides not only the incentive for environmental standards for facilities, but ensures also the protection of large areas of nature. Conservation and tourism need integration of cultural events or other important local traditions into both planning and activity stages of all projects.

2.2 Development Opportunities, Constraints and Threats

The coastal area of the Xai-Xai District is economically the most productive, aesthetically the most beautiful, and environmentally the most vulnerable area. By virtue of the three major energy forces enacting in this zone (marine, fluvial and the Eolian) it is extremely sensitive to extraneous pressure. Disruption of the equilibrium has concatenated a chain reaction, and if urgent mitigate measures are not undertaken, the areas will get irreparably degraded. Such degradation is discernible in many coastal regions of the world. Natural disruptive forces do cause such harm, but if human interference is controlled, natural healing and resetting of dynamic equilibrium will be achieved. Unfortunately, because of the irrational ill planning of coastal development, and avid utilisation of the coastal marine resources, lots of harm have been caused to these areas.

The Xai-Xai District coastal area that was pristine and natural in the recent past, is now in the process of degradation. Since this region is due to be under pressure of a rapid development in the near future, the coastal area management plan will effectively control the haphazard and reactive development, and save it from environmental degradation.

2.2.1 Opportunities

Consolidation of political situation in the country has created much better conditions for the development within the District of the Xai-Xai coastal area. Having in mind the unfavourable national and provincial economic and social heritage, the onus of the development expectations will be put on natural resources. With its valuable natural resources, such as unspoiled beaches, abundance of water and fish stocks, the coastal area of the Xai-Xai District is amongst the first to benefit from the free flow of capital, goods and visitors. The prospects of some of these resources could yield results in the short run (fishery), while significant benefits of the others will be felt only in longer run (tourism). The most significant opportunities for the development are within agriculture, fisheries and tourism.

Although being a predominant activity in the District, agriculture has a very low output with a tendency of farmers to produce for their own subsistence needs. Presently, the main agricultural areas are located within the area of interior dunes. The most fertile land of the Limpopo Valley, and longitudinal valleys between coastal and interior dunes are presently used only as pastures due to constant flooding. With the rehabilitation of the dikes and irrigation system these areas could provide a surplus of agricultural products to be sold on the market, and/or what is most profitable, to satisfy the growing needs for food by tourism.

Fisheries, almost barely present in the District, could become a notable economic activity. Although the District's coastal waters are not the most abundant fishing grounds of Mozambique, they offer the opportunity for the development of significant artisanal fisheries. Supposed that the necessary facilities, tools and training were provided for the local population, fisheries could provide a steady source of income, either the catch is sold within the country, or exported (South Africa), or like agricultural products, delivered directly to hoteliers and tourists.

Very soon, tourism is likely to become the most profitable activity in the District. The Xai-Xai coastal area has the advantage of being reached by car in one-day travel, and could even serve as a weekend destination for visitors from South Africa, which is a relatively large tourist emitting market. Not only the strip of coastal dunes with virgin beaches and exuberant vegetation, but also the points of interest like the Limpopo mouth, small lakes in the area behind the dunes, and the Baixos de Inhampura coral reef, make this area a highly attractive natural environment for tourism development. Besides opportunities for the development of a traditional beach tourism, which is limited to the beaches in small lagoons, there are great potentials for game and sport fishing, diving and other marine tourist activities in the near-shore and off-shore waters, including visits to the immediate 20 kilometres long Baixos de Inhampura coral reef.

Development of tourism in Xai-Xai could, as an option, bring positive impacts on the area and on the country as a whole. Such impacts could be summarised as follows:

- direct economic benefits from providing employment, income and foreign exchange, which would lead to the improvement of the living standard of the local population of Xai-Xai and regional development, as well;
- development of tourist activities implies the increase of government revenues, through various types of taxation on tourism, which could be used for the development of community's facilities and infrastructure, and economic development, in general;
- as indirect economic benefit, tourism in Xai-Xai could be a catalyst for the development of other activities, such as fisheries, agriculture and industry (mainly the beverage factory and ceramics) through supplying of goods and services. The improvement of transportation facilities and services, and other infrastructure necessary for tourism, which will also serve the social and economic needs of the community, has been envisaged;
- stimulus for conservation of important elements of cultural heritage as tourism is expected to finance them partially as tourist attractions.

The existing infrastructure and tourist capacities, although modest and of low quality, are the additional factors already attracting tourists and developers. If developed on sustainable basis, the future tourism, which in the beginning should count on visitors from South Africa, could have an extremely positive impact on the development of other activities, and, consequently, on the employment in the District. Besides the already mentioned development of agriculture and fisheries, the development of construction and food industry, and a wide range of service activities, is to be expected.

2.2.2 Constraints

Constraints to the future development are generally originated in the low level of development (poverty, illiteracy, malnutrition, and unemployment) being worsened by the consequences of the war and political, economic and social transition of the country. The problems which may constrain the expected development process are the following:

- loss of fertile land caused by flooding and salinization in the Limpopo river plain;
- high growth and concentration of population and refuges within the District's coastal area resulting in pressure and over-exploitation of natural resources;
- low level of housing and lack of the adequate infrastructure and facilities, such as secondary and feeder roads, water supply, electricity in the rural area;
- lack of traditional skills, tools and equipment for exploitation of abundant fish and shrimp stocks in the area;
- lack of port or landing facilities for fisheries and tourist boats; and

- lack of the adequate hotel accommodation due to ruined hotels in the Xai-Xai and Chongoene Beach.

2.2.3 Threats

The low level of development and the above mentioned population concentration have created a number of environmental problems which may seriously threaten the needed and expected development within the coastal area of the Xai-Xai District. They are the following:

- deforestation caused by felling for charcoal production, fuelwood and construction material;
- soil erosion caused by deforestation and agriculture practice in the area of coastal and interior dunes;
- erosion of coastal dunes caused by clearing the dunes vegetation for tourist purposes (camping sites and bungalows) and fuelwood;
- extinction of wildlife caused by loss of habitats (deforestation) and hunting; and
- over-harvesting of mussels and oysters on the beach-rock barrier by rural population in order to satisfy the basic needs for food.

It is to be expected that the future development could bring additional threats to natural resources, such as fishing and diving in the protected areas (nursery grounds and coral reef), semi-artisanal fishing practised by tourists, degradation of the coastal dunes vegetation caused by developers and visitors, pollution of the protected beaches and lagoons, etc. In order to avoid these negative impacts upon environment, some of the existing institutional and management problems should, among others, be eliminated at first, namely:

- lack of the adequate development and management plans and projects;
- lack of control (licensing, taxation) over exploitation of natural resources by tourists and local population;
- lack and overlapping responsibilities and competencies of the local authorities in the management of coastal issues; and
- lack of data, control and management of wildlife and marine life.

Nevertheless, it is worth noting that if not well planned and controlled, it could be expected that tourism in Xai-Xai would generate negative impacts that might be difficult to control. These impacts could be as follows:

- the loss of potential economic benefits for the locals, and resentment of residents if tourist facilities were owned and managed without involvement of the local community;
- without integrated development planning following the development of tourist activities, foreign exchange earnings could not be substantial since many goods and services would be imported from outside;
- the pre-emption of beaches and other amenity areas intended for exclusive tourist use without access for residents, will certainly lead to local resentment and conflict, and loss of amenities. It is important to stress that in some areas of the southern coast of Mozambique these kinds of conflicts have already been registered. Therefore, it is important to prevent or to reduce them to a minimum in the Xai-Xai area.

2.3 Xai-Xai ICAM Strategy Framework

The sand dunes are classified in Category III of IUCN and, consequently, they need protection by virtue of their special characteristics, importance of national uniqueness, and opportunities provided for interpretation, education and public appreciation. In addition, they have both recreational and tourist values, and should be managed in a way to be relatively free of human interference.

Based on the presented principles, the ICAM Strategy Framework for the Coastal Area of

Xai-Xai should depart from the two major policy decisions, namely:

1. Biodiversity protection of naturally the most valuable and environmentally the most sensitive areas of coastal dunes, the Limpopo river and the Baixos de Inhampura Coral Reef, which if preserved and maintained, would in turn benefit the local population and national treasury on a long-term basis.
2. Sustainable development of environmentally less sensitive, physically and functionally appropriate areas and sites for the development of agriculture, fisheries and particularly tourism, including residential zones and relevant infrastructure.

The belt of particularly high coastal dunes stretching all along the coast and interrupted only by a very narrow Limpopo river mouth, should be entirely protected. A degree of protection can vary for different sections, particularly for areas of the existing and future development.

Apart from a strong commitment of biodiversity protection of the coastal dunes belt, it is also necessary to propose the appropriate area and management framework for the needed economic development. It is obvious that tourism development and related infrastructure construction will bring alterations to particular segments of coastal dunes environment. The task of this ICAM and the projects that will follow, is to propose and implement a concept of sustainable tourism development, in order to minimise negative impacts on immediate site and to avoid negative impacts upon environment in the majority of the Xai -Xai District coastal area. However, it is also to expect that the development of the mentioned activities, particularly tourism, could, if properly managed, bring significant improvement to the state of the environment in the already degraded areas (coastal dunes vegetation, beach rock depletion).

2.3.1 Biodiversity Protection

Three important Environmentally Sensitive Areas (ESAs) and the relevant sub-areas can be recognised in the Xai-Xai District coastal area. They are characterised by the following:

a) Coastal dunes in the Xai-Xai coastal area are only a segment of the world's highest vegetated dunes range, extending from The Republic of South Africa to the Bay of Sofala. The strip of coastal dunes of Xai-Xai incorporates three major sub-areas:
   - an intertidal zone including the narrow belt of beach rocks and sandy beaches whether open to the ocean waves action or confined within lagoons;
   - densely vegetated or partially eroded dune hills covering a wide area of 2 - 5 km; and
   - the area behind coastal dunes recognised as temporary flooded longitudinal valleys or a chain of small mainly fresh water lakes.

b) In view of the management requirements, the Limpopo river, although a unique ecosystem, could be divided in two spatial units:
   - the river mouth which forms a small estuary including wetlands on its right bank; and
   - the river course and lower valley, including mangroves on the river banks.

c) Baixos de Inhampura Coral Reef, a submerged reef parallel to the coastline.

The biodiversity protection scheme - to be further developed into detailed action plans of environmental conservation and restoration for each identified area - will also provide the basis for planning tourism development and related infrastructures compatible with the protection of marine, wetland, and terrestrial environments. The above identified environments could be classified according to the IUCN classification system into the following categories:

- Category II: National Park
- Category III: Natural Monument
- Category IV: Habitat/Species Management Area
- Category V: Protected Landscape/ Seascape
- Category VI: Managed Resource Protected Area (Terrestrial/Marine)

Besides selecting the adequate category of protection, a question arises whether to propose each of the above listed ESAs to be established as an autonomously protected area or as a segment of the unique larger coastal protected area. Since the coastal dunes belt stretches far beyond the District's boundaries and comprises other ESAs (e.g., the Bilene lagoon), it seems reasonable to propose the following protection scheme (see Map):

- Managed Resource Protected Area (Terrestrial/Marine-Category VI)[3]: the entire coastal belt stretching beyond the District's boundaries, comprising ESAs: a) coastal dunes; b) Limpopo river; and c) coral reef;

Within this larger protected area, the following two specially protected areas should be established:

- Habitat/Species Management Area (Category IV)[4]: Limpopo river; and
- Habitat/Species Management Area (Category IV): Baixos de Inhampura Coral Reef.

Special protection and conservation requirements should be designed for each of these categories consequently governing the choice of the appropriate management framework and types of activities compatible with the area (e.g., tourism development).

[3] Alternative could be the following: Category V - Protected Landscape/Seascape

[4] Alternative could be the following: Category VI - Managed Resource Protected Area (Terrestrial/Marine)

Coastal Dunes

The average width of the coastal dunes belt is about 4.5 kilometres, while the average height of this chain is about 60 meters (the highest peak has 126 meters). Being only a segment of the coastal dunes belt which stretches into the neighbouring Districts (Provinces), the protected area should extend beyond the Xai-Xai District boundaries.

As it is proposed above, the entire coastal dunes ESA should be protected as the Managed Resource Protected Area (Terrestrial/Marine-Category VI). Special protection and conservation requirements should be designed for each of the sub-areas (intertidal zone, the dune hills, the area behind the dunes) consequently governing the choice of compatible types of tourism or other appropriate activity development. Consequently, within the segment between the Xai-Xai and Chongoene Beach, the development of housing and tourist accommodation capacities, the related infrastructure and services should be allowed, but planned and controlled. The relevant management proposals for the sub-areas (protection, conservation, restoration and regime of the activities), as well as for the entire segment dedicated to tourism development and comprising the elements of all the three sub-areas, are elaborated in more detail within Chapter 2.4.

Limpopo River

The Limpopo river ESA should be protected as a Habitat/Species Management Area (IUCN Category IV), which includes both mentioned spatial units: a) the river mouth; and b) the river course.

The river mouth and its small estuary are a segment of the river course stretching through the area of coastal dunes in the length of about 6 km. Only the western side of the river mouth bears distinct characteristics of the estuary (saltmarsh and mangroves). The area has already been protected (nature or forest reserve) but notable improvements of environmental conditions in the area have not been

achieved yet (signs declaring protection of the site have been removed by the local population).

Although small in size, the estuary is not only important as a nursery ground for shrimp and a habitat for mangrove crab, but is presently the only fishing ground (mostly sardines) that can be reached by local fishermen possessing only small engineless canoes. Within the management regime (IV Category), fishing activity should be allowed in the area, even the creation of a small artisanal fisheries centre is possible, but planned and strictly controlled. Agriculture and felling should be restricted in this area.

The river course, between the Town of Xai-Xai and the sea, meanders through the valley partially bordered by the dikes built as a protection against flooding. The expected rehabilitation of the dikes, drainage and irrigation system in the lower Limpopo valley should be carried out fully respecting preservation and restoration of the riverine environment dominated by mangrove colonies along the river banks. It is important to avoid pollution of the river discharging the future agricultural runoff outside the river course and estuary. It should be also noted that the upstream pollution caused by the Xai-Xai Town urban liquid waste should be adequately eliminated by a proper waste water treatment and disposal.

Baixos de Inhampura Coral Reef

The Baixos de Inhampura barrier reef is situated at 25°10' southern latitude and laid along the coastline at the average distance of about 3 kilometres from the shoreline. The reef is approximately 20 kilometres long, stretching in the ENE-WSW direction, almost from Chongoene Beach to some 8 kilometres from the Limpopo river mouth. The reef rises from 20 meters (seaward side) up to 1.5 meters at the highest point with the average 5 meters depth of the reef flat from the lowest neap tide. In its central part, the reef is built up of three parallel ridges. According to scarce and partial information available, there is the presence of abundant coral colonies on the reef.

In all available bibliography and the listed references, there is no single information about the reef, nor it was available during the mission, except the navigation chart in a 1:200,000 scale. There is an evident need for the identification of the main characteristics of this reef, among others, to answer the crucial question whether the reef is entirely built up by corals or that there is only the presence of coral colonies on the rocky ground like on the beach rocks along the shoreline.

When applying the precautionary principle, the Baixos de Inhampura Coral Reef should be at least protected as the Habitat/Species Management Area (IUCN Category IV). Later on, if the necessary and envisaged survey of the reef proved its larger biodiversity, the protection category could be raised even to the establishment of a marine national park. The basic necessary activities in providing reliable information on the reef, are presented in Chapter 5.

2.3.2 Sustainable Development Strategy

Agriculture

Development of agriculture, being essential for subsistence of the local population, should be directed towards the area of the Limpopo Lower Valley and interior dunes. Protection against flooding, and restoration of the drainage and irrigation system as part of the integrated watershed management, is a prerequisite for the rehabilitation of agriculture in this area. This project should be designed in a way to preserve natural ecosystem of the lower Limpopo, particularly mangroves growing along the river banks. The agricultural activities within the coastal dunes could be avoided. Development of agriculture in the valleys behind the coastal dunes can be planned taking into account importance and vulnerability of the relevant groundwater aquifer.

Fisheries and Harbour Development

There are favourable, but limited conditions for the development of the artisanal fisheries centre in the Xai-Xai Beach and at the Limpopo river mouth, where the fishermen colony already exists. Both of these two locations have some advantages, but also disadvantages. In spite of only few advantages, the third possibility to develop the artisanal fisheries centre somewhere along the "open" coast seems unreasonable, because of many disadvantages (the rough sea, high cost of breakwater construction, no available infrastructure, no fishermen colony at the site etc.).

Taking into account all these advantages and disadvantages, it seems reasonable to propose development of the artisanal fisheries centre at the Limpopo river mouth, if further surveys prove the possibility of entering the river mouth. At the same time, the Xai-Xai Beach seems to be suitable for the development of a tourist port, including existence of a small fleet of fishing boats to serve for game fishing and excursions (including visits and diving on the coral reef).

Tourism and Housing Development

Within the 67 km long coastline of the Xai - Xai District, tourism, residential and the relevant infrastructure (roads) development should be confined and concentrated at the places where this activity already exists, namely, in the area between the Xai-Xai and Chongoene Beach. Any development of tourist accommodation capacities outside of this area should be prevented in order to protect the remaining uninhabited and unspoiled environment of the coastal dunes. In such a way, alteration of natural environment is confined to a relatively small section of the coastal dunes (9 kilometres in length or about 13% of the District's coastline). Besides, the advantages of concentrating the future tourism and residential development along this segment of the coastal strip, are, among others, the following:

- along the entire coastal strip, only two lagoons offer protected beaches being most suitable for bathing and practising of other marine activities;
- the existing tourist centre in the Xai-Xai Beach and a hotel in the Chongoene Beach will facilitate development and operation of the nearby future tourist sites;
- some of the existing infrastructure facilities at the site (road, gasoline station, boat landing facility) will help start the new tourism development;
- concentration of tourist capacities in this section of the coastal strip will allow the rational construction of the adequate infrastructure (water supply network, liquid waste treatment and disposal, energy supply, feeder roads, boat landing and mooring facility, etc.).

Development of settlements within the coastal dunes area, should be restricted except within the segment of Xai-Xai to Chongoene Beach. The most appropriate area for this purpose are the interior dunes including the area behind the coastal dunes where a chain of small villages already exists.

Infrastructure Development

The existing infrastructure cannot meet demands and requirements of the proposed tourism and settlements development. The strategy of the necessary infrastructure development should be based upon the following:

- the future infrastructure investments, in general, should serve the local population and tourism development. It is important to ensure that the adequate share of costs of infrastructure development will be carried by investors involved in tourism;
- demand for energy will be highly increased and it should be provided from the sources at the provincial (national) level. The main efforts are expected to be made in developing distribution network;

Table 2. Road Network

Road	Necessary improvements	Distance (km)
Zongoene to national road	major improvements	33.0
Limpopo mouth to Xai-Xai	major improvements	26.5
Chongoene to national road	minor improvements	4.0
Longitudinal backset road	construction	7.0
Tourist resort service roads:		
• western lateral road	construction	2.5
• eastern lateral road	construction	3.0

- the existing road linking the Xai-Xai Town and Beach will satisfy the needs for the long period. Minor improvements of the road linking the Chongoene Beach and the main national road are necessary while major efforts should be directed towards construction of the feeder roads (see Table 2).
- the roads should be laid and constructed causing minimum damage to the fragile dunes morphology and environment, particularly by avoiding the steep slopes and hilltops. In order to satisfy these requirements, the proposed tourist resort (and villages) should be serviced by roads passing through the area behind the coastal dunes and lateral valleys of the coastal dunes (see Maps). The same principle should be applied to linking the Limpopo mouth with the national road.
- demand for potable water, which will be highly increased, should be satisfied from the abundant groundwater sources available in the area. The needs of tourism and residential population should be taken into account in future investments in water supply network.
- construction of the adequate liquid waste treatment and disposal facilities should be the obligation of tourism development. The most appropriate alternative is to build an integral system (with separate network for liquid waste and drainage) for the whole tourist resort. It is necessary to ensure construction of this system in phases.

2.4 Selected Management Issues

Within the ICAM course, and particularly based on the findings of the Coastal Profile and the above elaborated Management Strategy Framework, several important issues to be managed have emerged. They were selected having in mind the natural resource base and its potential for sustainable development, the existing socio-economic conditions, and the need for biodiversity conservation and protection. They are the following:

1. Management of the coastal dunes and intertidal area (beach rock and beaches, the coastal dunes and barrier lakes) developing appropriate conservation, protection, rehabilitation and monitoring practices;
2. Assessment of agricultural potential of the Limpopo Lower Valley and the basic management proposals in harmony with the wetland environment (the Limpopo river course);
3. Identification of the main characteristics and appropriate protection measures for the Baixos de Inhampura reef;
4. Managing tourism development in the environmentally fragile coastal and marine area, having in mind the inherited low level of development and transition period in the country;
5. Managing fisheries development in order to utilise the available marine resources, including, among others: (a) education and training of the local fishermen and rural population; (b) providing fishing boats, tools and equipment; and
6. Providing harbour and (or) landing facilities for fishing and tourist boats.

3 COASTAL DUNES MANAGEMENT

3.1 Depositional Dynamics

The dune deposits represent genetic population influenced entirely by the Eolian processes. They are the product of the elastic filtrate derived from the adjacent back-shore by the onshore wind. They comprise fine textured sand due to the low competency of the wind, having the narrow energy regime. The windowing of fines and their deposition on dunes produces population that has a relatively high degree of positive skewness. The dune sand has been transported by the onshore wind of 15-20 km/hr speed (threshold). Finer sands from the beach or ridge have been filtered out and transported onshore. The entrapment of these sands could have been a small barrier or even grouting, when transportation drops down. Gradual entrainment of sand has given rise to the extensive feature with predominant wind face and slip face, the former having the slope of 15°-22° and the latter 22°-28° at many places. Once the supply of sand has dwindled and transportation of energy slacked, the vegetative colonisation creeps gradually in.

The very important point that should be noted is that the dune formation started by the onshore wind brings sand from the beach and the back-shore as a filtrate, and the offshore wind retransports some sand as few back. Once the stable morphology has been attained in relation to width, height and slope, and sand movement has decreased significantly, the vegetative colonisation starts. Any modification in the morphology, such as height and slope of both faces, would give rise to serious instability and the whole area would be in a chaotic disequilibrium, unless reactive costly measures were undertaken. Since the dune sand has particular grain size (3.0 to 4.0) diameter, rounded in nature, well sorted and clean from other particles, the dune deposit is highly sensitive to energy fluxes, as well as to outside interference. Once the packing fabric is disturbed, the entire dune area will be reactivated energetically, giving rise to sediment cataclysm. The avalanching effect would be disastrous for the environment in general, and human in particular. When designing any development on the dune, these natural dune intricacies should be taken in consideration. It is worth noting that the inland dunes being of greater scale and having undergone longer stabilisation period, are comparatively less sensitive than the foredunes.

3.2 Coastal Dunes - Environmentally Sensitive Areas

The coastal dunes in the Xai-Xai coastal area are only a segment of the world's highest vegetated dunes range extending from South Africa to the Bay of Sofala. The strip of coastal dunes of Xai-Xai incorporates three major sub-areas:

a) an intertidal zone including the narrow belt of beach rocks and sandy beaches whether open to the ocean waves action or confined within lagoons;

b) densely vegetated or partially eroded dune hills; and

c) the area behind the coastal dunes recognised as temporary flooded longitudinal valleys or a chain of small mainly fresh water lakes.

The average width of the coastal dunes belt in the Xai-Xai District is about 4.5 kilometres, while its average height is about 60 meters (the highest peak has 126 m). Being only a segment of the coastal dunes belt which spreads into the neighbouring

Districts (Provinces), the protected area needs to be extended beyond the Xai-Xai District boundaries.

Intertidal Zone

The beach rock is distinct by virtue of its location and extent. It is not a typical calcarenite or calcirudite deposit, but in fact, it is a type of calcareous sand stone. From hand analysis megascopically it seems to comprise sub-rounded to rounded quartz, small percentage of felspar and some heavy minerals, such as titanium, zirconium, iron oxide, rutile, etc. Cementing materials, as per some information, are calcareous. Sand grains are generally coarse to very coarse, and high packing and lithification have imparted tough characteristics with high tensile strength.

The provenance of the beach rock materials is from the hinterland, brought down by the major rivers such as the Limpopo, and reworked by waves. Fresh water from the seapage or resurgence in the coastal areas contributes to the formation of the beach rock. Cementing materials could have been derived from sea water and interacted by fresh water. The coastal retreat is conducive to this formation and the extensive deposit in the tropical region is due to this effect.

The intertidal zone, particularly the belt of beach rocks, runs parallel with the beachline. Some segments of the beach rock belt, particularly the segment between Xai-Xai and Chongoene, are not visible since they are covered by sand forming a barrier which encompasses small lagoons. Parts of the barrier are scored, and partially or completely submerged. The beach rock formation is a very important coastal attribute of the Xai-Xai ecosystem which plays a preponderant role in its stability. Actually, it is a natural endowment which enables the ecosystem to withstand energy fluxes while allowing certain coastal activities. The beach rock formation in the area of Xai-Xai holds out against the force of attacking waves protecting the incipient lagoon ideal for recreational activities. The beach rock is a habitat of and a nursery for many marine species (mussels, oysters, lobsters) of which some are seriously threatened by over-harvesting. The main characteristics of the intertidal zone (beach rock) are as follows:

- the sea of Xai-Xai is open and there is high incidence of swells and storm waves on the beach. The beach rock acts as a natural breakwater to dissipate wave energy protecting the beach and coastal dunes. Because of the availability of large volume of sand from the adjacent foredunes, any scouring of beach deposit is replaced by sand from the dunes;
- position of the beach rock belt off the Xai-Xai - Chongoene Beach enabled the creation of small coves along it which are used by local residents and even by tourists for swimming, and as shelters for boats;
- the beach rock is also a favourable habitat for many species of marine flora and fauna. The predominant fauna species are: oysters (*Sacostrea cucullata*), mussels (*Perna perna*), limpets (*Patellas* sp.), barnacles, starfish, sponges, etc. The over-harvesting of mussels affects significantly coastal ecology by decreasing the rock lobster population and thereby disrupting the food chain, and by felling trees growing on stabilised stabilised dunes for cooking the mussels;
- besides providing shelter, and feeding and breeding ground for some marine organisms, the beach rock maintains the reef biodiversity and food chain linkages;
- the beach rocks also provide the provenance to beach sand deposits, by being broken and abraded by wave action. The gradual wave reworking of this deposit produces a limited amount of coarse-grained sand being important for the beach stability of this area;
- they are also used by some residents as platforms to fish and by tourists to walk over them. This will have the negative impact on the beach rock ecology, with pronounced trampling in the long run;

Coastal Dunes Belt

The coastal dunes that lie adjacent to the beach (foredune) are smaller in height and width, but the grain size is more or less similar to that of the inland dunes. Because of the proximity to the beach, they are subject to an excessive trampling and even mining of sand for construction. As a result, the sand deflation and blow-away are clearly visible. The wave reworking has also scoured the deposit, swirling back on the beach, creating admixture of both fine and coarse sand, and a flatter topography with fine grains of sand plastered on the beach face.

These foredunes are in some sections missing giving way to immediate rise of a mass of transversally running 100-metre-high inland dunes extending several kilometres landward at the right angle (N-S) to the direction of the prevailing wind, which provides abundant supply of sand. The well sorted and fine-grained sand is mostly quartz formed by the wind effect. The provenance of sand is from the hinterland. It is brought down by rivers, reworked by waves and transported to form the dunes. Most of these dunes are covered with grasses, shrubs and trees.

Barrier Lakes and Longitudinal Valleys

Barrier lakes and longitudinal valleys (mainly freshwater) stretch all along the backset of the coastal dunes. The altitude of this geomorphologic formation varies from the sea level up 15 meters above it in some sections. The soil, which is peaty in most of these narrow and often flooded valleys, is quite favourable for agriculture. This stretch of valleys and lakes is the immediate recharge area of the rich ground water aquifer, meaning that any soil or surface water pollution (e.g., sewage or agriculture run-off) will contaminate it. The excessive use of ground water in this area, which, however, is not the case presently, may disturb the equilibrium between the sea and ground water resulting in the intrusion of saline water into the aquifer.

Clearing of the dunes' vegetation has serious impacts on this area. The sand from the adjacent denuded dunes is blown away into the valleys disturbing the natural vegetation cover and agriculture areas. It should be also noted that the ecosystems of these small lakes are very sensitive and fragile, in particular their fauna (fish) which is vulnerable even to comparatively small human impacts (fishing with nets, increased salinity, etc.).

The coastal dunes are perhaps the most sensitive and threatened areas in the District of Xai-Xai. They have been depleted in some areas, such as Chongoene, for wood and construction material for tourist facilities. Actually, there is a link between the depletion of dune forests and over-harvesting of mussels on the beach: the mussels are cooked and their meat is processed for the market right on the beach. As a result, not only the dunes are deforested and mussel depleted, but large areas of the beach and dunes are strewn by discarded shells.

At several places, deforestation and burning have been observed disturbing the dunes' stability. Any change of the morphology (height and face of the dunes) by deliberate acts, may disturb the equilibrium of the entire area, unless appropriate measures are undertaken.

3.3 Significance and Importance of Dunes

The dune plays a very important role in the economy of the Xai-Xai District. It has been present there before colonisation, growing, changing and being stabilised by natural forces. Human interference has significantly modified its morphology and it has relentlessly been responding to such changes by resetting to a new equilibrium. It provides a high potential for tourism, agricultural and residential development, requiring intensive care and implementation of the huge mitigation measures. Some of the major values of the dune are:

<u>Economic Values</u>

The dune provides great economic values for the local people, such as wood for fuel,

grasses for animals, land for agricultural, as well as place for shelter. Even game animals are hunted for food. The inland (Palaeo) dune has been cultivated for food crop, fruit trees and vegetable, and is supporting many people, and supplying food for many villages. Besides residential units, many infrastructure services, such as road network, power lines, and telephone lines have been placed on the dune. In addition, bungalows, hotels, and sports facilities are being developed on it.

Ecological Values

The dune is an ecological 'niche' where a mutty of flora and fauna is living. It provides high biodiversity and habitats for many coastal communities, particularly birds. A detailed ecological survey could reveal genetic diversity and even plant species that have great values in the pharmaceutical field.

Water Resource

It has been observed that the dune valleys have potential groundwater reservoirs and at some places, lakes are also noted. Some of the prominent lakes are: Pave, Sane, Coloantique, Nhamanjene, Leanule, Magangane, Sauce, Chiboene, Giné, Chissura, Bussalene, Chouze, Chacolnane, Nhoncuana, Funguine, Matchive, Gagoe, Chunhule, Mino, Sauzative, Chance, Chimboe, Chilachive, Mahambué, Nhamagonhave, Chinginze, Dâmbue, Paquelane, Malembue, Masseque. The coastal segment of Xai-Xai gets potable water from groundwater.

Sand Reserve

By its physical characteristics, the dune is an excessive sand reserve that has been deposited by nature, to be revised in the case of difficult situation. The beach erosion, which is a common phenomenon in the coastal area, is the offset from sand derived from the dune and the coastal ridge. Despite strong reaction, no evidence of beach erosion can be noted at Chongoene Beach, because the scarps formed are obliterated by sand derived from the dune. On the other hand, the coastal segment lacking such a reserve, is in a very poor condition.

Box 3
State of the Dune Area

A quick glance on the dune field reveals that except for some spots adjacent to the coastline, it is in the undisturbed state. The large road network on the inland (Palaeo) dune crest, housing units all along it, and agricultural activities practised on the flanks and trough, have not shown signs of significant detrimental degradation. The dune field has supported such development since a very long time. Successive colonisation of different plant communities since thousand of years has provided a relatively fertile soil, which gives good agricultural yield. The structural framework of the dune has also been stabilised by rainfall and physical pressure. The size being massive and destructive energy less, this dune has not witnessed any significant damage. However, some at the coastline are witnessing serious degradation. This has been caused by anthropogenic activities, such as burning, walking over, deforestation, construction, creation of track and trails, and even driving.

Aerial photos have revealed many blowouts south of Xai-Xai. Near Chongoene, some dune crests and limbs have been denuded. Pelling and gullying by rainfall have given rise to a disastrous slumping of sand. Some of the vegetation at the crest have their roots exposed. The daily huge amount of sands are rolling down the hill and a cascading effect is destroying the whole dune flank. Passing of vehicles, animals and people could aggravate the problem. The incidence of the rain impact and strong wind on such a degraded site could annihilate the whole region, unless mitigation measures were urgently implemented.

Other problems encountered are mining of sand and levelling of the dune for construction. Mining of sand from the dune face has been noted at one km East of the Halley Complex. Some people were caught red handed removing sand from the dune with the help of a lorry. Also, other vestiges have been observed. On the other hand, west of the Halley Complex, the dune surface has been levelled down for the construction of residences.

National Heritage

The dune has been used since many hundreds of years for residential, agricultural and recreational activities. People were born, lived and died on it. It was a shelter and a source of food. It was the dune where people searched for inspiration to struggle and fight the daily life. Many philosophies and cultures took their roots there. In other words, it is a cultural place and hence it should be preserved as the national heritage.

Aesthetic Beauty

The form of the dune, its setting and landscape with crests and valleys abounds in beauty. The green vegetation, chirping and frolicking of birds and butterflies, hissing of wind on the leaves, a kaleidoscopic scenery with the incidence of sunrays on the vegetation are enchanting. A stroll in the late afternoon or early morning cannot be better refreshing. The dune is still pristine and its natural beauty is ineffable. This natural asset should be protected and preserved.

3.4 Management Strategy

3.4.1 Development Opportunities

Tourism is the most important development opportunity that demands planning. By virtue of its location at the coastline, the coastal segment between the Halley Complex and Chongoene provides a good opportunity. However, care should be exercised to undertake only rational and sustainable development. Because of the site constraint and a statutory requirement of buffer of 100 m, a very limited land is available for tourism. At some places along this segment there are areas available for tourism, but unless a well defined plan were prepared, and carrying capacity assessment undertaken and backed up by environmental impact assessment, tourism could not be developed.

Unfortunately, many haphazard developments are coming up at the Study Site, and no rational use of the site has been noted. In some valleys fringing the coastline, bungalow complexes have been constructed. This site could sustain much more, if the development were well planned. Some houses have also been constructed around the dune vegetation on the flank. The land clearing at this spot is giving rise to dune's degradation.

Development Guiding Principles

The following guiding principles are to be considered when devising tourism development at the project site:

- the inland (Palaeo) dune is comparatively less sensitive than the Sore dune;
- The dune's natural recovery is tremendous, and damage caused by nature or humans could be self heeled, if further human interference were controlled;
- since the dune has limited development opportunities, carrying capacity assessment of a particular site should be performed prior to any development;
- development should not be haphazard, but planned, and it should be fully integrated into the local environment;
- the stable site should be optimally and rationally used;
- pollution of groundwater and the sea should be taken care of;
- during development, no introduction of exotic species, either plants or animals, should be allowed;
- since there is a trend of sea level rise, each development should have required set back, and should be put up at a safe level. Building structures should be designed in a way to take care of the rising sea;
- the setting and building architecture should be compatible in the natural 'cachet'. Many coastal structures would be proposed by hotel developers. Only those indispensable should be allowed after submission and proper assessment of the environmental impact statement;

- ecotourism should be promoted, and the site's natural attributes should be exploited;
- since the site will bear tremendous drinking water pressure, provision should be made to counteract it. Water conservation should also be practised;
- road construction should be adapted to the dunes morphology in order to achieve the maximum stability of dune hills. Public transport with non-polluting vehicles should be considered in the mature phase of resort development;
- due to the existing potential of the Eolian and solar energy, the maximal utilisation should be realised in the future;
- the stakeholders, local residents, NGOs and local authorities should have their representatives, who would discuss coastal development. However, the license granting authority should make judicious balance between sustainable development and protection of the environment;
- all projects that require EIA need post project monitoring and auditing to be carried out. The monitoring team should be very active, and if negative impacts became evident, immediate rectification should be made by the project proponent;
- the management of marine resources should be given high priority. Depletion of resources, loss of biodiversity, pollution of the sea from land-based and marine sources, such as oil spill and chemical spill, should be under permanent control;
- besides socio-economic also cultural values should be considered and given due importance in the framework of tourism development.

3.4.2 Goals and Objectives

Conservation and sustainable development of the coastal dune areas is the overall goal. The dune should be in the first instance protected and preserved, and any development opportunities provided should be judiciously used so as not to disrupt its natural characteristics and support system.

In principle, the entire dune area should be protected and preserved, and no development other than conservation should be allowed. However, taking into consideration size constraints in the coastal zone, various tourist attributes present in the area, and tourist development trend, it is thought wise to prepare tourism development plan with selected tourist activities based on sustainable development principles. Development control should be rigorously exercised at all stages through the EIA processes, where the prediction of negative impacts is undertaken, mitigation measures should be designed and implemented, and post development monitoring and auditing should be carried out. In this way, less harm will be caused to the area with the proactive planning and management. Perhaps, this will be one of the few sites in the African region, if not the only one, where such a development plan has been prepared for an area which is relatively pristine but highly sensitive.

Within this general goal, the particular objectives are as follows (with reference to Chapter 2):

1. Protection of the entire coastal dunes belt as the Managed Resource Protected Area (Terrestrial/Marine - IUCN Category VI) stretching beyond the District's boundaries, comprising intertidal area, the dune hills and barrier lakes;
2. Restoration of the eroded and deteriorated segments of the coastal dunes area;
3. Sustainable development of the environmentally less sensitive, physically and functionally appropriate areas and sites, particularly the development of tourism, housing and relevant infrastructure in the Xai-Xai to Chongoene coastal dunes segment;
4. Selective approach in designating the development areas within the Xai-Xai to Chongoene Beach Resort segment, based on carrying capacity assessment (as referred in Chapter 6).

3.4.3 Management Strategies

Intertidal Area - Beach Rock

The beach rock is more or less flat, with a slight southern dip, carved by the sea action in the past. Impact of waves on this feature has given rise to the sea abraded platform, the crest of which is 5-20 m wide at places. The seaward face or the reef slope has suffered pronounced rills and, at a few places, blocks of this reef have crumbled down. This phenomenon is also observed in the back reef areas. Besides physical impacts caused by waves and tides, the solution cavitation, as well as boring by sedentary invertebrates inhabiting this feature, have carved out a typical reef morphology. In addition, collapse of blocks has also given rise to underwater cavities. The crashing of waves on the reef during high tide gives rise to lots of salt sprays.

By virtue of its particular ecological, scientific, educational and strategic importance, the beach rock has been classified in the category III of IUCN. The site is of the outstanding national significance, and it should be protected because of its uniqueness and ecological significance. It should be managed in a way to make it relatively free of human disturbance.

Protection and management of the beach rock and its resources include two tasks:

1. Assessment of the beach rock vulnerability in relation to beach protection:
   - survey of the beach rock on the project site, and transposition of data on a map of appropriate scale 1:5,000. The length, width, thickness, composition, etc. should be examined;
   - investigation of the associated marine lives;
   - carrying capacity assessment of the various exploitable resources (fish, lobster, mussels);
   - assessment of the beach rock under erosion identifying wave hydrodynamics and transformation, current direction, tidal amplitude, wind effects, beach morphology, grain size distribution, sediment transport, assessment of energy impacts on the beach rock, ripcurrent etc.; and
   - providing of regulation to control the use in this area, with well defined institutional framework for proper enforcement;
2. Assessment of the beach rock in relation to its ecological function, and maintenance of biodiversity, comprising:
   - survey of all marine flora and fauna;
   - investigation of their health, growth rate, concentration, productivity; and
   - carrying capacity assessment of the beach rock and environs.

In the short term, exploitation of mussels from segments of the beach rock should be banned, depending on the recommendation of the team to be set up for the preparation of the assessment studies. The decision should be made by the local population, stakeholders and relevant authorities.

Once the studies have been completed and the appropriate recommendations made, the Government should immediately formulate and proclaim the necessary legislation, and put in place the appropriate institutional framework to manage the beach area. A regular monitoring should also be undertaken to take stock of its health, vitality and adverse impacts.

Coastal Dunes Belt

The Xai-Xai dune fields are an important feature of the coastal landscape of the area. The programme of the dune management and preservation should be developed as part of the ICAM plan. Because of a dynamic nature of sand dunes, and their interdependence with beaches and the near-shore processes, the dune management cannot be considered in isolation. In some areas, “over-management” is also a problem, since the dunes become fixed and vegetated preventing the necessary sediment movements for continuing dynamic equilibrium.

Human activities affecting the Xai-Xai coastal dunes include damage caused to vegetation cover by grazing, opening of

access pathways, vehicle traffic, and garbage accumulations.

Several modes of construction within the dunes area, such as dune fencing, beach access, tracks and pathways, walkovers, and special vehicles access to the beach, may be considered in this area. If the main road would be set through the back side of the dunes, then perpendicular access to the beaches should be provided. With respect to the dune stabilisation and planting, the inventory of the native vegetation used in this area should be carried out. Thus, any further stabilisation could be done using native material.

The long-term monitoring of the coastal dunes area should include monitoring of the shoreline, including the near-shore beach, the beach rock and the intertidal area. Monitoring of both cross-shore and longitudinal profiles should be carried out. In the Chonguene hotel beach area, where the dune field is moving towards the hotel property, the longitudinal movement is important due to wind action. However, the dune front location seems to be stable.

Several houses and similar constructions are found on the foredunes, in the Xai-Xai beach front. The baseline should be established along the shore at this location in order to implement effective setback restrictions for the future construction.

In Mozambique, the setback line of 100 m has been regulated by law. Historic erosion rates of the coastal area should be examined, and the setback line should be established to move development back from the shoreline. No construction should be allowed seaward of the baseline. Only limited development should be allowed between baseline and the setback line, subject to case by case evaluation.

The potential hazard caused by the wind-blown sand should be given consideration during the preliminary phase of this project. Coastal sand drifts may cause burying of roads and other infrastructure. They could block drainage facilities and accumulate near houses and hotel accommodations. Moderate wind speeds of about 10 m/s are capable of moving unconsolidated sands on the beaches, and sand drift problems tend to become nuisance and chronic. Strategies should be developed to minimise the possibility of inconvenience caused by the wind-blown sand.

The dune usage management subjects should include the following:

- the dune usage for coastal protection;
- methods for re-establishment of the dunes;
- the dune stabilisation and planting;
- description of dune plants in Xai-Xai;
- the need for applying seedling nurseries and fertiliser programmes;
- dune fencing, beach access, tracks and pathways, walkovers; and
- vehicle access to beaches.

Public education and awareness should be needed to encourage the management procedures aiming at protecting the integrity of the dunes in the long term. Also, the long-term monitoring of the dunes should be needed, including the location of the baseline which should be established along the shoreline.

Barrier Lakes

The characteristic feature of the southern coastal area of Mozambique are large coastal lakes, swamps and temporary rain-filled pans which occur behind the dune systems. The most important coastal lake in the Bilene - Xai-Xai region is Lake Uembjeo/ Bilene (32 km^2). Unlike other coastal barrier lakes, Lake Bilene is occasionally linked to the sea via a channel which gets occasionally closed by the formation of sand bar. The other barrier lakes, by contrast, have no links with the sea. This explains the existence of typical freshwater/brackish fish species that occur in these water bodies.

The Mozambican coastal plain was formed by marine transgression in the Pliocene. In the succeeding regression, the sea left a series of long-shore dunes running as sandy ridges parallel to the shoreline. The coastal

lakes now appear as stranded water bodies behind the coastal longshore dune system (Boane, 1996).

The setback of coastal dunes within the boundaries of the Xai-Xai District, comprising barrier lakes and longitudinal valleys, is relatively densely inhabited. The lakes serve as a water source for population and livestock, while the valleys with fertile soil, if not flooded, are intensively cultivated. Presently, groundwater is a source for water supply of the Town of Xai-Xai and Xai-Xai Beach. Groundwater is used for commercial and industrial activities. One of the industries, which is expected to develop rapidly, is tourism, especially in the Xai-Xai Beach area.

Due to the physical origin of the lakes there is a high level of adherity with the associated groundwater aquifer. As a consequence, groundwater, being an important source for the future water supply, could be easily polluted from human activities within the lakes area. To avoid this, the following management strategy should be applied in the area:

- character, capacity and potential for water supply of the groundwater aquifers should be studied in details;
- vulnerability of the aquifer to pollution should be assessed, and human activities in the area, particularly agriculture practising, housing and tourism development, should be controlled, and appropriate protection measures should be implemented.

3.5 Action Plan

3.5.1 Long-term Actions

The following activities should be included in the long-term management strategy:

a) Legal

- to establish the Managed Resource Protected Area (Terrestrial/Marine - IUCN Category VI) for the entire coastal dunes belt;

b) Management Plans

1. In the first instance, the whole dune area should be surveyed and assessed as follows:
   - state of the vegetation and places where it has been denuded, identifying the cause;
   - degradation sites, extent, causes, and restoration measures, and programme;
   - extent and potential agricultural land, fertility status of soil, availability of water;
   - assessment of groundwater and of the potential of the adjacent lakes for drinking and irrigation purposes;
   - size, form and slope of the coastal dune valleys, the degree of their sensitivity;
   - state of vegetation, degree and causes of erosion;
   - geotechnical studies of these valley areas to assess parocity, permeability of soil, load bearing capacity so as to determine type of structures the ground can sustain; and
   - monitoring of the lagoon water aimed at establishing the presence of coliform bacteria, phosphate, turbidity, heavy metals, etc.
2. Elaboration of the Protection and Conservation Management Plan for the protected area including, among others, the preparation of Working Guidelines to control the degradation of the coastal dunes. Some relevant points to be considered are:
   - the dune vegetation should not be removed or damaged;
   - burning of the dune vegetation should be declared illegal and punishable;
   - no development, such as permanent buildings - services, should be allowed without prior approval of the relevant authorities. For major developments, the EIA license should be required;
   - cutting of trees on the dune should be prohibited. Special areas should be

developed as plantations for fodder, timber and construction;

- construction of roads and tracks on the dune should be controlled, and traffic of vehicles on undeclared roads should be stopped;
- mining of sand from the foredune should be stopped;
- hunting of animals and birds, especially endemic, should be banned;
- abstraction of water should be monitored and controlled to prevent sea water intrusion.

3. Rational development of the coastal dune for tourism industry considering the following criteria (the proposal elaborated in detail in Chapter 6):
   - to develop tourist facilities taking into consideration the various site constraints and environmental sensitivity;
   - to promote ecotourism that involves observing, enjoying and respecting the natural environment and local culture;
   - to promote inland tourism in order to spread the development inland, and to relieve pressure on the beach and lagoon;
   - to ensure that tourism does not have negative impacts on the natural environment;
   - to meet adequately the recreational need of the local inhabitants; and
   - to integrate tourism and recreational uses with other objectives in this area.

c) Institutional

- to establish the management framework for the Managed Resource Protected Area.

3.5.2 Short-term Actions

Sustainable Exploitation of Coastal Resources - EU Sponsored Project

Mussels (*Perna perna*) are collected from the beach rock by the population coming from inland areas as far as 40 km away. About 400 to 500 men and women, collect, as estimated, around one ton per month. They collect mussels of any sizes (sometimes very small) and boil them on the beach for their own consumption, or dry and sell them in the market of Xai-Xai. As they use fuelwood available around, the dune vegetation has been depleted for many years, thus allowing large areas to erode.

The wind-blown sand from these eroded areas affects and deteriorates agricultural land at the backset of the coastal dunes, and even the inland dunes. Firewood has also been collected from these areas. Farming, being practised in some areas of the coastal dunes, is a serious cause of erosion. These harmful activities are practised by population from the adjacent communities, such as the Xai-Xai Beach, Macamwine and Chinunguine.

Objectives

In order to reverse the existing practice of non-sustainable use of coastal resources, such as mussels and oysters over-harvesting, and cutting and burning the forest, the European Union is financing the project (250,000 ECU) aimed to introduce sustainable management of coastal resources in the Xai-Xai coastal zone, and, at the same time, to improve the socio-economic conditions of the local population. The immediate objectives of the project are:

- to identify and implement the alternatives to mussel collection; and
- to recover depleted forestry resources by planting the trees to be used as a fuelwood source.

Expected Results

1. The local coastal communities implementing proper management of coastal resources with support of traditional authorities;
2. Fruit trees planted and growing in predetermined areas of the inland dunes. During growing period of the fruit trees, creeping plants of different types will be planted (such as water melon and melon);
3. A number of bee-hives producing honey, its packaging and commercialisation;

4. Indigenous creeping plants planted for the purpose of recovering land-hills;
5. Trees planted for the purpose of dune recovering, and also for timber and fuelwood.

Strategy of the Project

The non-governmental organisation "Grupo de Trabalho Ambiental" (GTA) – Environmental Working Group is the executing agency, while MICOA is supervising the project. The plants are to be supplied by the Association of Private Entrepreneurs (FRUTISUL) and Provincial Services for Forestry and Wildlife (SPFFB). FRUTISUL will also provide training and equipment for honey production.

The communities will be organised in Bairros (settlements). 450 families have already been identified in Chinunguine, 250 in Macamuine and 175 in the Xai-Xai Beach, giving a total of about 5,000 people. The communities will appoint their representatives to work on the project. A very important part of the budget and activities of the project is related to environmental education.

The project started already in January 1997.

Rehabilitation of the Eroded Dunes

Coastal dune being very sensitive and unstable, with the exertion pressure without giving time for its recovery, has given rise to blow outs, sand creep, sand slump and wind deflation. Aerial photos reveal a large number of such degradation behind the coastline, being more prominent west of the Limpopo mouth. In the Eastern segment, the degree of degradation is relatively less pronounced, but still exemplified by bare vegetation and pronounced rills and gullies. As mentioned before, human activities have initiated the degradation process, and nature is accelerating the same. Every second, millions of sand grain are rolling down the hill.

The dune foot and the crest are the two areas that are more stable when compared to the limbs, because sand grains lie at high angle of repose generally in excess of 25º. The vegetative colonisation increases, through anchoring by the roots of sand, the dune face roughness with concomitant decrease in wind erosive power. Diminution of rain impact with the presence of canopy and cover of humus, and the increase of humidity and wetability under the canopy, have all contributed to the increase of the dune's stability. As the dune field is a harmonised system comprising the various well knit facets, disruption of any segment will bring about avalanching effect. This phenomenon is precisely being noted near Chongoene. The dune limb in some areas has suffered serious erosion. Thousands of tons of sand have fallen down the dune hill. Crests and the foot are still protected with grasses.

In order to stop erosion process and to rehabilitate the most affected areas, the local authorities should undertake simple and relatively low-cost restoration of indigenous vegetation.

Options

There is a number of practical measures that could be put in place to halt further degradation. The most common ones are fences and vegetative arrest.

Fences could be of any type in wooden, plastic, rubber, textile fabric, entangled coconut choir, etc. The most common ones are wooden and fabric. The wooden fence should be secured fixed in sand, the height should match the result to be achieved, and spacing should be made in a way that neither sand turbulence and scouring could occur, nor large amount of sand could be filtered out.

Fabric fences have also been used in many countries. They need to have porosity of 40 - 50%. They are lighter, less bulky, more durable and easier to handle, but more expensive. With accumulation of sand in large quantity, these fences get easily damaged and, at the same time, attract vandals.

The said fence would, by its own, be effective for a short period of time. Heavy rainfall may erode these parts of the dune.

The vegetative colonisation programme with post plantation management including watering, application of fertiliser, recruiting and maintenance, would afford double stability.

The vegetative colonisation of the dune surface is perhaps the most effective, the cheapest and the easiest method of rehabilitation. The vegetative species are readily available at the site. Their plantation and regular management, till plants can sustain growth on their own, would be the best option. The sites that have been recommended for rehabilitation are located on the limbs, 5 m from the foot to 40 m or more. The recommendations are the following:

Recommendations

- the vegetation to be planted should be of species dominant at the site. For that purpose, it is recommended to get seedlings of shrubs (potted) 40 cm x 40 cm black polythene bags. The soil should be humus and sandy top soil. These should be planted along the contours dug in holes of 60 cm which should be 75% filled with humus. The planting distance should be 2m x 3m. In addition, local grasses should be planted between the rows. These grasses should be planted in tufts at the distance of 30 cm x 30 cm, and in the upper reach 50 cm x 50 cm so as to cause minimal disturbance.
- the regular watering and fertiliser application programme should be executed. Watering should be done every day for at least one month and every alternate day for at least 3 months, depending upon rainfall. After this period, a bi-weekly watering for further 6 months would be sufficient to allow the vegetation to colonise the site. The author recommends that drip irrigation be designed and provided. This will save the burden of regular climbing up and down the fence, causing further instability. The irrigation pipes and valves are very cheap. A tank made up of plastic or metal drums connected together with pipes would be adequate to irrigate the site for two to three months. This will also control loss of water.

  As for fertiliser, Triple Super Phosphate and Ammonium Nitrate 50 kg/150 kg per trench, respectively, would be ideal. These could be cast through the drip irrigation system.

  The provision of drip irrigation may seem exaggerated, but it is the only practical solution to make this project a success. Prior to putting the fences and vegetation, the irrigation system should be designed and placed during the implementation. Working on the dune would cause more harm to its stability and this should be disallowed.
- the adjacent vegetation should also be given additional care in the form of fertilisers and, if possible, irrigation during the dry period. This will reactivate their growth and the inlaying eroded zone would be protected from further damage. Provision of mulch on the surface retained by forked wooden pickets would abate entrainment of sand during the strong wind condition and heavy rainfall.

Management

To manage the rehabilitation of the dune the following steps need to be taken:

1. Preparation of cost estimate to this project;
2. Identification of financing source;
3. Preparation of works programme;
4. Setting up of monitoring team.

It is also recommended that the rehabilitated sites should be fenced from the road site, and appropriate notice should be placed to inform people of the measures that are being taken against dune degradation, and that the protective instruments should not be tampered or removed. In this context, a sensitisation campaign should be launched, and the local people and stakeholders should be invited to participate.

4 LIMPOPO LOWER VALLEY

4.1 Limpopo River

The District of Xai-Xai contains considerable surface and groundwater resources which are essentially a segment of the Limpopo river basin, except for two relatively narrow strips along the coast. These two strips are located on both sides of the Limpopo river mouth and constitute the catchment areas for several lakes that can be found in inter-dunal depressions along the coast. However, it is important to note that, because the majority of surface water resources of this District are generated upstream, description has necessarily to be extended beyond the physical boundaries of the District itself.

Box 4
Limpopo River Basin

The Limpopo river is the main water course crossing the District. It is formed after confluence of the Notwane (flowing from Botswana) and the Marico and Crocodile rivers (flowing from South Africa). The main tributaries of the Limpopo river in Mozambique are the Elefantes river (the right bank) and the Nuanetzi river (the left bank). These two tributaries are international rivers, and have their sources in South Africa and Zimbabwe, respectively. Other important tributaries are the Changane (the left bank) and the Lumane (the right bank), both entirely in Mozambique.

The Limpopo river basin has a total area of 412,000 km^2, and is shared by Mozambique (19%), South Africa (47%), Botswana (18%) and Zimbabwe (16%). The mean altitude of the whole Limpopo river basin is 840 m. Most of the Mozambican part of the basin lies below the altitude of 400 m. However, the altitude varies considerably from 1,200 m in the upper reaches of the Elefantes river sub-catchment to 150 m in the Changane river sub-catchment. The lower Limpopo, which includes the District of Xai-Xai, is, in general terms, poorly drained and subject to inundation during the occurrence of floods.

The most important storage facility in the Mozambican part of the Limpopo river catchment is the Massingir dam (Elefantes river), which was commissioned in 1978, with design life-storage capacity of 2,840 MM^3. For safety reasons, this facility cannot yet be impounded to design capacity due to serious leakage problems appearing in its foundations. Meanwhile, the Southern Regional Water Administration (ARA-Sul) is preparing a project for the rehabilitation of the dam.

The Limpopo river has a regime dependent on precipitation. The flow is characterised by great annual distribution variation, being very high in the rainy season, and low in the dry. The flow downstream of confluence with the Elefantes can be characterised by that at the Chókwè Gauge station (see Table 3). The means in the Table show the annual variation, and it can be noted that the flow in the wet season (December-April) contributes significantly to the mean annual runoff (4169.06 MM^3).

Studies carried out indicate that flow characteristics of the river are strongly affected by significant water abstractions in the upstream countries. This situation tends to deteriorate due to further developments in both South Africa and Zimbabwe.

Table 3. Mean Flow at the Chókwè Gauge Station (1951/1952 to 1994/1995)
Source: (Monografia Hidrográfica da Bacia do Rio Limpopo, 1996)

Month	Flow (m^3/s)	Month	Flow (m^3/s)
January	289.89	July	21.76
February	556.98	August	13.17
March	327.56	September	8.85
April	131.60	October	15.40
May	65.22	November	36.96
June	31.43	December	87.55
Mean Annual per Month:	**132.2 m^3/s**		
Mean Annual Runoff:	**4169.06 MM^3**		

The water quality of the river is, in general, good. However, some salinity problems affect the usefulness. Salt intrusion from the ocean in the estuary causes salinization, which under normal flow conditions does not pose problems upstream from Xai-Xai, but in dry years causes problems up to 80 km from the river mouth and makes the water inappropriate for irrigation (Matola, 1995).

According to studies carried out in 1980 and 1984, the salinization problem in the Lower Limpopo is also related to inflow of saline drainage water, which originates from the Chókwè Irrigation Scheme (SIREMO). Besides, the base flow from the Changane River might be saline due to salinity of groundwater. Salinity up to 1 g/l has been measured downstream of the Chókwè irrigation scheme (Promexport, 1983).

4.1.1 Floods in the Limpopo River Basin

The floods in the Limpopo river basin originate from occurrence of high rainfall volumes in South Africa, Botswana and Zimbabwe, representing 80.7% of the total basin area. The floods in the Lower Limpopo are immense causing high economic and human losses when the Limpopo and Elefantes peak flows coincide after confluence. During floods, the Limpopo river overflows and floods from Chókwè and further downstream to Xai-Xai. Some protection dikes exist along the river, protecting principally the irrigation schemes. The maximum flow of 7,800 m^3/s was registered during the flood in 1955. During elaboration of the present profile, one more flood occurred in the Limpopo river, in February-March 1996 with the maximum flow of 4,300 m^3/s registered at the Chókwè station. From the preliminary analysis by DNA, it could be concluded that damages caused by this flood were less than the others that occurred in this river. Particular mention goes to reduction in human losses.

The experience obtained from the 1981 flood has taken DNA to improve the Flood Warning System including correction of the Model coefficients, in order to reduce the impact of floods of the Lower Limpopo. Adding to that is the rehabilitation of the Massingir dam to be carried out soon, which will improve regulation of the floods in the Elefantes River. This experience also showed that special attention should be given to the construction of flood protection dikes and embankments to protect irrigated areas as they could have serious consequences for the floods due to reduction of the flood river bed.

The improvement of co-operation with the upstream countries, the Flood Warning System of DNA, and the skills to deal with new technologies for the treatment of hydrologic data, allowed earlier prevision of the peak flows. This output was an essential tool for the water authorities, because they were able to issue information in time to the population settled in the areas susceptible to be inundated.

The measurements of the suspended solids transport on the Limpopo river in Xai-Xai are not carried out on the daily basis. However, from the observations made during the period from 1973 to 1978, the highest mean load concentration was 9,680 g/m^3 and the minimum 80 g/m^3. Seven droughts occurred within the basin from 1961 to 1966 and also in 1982/1983. It has been reported that during dry period the tidal influence reaches 80 km upstream and this increases salinity of the fresh water, as well as of land and aquifer.

Taking into account the annual flow and the figures on suspended solids, one may speculate that sediment transport of the Limpopo river is at least 10 million tons/year. This figure indicates the possibility of high influence of the river deposit on the adjacent marine environment, particularly corals growth on the nearby Baixos de Inhampura reef.

4.1.2 Groundwater

The two main hydrological features of water supply in this area are: a) the alluvial valleys; and b) the dune valleys.

The alluvial valleys are formed in the main valleys of the Limpopo river where 40 holes have been bored for water. The specific flow in these boreholes varies from 0.12 m^3/h/m at Chiarre to 15.6 m^3/h/m at Zongoene. The average productivity is 1.0 to 4.0 m^3/h/m. The water quality is good with EC values below 1500 MS/cm.

The water from the Limpopo river is mainly used for irrigation. This water is also used for urban and rural supply, energy production, control of saline intrusion and flood control. The consumption for domestic use is almost insignificant, because the largest urban centres,

Xai-Xai and Chókwè, are supplied by groundwater. Presently, groundwater is a source for water supply of the Town of Xai-Xai and Xai-Xai Beach. Groundwater is used for commercial and industrial activities. One of the industries, which is expected to develop rapidly, is tourism, especially in the Xai-Xai Beach area.

As pointed out earlier, there is a problem of the sea water intrusion and the resulting poor quality of water. This problem could be solved by releasing water from the Massingir dam and thereby "pushing" saline water back. It is estimated (Matola, 1995) that 7,5 m^3/s would be needed for that purpose. This would make possible the use of water from the river for irrigation in the Lower Limpopo, upstream of Xai-Xai.

The use of water for flood control cannot be considered to be relevant because there is no storage infrastructure to retain the peak flow in the Limpopo river. However, the Massingir dam (the Elefantes River), once reconstructed, can be used to reduce the impact of flood downstream of confluence.

4.1.3 Environmentally Sensitive Area (ESA)

The whole Limpopo Lower Valley is environmentally very sensitive, but in the view of management requirements, although a unique ecosystem, it could be divided in two spatial units:

- the river mouth which forms a small estuary including wetlands on its right bank; and
- the river course and the lower valley, including mangroves along the river banks.

During drought periods, the sea water penetrates as far as 80 km into the Limpopo river, while flooding of the lower valley occurs frequently during the rainy season. The last major flooding was in February-March 1996 when the entire lower valley, including a number of settlements, farmlands and roads, were under the water.

Mangroves, exclusively *Avicennia marina* grow on both banks of the river. Some areas along the right bank of the Limpopo river mouth were completely cleared of mangroves in the past. The remaining mangrove areas are in a very good condition. However, along some stretches they are still cut down for the construction or cleared for agriculture.

The River Mouth - Estuary

The river mouth and its small estuary are a segment of the river course which extends through the area of coastal dunes in the length of about 6 km. Only the western side of the river mouth bears some distinct characteristics of the estuary (mangroves). Although small in size, the estuary is not only important as a nursery ground for shrimp and a habitat for mangrove crab, but is presently the only fishing ground that can be reached by local fishermen possessing only small engineless canoes.

The River Course

The river course between the Town of Xai-Xai and the sea, meanders through the valley (about 65 kilometres in length) partially bordered by the dikes built as a protection against flooding. The expected rehabilitation of the dikes, the drainage and irrigation system in the lower Limpopo valley should be done fully respecting preservation and restoration of the riverine environment dominated by mangrove colonies along the river banks. It is important to avoid pollution of the river discharging the future agricultural runoff outside the river course and estuary. It must be also noted that the upstream pollution caused by the Xai-Xai Town urban liquid waste should be eliminated adequately by a proper waste water treatment and disposal.

The Limpopo estuary has the following resource value:

- area that is significant for diversity of ecological communities found in this habitat;
- area of a significant biological productivity;
- area with ecologically important marine species;
- area important for species maintenance;
- area characterised by special ecosystem structure;
- area important for artisanal and recreational fishing;
- area important for tourist and recreational activities other than fishing; and
- area of a research opportunity.

The major concern of the Limpopo Estuary are:

- over-harvesting of the estuarine resources, especially fish and shrimp;
- cutting of mangroves;
- pollution of the estuarine water from sewerage, pesticides, and inorganic fertilisers coming from the upland;
- excessive amount of silt and other toxic substances;
- saline water ingress inland; and
- tourist accommodation capacities development (hotels).

4.1.4 Mangroves

Aerial photos and maps reveal that the banks of the Limpopo river support impressive mangrove vegetation. According to the information available (M. Saket and R. Matusse), there were 387 ha of mangroves in the Gaza Province in 1990, of which majority could be attributed to the Limpopo river. The line patches of exclusively *Avicenia Marina* mangroves are stretching along the river banks more than 30 kilometres upstream[5]. However, in some areas the mangrove plants are being cut for construction and the land is being cleared for farming. This is a serious harm caused to the Limpopo ecosystem. The Limpopo mangroves are very important ecological assets and need protection. Some of the functional utilities are:

1. They are prime breeding, feeding and nursery grounds for the juvenile fish, shrimp, crabs, etc.;
2. They are protecting the adjacent areas from damage caused by storm surges and flooding;
3. They retain terrigenous sediments that would otherwise go into the sea.

[5] Observed during the boat trip from the river mouth to the Xai-Xai Town.

Through this function, they stabilise the land and also build the same;

4. They support the host of wading birds and provide uniqueness to the wilderness;
5. They can be utilised as scenic, educational and tourist values;
6. They are primary food producing agents for the aquatic food chain.

Cutting down of mangrove vegetation would not only cause discharge of lots of terrigenous sediments but, would also decrease productivity of the estuary.

4.2 Development Potentials

Agriculture

The lower Limpopo valley (area downstream of the Xai-Xai Town of about 200 km^2) is flat, characterised by the river meandering habitat, huge flood plain and oxbow lakes. During the heavy rain, the flood water incurs on the adjacent low lying areas causing havoc. During the dry season, the rising tide transgresses about 80 km inland, contaminating the fresh water and flood plains with saline water. It has been noted from records that salinity is a serious problem; saline soil occupies 8% of the total productive area in the High Limpopo Valley, 30% in the Median Limpopo Valley and 70% in the Lower Limpopo valley. The problem is compounded by the lack of drainage causing water logging, thereby decreasing the crop yield tremendously. It has also been reported that salinity in the lower Limpopo is related to the inflow of saline drainage water which originates from the Chókwè Irrigation Scheme (SIREMO). Values of 1g/l have been measured down stream of the Chókwè Irrigation Scheme.

The two major constructions in the Limpopo river basin within Mozambique are the Massinger dam on the Elefantes river, and the Macarretane weir at the inlet of the Chókwè Irrigation Scheme. The Massinger earth dam is about 5 km long and 40 m high, with storage capacity of 2,800 mm^3. However, because of leaks and positioning of sluice gate, the storage capacity does not exceed 1,400 mm^3. If these problems were resolved, the problem of drought could be mitigated in the short term.

Other proposals made are the construction of earth dam at Mapai, near the border with the RSA, on the Limpopo river, with storage capacity of 10,000 mm^3, and two other dams on the Chongoene and Lumane rivers. 200 boreholes have also been earmarked in the lower Limpopo river basin. The Lower Limpopo Valley has lots of irrigation potential, because there is enough water available, but its quality should be controlled and the saline land reclaimed.

Artisanal Fisheries and Harbour

There is an evident opportunity for the development of an artisanal fisheries centre and a small port within the Limpopo river mouth without causing serious threat to the estuarine ecosystem. These issues are elaborated in detail in Chapters 7 and 8.

Tourism and Recreation

The picturesque estuary and the Lower Limpopo river course, although prone to flood and with both banks quite densely populated, are excellent tourist recreational area, particularly for boating and canoeing downstream from the bridge to the estuary. The river mouth, the whole estuary and particularly the old lighthouse, are extraordinary excursion points which attract the visitors. This and other relevant tourist development opportunities are elaborated in Chapter 6.

4.3 Goals and Objectives

It should be noted that the Limpopo Lower Valley is only the final, and, probably, environmentally the most sensitive segment of the vast Limpopo river basin. Only elaboration of the comprehensive Limpopo watershed management plan, what is an issue of the international co-operation, could give answers related to flooding, pollution, salinization, erosion and other basic problems. In lack of this comprehensive plan only the inputs for biodiversity protection and relatively

confined development issues are tackled in the Xai-Xai ICAM Strategy.

Within comprehensive framework of sustainable development of the Limpopo Lower Valley two specific goals have outstanding importance, namely:

1. Sustainable development of agriculture, including rehabilitation and construction of the drainage, irrigation, and flood protection systems in the Limpopo Lower Valley;
2. Maintaining the productivity of the Limpopo estuary ecosystem, including:
   - sustainable management of the estuarine resources and protection of its ecological assets; and
   - promotion of uses compatible with conservation and sustainable development objectives.

4.4 Management Strategies

4.4.1 Agriculture and Irrigation

Presently, the Lower Limpopo Valley is mainly utilised as a grazing area. The crops, mainly maize and rice, can be found at the margins of the valley. There is no doubt that with the implementation of adequate reclamation measures, the major part of the valley could become important agricultural area.

The larger part of the valley was either drained to allow movement of excess water, or developed for irrigation during colonial period and after independence. Most of the drainage channels do not function effectively, because of the lack of maintenance. Most of them are overgrown with reeds and weeds, which are trapping sand and mud. The principle channels are very deep, and need mechanical equipment to be cleaned. The Sistema de Regadio do Baixa Limpopo (SRBL), the public organisation in charge of construction and maintenance of the drainage structures in the District, lacks funds to maintaining the principal channels. The land users do not contribute materially, financially or morally to the maintenance of the principal channels. However, they maintain small channels bordering their fields.

Most of the principal collectors cannot cope with the volume of drainage waters, because they were underdesigned. The drainage network has expanded without corresponding increase in the capacity of the collectors. This results in flooding during heavy rains. Some closing and opening systems at the exit to the Limpopo are no longer in function, maintaining the closed position. These systems are in the low position, so when the Limpopo water level is very high, there is no effective net movement of water from the drainage system.

Although it appears that some major studies[6], and even limited construction of irrigation and drainage network, have been carried out, some strategic tasks are to be performed, namely:

- analyses of water quality and its suitability for irrigation to be performed on regular basis;
- assessment of water availability for irrigation during different periods;
- assessment of the area under irrigation and of potential agricultural land that needs irrigation;
- investigation of fertility status of land and different crops that could be grown;
- investigation of the area waterlogged and drainage network that should be constructed;
- assessment of land that could be reclaimed, creating appropriate measures with cost benefit analysis;
- investigation of the area affected by saline intrusion, identification of the causes, preparation of rehabilitation programme with cost benefit analysis;

[6] National Family Sector Agricultural Development Programme (PRE-Programme) under UNDP, FAO and Ministry of Agriculture and Fisheries.

- assessment of irrigation and fertiliser impact on the river water with regard to pollution and environmental degradation;
- re-allocation of people living in the flood prone areas with appropriate intervention of the State;
- installation of the effective flood warning system; and
- designing and construction of dykes, dams, spill gates, drainage channels, etc. to control flood release of water. Some proposals have already been made by the relevant authorities.

4.4.2 Limpopo Estuary Conservation and Protection

The Limpopo estuary is semi-enclosed having free circulation with the open sea. The sea water in the Limpopo estuary is measurably diluted with fresh water derived from the land drainage.

This estuary is critical and vulnerable, but important ecological niche. It is a buffer zone between the silt laden freshwater of the river system and the sea. It supports a variety of fresh water and marine organisms, and provides filtering media and settling basin for silt brought down by the river. It is a very important habitat for marine fish and crustaceans. The Limpopo estuary provides fishing ground for hundreds of fishermen. In the upper reaches, hippopotamus (*Hippopotamus amphibius*) and crocodiles have been reported. There is potential of 950 tons of mangrove crabs (*Scylla serrata*) per year in the estuary. The mangrove swamp that lies within the estuary plays a preponderant role in maintaining high production of food level, besides affording protection from storm surges and floods.

The exceptional natural value of the estuarine type of system derives from combination of physical properties that separately, or combined, perform a unique set of functions beneficial to the biota. The more important properties are:

- Confinement - from wave action enabling plants to root and shell fish larvae to attack, and permitting the retention of suspended life and nutrients;
- Nutrient storage and recycling - The estuary has high capacity for energy storage. Marsh grass and submerged grass convert and store nutrients for later use. Physical conditions promote retention and rapid recycling of nutrients to animal tissues;
- Depth - Shallowness permits light to penetrate to plants over much of the bottom, improving flushing and discourage oceanic predators;
- Salinity - Because of change in salinity, fostering rich and varied biota, oceanic predators are kept off and encourage estuarine forms;
- Circulation - Fresh water outflow, tide and salinity create together a beneficial system of water movement and transport for suspended life;
- Tide - Tidal energy provides an important driving force; tidal flow transports nutrients and suspended life and dilutes and flushes wastes; tidal rhythm acts as an important regulator of feeding, breeding and other functions.

Land Reclamation Threats

Taking into consideration the above characteristics of the estuary, any modification of biota, circulation pattern and water quality would have deleterious effects on the estuarine ecosystem. The most notable land reclamation is cutting down of mangrove vegetation and putting land into agricultural use. This reduces significantly breeding, nesting and shelter grounds of many juvenile marine organisms, and also promotes entrainment of huge amount of sediments into the estuary, that eventually could get discharged into the sea causing immense ecological damage. It is recommended that mangroves should be protected, and other surrounding bare areas should be planted with them to increase yield of fish, shrimp and crabs, etc.

Other land reclamation that could be undertaken is polderisation of a saline flood

plain achieved by providing a drainage channel all along the area to be reclaimed, and to allow rainwater to leach gradually down the salt content. In a few years, highly contaminated saline soil is treated and rendered suitable for growth of normal crops. If land were reflooded or contaminated by saline water, this treatment should be resumed. Hence it is important that the land to be reclaimed should be at least 1 m above the flood line to prevent saline contamination through direct contact or through capillary action.

If this activity were undertaken in the upstream, it would not pose any environmental problem. However, subsequent use of inorganic fertilisers and pesticides would affect the estuarine water quality down stream.

On the other hand, regular and excessive use of irrigation water forms saline crust in the soil and, in the long run, decreases production field. Fresh water contaminated with saline water would accelerate the saline crust formation. It is, therefore, recommended that irrigation should be judiciously effected, and water use should be rationalised.

It is also recommended that fertiliser costing and pesticide application on the Limpopo flood plain should be rigorously controlled. Consultations with stakeholders, NGOs and locals should be undertaken prior to decision making on limitation of catch, use of seasonal nets, etc.

Estuary Management Strategy

As it has already been suggested in Chapter 2, the Limpopo Estuary is designated as the Habitat/Species Management Area (IUCN - Category IV).

The natural conditions should be ensured to protect nationally significant species, group of species, biotic communities, or physical features where they require specific human interference for their perpetuation. Scientific research, environmental monitoring and educational use should be the primary activities associated with this category.

The objectives of the estuary management strategy could be summarised as follows:

1. Maintaining the productivity of the area as feeding, nursery, breeding and nesting ground for artisanal, recreational and commercial fisheries;
2. Preserving natural character and scenic value of the site;
3. Protecting quality of the estuarine water;
4. Controlling up-stream activities that may degrade or destroy part of or the whole value of the area to undergo conservation and sustainable development.

To achieve the above mentioned objectives, the following activities should be undertaken:

- preparation of monitoring programme to establish water quality, bathymetry, species diversity, concentration quantity and health of the estuary;
- preparation of carrying capacity assessment of the estuary in relation to fisheries and other harvestable species;
- provision of fish landing facilities, chilling plant, transport, security, insurance, soft loan, advice, social aids for school children, etc.;
- preparation of a plan to control the estuarine resources exploitation. Control permits, limitation of catch, use of seasonal nets, etc. should be envisaged;
- necessary legislation and institutional arrangement should be formulated to control and enforce the law;
- effluent discharge from land-based sources should also be monitored, especially sewerage, pesticides and fertilisers.

It is also important to mention the activities, which may have serious adverse impacts on estuarine ecosystem and which, in principle, should not be permitted. They are as follows:

- discharge of effluents, toxic substances or any harmful wastes into the estuary;

- use of unauthorised fishing methods, such as explosives, poisons, nets with mesh undersize, etc.;
- fishing during unauthorised period, catching undersize fish, or catching during spawning;
- cutting down vegetation, such as mangroves;
- construction of houses, hotels, structures or any other development not being in compliance with the management plan, or lacking mandatory permits and license from the relevant authorities;
- blocking of the estuary passage, or tampering with flow rate or circulation;
- opening of the estuarine mouth, dredging it without plans, detailed projects, or particularly environmental impact assessment studies;
- construction of structures without authorisation, such as setties, causeways, piers, fishlanding platforms, etc.;
- reclamation of industrial, urban, aquacultural, agricultural or port development, without plans, detailed projects and, particularly, environmental impact assessment studies and the necessary permits of the relevant authorities;
- hunting birds, particularly endemic; and
- use of strong outboard motors or defective motors causing oil spills.

Mangroves

Mangrove swamps are the most precious and thus vulnerable asset within the estuary. This area should be managed in a way to protect natural resources and ecological systems so as to contribute significantly to economic, social and material needs of the people. There are no delimited boundaries but this area to include the mangrove swamps and the estuarine areas to extend 80 km inland. In order to restore and properly manage the mangrove areas within the estuary, the following activities are recommended:

1. To assess the productivity of the estuary through evaluation of the different harvestable sea foods.
2. To evaluate the significance of mangroves in increasing and maintaining the food chain.
3. To assess the area and sites to be reforested, and to prepare reforestation plan of action.
4. To designate the area and sites of mangrove swamps to be given specific and more strict protection.

4.5 Action plan

a) Legal

To establish the Habitat/Species Management Area (IUCN - Category IV) for the Limpopo estuary.

b) Management Plans

1. Initiating the elaboration of the transboundary Watershed Management Plan of the Limpopo river through the regional associations, involving the RSA, Botswana, Zimbabwe and relevant international organisations (UNEP, FAO and others).
2. Formulation of comprehensive management strategy of the Limpopo Lower Valley including:
   - preparation of the permanent flood prevention plan, including flood warning and control systems;
   - preparation of the land reclamation programme for agricultural development; and
   - preparation of the drainage and irrigation management plan.
3. Preparation of the estuarine resource management plan including:
   - investigation in the productivity of the Limpopo Estuary through assessment of the exploitable estuarine resources;
   - preparation of carrying capacity assessment and environmental impact assessment;

- preparation of guidelines for sustainable resource use practice;
- preparation of management plan for mangroves restoration and protection:
  - putting up appropriate structures for controlling damage to mangrove swamps;
  - formulation of appropriate legislation to control cutting of mangrove stands;
  - assessment of mangrove vegetation extent, their state and condition;
  - identification of areas where afforestation should be undertaken;
  - providing of alternate farming areas.
  - preparation of appropriate legislation and rigorous enforcement of the same;
  - holding regularly sensitisation campaigns to explain and convince those involved in mangroves destruction; and
  - declaring mangrove swamps as protected area with controlled access;

c) Institutional

- to establish management framework for the Limpopo Estuary Habitat/Species Management Area;

The actions recommended are exhaustive and would require funds and consultancy services. Also, those issues that have not been taken care of should be given priority. Governmental institutions such as DNA, MICOA, INAHINA, INPF, DRN, University Eduardo Mondlane, Ministry of Agriculture, etc. should be involved.

5 BAIXOS DE INHAMPURA REEF

5.1 Preliminary Information

In an early stage of the Xai-Xai ICAM preparation, the Baixos de Inhampura reef was outlined as an important natural asset of the coastal area. While trying to identify the reef origin and bio-physical characteristics, information collected within the framework of this ICAM were sufficient just for the following conjecture:

- although divers' guides (South-African rent-a-boat owners) reported on abundance of corals, position and shape of the reef, and presence of the extensive beach rock formations along the coastline suggest the possibility that the base of the reef is built of submerged beach rock formations;
- natural conditions are not very favourable for extensive growth of corals. Due to personal observations, the Limpopo river is not significantly polluted. The main constraint to the growth of corals could be suspended sediment brought by currents from the nearby Limpopo mouth. During immense flooding in February/March 1996, the whole reef area was exposed to a very turbid water from the Limpopo river;
- since now, the reef has not been seriously threatened by human activities. Human presence on the reef is very scarce and limited due to absence of fishermen and boats in the area. Presently, there is only a couple of fishermen rarely fishing on the reef while divers' visits are temporarily and organised on request by a couple of South-African rent-a-boat owners;
- development of fisheries and tourism at the Xai-Xai to Chongoene Beach could bring serious threats to the Baixos de Inhampura reef. The reef is highly attractive for fishing and diving. Even though it is not an extensively developed coral reef, the need for protection and appropriate management is evident;
- local population (fishermen and authorities) favours the idea of establishing the reef as a specially protected area. They see the lack of a necessary equipment, such as a boat for effective surveillance of the activities on the reef and along the shore, as the main problem in protecting the marine environment.

These and other relevant information on the surrounding environment, such as surveyed conditions (Limpopo flooding and water turbidity, beach rock formations along the coastline) were reported to the UNEP and FAO with a proposal to apply the Methodology for a Rapid Assessment of Coral Reefs developed for the West Indian Ocean (WIO).

A proposal to survey the reef was accepted, and in May 1997 a mission was organised, composed of bio-physical and socio-economic group to survey the reef. Unfortunately, due to bad weather conditions during the mission, and limited transparency of water, diving took place only one instead of five planned days. Anyhow, the collected results gave the first reliable data about the Baixos de Inhamura reef, as presented below.

Box 5
Bio-Physical Characteristics of Inhampura Reef

Baixos de Inhampura (Inhampura Reef) is located in the Xai-Xai District of the Gaza Province in Mozambique. The British Admiralty Chart No. 42633 gives the position of the reef as 25º10' South stretching approximately 20 km in the East-North East-West South-West direction from Praia de Xai-Xai to within approximately 8 km from the mouth of the Limpopo river. The mean distance of the reef from the shore was calculated as 3 km. According to the chart, the reef rises quite steeply from 20 m to 1.5 m above the Chart Datum at the highest point with three distinct shallower (less than 5 m) sections. Mean tidal ranges are 2.4 metres and 0.4 metres at spring and neap tides, respectively. A preliminary look at the reef by one of the first mission members reported on abundance of corals on the reef (Mission Report).

Mean Tidal Height above Chart Datum (in metres)		
	Mean High Water (MHW)	Mean Low Water (MLW)
Spring Tide	3.2	0.8
Neap Tide	2.3	1.7

Source: British Admiralty Chart 42633.

According to information from the socio-economic survey, the main users of the reef, in order of frequency of use, are: 1) sports fishing charter boat owners; 2) recreational fishermen that bring their own boats.

One of the charter boat owners who caters for fishing and diving charters informed that:

1. The shape of the reef is close to that given by the British Admiralty Chart, but that there is a spur that runs at 45º angle in the north-western direction toward the shore from the southern section of the reef.
2. The reef is approximately 20 km long.
3. There are abundant corals on the reef;
4. There is a series of other deeper reefs that run parallel to Inhampura Reef, which are more extensive than given in the chart.
5. There is a list of target fish species.

Data to be collected by the bio-physical component of a rapid assessment were identified through analysis of the proposed management options and identified threats to the reef. The management options were:

a) development of tourism. Two scenarios for the development of tourism were considered, namely: non-extractive snorkelling and diving, and sports fishing (including spearfishing);
b) development of the marine protected area;
c) development of artisanal fisheries.

Identified threats were: pollution (from agriculture and sewage) and sedimentation borne by the Limpopo River; and coral predators.

Results

The results of the mapping indicate that there are three sub-habitat types represented on the reef, namely:

- the northern section seems to be dominated by the rock and macro-algae with very little hard or soft corals;
- the mid section is still dominated by the rock and macro-algae, but has more hard and soft corals;
- the southern section has no corals, but increased cover of sponges and corralling algae;
- there was no evidence of structural damage or of any ecological imbalances (e.g., high densities of urchins). A total of 5 turtles were recorded even with the poor visibility.

5.2 Summary and Recommendations

1. The reef is made up of base rock with a very incomplete veneer of coral growth. As such, it is not a coral reef, but rather a coral community. It appears to resemble those reefs to the south of Maputo surveyed by the Oceanographic Institute of South Africa;
2. The mapping of the reef flat indicates that there are three sub-habitat types, but this can only be a preliminary observation as mapping of the reef slopes was not possible;
3. The area appears to be important for turtles, because 5 were seen over a period of 4 hours with a very poor visibility;
4. The reef is very exposed for much of the year and this may be an important factor in trying to develop diving or artisanal fisheries industry;
5. A rapid assessment should be completed before any final recommendations are made on which management option(s) should be considered.

6 TOURISM DEVELOPMENT

6.1 Demand and Accessibility

The road distance between the Xai-Xai and Maputo International Airport is about 210 kilometres. It is 831 km from Johannesburg, 458 km from Nelspruit, and 872 km from Durban, the three of the nearest South African cities which are the main areas of generation for tourists visiting Mozambique.

The southern Mozambique, in particular the Beach of Xai-Xai, is traditionally known and popular in South Africa because of the natural beauty of its beaches which, unlike beaches in South Africa, are as yet unsaturated. On the other hand, diversity of the marine resources, and excellent potential for diving and fishing, are lasting attraction for tourists from the hinterland, in general and the RSA in particular. Here are also included tourists from overseas who used to come to experience wildlife in the countries such as Zambia, Zimbabwe, Malawi and South Africa. They are now tending to extend their sojourn and to include more tourist areas of different offer in their programmes.

The easiest access to the coastal area of Xai-Xai is by road from Maputo which is 212 km far from the area. The main entrance routes are Maputo-Namaacha and Maputo - Ressano Garcia. These roads are being improved owing to the Government's programme of roads rehabilitation and revitalisation in rural areas. The railway lines (Maputo-Goba and Maputo-Ressano Garcia to the RSA, and Maputo-Chicualacuala to Zimbabwe) used to be quite popular prior to the declaration of independence.

There are regular international flights to the Maputo Airport from the RSA, Zimbabwe and Portugal. The landing strip in the Town of Xai-Xai enables light planes taking off in Maputo to reach the area in only 45 minutes.

The access by 4WD vehicles to other areas of the Xai-Xai coast, such as Zongoene Beach, Praia Velha, Praia do Alho and Praia de Chongoene, is possible by sandy paths. To avoid roads, some of which are in a very bad condition, or to shorten the distance, tourists sometimes venture to take a walk along the coast from one beach to another (Praia Velha e Praia de Chongoene).

In the last five years, a number of travel agencies in the southern Mozambique has been increased. Some of these agencies run coach services between Mozambique and South Africa. On the other hand, according to the information provided by the National Directorate of Tourism (DINATUR) there is growing interest of travel agencies in South Africa to include Mozambique in their packages for the overseas tourists, aiming to make the offer diverse. A relatively streamlined procedure to obtain entry visa recently put in practice, and the fact that Mozambique has just become the 53rd member of the Commonwealth, will probably help the growth of tourist turnover, especially from the neighbouring countries.

6.2 The Present Xai-Xai Tourist Services

There are 5 establishments in Xai-Xai offering rooms and 465 beds, and a camping site. Two of the main hotels of the District situated in the Xai-Xai coastal area (87 per cent of all accommodation) had to be closed down because of disrepair they fell into during the war period. Out of the total, 72 rooms and 108 beds are now being rehabilitated, and hotels are expected to be reopened for visitors in 1997. The City of Xai-Xai, together with its coastal area, offers

44 rooms in hotels and a camping site with 12 beds in bungalows, apart from the tents' capacity. A house of a state company with four bedrooms has been accommodating visitors although without license.

For meals and beverage, Xai-Xai offers 13 pubs, 2 restaurants and one bar. In the Xai-Xai Beach, there is a restaurant at the Halley Hotel and the other at the camping site, and a tavern ("barraca") with total of 160 seats. On average, these are two-star establishments. However, as some of these establishments have not been properly maintained since 1982, the Department of Tourism needs to revise the ranking list of catering.

The presently available 36 beds in the coastal area are expected to meet domestic demand, which is high on weekends during hot season, from September to May. The international demand has also its peak during that period, and inflow of tourists from South Africa is habitual on feasting days, such as Easter, and during school holidays.

Tourist services provide about 237 jobs. 90 per cent of personnel (103 work in accommodation establishments, implying the average ratio of 0.8 employees per room) have basic education only and have not underwent any professional training. The average salary does not exceed equivalent of 20 US$ per month.

Existing Tourist Ventures

Over the last four years, the local authorities have been under pressure by requests for plots of land (1.5 ha on average) along this stretch of the coastline. The majority of concession seekers are South Africans in association with Mozambicans, who venture for the first time to run their own business. Although ninety-five per cent of the requests envisage the establishment of homesteads and/or camping grounds (MICOA and UEM, 1995), 90 per cent have not fully followed the procedure established by law (DINATUR 1995 Report), due to:

- lack of information available to public;
- difficulties of public authorities in assisting the entrepreneurs as result of institutional weakness; and
- technical and financial weakness of the ventures.

The plots being requested by ventures for tourist business are located along the beaches. Many concession seekers cleared plots of land (in some cases by removing dune forests) and started constructions illegally (MICOA and UEM, 1995). Seven-odd illegal settlements have been observed along this stretch of the coast, but the construction was stopped by the authorities until all the formalities have been completely fulfilled.

Although tourism has a long tradition, back since the colonial times, the conflicts with local population are a constant problem, which may become even more severe in the future as it is likely to result in non-sustainable use of coastal resources by tourists (e.g., land and fish, the resources the local communities depend on). Presently, the local population has little or no economic benefit from tourism development.

6.3 Tourism Development Initiatives

Over the last five years, the middle-aged families (35 to 40 years of age) with two or three children (2-10 years) constitute, on average, the largest segment of the international tourist market for Southern Mozambique. They usually travel in a group of two or more cars carrying basic food supplies, tents and small power generators, recreation boats and water sport kits. The activities they prefer are fishing and other water sports, and sun-bathing and swimming[7]. As time goes by and peace in Mozambique becomes reality, tourists are regaining confidence in travelling to Mozambique, which suggests the tourist boom in the near future.

[7] Information collected in the interview with officers in the Provincial Tourism Department of Gaza (DPICT) and with private tourist operators in Xai-Xai.

To that aim, the National Tourism Policy has accorded priority to redesigning of master plans in all tourist zones, which are easily accessed and located along the coast. The principal goal is to establish harmony in land use between interested groups, and to achieve sustainable tourism development.

Governmental Tourism Policy

Some of the Mozambican Governmental intentions to reorganise tourism industry are:

- strengthening of control over tourism;
- licensing for all operations and prevention of illegal operations;
- provision of master plans for tourist areas located along the coastline; and
- setting up a mechanism for effective intersectorial co-ordination between public authorities involved in tourism, and between the public and private sectors. It is in that context that the Facilitation Tourism Commission has been recently approved by the Council of Ministers and the Tourism Fund, whose main scope of activity addresses promotion of tourism development.

With exception of the Ponta D'Ouro area, tourism policy allows camping in the southern Mozambique. However, it determines that the facilities provided should include chalets and that all constructions should be ecologically sound according to the principles established by the relevant authority. It requests that quality of the facilities provided should not be below that of two-star hotels, and that the establishment should fulfil environmental requirements, that is, it should maintain natural environment as much as possible.

While making full use of modern construction technologies, equipment and services, the local and other African architecture should be favoured, and local materials should be used in developing tourist facilities.

Xai-Xai Development Initiatives

Tourism development and turnover is expected to grow in this zone, especially because:

- the growing number of tourist marketing and travel agencies suggest the rise of awareness about tourist potential of Mozambique;
- organised tourism is expected to start in Mozambique through travel agencies, especially in relation to international water sport competitions, which were well known prior to the declaration of independence;
- domestic tourism will develop with the expected per capita income increase of the middle-class Mozambicans**;**

Table 4. Authorised Hotel Projects Along the Xai-Xai Coastline (in 1995)

Source: Ministry of Tourism

Name of the Project	Location	Area in ha	No. of rooms	No. of beds	Class
Zongoene lodge	Limpopo river mouth	7.0	30	60	***
Hotel Son do Mar	Xai- Xai Beach	1.8	32	64	***
Bengusta B. Hotel	Chongoene Beach	10.0	40	80	***
Paraíso Hotel	Praia do Alho	4.0	54	66	**
Total		**22.8**	**156**	**260**	

- realisation of a trans-boundary project towards creation of wilderness park linking Banhine National Park in Gaza, Krueger National Park in the RSA and the park in Swaziland, will attract a large number of tourists. The neighbouring coastal area of Xai-Xai may benefit from it offering accommodation and additional entertainment.

As result of the national and local efforts in promoting tourism development, and interest for developing along the Xai-Xai District coastline, there is a number of the ongoing tourist projects. Four private tourist projects covering the total surface area of 22.8 hectares with capacity of 156 bedrooms and 260 beds, have been approved by the Government. They are listed in Table 4.

It may be estimated that the project will provide job for 125 people, of which 80 per cent will require only basic education. This will be an opportunity for the local people, especially women, to get job. Although, this number may seem insignificant, it may induce more jobs once the tourist potential is made a full use of. In Xai-Xai, like in other places in Mozambique, resources of interest for tourists (culture manifestations, handicrafts, water sport services, transport services and good restaurants) which may yield good economic benefit, have not been explored.

High expectations from tourism would become reality only if the environmentally sensitive coastal areas were developed in sustainable way. This includes the following conditions:

- to designate appropriate areas for tourism development;
- to develop and implement land-use plans for these areas, which should include areas for the development of accommodation establishments, business and commercial centres, restaurants, boats launching and mooring, etc.;
- to propose feasible policy of action to create appropriate environment for ventures, such as boat hire, tourist transport, and organisation of events of interest for tourists (e.g., international water sport competitions).

6.4 Tourism Development Strategy

It is extremely important for the local community to be involved in tourist activities. The benefits could be realised in a way that the community is willing to play an active role in promoting actions towards protection, preservation and revitalisation of the cultural and natural patrimony, which are the important elements of tourist product.

The involvement of the local community in tourist activities should be realised in the following way:

- promotion towards creation of the local tourism commission, which will integrate the local tourism entrepreneurs, fisher–men representatives, representatives of the local community (maybe traditional chiefs), and the local administrative and tourist public sectors;
- creating of concrete actions and designing of programmes to promote small and medium enterprises for local residents, and establishment of measures to motivate informal sector to grow and become formal, particularly in relation to accommodation and restaurants, handicraft production, furnishing, fisheries, etc. At this level, some incentive schemes could be drawn, such as supplying equipment, providing special loans and specific technical assistance;
- a mechanism that obliges entrepreneurs to train the local staff to fill the upper level position should be established and given deadlines. Apart from this, it is important that the Hotel School Andalucia designs programmes and is prepared to carry out the mobile brigade training to Xai-Xai, when requested.

6.4.1 Tourism Development Opportunities

Coastal Landscape

The entire coastal area of the Xai-Xai District is a very attractive landscape all over the

year, with clear blue ocean waters, yellowish pristine beaches, green dune hillsides and tranquillity of the Limpopo Valley. In all this beauty, three areas could be distinguished as extraordinary scenic values. They are:

- the narrow coastal belt where ocean waves break with thunder, and driving surf and waterfalls of sea foam over the beach rock to be finally calmed down in the shallow transparent water of small lagoons. This ever lasting dramatic play of the ocean on clean yellow-white beaches is accentuated by the backcloth of exuberant greenery of the dunes;
- the wide and green Limpopo Lower Valley, and small estuary where mangrove and casuarine forests are growing along the river banks surrounded by the tranquil flow of the river. The impression of greenery and tranquillity becomes the strongest in the estuary in contrast with the river mouth where one witnesses a never-ending battle of river with ocean waves;
- the green landscape of tiny lakes filling the depressions in the area of coastal dunes catching the eye with their calm waters and gently sloping shores.

Sandy beaches open to the ocean (with hidden or on beach sand exposed rock) and lagoons (protected by it) are the two types of the shore landscape which can be found along the unindented District's coastline. The beaches are generally wide and sandy with sand grains not being very fine. The coastal dunes are composed of yellow and white sand, in some places covered by indigenous vegetation and in others by casuarine forests. The dune hill slopes are generally steep. Some dunes have lost their vegetation which enables erosion to advance very fast. However, visual impression of the coastline is still very pleasing, which makes it attractive to visitors. This indicates enough why valuable assets should be fully utilised for the future tourism development.

Both banks of the Limpopo river are of great scenic value. However, tranquillity of the estuary with shallow sandy shores with exuberant mangrove and casuarine forests is the place which attracts mostly attention of visitors. The most beautiful view over the valley and the estuary is from the lighthouse, which could be the frequently visited belvedere in the future. In the estuary, particularly in the Marine Mission on the right and fishermen village on the left shore, there are attractive sites where tourists may want to take a rest enjoying the pleasant scenery.

Similar to the Limpopo river estuary, the lakes and their shores are also places of serene beauty, offering the visitors sharp contrast to the ever moving ocean. Being close to the future Xai-Xai Beach tourist resort, Ualute Lake could attract visitors. Its main attraction lies in its water colour, which is constantly changing depending on weather conditions. Although small, the lake is suitable for some water sports, e.g., canoeing.

Development Opportunities

The coastal area of the Xai-Xai District, offers, among others, the following tourist and recreational opportunities (see Map):

- the area suitable for development of tourist centres, resort villages and hotels, as already mentioned, between the Xai-Xai and Chongoene Beaches;
- protected lagoons for bathing and snorkelling, and the possibility to develop a small tourist port;
- marine environment suitable for marine sports, such as ocean game fishing, sailing and surfing, diving on the reef;
- bathing, walking and jogging along distant sandy beaches, and in the area behind the coastal dunes;
- excursions and recreation activities (canoeing) along the Limpopo river, in the estuary, and on freshwater lakes (Lake Ualute); and
- developed urban centre, the Town of Xai-Xai, able to support the coastal tourist area with necessary services and infrastructure.

6.4.2 Xai-Xai Beach to Chongoene Beach Tourist Resort

Being part of the coastal dunes protected area of the Xai-Xai to Chongoene Beach, the proposed tourist resort should be developed respecting as much as possible natural and landscape aesthetic values, particularly the dunes' indigenous vegetation and morphology.

Following this principle, the least harmful to the dunes' environment and most suitable for the development of tourist accommodation structures, are small valleys on the seaward side of the coastal dunes. Environmentally most fragile sections, the steep hill slopes dividing these valleys should be kept undeveloped and indigenous vegetation cherished (see Map).

The proposed tourism development areas are linked to road network by feeder roads, which meet the following important environmental and functional requirements:

- longitudinal service roads linking tourist centres of Xai-Xai and Chongoene Beach in the environmentally less sensitive area of coastal dunes substitute environmentally harmful and functionally improper road along the beaches. Besides taking over the resort service traffic, this road also links the chain of villages in the area behind the coastal dunes;
- the proposed tourist accommodation sites are linked by service roads penetrating the coastal dunes through lateral valleys at the altitudes not higher than 40 meters, therefore avoiding sharp cuts of hill slopes and "scarves" to the seaward exposed landscape. Taking into consideration the instability of the dunes' environment, this solution conforms maximally to dunes' morphology with the best technical elements, therefore being cheaper related to construction and maintenance costs (see Map);
- consequently, the existing road could be easily turned into an attractive pedestrian communication along the public space behind the beaches, linking the proposed tourist sites and allowing traffic passing free towards beaches. The transport along this promenade should be designed only for emergency vehicles and public transport, and it should be used only by low or non-polluting vehicles (small trains on tyres or similar).

Tourist Centres

Situated on the opposite sides of the coastal segment proposed for tourism development, the sites of: a) Xai-Xai Beach; and b) Chongoene Beach, have prerequisites to become focal points or centres of the future tourist resort. The Xai-Xai Beach has already developed into a small tourist centre while the Chongoene Beach, with the rehabilitation of the existing hotel and development of a new accommodation capacity on the eastern side, could have similar function within the future resort.

The Xai-Xai Beach

The Xai-Xai Beach developed as a tourist destination in the late colonial times. The main reason for establishing the resort was the presence of a shallow lagoon which allowed bathing and offered shelter for small boats. Later on, a settlement was formed on the slopes of the coastal dunes. Today, the settlement has about 1,000 inhabitants, one operating hotel (and one in renovation), a dozen of bungalows for rent, spacious camping site, gas station, several restaurants and a recently built boat slip**.** The majority of tourists are South-Africans arriving by car, a number of them equipped with a boat on trailer, interested in fishing and other marine sports.

With majority of the proposed accommodation capacities located outside of the existing settlement, the Xai-Xai Beach could become a real tourist centre in the future. The area for building new hotels along the protected beach in the lagoon, is rather limited. Remaining opportunities are at the eastern and the western outskirts (east of the Halley Complex and around the Wenela House). The future development of the settlement should be based on the following strategy (see Map):

- the lagoon should be designated for bathing, and a section of it for a small harbour with limited beach backset for harbour support activities;
- the flat area behind the lagoon and the beach should be developed as a pedestrian promenade accommodating necessary public and tourist entertainment services. The existing camping site should also be used for this purpose in the future. Consequently, the remaining flat area at the eastern border of the camping site should be restricted for further development of hotels or bungalows, and dedicated to construction of buildings, which will serve the whole resort, and, at the same time, yield more profit;
- within the existing settlement and its northern and western outskirts, there is appropriate space for the development of new housing, bungalows and even small hotels. Approximately 50 hectares of land could be designated for this purpose and other needs (sport and recreation, service area, etc.). The existing main road network should be equipped for the future needs, except the path towards the Wenela House, which should be shifted a couple of hundreds meters inland in order to protect the eroded blufftops;
- on the western side, the Wenela House should be a boundary of the future development. At this site, there is a possibility for the new concentrated tourism development (hotel or tourist village on about 4 - 6 ha of the land), which is limited by scarcity of appropriate beach area (in the greatest part of this coastal segment the beach rock is exposed preventing from safe bathing);
- in the vicinity of the Halley Complex (eastern outskirts) there is another area for the future concentrated tourism development, comprising about 8 ha of the two small seaward oriented valleys;
- the above mentioned future tourism development in the vicinity of the Halley Complex and the Duna Nhachumbo - West, are the only areas which are, due to unfavourable hills' morphology, linked with a longitudinal road placed between the beach and the dunes. In order to mitigate the negative impacts of this road on the functional organisation of beach backset, the road should be located at the very foothill.
- the steepest hillsides at the eastern Xai-Xai Beach outskirts should be kept undeveloped, and the existing vegetation cherished and restored.

The Chongoene Beach

The most appropriate site to accommodate the future tourism development at the Chongoene Beach is located on the eastern side of the existing hotel. It is a relatively flat elevated area moderately sloping seaward, scarcely covered with indigenous vegetation (See Photo). Above the beach, the average altitude of the area is 20 meters, while at some 300 meters landward it reaches 40 meters above the sea level. The advantage of this site are long protected beaches with the beach rock forming a shallow lagoon on the eastern and western side of the existing hotel (almost 3 km in length). The proposed development area is about 1 km in length with possibility to be extended further east. The existing road linking the site to the national road has a very steep section that could be avoided by a construction of a new segment on more suitable eastern side of the development area (see Map).

The steep western segment of the Chongoene Beach (between the existing hotel and Duna Nhachumbo - East), 1.5 kilometres in length, should be protected from tourist accommodation development, and the dunes' vegetation restored. Only some service facilities such as café, restaurants, etc. located in "light" buildings, could be built along the walkway at the backset of this beach.

Table 5. Tourism Development Sites

Site	Suggested Use	Length (km)	Area (ha)
Xai-Xai Beach - existing and new	tourist service, hotels, housing, marine centre	1.1	70.0
Xai-Xai Beach - Wenela House	housing, tourism	0.8	15.0
Xai-Xai Beach - Halley Complex	hotels, tourist village	0.4	8.0
Duna Nhanzuane	tourist village	0.8	20.0
Duna Nhachumbo – East	tourist village, camping site	0.4	10.0
Duna Nhachumbo – Central	tourist village, hotels	0.8	25.0
Duna Nhachumbo – West	hotel	0.3	6.0
Chongoene Beach	tourist services, hotels, tourist villages	1.0	30.0
Total	**tourist resort**	**5.6***	**184.0**

* Total length of the Xai-Xai to Chongoene Beach coastline segment is about 9.0 km.

6.4.3 Tourist Accommodation Capacity

Along the Xai-Xai to Chongoene Beach coastline, several sites, mainly seaward oriented valleys, are designated to accommodate hotels, tourist villages, camping sites, etc. These sites have the following common characteristics and values:

- the highest altitudes are not over 40 meters in order to avoid the unstable steep slopes and visual exposure in the landscape;
- the sites are serviced by roads at the landward side, therefore allowing the attractive seaward side remain undisturbed by traffic (including parking lots) and service activities;
- all the sites are shifted from the shoreline at the distance of about 100 meters to allow creation of attractive public space including beaches, foredunes (to be protected), promenade with entertain–ment buildings (cafe', restaurants, etc.).

Besides the already established tourist site of the Xai-Xai Beach and somewhat Chongoene Beach, several new sites have been proposed to be developed. They are listed in Table 5 (See also Map).

Having in mind the very low density of 50 visitors/residents per hectare, the area between the Xai-Xai and Chongoene Beach can withstand more than 9,000 persons without causing serious pressure upon resources, if properly developed. Within this number, about 3,500 visitors could be accommodated in the new concentrated tourism development sites (35 tourists per hectare on 104 ha in total). The rest of 5,500 are residential population and visitors in the existing and new tourist capacities of the Xai-Xai Beach.

6.5 Action Plan

6.5.1 Ongoing Projects

A number of projects concerning the Xai-Xai District coastal area are in the preparatory or already in the implementation phase. Besides ICAM, of which the demonstration project is being implemented (rehabilitation of the beach dressing and toilet building), several other projects are sponsored by international institutions, namely:

- Master plan for development of tourism in the coastal areas of Mozambique is under elaboration by the Dangroup. Among others, this project will bring up the general policy for tourism development in the Xai-Xai District coastal area, without specific details of

land use and infrastructure development. The first output[8] of this project in chapters relevant to the Xai-Xai coastal area is compatible with management strategy set up in this ICAM;

- Natural coastal resources management project sponsored by the European Unit will be implemented in the Xai-Xai coastal area primarily aiming at sustainable use of coastal resources. Reforestation and protection of the coastal dunes area, sustainable harvest of shellfish in intertidal zone, and development of forest and fruit trees plantations, are the main components of this project.
- Coral reef survey training activity including necessary equipment, sponsored by DANIDA and SIDA-SAREC, will be developed and part of it implemented in the Xai-Xai coastal area;
- Coastal zone management centre will be founded in the Xai-Xai Beach, sponsored by DANIDA, of which rehabilitation of the building to host the centre at the Xai-Xai Beach is already taking place.

All these projects are in the course of the ICAM process development or its implementation mainly oriented towards the management of natural environment of the coastal area. At the same time, the tourism master plan (DANGROUP) and this ICAM proposed, among others, management strategy for tourism development in partially built-up environment of the Xai-Xai to Chongoene Beach area. Further and more detailed development of this strategy is what is mostly needed to cover the implementation of ICAM.

Requests for tourism development concessions have been made through a variety of channels, and, consequently, there is much confusion over claims for land. In several cases, there are overlapping claims for the same piece of land.

The key factors resulting in confusion over requests for plots of land are: (a) lack of co-ordination between agencies; (b) lack of any uniform procedure for applying for concessions; and (c) the failure to register and map requests with the cadastral (Provincial DINAGECA Offices in Xai-Xai).

Particular problems related to tourism development are as follows:

- many requests for tourism development concessions are made at the District level with little or no liaison with local authorities/local communities;
- the absence of clear guidelines caused several agencies to process concession requests often outside their jurisdictional competence;
- it appears to be no standard fee charged by the various agencies involved in processing applications;
- lack of inter-institutional co-ordination and unclear jurisdictional responsibility;
- local authorities have not been informed/updated regarding current tourist development policy and regulations;
- weak institutional capacity to evaluate and process tourism investment proposal (consequently, development proposals by "opportunistic" developers are often approved);
- lack of transport and communication at the District/Local level to monitor and control tourist activities;
- lack of the Tourism Master Plan and land-use plans; and
- failure of higher level staff to act upon and back up recommendations/reports made by technical staff resulting in low morale.

[8] Outline of Strategy Plan for Coastal Tourism Development in Mozambique by Nils Finn Munch-Petersen, January 1997

Box 6
The Present Land Allocation for Tourism

The illegal and uncontrolled tourist activities are causing increasing concern along much of the southern Mozambican coast. Many requests have been submitted to the Provincial and District authorities for land concessions to establish holiday homesteads, camping grounds, "ecotourism" ventures, etc. along the Bilene - Xai-Xai - Chonguene stretch of the coastline. A substantial number of these requests have been made by South-Africans. Some prime sites along this stretch of the coast are being acquired without any long-term socio-economic and land-use plans in place. Within the boundaries of the Xai-Xai to Chongoene Beach coastal area (about 9 kilometres of the coastline), the following activities are under way:

- in the flat area on the eastern side of the camping ground there is ongoing construction of "time-share" accommodation ("Som de Mar"), with structures occupying this prime site in a very irrational way;
- a ground survey carried out along Chongoene Beach revealed that 10 individuals are currently "residing" along this stretch of the beach, or have staked claims to plots of land as indicated by signs and markers. On several plots, tourist facilities were at the advanced stage of construction. The basic accommodation facilities (reed huts) were constructed on most of other plots;
- on another plot, the large area of dune forest was cleared for a caravan park and a "house" was constructed immediately adjacent to the road.
- the stretch of the shoreline from the north of the Som de Mar complex to the City Council boundary is currently undeveloped although the Conselho Municipal has drawn up a tourism development plan comprising a series of contiguous 50 x 500 m plots;
- this plan, in effect, maximises the number of tourist operations along the ecologically sensitive stretch of the coastline and, if implemented, will result in a destructive and irreversible transformation of the dunes environment along this prime stretch of the coastline. As described, this plan is totally opposite to the proposed ICAM management strategy for the Xai-Xai District coastal area, and clearly falls outside the National Tourism Policy which advocates "high quality/low impact" tourism for the Xai-Xai - Chongoene coastal area. In addition, this type of tourism development will severely jeopardise any future tourism development along the adjacent Praia de Chongoene.

Although infrastructure and facilities are obsolete and weak, the entire ongoing development in the Xai-Xai Beach counts on the existing infrastructure which cannot satisfy the current needs. Water supply is generally restricted on few hours per day and establishments, including family houses, are forced to build their own reservoirs. Breakdowns of electricity supply are very often and occur, as a rule, after every minor storm.

The mentioned development within the coastline stretch between Xai-Xai and Chongoene Beach relies on the shoreline path laid at the immediate backset of the beaches or foredunes. Besides being destructive to fragile dunes environment, such as destruction of the vegetation, causing soil erosion, allowing sand mining, and riding along the beaches, this path cannot be effectively used as a service road due to its elements.

The growing tourist activities in the Xai-Xai Beach, such as construction and services, create employment opportunities and, therefore, attract the District's population to settle at the outskirts of the settlement. This kind of squattering neighbourhood, although, at the moment, confined on a small area, could, if not controlled, threaten very soon the chances to plan the development of this tourist resort.

6.5.2 Integrated Development Plan for Xai-Xai to Chongoene Beach Tourist Resort

Traditionally, the resources of the Mozambican coast, as in most places, have been developed in sectorial manner (e.g., fisheries, agriculture, tourism) with little regard to the inherently integrated nature of coastal and marine ecosystems that support these sectors. Coastal zones are also usually managed only around political/ administrative boundaries rather than environmental units, which often results in overlapping jurisdictions and responsibilities. Finally, sectorial approaches, particularly in tourism development, target often short-term rewards without taking into account the long-term costs of resource depletion. If Mozambique maintains a *status quo* of *ad hoc* investment strategies, the result will be further decline in environmental quality and functioning, increase of conflicts among the users of the coastal zone, and diminishing of resources available to those users. A new model of the coastal zone planning and management to guide investment strategies is needed for the people of Mozambique and interested donors, targeted both at the private and public sectors.

Rationale and Goals for the Plan Preparation

This new, integrated approach to coastal development will ensure that the beautiful environment of the Xai-Xai coast remain intact and continue to support the present and future generations. It charts transition course to plan for growth which could co-ordinate diverse activities and users while managing and protecting the ecosystem. It requires a multiple-use approach and participation of all the stakeholders in integrated and participatory manner. (These stakeholders include governments at the national, District and local levels, the non-governmental organisations, research interests, and private sector.)

The plan envisages the process of designating zoning and activities, for both conservation and development, to mitigate conflicts and environmental costs, and to maximise the net benefits for the society. Once adopted, the Plan provides the blueprint for development and the way to monitor progress of particular actions and specific zones. It operates through the clearly defined development zone, but is viewed from within the context of broader District's coastal area.

There are numerous reasons why the Xai-Xai Beach needs the plan today. The most important are:

- the coastal stretch between the Xai-Xai and Chongoene Beach, compared to other parts of the Province is one of the most important and economically the most valuable spaces, from both development and environmental point of view;
- although population level in the coastal zone has been rather limited so far, economic and social transition of Mozambique will cause migration of many people towards the coast and, if they were not received in organised environment, it could cause serious deterioration of natural and men-made resources;
- there is the nationally declared need, international market demand and proclaimed strategy to reverse the existing trend of involuntary outgrowth into organised sustainable tourism development in the area;
- by creating conditions for the organised tourism and housing development in the designated area, the pressure and threat of uncontrolled outgrowth spreading in neighbouring naturally virgin areas will be minimised;
- the adequate funding framework should be developed as part of this plan, so that the present and future tourism and housing developers, who are obtaining the prime building sites, could contribute significantly to development of the necessary infrastructure in the area;
- based on integrated approach in solving the problems relevant to environmental protection, sustainable development of

tourism accommodation and housing, supported with adequate infrastructure and facilities development, institutional framework and capacity building, this project could serve as pilot project for establishing the tourist resort in the environmentally sensitive and fragile area of coastal dunes.

Components of the Plan

Taking ICAM for the Xai-Xai District coastal area, particularly its Tourism Development Strategy issue, as a basis to achieve the above goals, the Plan should contain the following components:

a) Environmental considerations based on carrying capacity assessment and environmental impact assessment based on the expected tourism and housing development pressure;

b) Land-use plan, including spatial structure and organisation, to designate and clearly delineate the built-up areas for tourism accommodation, public and recreation facilities, housing development from the dune green areas that should protect the most fragile dune segments;

c) Development and construction pattern plan relevant to the type and capacity of tourism and housing structures, public, recreational, commercial and infrastructure facilities, modes and types of construction in the fragile dunes environment;

d) Communication network comprising roads, pathways and parking areas network, small port or mooring site, and boat landing facilities;

e) Infrastructure network including water supply, electricity supply, liquid and solid waste treatment and disposal;

f) Implementation framework including funding, institutional framework and strengthening, capacity building.

6.5.3 Elaboration of the Plan

The Plan should be elaborated by the joint team composed of international, national and local experts (appointed at the Provincial, District and Municipality level). The majority of them should be from the municipal and provincial institutions and authorities. These institutions should be responsible for plan elaboration and its further implementation. The preliminary list of tasks, the relevant institutions and their role in the plan preparation is given in the Box 7.

The plan preparation should take place in Xai-Xai. The nature of the project and experience in the country call for joint work of national and international experts. Individual or separate work of international or national experts should be minimised.

Box 7
Contents of the Plan

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1.2 Input from the ICAM Management Strategy for the District coastal area

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Map: Spatial development structure (scale 1:25,000)

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Map: Land-use plan (scale 1:5,000)
Map: Development structure plan

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- 5.2.1 Main funding sources
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7 ARTISANAL FISHERIES DEVELOPMENT

7.1 The Present Situation

The bulk of fishing activity in the District takes place at the Limpopo river mouth, where the estimated number of 200 canoes catch mostly small demersal species. The characteristics of the District fisheries may be summarised as follows:

- trawling for prawns in the coastal waters by fishermen from outside the District (from Maputo and other more developed fishing centres);
- most of fisheries resources in the open sea of the Xai-Xai District are utilised by a fleet coming from Maputo (semi-industrial vessels, with ice storage and of capacity to be 4-6 days in the sea);
- fishing in the Limpopo estuary practised by a co-operative from Zongoene and individual fishermen from both sides of the river. They have small canoes and practice bottom-line fishing;
- the near-shore bottom-line and game fishing are practised from small boats (7-8 m long, two outboard engines) owned by a few artisanal fishermen from the Xai-Xai Beach;
- the bottom-line and game fishing practised by South-Africans in the near-shore sea, disguised very often as sport fishermen;
- fishing with nets and lines in fresh water lakes practised by the local population;
- artisanal and sport fishing boats usually have two outboard motors, and are fairly well equipped with safety gears, and equipment for trawling and bottom-line fishing, including GPS and echosounder;
- the price of the best quality fish sold by few artisanal fishermen in the Xai -Xai Beach is approximately 2 US$ per kg.

The only fishing activity in the near-shore sea practised by the native population is bottom-line fishing from the shore, harvesting shells on the beach rock, or assisting a few artisanal fishermen, primarily South-Africans and Portuguese origin, on their boats.

The fishermen face lots of difficulties in selling their catches because of the following reasons:

- lack of transport facilities. The road network is not good, and transporting fish from the village to the market takes a very long time, and often, the fish become unmarketable;
- lack of chilling or refrigeration facilities for preservation of the fish caught overnight;
- lack of the fixed market outlet;
- lack of fishermen organisation to manage their activities, particularly sale;
- middlemen from the RSA buy lobsters and shrimp, and smaller fish are left to fishermen to dispose of.

7.2 Potentials

Table 6 shows the present and estimated potential catch in the Province of Gaza.[9] There are no estimates for the potential of inland waters, and figures speak of the present catch.

[9] From a study carried out in 1994 and published in March 1994, the IDPPE (Institute for the Development of Small-Scale Fisheries)

Table 6. Present and Potential Fishing Catch for the Province of Gaza (in tons)
Source: IIP, DPAP-Gaza and interviews

Resource - species	Estimated present catch - Artisanal	Estimated present catch - Semi-industrial	Potential catch	Exploited of the total potential (%)
Shrimp	50	150	950	21
Large Demersal	50	500	5,100	11
Small Pelagic	-	-	3,500	-
Small Demersal	4,000	-	5,400	74
Rock Lobster	10	-	-	-
Mangrove Crabs	20	-	950	2
Shells	20	-	-	-
Fresh water species	500	-	-	-
Total	**4,630**	**650**	**15,900**	**33**

The fish catch potential of the Province as a whole is very high and, with the exception of some species, it does not seem to have been fully utilised. The catch estimates for Penaeidae shrimp are approximately 950 tons, for large demersal species (*Sparidae, Serranidae, Lethrinidae*) about 5,100 tons, for small demersal species (*Scianidae, Sphyraenaidae, Mugilidae*, etc.) about 5,400 tons, and for small pelagic species (*Engraulidae and Clupeidae*) about 3,500 tons a year. The small pelagic species are mostly caught between Monte Belo and Ponta Zavora (Anon., 1991). In the area of mangroves, around the mouth of the Limpopo river, the estimated catch potential of mangrove crab (*Scylla serrata*) is 950 tons per year.

It seems that only a very small percentage of the totally estimated potential of approximately 15,900 tons of the most important fishery resources a year, is utilised (Anon., 1991). This amount does not take into account other resources such as molluscs, rock lobsters, sharks and large pelagic species.

The fact that the Institute for Fisheries Research carries out no monitoring whatsoever, may certainly create problems in the future. Moreover, with the exception of semi-industrial fisheries and some artisanal fishermen, nobody has licenses or pays any taxes for fishing, including South-Africans who are reported to catch hundreds of kilograms of fish passing as "sport" fishermen.

As far as the District is concerned, the above mentioned study[10] proposes six important fishing centres: Chilaulane (Chongoene Beach) with the estimated number of 50-100 fishermen, Praia de Xai-Xai, with less than 50 fishermen, Barra do Limpopo, Salvador Allende and Voz da Frelimo (three centres at the Limpopo mouth) with the estimated number of more than 200 fishermen each and, finally, Gutsuine, near the Limpopo river mouth, with less than 50 fishermen.

7.3 Strategy

There are several historical reasons, being physical or social, why the native population has not developed capability for fishing in the near-shore sea. First of all, it is the unindented high energy coast which is a hostile place for sheltering the boats. At the same time, there were enough resources in the lakes, river estuary and along the shores (on the beach rock) to satisfy the modest subsistence needs of a relatively small

[10] From a study carried out in 1994 and published in March 1994, the IDPPE (Institute for the Development of Small Scale Fisheries)

population at the coastline. The low level of development and poverty of the population was also one of the main constraints in developing fisheries activity. Although the Portuguese are among the best fishermen nations, during the colonial times, the priority was given to agriculture, particularly in the Limpopo Valley, while fishing in the area was neglected.

With the development of the capital infrastructure (the national road) and especially tourism, the conditions for developing fishing activity are slowly improving. The expected future tourism development is going to create the local market particularly interested in the high quality demersal fresh fish, to be offered in hotels and restaurants. The new market and improvement of infrastructure in the area (electricity, feeder roads, boat landing facilities), followed with the growing economic potential of the native population, is going to create the new, favourable environment for the small-scale or artisanal fisheries development.

Development Opportunities

Although there is no existing fisheries tradition in the area, there are some prerequisites favouring the idea and incentives for the development of artisanal fisheries in the area, particularly at the Limpopo river mouth. In order to propose the fisheries management strategy, it was necessary to assume some starting points, not only relevant to the existing conditions, but also anticipating the expected development processes. The most important assumptions, with their advantages and disadvantages, are listed as follows:

- the existing resources and catch potential is high, particularly for large demersal species, shrimp and large pelagic fish, generally related to the near-shore sea. The fishing grounds compatible with artisanal fishing extend at average 15 km offshore (100 meters isobath);
- the average bottom-line fishing catch of a small boat (7 meters long) is between 100 and 200 hundred kilos of large demersal species per day. There are only several boats fishing in the area daily, which gives enough room for a significant increase of the boats without depleting fish stocks;
- although modest, the price of 2 $ per kg of high quality fish gives enough income to invest into boats and equipment;
- a relatively large number of fishermen fishing in the Limpopo river could be easily trained for the near-shore fishing;
- although there is no fisheries tradition and widespread skill for the near-shore fishing, there is already a number of native fishermen who gained basic skills while helping the foreign origin fishermen on their boats;
- presently, there is almost a complete lack of infrastructure and facilities, particularly at the Limpopo river mouth (electricity, paved road, harbour, water supply, fuel supply, etc.). Most of these needs will be solved soon, not only to supply the densely populated Zongoene area and a new hotel in the Limpopo estuary, but also to support fishing activity in the estuary.
- the lack of harbour is the main constraint in developing fisheries in the area. For the moment, the only low cost and fast solution to develop a small harbour to host artisanal fisheries boats seems to be the Limpopo mouth. Alternatively, the Xai-Xai Beach could host sport fishing boats. These opportunities are elaborated in Chapter 8.
- small boats operating in the Limpopo river are not fitted to go offshore, to the open sea. The existing fishermen co-operatives and a relatively large number of individual fishermen from the Limpopo river, would have interest and desire for the near-shore fishing, if they could buy boats, tools and equipment. It was reported that if adequate equipment and means were available, the offshore artisanal fishing in the Xai-Xai area would be improved. Experience in estuarine fishing qualified them for the training in

the near-shore fishing, what could be done relatively fast and at low cost;

- although there are no fisheries tradition and widespread skill for the near-shore fishing, there is already a core number of native fishermen who gained the basic skills while helping the foreign origin artisanal fishermen in the near-shore fishing;
- the fish market is presently weak. Fish are sold to middlemen for export to the RSA or for the local market (hotels, restaurants, local population and tourists). It is expected that with the development of tourism, the fish market will develop significantly, particularly with regard to the presently lacking fish freezing equipment. Alternatively, with the expected growing income of the local population, the demand for the lower cost small pelagic species will also rise;
- a process of the artisanal fisheries development is characterised by foreigners owing boats and equipment, hiring local crew, and paying them for their service, and retaining a significant profit selling the fish catch. This practice, with limited benefit for the local population, could be improved or even changed if there were at least control or support from the Government to co-operatives and individual fishermen;
- the alternative to artisanal fisheries is the sport fishing for tourists, which is also practised in the area, mainly in the Xai-Xai Beach by South-African skippers, with some help of the local boys. They mainly go surface trawling for large pelagic species, but sometimes also practice bottom-line fishing. Tourists, usually 4 in a boat, are charged 25 $ per person for a few hours fishing. With tourism gaining steam, this kind of service could also be provided by local population, if they were supported to get boats and equipment;
- the latest events in the area confirmed that there was growing interest for artisanal fisheries. The fishermen association “A Voz da Frelimo” from the right bank of the river is, among others, trying to buy a boat. Another initiative exists on the left bank of the Limpopo, in the Chilaulene area, where there is a cold store container with capacity of freezing 500 Kg of fish per day. It belongs to a group of 14 owners of boats and nets (there used to be 49 nets in the area), who believe to attract more fishermen to join the association. The cold store is used for storing the first grade fish and shrimp. A tractor is collecting fish to bring them to the Xai-Xai Town. The problem that still exists is a low demand for fish and shrimp. It is also reported that if the Zongoene hotel offered better prices for shrimp and fish, more fishermen would be attracted to sell fish in the hotel.

From the points listed above, it is obvious that artisanal fisheries in the area would develop spontaneously, slowly and with possible negative side effects, if it were not supported and, in a way, managed by the Government. If backed by various governmental and private institutions the development could be faster, smoother and, what is most important, with more benefits for the local population.

7.3.1 Goals and Objectives

The main goal is to support and help the development of a sustainable small-scale or artisanal fisheries in the area. The particular management objectives are the following:

- provision of the basic infrastructure at the Limpopo river mouth as prerequisite for the artisanal fisheries development, including:
  - paved roads to Zongoene (the right bank) and Chilaulene (the left bank) Limpopo mouth area;
  - electricity and water supply on both estuary banks; and
  - the safest pass through the Limpopo river mouth and a small harbour or fishing centre, all without endangering the estuarine ecosystem;
- supporting the development of artisanal fisheries by imposing tax rebate on the purchase of outboard motors, fishing

gears and associated equipment, providing soft loans, and especially imparting training to fishermen on the basic and new technological development for improving fish catch;

- a regular assessment and monitoring of fish stock, control of fishing practice and tools.

7.3.2 Strategy

According to "Regulamento Geral de Execução da Lei das Pescas, Decreto número 37/90 de 27 de dezembro de 1990", artisanal fishing in Mozambique is defined as follows:

> *Artisanal fishing is a localised fishing activity practised without or with small boats of maximum length of 10 m, in periods not exceeding 24 hours. Traditional methods are used for artisanal fishing, and ice is rarely used for conserving the catch.*

To achieve the above mentioned goals and objectives, the Artisanal Fisheries Project should be developed comprising the following components:

1. Assessment of fishing potentials (fishing grounds and stocks) in the area, including for the protection proposed Baixos de Inhampura reef. In order to identify properly breading and feeding grounds, there is the need to evaluate fishing stocks in more detail, during the yearly cycle. The identification of proper fishing methods, techniques and tools, and carrying capacity assessment for fisheries should also be elaborated;
2. Market assessment potentials and funding sources;
3. Elaboration of the programme and projects for development of a small artisanal fishing centre in the Limpopo estuary, including:
   a) necessary services for the boats:
      - berthing facilities to facilitate unloading of catches, and loading of gear and supplies;
      - fuel and water;
      - ice;
      - workshop, repair and maintenance facilities including provision of slipway; and
      - the area available for gear repair and storage.
   b) handling of catch:
      - market building;
      - ice making plant and storage;
      - fish cold storage; and
      - vehicle access and parking.
4. Assessment and harmonisation of harbour development studies and project (as elaborated in Chapter 8) with the requirements of artisanal fishing centre;
5. Elaboration or assessment and harmonisation of the basic infrastructure projects with requirements of the artisanal fishing centre programme.

The big game fishing is a very popular sport, and many competitions are held at the national and international level all over the world. The fish caught remain in the area and no attempt is made to transport the fish to the place of domicile of the competitors. In this line, the policy should be formulated for sport fishing. Besides the artisanal fisheries project, potentials and a programme for sport fishing should be assessed, and the adequate programme should be developed. The primary location for hosting sport fishing boats is the Xai-Xai Beach, but a number of boats could also be available in the Limpopo estuary.

Benefits and Risks

Although such development projects bring significant benefits to the area and population, there are still certain risks. The benefits are primarily linked to the population well-being, what is extremely important in the case of a poor developing country. On the other hand, the risks are mainly related to a possible failure of the project, and particularly to environmental degradation. The main benefits and risks could, among others, be the following:

Benefits

- improvement of living standard of the local communities, and employment opportunities increase;
- source of proteins; improvement of health of fishermen and population;
- upgrading of tourist offer, and provision of fish for tourist industry; and
- better exploitation of the available natural resources.

Risks

- depletion of fish stocks;
- over-exploitation of the available resources; destruction of fishing grounds (use of explosives, poisons, oversized nets, etc.); and
- degradation of the naturally valuable areas, such as the Limpopo estuary and Baixos de Inhampura reef.

7.4 Action Plan

It would be irrational to expect that the above mentioned projects could be elaborated and implemented at once. Development of fisheries, being it sport or artisanal fishing, depends highly on pace of tourism development in the area. Even more, in the case of Xai-Xai the development of these two activities is interdependent. That is why artisanal fisheries should be developed in phases, but having in mind the general objectives and adapting them in time regarding an accurate assessment of the resources.

Preliminary Phase

To some extent, the project of the small-scale or artisanal fisheries development in the open sea is too ambitious, because there have been very bad experiences in other parts of Mozambique. If there is no tradition to use boats with engines, it would be better for the development to rely in the preliminary phase on support of the already established pattern of co-operation between experienced foreigners (or nationals, if they posses the skills) and the local population. It has been suggested that middlemen provide for fishing gears, nets, boats on lease, and buy fish at fair price. It means that the Government would support the incentives with loans and other means, if there were an experienced borrower. This proposal is viable, but the State should exercise the proper control through its various authorities and departments.

Within this phase, which may have duration of three years, the support by and co-operation with national institutions like IDPPE and IIP is essential to create a sort of co-management process, giving advises, collecting information, data and impressions from fishermen. At certain time, fishermen themselves would develop the idea of the adequate resources management.

It is expected in this phase that the basic infrastructure (adequate road, electricity) will reach the Limpopo estuary. Also, the essential studies like assessment of the pass through the Limpopo river mouth, including bathymetry, currents, hydrodynamic and tidal conditions, coastal engineering survey, should be completed (Chapter 8.6).

Even in the preliminary phase some initial construction could be performed in the Limpopo estuary. Actually, the construction of small wooden pier is presently being performed by fishermen at the left bank of the river (Barra do Limpopo). This kind of small-scale actions, such as marking the pass and the corridor through the Limpopo estuary for safety reasons, and to avoid conflicts between the offshore and estuarine fishermen, should be supported by governmental institutions.

Summary of the activities to be undertaken in the short term (up to three years), are as follows:

1. Support, facilitation and monitoring of the initial joint ventures between entrepreneurs (experienced foreign and national fishermen) and local fishermen;
2. Construction of the basic infrastructure in the Zongoene and Chilaulene areas (roads, electricity, etc.);

3. Elaboration of the basic studies regarding harbour development in the Limpopo estuary, and a basic study relevant to the artisanal fisheries potential; and
4. Small-scale improvement of the existing conditions within the Limpopo estuary (marking the pass, small peer construction, instalment of modest freezers, etc.).

Planning phase

Outcomes of the mentioned studies, the results of co-operation of the local population with experienced fishermen, the attained level of tourism development, and the relevant market demand, should give a proper scope of the project to be realised in the second phase. If the results were positive, then the programme for the establishment of fisheries centre should be elaborated in the second phase, including funding proposals.

Summary of the activities to be undertaken within the medium term (up to six years) is as follows:

1. Market assessment potentials and funding sources;
2. Elaboration of projects for the development of a small harbour; and
3. Elaboration of the programme and projects for the development of a small artisanal fisheries centre in the Limpopo estuary.

Construction of artisanal fisheries centre, if proved to be viable, and physically and environmentally appropriate, should take place after the studies and projects have been completed. In the construction phase, the engagement of governmental institutions should be significant, particularly facilitating in the provision of funds, issuing building permits, and surveying construction.

8 PORT DEVELOPMENT

8.1 Background

There is evidence that in the colonial times the Limpopo river was navigable from its mouth up to the Xai-Xai Town. Lacking road access, goods and passengers were transported by small steam shipboats from Maputo directly to Xai-Xai[11]. Actually, having the advantage of being a port town, Xai-Xai was a regional distribution centre with a narrow-gauge railway (which is still operating from time to time) connecting it with the hinterland. Later on, due to war times and changing morphology of the Limpopo mouth, this navigation route was abandoned, and the national road became the main transportation corridor.

Presently, the nearest harbours or boat landing facilities to the Xai-Xai coastal area, which can accommodate small fishing and tourist boats, are located in the area of Maputo, some 200 km south, and in Inhambane, about 300 kilometres north. The lack of shelters for boats along the large stretch of high energy and unindented coast, is one of the main reasons for deficiency of coastal activities, particularly fisheries and marine transport.

As already outlined in the Chapter 6, one of the main advantages for tourism development in the Xai-Xai area, are marine related activities, such as sport fishing and diving, sailing, wind surfing, etc. Most of these activities cannot be developed without an adequate shelter for boats, boats landing facilities or a harbour. The lack of these facilities could seriously limit development of tourism in the area.

This issue deals with needs, constraints and opportunities for the development and construction of a tourist and fishing port, harbour or boat landing facilities. We shall concentrate in this Chapter on the port and marine facilities development as these facilities are needed to service tourist and recreational activities, as well as commercial and sport fishing.

8.2 Requirements

Presently, when the Xai-Xai District coastline is becoming very attractive area for tourism development, the existing infrastructure needs rehabilitation and upgrading, while construction of the new one is a prerequisite for any significant economic growth of this area.

Over the long term, the potential harbour and boat landing facilities should, presuming dynamic development of the area, serve the following marine related activities: (1) Artisanal fisheries; (2) Tourism; and (3) Transport of visitors. These activities demand the following types and groups of boats:

1. Small artisanal fishery boats (up to 10 m in length), owned by local residents from the areas where some initial activity already exists;
2. Tourist boats, preferably in the area of a concentrated tourist accommodation, which could be grouped as follows:
   - a limited fleet of small rigid or semi-rigid boats which are chartered to visitors for sport fishing, diving, excursions, etc. A limited number of boats owned and used exclusively by local residents and steady visitors are included in this group;
   - excursion boats, including glass bottom boats;
   - boats brought on a trailer by visitors; and

[11] In the Portuguese colonial time, the Xai-Xai Town was called Joao Bello

- small yachts cruising along the Mozambican coast;

3. A small excursion liner connecting Maputo, Xai-Xai, and Inhambane.

The harbour should offer vessels shelter from winds and waves. The natural sheltering features, such as headlands, promontories, offshore shoals, and protected bays and estuaries, are generally preferred for harbour siting as artificial sheltering (such as breakwaters) is very costly and sometimes economically unfeasible.

Ideally, the harbour should ensure the maximum protection from waves and currents, as well as:

- an easy access for boats, in terms of both depth and width;
- an adequate turning basin for easy manoeuvre of boats;
- adequate moorings and berths, both in terms of number and size;
- minimum initial and maintenance dredging;
- suitable conditions for navigation and anchorage;
- sufficient circulation to ensure good water quality;
- adequate land and onshore facilities; and
- room for future expansions, both in the harbour and on land.

8.3 Development Opportunities

The coastline of the Xai-Xai District consists of long sandy beach stretches and dunes interrupted only by the Limpopo river mouth. Thus, there is a limited number of locations where natural refuge features are available for development of harbour facilities. The beauty of shoreline features attracts a great number of tourists all the year round, thus creating the need to provide the necessary infrastructure facilities for the development of tourism and fishing activities.

Existing Conditions

Actually, the natural refuges for harbours are available only in two sites, namely: (1) In the Xai-Xai lagoon, and: (2) Inside the Limpopo estuary.

1. Recently, a boat launching facility has been constructed in the Xai-Xai lagoon, behind the detached beach rock formation. Since the boat launching slip has a concrete platform lying considerably over the high tide level (about 3 meters), boats should be pushed or tugged from (to) the trailers over the steep sand slope. Although the slip is equipped with electrical winch, launching and pulling operation over sand is not smooth and requires assistance of at least several people. After every trip, boats are pulled out on the concrete platform, because mooring in the lagoon is not possible and safe at the moment.

   Anyhow, the main problem for boats in the Xai-Xai lagoon is a difficult and dangerous passage through the beach rock barrier. Although some modifications have been made, it is narrow, rocky at the half bottom, and can be used only at high tide and good sea conditions. At this moment, the Xai-Xai lagoon can be used only by very experienced skippers, almost only the locals who are familiar with passage conditions, even then not longer than 50% of days in the year.

2. Presently, the Limpopo estuary is mainly used for artisanal fishing (although there is evidence of limited sport/commercial fishing practised by foreigners), whereas the Xai-Xai lagoon is mainly used for sport fishing. The local population from both banks of the river fishes in the estuary. A few boats navigate at the river mouth and fish in the near-shore sea, including two boats owned by a hotel which is under construction.

Table 7. Basic Port Location Characteristics

Site	Advantages	Disadvantages
Xai-Xai Beach Lagoon	• existing tourist capacities and tradition; • high potential for tourism development; • medium cost of small port construction; • existing infrastructure on land; • existing local fishermen and skippers;	• difficult navigation through the passage to the open sea; • limited mooring space and safety conditions; • limited space for port and fisheries centre development; • potential conflict between land and sea use, and tourism;
Limpopo Estuary	• acceptable conditions to navigate through the passage to the open sea; • very low cost of small port construction; • existing colony of local fishermen; • available space for port and fisheries centre development.	• potential pollution of the estuary; • no adequate infrastructure on land (energy and road); • potential conflict in use of estuary between tourism and fishery; • potential need for continuos dredging of the river mouth passage.

According to the local marine authority officer and fishermen, the passage to the sea through the river mouth is easier, less dangerous and passable more days in the year than through the Xai-Xai Beach lagoon. The tidal range is also lower, while boats are very safe when mooring at the estuary.

Location Alternatives

There are favourable, but limited conditions for the development of artisanal fisheries centre in the Xai-Xai Beach and at the Limpopo river mouth where fishermen colony already exists. Both of these two locations have some advantages, but also disadvantages. In spite of only few advantages, the third possibility to develop artisanal fisheries centre somewhere along the "open" coast seems unreasonable, because of many disadvantages (the rough sea, high cost of breakwater construction, no available infrastructure, no fishermen colony at the site, etc.) The characteristics of the two potential sites for the development of the centre are given in Table 7.

Taking into account all these advantages and disadvantages, it seems reasonable to propose development of the artisanal fisheries centre primarily at the Limpopo river mouth. At the same time, the Xai-Xai Beach seems to be suitable for the development of a tourist port, including existence of a small fleet of fishing boats to serve for game fishing and excursions (including visits and diving on the reef).

Thus, it is appropriate to propose development of both locations, maintaining its present trend, mainly artisanal fishing at the Limpopo estuary and sport fishing in the Xai-Xai lagoon.

8.4 Goals, Objectives and Expected Benefits

The potential benefits of having a tourist harbour between Maputo and Inhabame, are self evident since tourism development in the region may increase and future destination resorts could become feasible within this area. As described in the National Tourism Master Plan, this development is expected to be over the long

term. The tourist harbour would support further development of recreational activities, such as game fishing, boat excursions along the coast and on the reef, etc.

Goals and Objectives

In the framework of the given physical conditions of high energy and unindented District's coastline, and evident opportunities for the development of artisanal and sport fishing, particularly tourism, the development of the harbour that could provide shelter for small boats, is the general goal. Within the expected timely development and given location opportunities, particular objectives are the following:

1. Development of a harbour at the Limpopo estuary with a primary function to accommodate the artisanal fishery boats;
2. Development of a small harbour in the Xai-Xai Beach lagoon primarily to give shelter for a limited number of small tourist boats.

Benefits and Risks

Benefits and risks of developing port facility for tourist and fishing activities, are as follows:

Benefits

- value of the increased supply of fish due to the availability of mooring more vessels, possibility of fishing on new grounds, access to new tourist areas, increased efficiency of the existing fishing and tourist vessels, more efficient unloading/loading operations, less downtime due to better shelter and more repair facilities, etc.;
- reduction in losses of catch due to improved unloading and preservation of fish;
- the increased monetary value of catch due to better quality of the fish sold, and upgrading of harbour facilities;
- the increased value of catch due to timely sale and market changes;
- the increased number of visitors with significantly higher expenditure rates per visitor; and
- income from foreign vessels, attracted by new harbour.

Risks

- potential degradation of the lagoon and river mouth due to increased usage. In this case, garbage accumulation and oil spillage are of particular concern, and measures for protection should be envisaged, such as oil spillage barriers, floating barriers towards bathing area, proper disposal of used oil, etc.

8.5 Development Strategy

In general, facilities and equipment needed for development of the fishing or tourist port project include: harbour area with a pier or quaywall; mooring site; cold storage area; area for sorting and packaging (fish cleaning, place for disposing organic refuse); water and electricity supply; storage for fishing tools; boat repair area; spillage floating barriers; gasoline supply or station; parking area; fish market; etc.

8.5.1 Harbour in the Xai-Xai Beach Lagoon

Even though the Xai-Xai Beach harbour site is located in the lagoon, the factors influencing location and orientation of the entrance are the same as for the open coast harbours, except for sheltering, which is naturally provided by the lagoon. If possible, the harbour should be located where there are adequate water depths for passing of the largest vessels (or boats) that are expected to use the harbour. In order to allow easy navigation through access channel, it should be located where there are no strong beam currents at any stage of tides.

The harbour should preferably be located in the area relatively free of littoral drift. Also, the provision of two entrances would benefit water circulation inside the lagoon.

In this case, it may not be an issue, as the beach rock is under water at certain stages of the tide.

Recently, the boat launching facility has been constructed in the Xai-Xai lagoon, behind the detached beach rock formation. This area, the cove in front of the Halley Tourist Complex, is the only suitable location for a small boat shelter. The cove is narrow, extending about 1 km, and fringed by beach rock and the beach. The beach is surfacially exposed during the mean sea. With tourism development in the Xai-Xai coastal area, mooring facilities should be provided for boats which would be used for game fishing, as well as for bringing tourists offshore for boating. Taking into consideration the size constraint, the boat mooring facilities should be designed in a way that part of the cove could be used for mooring of boats and part of it for bathing. The section west from the bollard should be used for bathing, pedallo, kayaking, and the other part for berthing and mooring of boats. Depending upon the size of the boats, about 20 normal size boats could safely be moored if the facility were properly designed. During rough seas, these boats would be towed up the beach by the winch safe from wave uprush. In no circumstances any boat should move to the bathing area site.

The strong proposition has been made by some fishermen to use these facilities for commercial fishing. This would give rise to conflictual issues and the fishing port would be ideally located at the Limpopo estuary. Until then, this site could tacitly be used by the fishermen in a controlled way and without further demand for refrigeration plant, fish cleaning and processing at the site, visceral, guts, bone disposal, etc.

The site may be developed further for a small harbour with permanent moorings. In fact, this is the only site in the lagoon that in the long run, with growing tourist capacity, may be developed as marine centre which, among others, should include the following services:

1. Offshore:

- improved and much safer maritime access channel through the beach rock formation equipped with adequate navigation signals allowing emergency entrance during the night; also, the marked navigation route in the lagoon to avoid unnecessary disturbance of bathers;
- permanent mooring site and buoys for approximately 20 boats averaging 7 meters in length, encompassed with floating oil spillage barriers;
- floating pier, to allow easy boarding, particularly to excursion boats; and
- improved winch or adequate lift to allow easy launching of boats.

2. Onshore:

- improved ramp to allow easy onshore handling of boats;
- onland boat parking space, large enough to accommodate larger number of boats in the case of rough weather;
- onland repair and fuelling facilities for boats;
- marine club house, including areas for fishing and diving services, excursion agency, restaurant, refrigerating room, premises for management and marine authority, etc.
- cars and trailers parking space.

8.5.2 Harbour at the Limpopo Estuary

Presently, there is a lack of appropriate onshore facilities to process and store fish in the Xai-Xai District coastal area. The domestic production is thus limited, and there seems to be high local demand for fish, which, for sure, will be increased with tourism development.

The primary function of the Limpopo estuary harbour is to accommodate small artisanal fishing boats that will develop in the area. Harbour requirements for artisanal fisheries would include a modest marginal quay, and a slip for hauling up crafts for

repairs and maintenance, in sheltered waters. Artisanal fishing boats are generally shallow draft small crafts which are put out to the sea in the morning and return before dusk. The catch is usually offered for immediate sale so that a small market place is required. Probably, it is convenient to provide also for a small size freezer.

At this moment, the site of the Maritime Commission on the right river bank in the Zongoene area seems to be the most appropriate location for the artisanal fisheries centre and the harbour. Presently, it is a base for several boats fishing in the near-shore sea and a small spontaneously established centre for estuarine fishing. A freezer (container of approximately 10 m^3 powered by electric generator) is established at the site, while a small wooden pier is under construction by the local fishermen.

Planning Considerations

In this case, location and orientation of the entrance are fixed by natural features. The access channel also depends on natural depths through the estuary bar, and may shift its location resulting in a difficult navigation. The harbour should preferably be located in the margin relatively free of sedimentation.

Firstly, a survey to establish the general fishing grounds and volumes of catch for fishing industry is necessary, both in the Xai-Xai area and in the neighbourhood. In order to establish fishing grounds and volumes, it is necessary to follow their life cycles, according to different seasons.

Market predictions include local and national potential, and exporting trends towards future demands and types of fish processing, when industrial fishing is developed. According to the existing data, industrial fishing is not considered for Xai-Xai. Labour and training requirements are important considerations, particularly for the near-shore fishing, where higher expertise is required.

Design of the fishing harbour centre should include the following services:

1. Facilities for fish catch:
   - landing (pier, mooring areas, storage);
   - handling (sorting; washing; weighing/ counting, ice filling, packing); and
   - selling (packing, sorting, stacking, loading, transportation, parking).
2. Facilities for fishing vessels:
   - berthing (pier, mooring areas);
   - outfitting (water supply, ice supply, fuel, provisions, bait, fishing gear);
   - repair and storage of gear; and
   - navigational aids.
3. Facilities for users:
   - rest rooms; and
   - eating places (including washrooms, administration and recreational areas).

8.6 Action Plan

The proposed harbour development on both sites should be implemented in several phases. It is obvious that these phases should be interlinked and harmonised with tourism and artisanal fisheries development in the area. The most important is the first or preliminary phase when the presumed inputs to this Management Strategy, (such as bathimetry survey, data on currents and waves, fish stocks, etc.) should be examined through sectorial scientific expertise, studies and projects. It is possible that some of these studies give results, which calls for significant modification of the proposed harbour development in this Strategy.

8.6.1 Planning and Design Phase

The preliminary or planning and design phase, should, among others, include the following basic surveys and expertise:

1. Xai-Xai Beach Lagoon
   - bathymetry and land survey maps of the lagoon and relevant littoral area;
   - climate, currents and tidal conditions;
   - coastal engineering survey (littoral movement of sand, waves);
   - preliminary project of the harbour including marine and land area;

- environmental impact assessment study; and
- cost estimate and feasibility study.

2. Limpopo River Estuary

- bathymetry and land survey maps of the river mouth and estuary;
- climate, currents, hydrodynamic and tidal conditions at the river mouth;
- coastal engineering survey (littoral movement of sand, waves, feasibility of dredging free access channel through the river mouth);
- study of navigation link between the Limpopo estuary mouth and the Xai-Xai Town;
- survey and estimates of the offshore fish catch and market potentials;
- development programme defining services and capacity of the artisanal fisheries centre;
- location selection and preliminary project of the harbour, including marine and land area;
- environmental impact assessment study; and
- cost estimate and feasibility study.

8.6.2 Construction Phase

Construction phase should follow the planning and design phase. However, having in mind a relatively high cost of the proposed expertise for both potential investment (3% to 6% of construction costs) and the need for urgent improvement of the existing conditions, particularly in the Xai-Xai Beach lagoon, some minor improvements should be carried out on the basis of a preliminary coastal engineering expertise. These improvements should be limited in scope and time in order not to become an obstacle for further major investment.

In the case of the Xai-Xai Beach lagoon the following improvements should be performed:

- improvement of maritime access channel into the Xai-Xai lagoon;
- provision of buoys and anchors for approximately 20 small boats, of up to 10 m in length, as temporary means to serve the existing needs;
- improvement of the existing ramp and providing better winch or lift. The slipway needs some modification, especially along the toe, since in the present condition, boats could not be pushed to the sea easily. The rail system is a good option for towing up and down the boats. Alternatively, rolling steel pipes could be fixed over enabling boats to roll up and down the ramp.
- the present slipway is very impractical for embarking or disembarking the boats. It would be almost impossible for children and women to climb the boats if they were tossing on the water. The proper jetty with fenders, impact pads, ropes, tying rings, etc. should be constructed. Light and winch should also be provided. Once the big game fishing is developed, perhaps some dredging would be required to berth bigger boats. In addition, special cranes would have to be installed for weighing the game for souvenir photos and also for recording tract and advertisement. The big game fishing would form part of the tourist package, and would be the enticing tourist promotion component.
- providing larger onland area for boat shelter during rough weather, and trailers parking;
- providing limited onland repair and fuelling facilities for boats.

In the case of the Limpopo estuary any provisory construction depends on prior provision of infrastructure at the site, primarily asphalt road, water and electricity supply. It also depends highly on the development of artisanal fishing in the area.

8.6.3 Institutional Framework

Besides The National Ports and Harbour Authority, such as the leading agency,

provincial, District and municipality authorities, the following governmental agencies should take part in the planning phase of harbours development:

- SAFMAR - Services for Maritime Administration
- INAHINA - National Institute for Hydrography and Navigation
- DNA - National Directorate for Waters
- MICTUR - Ministry of Industry, Commerce and Tourism
- DINAGECA - National Directorate for Geography and Cadastar
- IIP - Fisheries Research Institute

9 INSTITUTIONAL STRENGTHENING

9.1 Institutional Problems

Some positive steps have been taken towards the protection and sustainable use of natural resources in Mozambique, like establishing of the Ministry for Co-ordination of Environmental Affairs (MICOA). This Ministry has already elaborated the National Environmental Management Programme (NEMP), and environmental legislation, of which the most important environmental "umbrella" law is in the process of approval, is being elaborated.

At the Xai-Xai District level, there is mainly lack of technical human resources for good control and management of natural resources and environment. Besides technical capacity, resources and equipment for the control of sensitive and protected areas, or other areas of concern, are also lacking.

The coastal inter-institutional management group consisting of MICOA, DPAP, DPICT Marine Administration representatives has been formed in the course of this ICAM elaboration. The aim of the group is to guarantee the region's sustainable development through implementation of tough discipline on the use of resources. Owing to this group, sectorial pronouncements as regards socio-environmental impact of investment projects are now being taken into account.

Legislation issues relevant to coastal zone management are implemented sectorially, some of them being obsolete and some lacking. Some laws and regulations, particularly issues dealing with harmful exploitation of natural resources, are not fully enforced due to the lack of control or, in general, due to poverty of violators. Besides, the new legal acts are sectorially oriented, targeting very specific issues (e.g., tourism development) and consequently, not fully considering the impacts on other activities or on the environment.

9.2 Coastal Zone Management Framework

In June 1994, the Government approved the National Environmental Management Programme (NEMP), which is a master plan for the environment in Mozambique. It contains the national environmental policy, environmental umbrella legislation, and environmental strategy. The NEMP is also a programme of sectorial plans, containing projections for the medium and long term, aiming to lead the country to sustainable socio-economic development. The Ministry for Co-ordination of Environmental Affairs (MICOA) has taken the lead for environ–mental management in Mozambique.

One of the priority areas of the NEMP is a number of activities related to integrated coastal zone management (ICZM). Particularly, the Programme states that coastal management will be based on inter-institutional co-ordination between the relevant stakeholders and on the programme, which should be elaborated and approved by them. The main issues for this programme are (i) fisheries, (ii) coastal and marine ecosystems management, (iii) coastal and marine protection (iv) marine parks, and (v) tourism. The Programme also defines the activities for the short, medium and long term.

Related to different outputs of the Programme, the priorities in the Programme Support Document (PSD), which has been rolling the NEMP implementation strategy for five years, are the following:

- formulation of the national programme for integrated coastal zone management;

- establishment of a multi-sectorial task force for integrated coastal zone management;
- establishment of a Coastal Zone Management Centre in Xai-Xai;
- publication of a coastal atlas, with GIS capacity established;
- identification, implementation, and monitoring of pilot projects.

The creation of the Ministry for Co-ordination of Environmental Affairs, was the first major step undertaken in the direction of integrated management strategy for natural resources. In fact, a co-ordinating role that this institution plays, stresses the adoption of the principle of a collective, participatory and harmonised management process rather than a sectorial, isolated and discoordinated one. With the same objective, a multi-sectorial ministerial body, the National Council for Sustainable Development, will be created when the Parliament enacts the Environmental Law, with the aim to guarantee that all activities related to the management of natural resources are undertaken in a correct and co-ordinated way by all the stakeholders, starting from the planning and decision making level. Institutional arrangements have not yet been set up for coastal area management, but studies for that purpose have already been initiated.

Within MICOA, department responsible for the coastal area is assisted by an integrated team of professionals, the CZM Unit, and is responsible for all the activities related to coastal area management, including studies, planning, programme management and co-ordination.

In order to guarantee coherent, uniform and harmonised practices, the process of legislation production is also being undertaken by a multi-sectorial group co-ordinated by MICOA.

Considering the main constraints pointed out in relation to the issue of coastal zone management, some priority measures are herein proposed, both to solve institutional organisation incorrectness, and to avoid the legal framework gaps.

9.2.1 Institutional Organisation for CZM

The coastal zone is a typical zone of horizontal multi-sectorial intervention, where no institution may claim an absolute domain of the area. Thus, the specificity of the coastal zone, which is, as mentioned before, characterised by multiplicity of activities, and thus, by multiplicity of institutions involved, demands the adoption of the different management approaches.

The basic idea is that all types of activities and situations of the coastal zone should always be considered and analysed together. For example, tourist activities should not be developed without considering their effects on agriculture, fisheries or biodiversity protection. Similarly, urban development programmes should not be undertaken without the assessment of the consequences that could result in terms of land tenure conflicts, water pollution, loss of biodiversity, etc. Having this in mind as the main aspect of institutional arrangement for the coastal zone, it has been proposed to create a multi-sectorial body, co-ordinated and supervised by the Prime Minister. This body would be a subcommittee of the NCSD, with branches at central, regional and local levels.

The following basic and operational arrangements should be started by this body:

a) A clear definition of each institution's specific mandate in the coastal zone;

b) Adjustment of mandates to avoid gaps, overlapping powers and conflicts, and to allow harmonised procedures;

c) A clear definition of common responsibilities and management strategies of the coastal area.

A multi-sectorial technical working group has already been set up to develop preliminary studies for the creation of this body, whose responsibilities necessarily include:

- supervision of the process of land-use planning of coastal Districts and other coastal areas;
- establishment and supervision of the environmental legislation enforcement system, based on training, operating capacity and use of enforcement agents of the institutions involved, as well as local communities and human resources;
- establishment of a system of the coastal zone development projects approval, for which environmental impact assessment is a key tool.

This group, led by The Ministry for Co-ordination of Environmental Affairs, has been active since November 1995. It consists of representatives of the relevant institutions in coastal zones: Ministry for State Administration (MAE), University Eduardo Mondlane (UEM), Ministry of Transport and Communications, Ministry of Industry, Commerce and Tourism, and Ministry of Public Works and Housing.

9.2.2 Legal Framework for CZM

As referred earlier, there is a big gap in the existing environmental legislation concerning coastal zone management and protection. The priority areas for which legal instruments should be produced, are the following:

- the legal definition of the coastal zone, based on scientific studies and data;
- adoption of land-use plan for the coastal zone and enforcement mechanisms;
- the legal creation of the protected coastal areas, and definition of management mechanisms;
- enactment of rules and guidelines for the development of agriculture, tourism, urban infrastructures, industrial infrastructures, etc. in the coastal zone; and
- enactment of coastal pollution prevention regulations, and contingency plan for oil spills.

The coastal zone could and should benefit from the existing international legal instruments in the field of the environment, some of which have already been ratified by the country. Introduction of the provisions of environmental conventions in the internal legal system, and the development of the activities they propose, will, among others, bring benefits to coastal zone protection.

9.3 Programme of Coastal Resources Management

Some of the priorities for 1996 are the activities actually being more than short-term, which should be started as soon as possible. Among these activities are: **(i)** preparation of the Programme of Activities for the implementation of Coastal Resources Management (which includes the establishment of the Coastal Zone Management Centre of Xai-Xai), **(ii)** the coastal land-use plan (which includes the activities of the Inter-sectorial Working Group, and coastal mapping), and **(iii)** group of activities to start in the period from 1996 to 2001 (which are pilot projects with different priorities). Details about these activities are given below.

9.3.1 Coastal Zone Management Centre of Xai-Xai

In the scope of its work, the CZM Unit should lead co-ordination of activities in coastal areas. Activities like training local decision makers (governors, local administrators, stakeholders and others) are among the tasks to be implemented for the improvement of utilisation of coastal resources.

Research and monitoring capacities will also be installed. The current knowledge on the state of coastal resources, their potential and development is rather sectorial (Forestry Department dealing with mangroves and reserves, Fisheries Research Institute dealing with commercial fisheries, etc.).

In order to develop training, research and monitoring activities on the coast, the Coastal Zone Management Centre in Xai-Xai is considered to be of paramount importance.

Box 8
Coastal Zone Management Centre Tasks

The general tasks of the Centre are as follows:

1. To conduct research, surveys and data collection of the coastal zone, and its management and related issues at the local, provincial and regional level, including the establishment of a data bank;
2. To secure technical assistance to local governments, institutions, organisations;
3. To promote and implement popular awareness campaigns and to empower the community in the field of natural resources management and sustainable development;
4. To carry out short-term training courses on natural resources management and sustainable development for civil servants, private sector, NGOs and general public;
5. To implement environmental impact assessment to the activities developing within the region;
6. To promote and implement experimental and demonstrative activities in the field of coastal natural resources management and sustainable development;
7. To support the Provincial Directorate of MICOA in coastal Provinces in the area of CZM;
8. To co-ordinate all CZM activities in Mozambique, including shores of the lakes and reservoirs;
9. To coordinate the preparation and implementation of the National Coastal Zone Management Programme; and
10. To participate in the preparation of the National Biodiversity Programme.

The Centre is part of the Central Government, subordinated directly to the office of the Minister of MICOA. However, it will play an important role in advising coastal provincial governments.

9.3.2 Research

A significant part of the Mozambican population has always lived along the coastline. In one way or another, the wealth of biological resources has been affected by human activities. Thus, there is recognition of the complex system of relations existing between population dynamics, availability and use of natural resources, potential environmental problems and economic growth. The knowledge of these interrelations is still very weak, and lack of a broad overview of problems is obvious. Excluding some particular areas of the Mozambican coastal zone, no methodical and systematic data collection system has been established. On the other hand, the specificity in terms of population/resources/ environmental problems, varies from one region to another, according to ecological characteristics of each region.

There is a need to study, at micro level, the complex interfaces existing between population, environmental and development aspects in each region. This means that there is a need to know ecological structure of the region and resources existing in it, on the one hand, and carrying capacity of natural resources and resulting consequences of human activities, on the other.

If there is commitment for preservation of biological diversity, local communities should be considered and gender issues analysed, with the perspective of poverty reduction, ecosystems protection for a better balance between human activities and sustainable use of human resources.

Elaboration of a complete inventory of the existing coastal resources in Mozambique is one of priorities, as it will enable the

establishment of an information system allowing identification of the different ecosystems, and evaluation of its status.

Most of the major urban centres of Mozambique are also located in the coastal area. A rapid urban population growth, together with the lack of capacity of the municipal authorities to provide basic sanitary assistance exposes urban inhabitants to serious environmental health risks. Urban population growth contributes not only to a degradation of physical infrastructure, but also to sustainable development of a necessary resources base.

Having all this in mind, the above mentioned research activities in the coastal area should be developed, starting with the definition of priority areas of investigation. This investigation will constitute the bases for future action plans that should be promoted by MICOA.

The research activities in coastal areas should be carried out, at the short term, in the Coastal Zone Management Centre in Xai-Xai. In the medium and long term, the Centre will project and install two more research units on the coast of Mozambique (one in the Central region, and the other in the North).

9.3.3 Coastal Area Planning in Mozambique

As referred above, the inter-sectorial working group led by MICOA has been formed. The group is now preparing a draft of the Proposed Methodology for Coastal Area Planning, which will be presented and discussed during the next National Workshop. The methodology should be agreed on, and its implementation and monitoring should start upon it.

On the other hand, the mapping of the entire coast should also be performed as a precondition for the planning phase of the coastal zone management.

The first step of ICZM is land-use planning. The three different components should be taken into consideration in land-use planning, namely:

1. Geographic scope;
2. The current situation of coastal natural resources, and their potential use in local communities; and
3. Institutional framework and legislation for coastal management.

In a preliminary document to be discussed during the National Workshop on CZM in Mozambique, the following specific topics on the above issues, are proposed:

Geographic scope

Definition of the Coastal Zone

The coastal zone is to consist of a portion of the sea and a portion of land. It is proposed that the coastal zone include marine area along the coastline up to 12 miles off the coast. It is important to realise that the coast is also a marine ecosystem. It is equally proposed that the coastal zone is a fixed area of 20 km from the shoreline. Here, it is very important to consider that coastal cities are part of the coastal zone and should be dealt with accordingly.

Physical planning

Currently, the District is the smallest administrative unit intended for planning purposes in Mozambique. It is proposed, therefore, that physical planning of the coastal zone include the whole coastal District, and not only 20 km as proposed above.

Resources and current use

Methodology of Diagnosis

It is suggested to form multi-disciplinary teams to carry out the survey of coastal zones for the preparation of CZM (with holistic approach, and including fields like biology, ecology, agriculture, geology, climate, sociology, institutions, etc.). The teams should use all the available information, collect data using aerial photos, satellite, GIS, etc. They should also carry out ground checks. Rural appraisal methods should also be used by local communities.

Methodology for coastal zoning

It is proposed that a sort of macro-zoning should be carried out at the national level, until the major areas intended for protection, tourism and fisheries development, environmental rehabilitation, industrial and housing development, etc. are defined. Then, micro-zoning should be carried out at a higher level for urban development, infrastructure, water and electricity supply, etc.

Institutional framework and legislation

As suggested above.

Annex

Recommendations on Management Strategy Issues and Final Conclusions of the Workshop

(Xai-Xai Beach, August 1997)

1. Recommendations on Management Strategy Issues

1.1 Coastal Dunes Management (including intertidal resources) and Port Development[12]

(1) The traditional knowledge on and practices in inter-tidal resources management (especially mussels on the beach rock)[13], should be reactivated in order to prevent over-harvesting;

(2) The Inter-Institutional Technical Committee for Coastal Zone Management should be given more legal and functional power; the Committee should be allocated more financial and material resources; and the private sector should be incorporated into the Committee;

(3) More means aimed at a better surveillance of the coastal area (especially forests, wildlife and marine environment) should be secured;

(4) Public places should be preserved within sustainable development of the coastal zone[14];

(5) When allocating areas of coastal dunes to the private sector, adequate management, conservation and preservation should be secured through legal instruments, allowing control of the committed and implemented management rules and measures;

(6) Better boat launching facilities should be provided, particularly those constructed and designated for public use.

1.2 Lower Limpopo Valley Development

<u>Agriculture</u>

(1) To install an efficient system of flood warning;

(2) To install a better system of irrigation network utilisation in order to get liability for the misuse.

<u>Dunes/Mangroves</u>

(3) To avoid concentration of population in the adjacent areas of mangroves and, if possible, to assess the possibility of the existing population resettlement in the areas with more socio-economic opportunities for the better living standard;

(4) To improve the mangroves relevant legislation, and harmonize it with better law enforcement on agriculture, fisheries, and maritime;

<u>Estuary</u>

(5) Reforestation activities should take place on both sides of the Limpopo River;

[12] Recommendations suggested within the Working Groups.

[13] This traditional management practice of the intertidal resources exploitation includes, among others, harvesting of mature mussels and oysters species in selected segments of the beach rock every year, and control of catch quantity.

[14] i.e. references were made to SUIMO, Lda.

General

(6) To take necessary steps aimed to achieve the better respect and enforcement of the Land Law;

(7) Governmental authorities should monitor the implementation of the projects relevant to natural resources use.

1.3 Artisanal Fisheries Development

(1) The incentives of fishermen associations, medium and small-scale fishermen should be given adequate support from the relevant Governmental institutions including exchange of information between them;

(2) Governmental authorities should give the full legal status, rights, duties and competencies to fishermen associations. Fishermen associations, supported by and in co-operation with Governmental institutions, should, among others, collect data and control fishing activities, and contribute to scientific research;

(3) Fishermen training and capacity building in organisational principles, administrative and financial management, natural resources and environmental management should be given priority by the relevant Governmental institutions.

1.4 Tourism Development

(1) Local communities should be involved in the preparation of a tourism development plan;

(2) The relevant local administration should involve local communities into the work of the Inter-Institutional Technical Committee for Coastal Zone Management;

(3) The proposed elaboration of the Development Plan[15] is being fully approved and supported by the following recommendations:

(4) The current policy in land-use distribution should be implemented in the area from Praia Velha to Xai-Xai Beach, designated for housing development, and in the area from the Xai-Xai Beach to Chongoene, designated for tourism expansion;

(5) The Development Plan should be elaborated in a way to contemplate the expected dynamic tourism development; it should be flexible enough to allow the changes in tourist demands and needs in the course of time;

(6) The Development Plan should take into consideration the generation equity principle by designating adequately both coastal development and conservation areas for the use of present and future generations.

1.5 Baixos de Inhampura Reef Management

(1) Baixos de Inhampura Reef could be utilised, but fully respecting the specific ecosystem resources;

(2) An appropriate category of protection should be established, and adequate management measures applied to allow sustainable resources utilisation;

(3) Artisanal and sports fishing activities should be practised on the reef. The type and intensity of reef utilisation should be based on carrying capacity assessment, including other activities practised within the reef area;

(4) It is important to complete the assessment and evaluation of Baixos de Inhampura Reef, which started with the FAO/UNEP Expert Mission in May 1997;

(5) Special attention in managing the reef environment should be given to protected species (turtles, giant groupers, etc.). To provide the

[15] The proposed "Development Plan for the Xai-Xai to Chongoene Tourist Resort".

effective protection of this longitudinal submerged reef, an adequate zoning should be considered.

1.6 Institutional Strengthening

(1) Some of the Xai-Xai and other District (Manjacaze) authorities are under staffed. The Government should take steps to secure skilled staff and other means for the implementation of the proposed strategies and action plans;

(2) The ongoing support that the District's authorities are providing to Zongoene fishermen should be encouraged and implemented also in other areas where similar initiatives and conditions exist;

(3) There is the need to establish the agency for implementing the Pre-programme[16];

(4) The Inter-Institutional Technical Committee for Coastal Zone Management at the Provincial level should play a central role in the implementation of the proposed Management Strategy and relevant Action Plans;

(5) The relevant provincial Directorates for Tourism (MICTUR), Agriculture and Fisheries (MAP) should support the implementation of Strategy and Action Plans with staff and relevant resources, in the area of tourism and fisheries in Xai-Xai, and in the neighbouring Manjacaze Districts;

(6) A Sustainable Development Centre for Coastal Zone Management to be inaugurated in the Xai-Xai Beach, should support coastal surveillance (forestry, wildlife, and marine environment).

2. Final Conclusions of the Workshop

(1) Participants of the Workshop approve the proposed Management Strategy and Recommendations of the Working Groups;

(2) Participants of the Workshop find application of the integration and sustainable development principle crucial for a successful implementation of the Xai-Xai ICAM. The Inter-Institutional Technical Committee for Coastal Zone Management should be co-ordinating body between institutions related to coastal zone management. The Committee should play a fundamental role in the implementation of the proposed and other relevant action plans;

(3) Education and involvement of local communities in the Xai-Xai ICAM implementation should be one of the priorities, and local administration should be responsible for the promotion of this involvement. Where there is the need, the law should be enforced by local authorities;

(4) Institutional strengthening at the Districts' level should be prioritised by the Provincial Government, particularly in the Districts with elaborated coastal management plans;

(5) The proposed elaboration of the Tourism Development Plan brought to this Workshop is fully supported by the participants and suggested to be a priority in the Xai-Xai ICAM implementation.

[16] The project entitled "National Family Sector Agricultural Development Programme (PRE-Programme)" under the support of UNDP, FAO and Ministry of Agriculture and Fisheries.

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