MINISTRY FOR THE CO-ORDINATION OF ENVIRONMENTAL AFFAIRS (MICOA)

National Adaptation Programme of Action (NAPA)

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Maputo

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Acronyms

AH – Humanitarian Agencies
ANE – National Road Administration
ARA- Sul – Southern Regional Water Board
CTGC-
DINAGECA – National Directorate of Geography and Mapping
DNA – National Directorate of Water
DNGA – National Directorate of Environmental Management
GM – Government of Mozambique
HA – Hydraulics Agriculture
MAE – Ministry for State Administration
MCT – Ministry of Science and Technology
MD – Ministry of Defence
ME – Ministry of Energy
MEC – Ministry of Education and Culture
MF – Finance Ministry
MIC – Ministry of Trade and Industry
MINAG – Ministry of Agriculture
MINT – Interior Ministry
MITUR – Tourism Ministry
MIREM – Mineral Resources Ministry
MOPH- Ministry of Public Works and Housing
MP – Fisheries Ministry
MPD – Ministry of Planning and Development
MTC – Ministry of Transport and Communications
INAM – National Meteorology Institute
INGC – National Disasters Management Institute
MICOA – Ministry for Environmental Coordination
ONG – Non-governmental Organizations
PANCSD – National Action Plan for the Fight against Drought and Desertification
PARPA – Action Plan for the Reduction of Absolute Poverty
PROAGRI – Programme for Agricultural Development
TIA – Agricultural Research Work

Executive Summary

The occurrence of extreme climate events in Mozambique constitutes a great barrier to swift sustainable economic development due to human and material damages. This includes the loss of crops due to extreme events, which can occur at least once a year. As a result, the population lives in a situation of threat and instability. The Government of Mozambique (GM), Non-governmental Organisations (NGOs), and Humanitarian Agencies (HA) have been working to reduce the impacts of extreme events through the elaboration of various action plans and programmes. It's in this context that a multi-sector group called NAPA was established with the task of coordinating the elaboration and implementation of an action plan for adaptation to climate change in Mozambique.

The present document includes summaries of 4 initiatves, for various economic and social development sectors, with special emphasis on the prevention of natural disasters and Alert and Early Warning Systems; the agricultural, fisheries, energy, environmental and water sectors; coastal zones; and erosion control.

The choice of sectors was based on information contained in the following documents:

- Summary of available information on the Adverse Effects of Climate Change in Mozambique;
- Adaptation Measures to Climate Change;
- The Participative Evaluation Report and other programmes; and
- Strategies and national and sectoral plans that are relevant to the NAPA process, such as the government's five-year plan (2005-2009) and the PARPA.

It's hoped that the strict implementation of actions listed in this document will be a great contribution to poverty alleviation and sustainable development in Mozambique.

1. Context

Mozambique has been recording a significant economic growth particularly after the 1992 Rome Peace Agreement. Foreign investment experienced a sudden rise and inflation declined. The Government of Mozambique has been making significant efforts to eradicate absolute poverty through various initiatives such as PARPA and PROAGRI. However, this economic growth has not yet reached desired levels in a way that has impacted people's daily lives, particularly for people living below the poverty line. There are many factors contributing to slowing the current pace of growth of the national economy. These barriers include problems associated with climate variability and change.

Mozambique has an extensive coastline, constituting the western limit of the cyclone and tropical storms active zone. Therefore, it is regularly affected by tropical cyclones and other disturbances in each year, which place development initiatives targeted towards reducing poverty in peril. The country has regularly suffered from regular drought events, resulting in extreme negative impacts, which have halted efforts towards sustainable development.

The government of Mozambique recognizes that the country is vulnerable to catastrophes and that the hazards resulting from climate change are some of the factors that aggravate the situation of absolute poverty in Mozambique. The Governments Five Year Plan (2005-2009) was developed with those challenges in mind, and includes the following priority objectives to:

- Reduce the number of human victims and the loss of properties;
- Promote a culture of prevention; and
- Provide the country with the means for prevention and mitigation.

To implement these objectives, the Government commits to carry out the following actions to:

- Map zones of high risk;

- Strengthen early warning systems, through collecting timely information on tropical cyclones, torrential rains and drought, including the predicted locations of impact zones.
- Increase resources for the prevention and mitigation of natural disasters;
- Reinforce the capacities for institutional inter-sector coordination;
- Strengthen regional and international coordination, particularly in the management of river basins;
- Establish a database for data and information on climate change trends and impacts;
- Promote the construction and use of water storage systems in drought-prone areas for the irrigation; and
- Increase training and civic education.

The management of risks and the reduction of natural disasters have been a priority in the political agenda for Mozambique where thousands of people have been threatened every year from natural hazards. Under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC), 48 Least Developed Countries (LDCs) are preparing their National Adaptation Progammes of Action (NAPAs), a document that outlines clear and simple information on urgent and immediate needs with regards to climate change impacts and adaptation priorities.

It's in this context that an inter-agency NAPA team was created by MICOA, to coordinate the elaboration and implementation of activities aimed at reducing the impact of climate change and to establish climate change adaptation initiatives. The group consists of technicians representing The National Directorates of agriculture (current agricultural services), Energy (ex-MIREME), Health and Environmental Management, National Institute For Disaster Management, Meteorology, Hydrography and Navigation, Mozambique Red Cross and the Environmental Working Group.

In the elaboration of the NAPA, the most vulnerable regions, sectors and communities to the adverse effects of climate change (floods, drought and tropical cyclones) and to

poverty were consulted and prioritised. Other multi-lateral environmental agreements (such as the Conventions on Biological Diversity and Desertification) were taken into consideration during the NAPA process in order to strengthen the synergies between those Conventions when developing adaptation actions.

1.1 Purpose

The purpose of the NAPA is to present the immediate and urgent needs of the country that have been identified during the participative evaluation process, for the purposes of strengthening national capacity to cope with the adverse effects of climate change.

1.2 Specific Objectives

This will be accomplished by meeting the following objectives:

1. Strengthen the early warning system in the country;
2. Strengthen the capacities of family farmers to dealing with the adverse effects of climate change;
3. Improve the knowledge and strengthen the management of river waters;
4. Promote actions to limit erosion and to develop sustainable fishery activities;
5. Promote actions that will contribute to the mitigation of Greenhouse Gases (GHG);
6. Promote public education activities and information dissemination on climate change;
7. Improve the coordination between the various groups that work on issues related to the evaluation of climate change vulnerabilities and hazard risk reduction;
8. Promote the integration of climate change into decentralised district planning.

1.3 General Characteristics of Mozambique

1.3.1 Geophysical Information

Geographical Situation

Mozambique is situated on the eastern coast of southern Africa, between parallels of 10º 27' and 26º 52' south latitude and 30º 12' and 40º 51' east longitude. It borders the Republic of Tanzania to the north, Malawi, Zambia, Zimbabwe, South Africa and Swaziland to the west, and South Africa to the south. The east coast of Mozambique is on the Indian Ocean. The country spans an area of about 799,380 square kilometres, of which 786,380 square kilometres is land and 13,000 square kilometres is surface water.

There are many islands along the almost 2,700 kilometres of coastline, the most outstanding being the Quirimbas archipelago in the Cabo Delgado province; the Mozambique Island and the islands of Goa and Sena in the Nampula province; the archipelago of Bazaruto in the Inhambane province; and the islands of Inhaca, the Elephants and Xefina in the Maputo province.

Administratively, the country is divided into 11 provinces and 128 districts, administrative posts and localities. There are 33 municipalities, comprising the major urban centres, including 10 provincial capitals and the country's capital, Maputo (which also has provincial status).

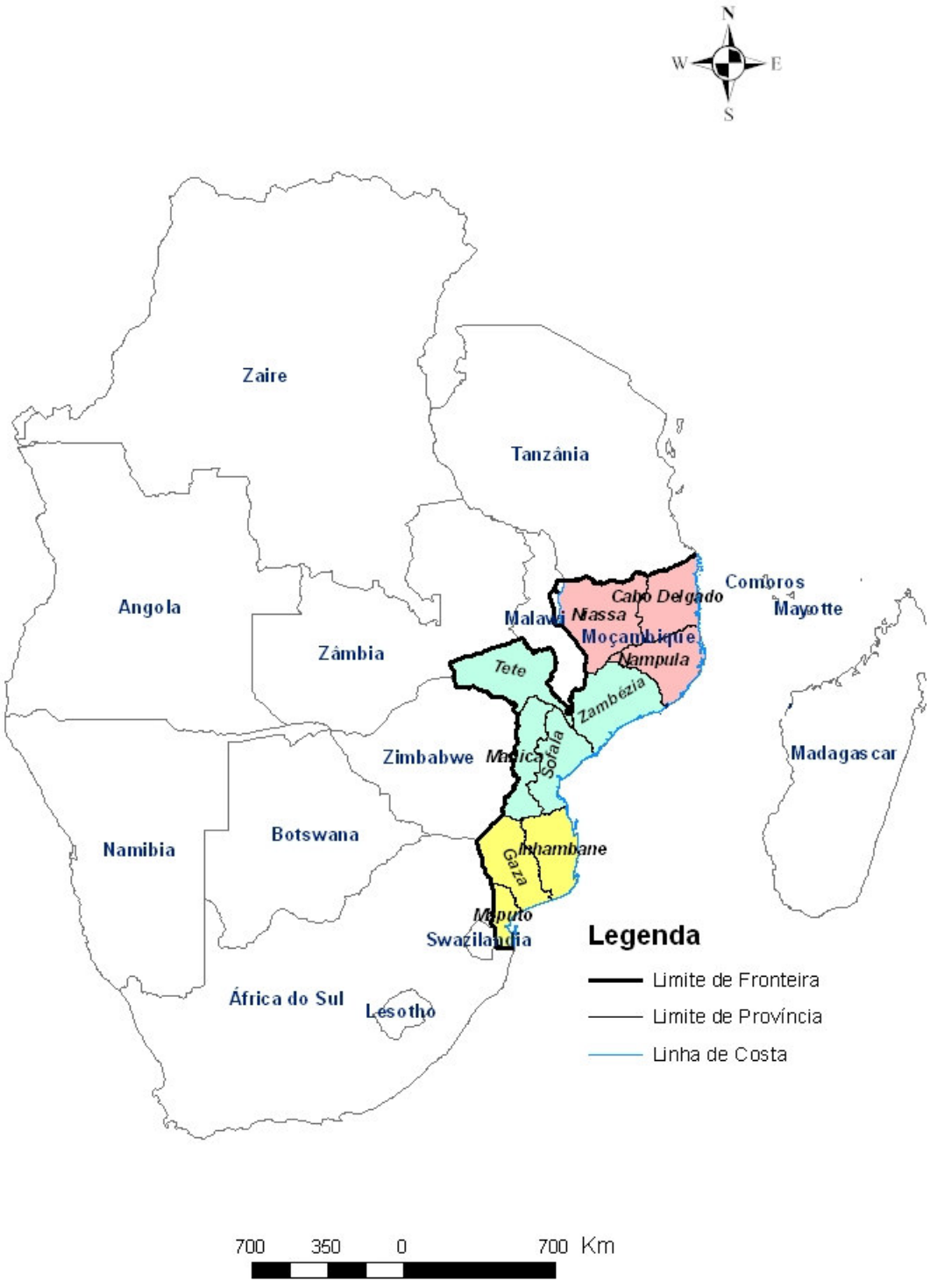

Figure 1**: Map illustrating the geographical location of Mozambique in southern Africa.**

The Relief

The Mozambican relief is marked by the presence of low lying land in the coastal region, and higher elevations in the north of the country. The average elevation is 370 metres above sea level.

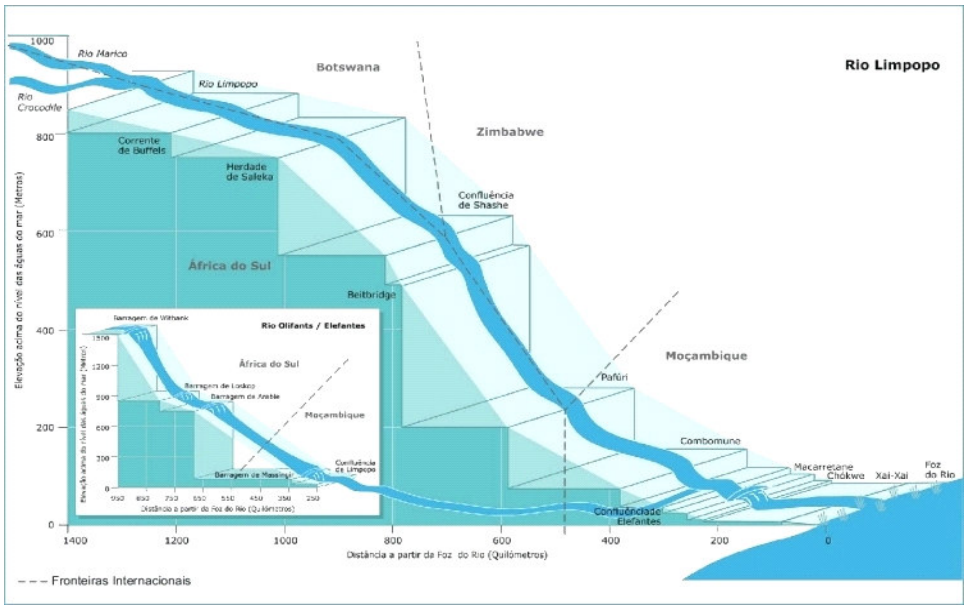

Figure 2: Relief aspects of Mozambique

There's a clear distinction between the region south of the Save River with an average elevation of only 120 metres; and the northern region of the Save River with an average elevation of 435 metres. The areas of higher elevation (the mountainous areas of Manica, the high Zambezia, and the plateaus of Angonia, Maravia and Lichinga) are also areas that receive high amounts of precipitation.

Climate

Precipitation

The largest area of Mozambican territory is situated in the inter-tropical zone with four distinct tropical climate of humid tropical, dry tropical, semi-arid tropical and a modified

climate due to elevation. The predominant climate is humid tropical, characterised by two seasons, namely a cool and dry climate from April to September and a hot and humid climate between October and March. Rainfall is the most intense between December and February.

The average precipitation varies from 400mm in Pafuri in the Gaza province, and up to 2,000mm in Tacuane in the Zambezia province. A diverse set of factors influence the precipitation patters within the country. The most prominent of these are:

a) Inter-tropical convergence zone –is characterized by low pressure zones, where vertical clouds are formed which bring about high precipitation events in all northern regions of the country and north of the Tete province, triggering the onset of the rainy season.

b) Tropical cyclones – are characterised by low pressure zones, horizontally moving hot and humid air masses which bring about high precipitation events. These generally occur along the coast in the central and northern regions of the country. Depending on the storms' intensity, these events can occur between October and April, and can be either favourable or unfavourable to agriculture, potentially causing floods and destructions such as those recorded in the years 2000 and 2001 in the southern and central regions of the country respectively.

c) Anti-cyclones – are high pressure zones which negatively influence precipitation patterns. These mainly occur in the interior of the country's southern provinces.

d) Southern cold fronts – are cold air masses originating from the South Pole that periodically migrate to the equator and bring about precipitation in the dry season. This occurs along the coast and brings about a second agricultural season.

e) Or graphic precipitation events – occur due to areas of high elevation, causing air masses to rise and cool, which causes precipitation in the plateau and mountainous regions of the country.

The coast line receives about 800 – 900 mm of precipitation per year. In the south of Mozambique, precipitation is relatively high along the coast, but decreases further into the interior of the country until the Libombos Mountains. At the Libombos Mountains, along the boarder of Swaziland and South Africa, precipitation increases again. The interior zones of the province of Gaza and the border regions adjacent to Zimbabwe and South Africa are all arid. Situated in Gaza province, Pafuri is one of the driest regions of the country, with an average annual precipitation of approximately 300 mm.

Mozambique's agro-climate is strongly differentiated by three zones:

1. The northern zone of the Zambezi river is humid, with a distinct rainy season. Generally, water is available for crops for a full growing season, with drought conditions occurring only twice every ten years.
2. The central region, between the south of the Zambezi River and the north of the Save River, experiences drought conditions approximately four years in every ten.
3. The southern region has a high risk of drought conditions, with drought conditions seven out of every ten years.

There is a close relationship between ecological zones and precipitation. Regions that receive more than 2,000 mm/year of precipitation are characterized by dense forests. The precipitation gradient decreases from the humid savannah region to the arid savannah region.

Temperature

Country-wide temperature variations are due to factors such as latitude, continental features and topography. In general, temperatures are higher at lower latitudes, and cooler

in the higher latitudes and in the west of the county in the provinces of Niassa, Zambezia, Tete, Manica and Maputo. In general, temperature distributions are as follows:

- 18 to 20^0C in mountainous areas;
- 22 to 24^0C in central and plateau regions of the north and central regions, as well as the eastern and western regions of the southern provinces; and
- 24 to 26^0C the whole eastern part of the northern and central regions and the interior of the country's southern regions.

13.2 Population and economic activities

Data from 1997 demographic and health census indicate that there were 16.9 million inhabitants in Mozambique, of whom 47.2 percent were men and 52.8 percent were women. The population growth rate was 3.6 percent. The population density in the northern region of the country was 23 inhabitants per square kilometre, 20 inhabitants per square kilometre in the central region and 14.4 inhabitants per square kilometre in the country's southern region. The population is mainly rural with approximately 73 percent of the population residing in rural areas.

Agriculture, livestock and fisheries are the most important sectors of the economy, with agriculture representing 80 percent of the country's labour force. The excellent agro-climatic conditions particularly in the country's central and northern regions and accessible surface water provide ample opportunities for irrigation. These conditions are favourable for cash crops, namely cashew nuts, sugar-cane, cotton, tea, beans, tropical fruits, etc. Portions of the agricultural, timber and fisheries sectors contributed to 50 percent of the country's total exports in 1998.

1.4 Characterization of Mozambique's vulnerability to extreme events

The climatic effects on human activities and natural resources can be described by two factors, sensitivity and vulnerability. Sensitivity is the degree to which the system responds to changes in the climatic conditions and, vulnerability indicates the degree to

which the system can cope with its impact, since vulnerability doest only depends on what the system is exposed to but also on its capacity to adapt to climate change.

There are two responses to climate change – adaptation or mitigation. Adaptation is a set of necessary proactive actions to adjust to climate change or reactive actions to deal with the consequences of climate change. The term mitigation refers to actions to reduce GHG emissions.

Mozambique is a vulnerable country to climate change due to its geographic location (about 2,700 kilometres of coastline, at the confluence of many international rivers flowing into the Indian Ocean, and land area that is under sea levels), high temperatures, aridness, infertile soils, many endemic diseases, lack of communication infrastructure, high level of illiteracy, high population growth rate, absolute poverty and a high dependence on natural resources that are dependent on precipitation.

The geographic location is one of the key factors that contribute to the country's vulnerability to extreme events since some of the tropical cyclones and depressions that are formed in the Indian Ocean cross the Mozambique Channel and affect the coastal zone. As global temperatures increase, Mozambique is experiencing increases in the frequency and severity of droughts in the interior and floods in coastal regions. For example, the southern region in 2000 and the central region in 2001 both experienced flooding events.

Many Mozambicans live in condition of absolute poverty, food and nutritional insecurity with severe consequences to human health. For example nutritional deficiencies are exacerbating the effects of HIV/AIDS. In addition, outbreaks of epidemics such as cholera, malaria and dysentery, have compounded people's already precarious living conditions.

Food production needs to increase to meet the increasing demand caused by rapid population growth. However, climate predictions indicate less rain for most of Africa, in

areas where many farmers depend on rain fall (Sanches, 2000). In addition, crop epidemics often occur during and after an extreme event, reducing agricultural production and worsening the emergency situation of agricultural families. Food and nutritional insecurity, as well as the above mentioned epidemics can exacerbate the effects of HIV/AIDS and other diseases, increasing people's vulnerability to climate change.

The most hazardous extreme events are drought, floods and tropical cyclones. Other environmental problems that affect the country include epidemics, plagues, slash-and-burn practices, industrial accidents and erosion.

Recognizing the need to identify and prioritise adaptation measures to reduce the vulnerabilities of community and sectors, MICOA through the National Directorate of Environmental Management (DNGA) and in coordination with the NAPA Team, conducted a participative evaluation of 31 districts to determine the which districts should be included in the pilot phase of the NAPA program (Figure 3).

In this participative evaluation process, about 621 people were interviewed at national level, 37 per cent of whom in the country's northern region, 24% in the central region and 30 per cent in the southern region. Twenty-eight per cent of the 621 people interviewed represent professionals from government institutions and NGOs, 29% are community leaders and the remaining 43% represent members of the community. In total, 1123 answers were obtained on the extreme events that affect the country. Of these, 508 answers (45.2 %) indicate drought as the most severe event, 387 answers (34.5%) floods and 228 answers (20.3%) mention tropical cyclones (picture 3). Drought is the extreme event that affects the country more, followed by floods and tropical cyclones.

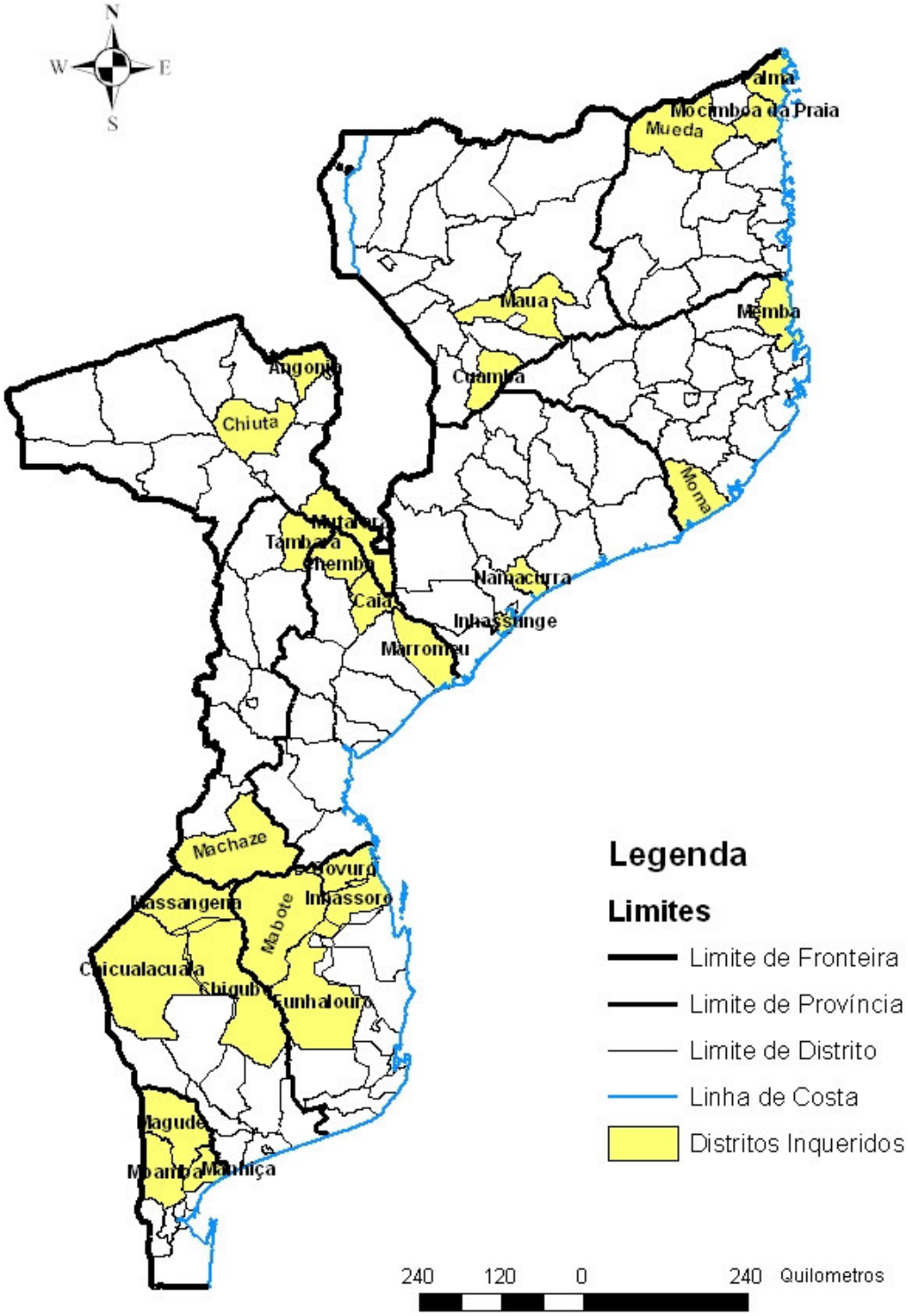

Figure 3: Map of geographical location of districts covered by the participative evaluation process.

Taking into account the main phenomena of climatic variability affecting the country, or in other words, drought and floods as well as the main causes and consequences – the interviewees generally mentioned the following strategies to help minimize the effects of natural disasters in people:

- Food support in the form of food for work;
- Distribution of crops that are resistant to drought (millet, cassava, sweet-potatoes);
- Distribution of seeds and agricultural utensils;
- Use of low-lying areas for agriculture;
- The drilling of boreholes and dams for water;
- Building of irrigation systems, the use of the "cegonha" irrigation system;
- Resettlement of people in areas not prone to floods;
- Reforestation, control of bush fires and environment education;
- Livestock and construction of basic infrastructures for livestock activity such as mangoes and drinking troughs;
- Publication of early warning systems;
- Rehabilitation of access roads;
- Creation of alternative ways of income;
- Expansion of the commercial network;
- Sensitisation of people to build houses in places not vulnerable to drought and other extreme events;
- Training of people to use sustainable natural resources; and
- Killing of elephants that destroy crops.

Considering the suggested criteria in the manual for the preparation of NAPA and the answers to the survey, the proposed criteria were prepared for use in prioritising actions and adaptation actions were defined. Priority criteria were submitted for approval in three regional seminars (Beira for the central region, Nampula for the north and Maputo for the

southern region). As a result of the seminars, the following criteria were approved and used in prioritising actions:

- **Level or degree of severity of the events (floods, drought and tropical cyclones)**
  - Number of deaths;
  - Loss of properties and infrastructures;
  - Number of displaced people;
  - Diseases caused;
  - Affected Eco-systems;
  - Environment degradation

- **Poverty reduction and the increase of adaptation capacity**
  - Food security (early warning, etc.);
  - Food availability;
  - Other income sources;
  - Availability, quality and access to drinking water;
  - Human health
  - Essential infrastructures;
  - HIV/AIDS (prevalence rate and orphans);
  - Land use and forestry management;
  - Cultural heritage;

- **Synergies with other multilateral environment agreements**
  - Conservation of eco-systems;
  - Actions to preserve the soil (bushfires, deforestation, erosion, etc.);
  - Others

After approving the priority criteria, ten provincial and one national seminar were held for the approval of actions and their prioritisation. This resulted in four actions in an order of priority presented in the present document. It's worth highlighting that the main

argument used by the seminar participants for the prioritisation was that the country's economic base is agriculture. However, with the frequent occurrence of climate events, if the early warning system does not work efficiently, less success in agricultural production must be expected.

Sections 1.4.1, 1.4.2 e 1.4.3, are a presentation of characteristics, affected regions and the impact of climatic events that have been affecting the country.

1.4.1 Drought

Drought and desertification are global environmental problems with serious social and economic consequences. The social costs are high and translate into the loss of livelihood opportunities in terms of employment, subsistence farming, and the separation of families due to death or migration.

Experience shows that droughts have negative impacts on different areas of livelihood activity and can cause different effects such as the:

- Loss of crops;
- Drying of water sources (wells, lakes, streams, rivers, etc.);
- Reduction of primary productivity in coastal zones, negatively affecting fisheries;
- Reduction of grazing areas;
- Increase in the price of agricultural products and basic foodstuffs;
- Increase of food imports;
- Increase in appeals for external aid;
- Loss of human and animal lives;
- Outbreak of diseases; and
- Loss of biodiversity

The causes of drought and desertification can be natural or anthropogenic. The natural causes are climate-driven, associated with the drastic reduction in the quantity of precipitation or changes in the precipitation regimes. The anthropogenic (or human)

causes include the excessive use of soils for agriculture, over-grazing, bush fires associated with opening up new cultivation areas, fire wood gathering, charcoal production and the industrial forestry sector. The factors of human origin are closely linked to poverty of the communities, which can lead people to remove or overuse land resource unsustainably.

Droughts are frequent in the central and southern regions of Mozambique, with some events occurring the northern provinces. Drought results from the shortages of precipitation and is associated with El Nino or ENSO (El Ninõ Southern Oscillation). Drought and desertification in Mozambique result from a combination of 1) low levels of precipitation, which result in lack of water to maintain vegetation coverage, and 2) the overgrazing and overuse of agricultural lands.

According to the National Action for the Fight against Drought and Desertification (PANCSD) in 2003, the causes of drought and desertification are inter-linked with poverty conditions and population life expectancy. Other issues linked to desertification include social, economic, cultural, food security, migration and access to potable water sources among others. According to PANCSD, Matutuine, Goba, Changalane, Mabalane, Namíta are areas impacted by deforestation, while Mabalane, Chicualacuala, Pafuri, Mabote, Moatize are vulnerable districts to erosion due to over-grazing.

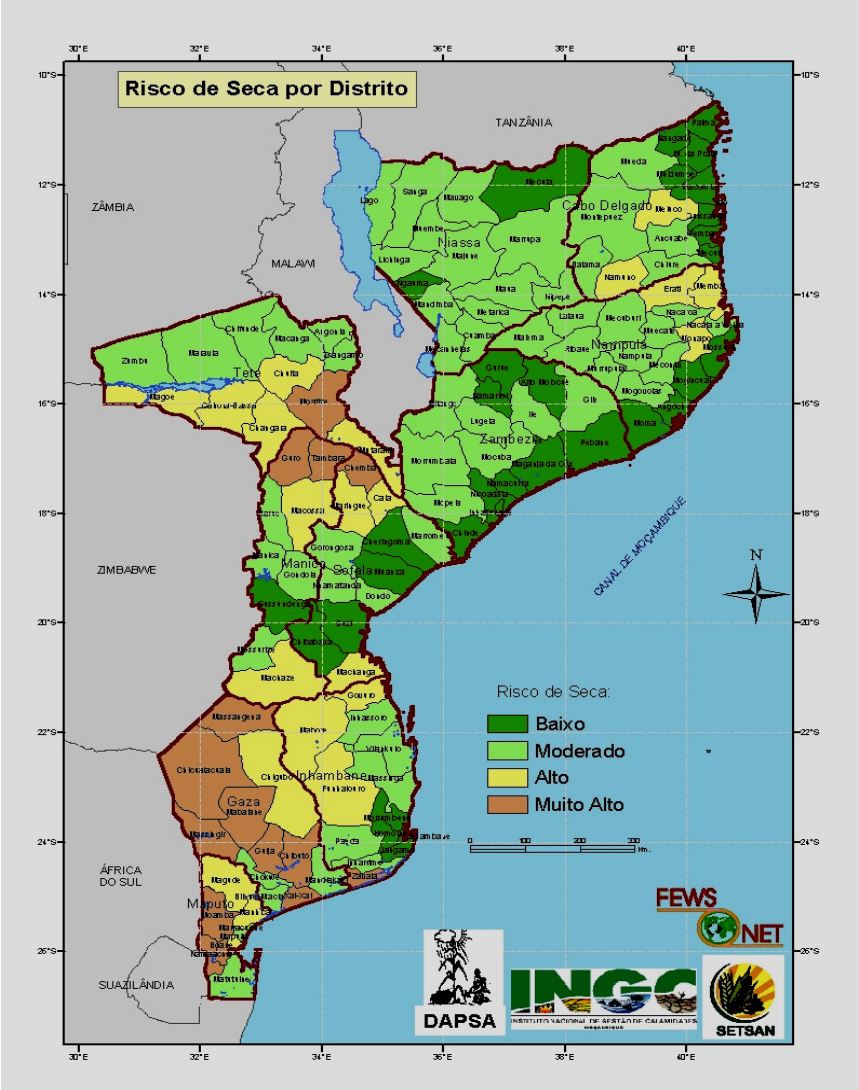

Figure 4: Drought prone zones in Mozambique

The areas identified as impacted by drought and/or desertification are shown in Figure 4 and Table 1.

Table 1: At risk or impacted areas from drought and desertification in Mozambique (MICOA, 2000)

Province	District	Main causes of desertification
Maputo	Moamba Namaacha Magude	Lack of surface water, low precipitation, uncontrolled bush fires, felling of trees for firewood and charcoal, reduction water levels in the Incomati river
Gaza	Mabalane Chicualacuala Massangena	Reduction of river water levels, low precipitation, uncontrolled bush fires, indiscriminate felling of trees for charcoal, firewood and building materials (timber, stakes, etc.).
Inhambane	Massinga Funhalouro Vilankulos Inhassoro Govuro	Low precipitation, uncontrolled bush fires, indiscriminate felling of tress for the production of charcoal, firewood and building materials
Sofala	Nhamatanda Gorongosa Maríngué Chemba Caia	Low precipitation, uncontrolled bush fires, deforestation, erosion.
Tete	Moatize Mágoé Changara	Reduction of river water levels, uncontrolled bush fires, over-grazing, erosion.
Manica	Macossa Machaze Tambara	Uncontrolled bush fires, excessive use of soil, deforestation
Nampula	Nacaroa and Memba	Reduction of the river water levels, rainfall deficit, uncontrolled bush fires, felling of tress for the production of charcoal and firewood

1.4.2 Floods

Floods occur during the rainy season, chiefly within river basins, low coastal areas and areas with drainage problems (2002/2003 Contingency Plan – INGC). Floods are influenced by La Ninã which causes tropical rains and cyclones, and effects of the Inter-tropical Convergence Zone. Table 2 summarizes data on historic flooding events in general and specifically in 2000 in some river basins of Mozambique.

Table 2: Historic and the year 2000 floods recorded in some river basins in Mozambique

Basin	Historic Floods				2000 Flood
	Nº	Period	Year	Q(m^3/s)	Q(m3/s)
Umbeluzi	4	1966-1984	1984	6150	1410
Incomati	12	1937-1998	1976	5260	11000
Limpopo	13	1915-1996	1977	8740	10581
Buzi	12	1957-1995	1973	8246	>10000
Save	5	1960-1981	1974	6300	>10000

Floods in the country are caused not only by precipitation that but also by the water discharge from dams in neighbouring countries situated upstream. Due to the number of river basins located in the country, including 9 river basins from international rivers, the country is currently vulnerable to floods regardless of whether flooding intensity increases. In the years 2000 and 2001, the country was affected by serious floods due to torrential rains in neighbouring countries which led to flooding in many river basins within Mozambique. The damages from the 2000-2001 floods are estimated at 800 human deaths and over 750 million US dollars worth of property damage.

The negative effects of floods are widely known worldwide and in Mozambique, and bring about the following consequences:

- inundations;
- loss of lives and property;

- loss of crops;
- outbreak of diseases;
- displacement of people;
- loss of biodiversity; and
- disruption of normal activities.

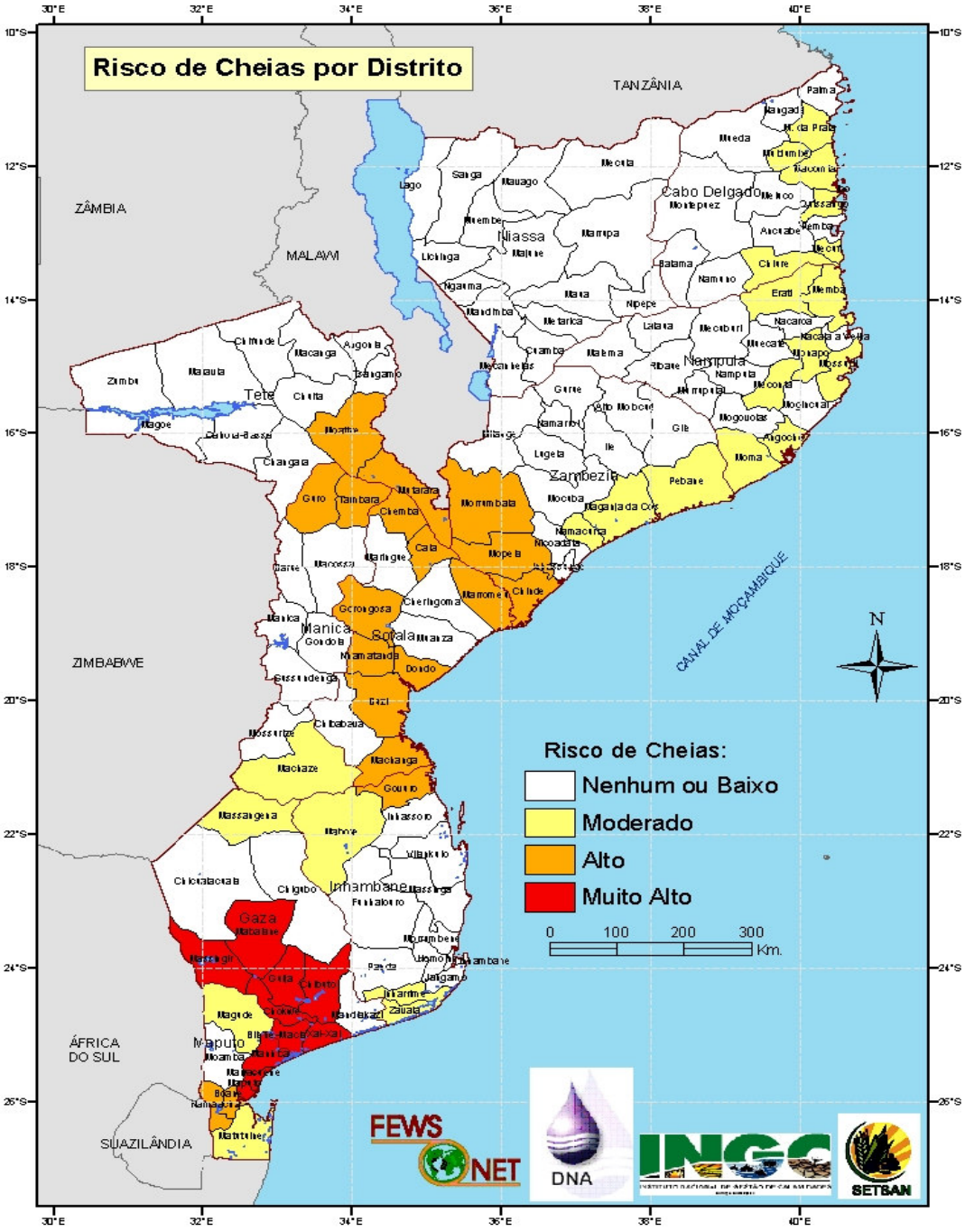

Figure 5: Flood prone areas in Mozambique. The colours indicate the level of risk in each zone.

The most vulnerable areas to the occurrence of floods (Figure 5) are:

- Maputo (Matutuine, Boane, Moamba, Marracuene, Manhiça and Magude),
- Gaza (Xai-Xai, Bilene, Chókwé, Chicualacuala, Mabalane, Massingir, Chibuto and Massangena),
- Inhambane (Inharrime, Vilanculos, Inhassoro and Govuro),
- Sofala (Machanga, Buzi, Nhamatanda, Dondo, Marromeu, Caia and Chemba),
- Manica (Machaze, Mossurize, Sussundenga and Tambara),
- Tete (Magoe, Zumbo, Cahora Bassa, Chiuta and Mutarara),
- Zambezia (Morrumbala, Mopeia, Chinde, Inhassunge, Namacurra and Maganja da Costa),
- Nampula (Moma, Angoche, Memba and Lalaua) and
- Cabo Delgado (Macomia, Mocímboa da Praia, Palma and Pemba-Metuge).

MICOA has published a manual of recommendations for the reduction of vulnerability in zones of informal occupation prone to floods titled "Learning to Live with the Floods - 2004". The document stresses the need to have an established early warning system, an emergency committee with well-defined, clear tasks for each member, and a contingency plan, and also identifies actions to be considered for flood mitigation, including the re-zoning of slums, improved sanitation, suitable constructions for areas prone to floods, and a reduction of deforestation, etc.

1.4.3 Tropical Cyclones

Cyclones normally occur along the coastal regions of Mozambique (and in some cases may also affect the interior) due to tropical depressions originating from the Indian Ocean. Figure 6, shown below, depicts that zones that are often affected by cyclones.

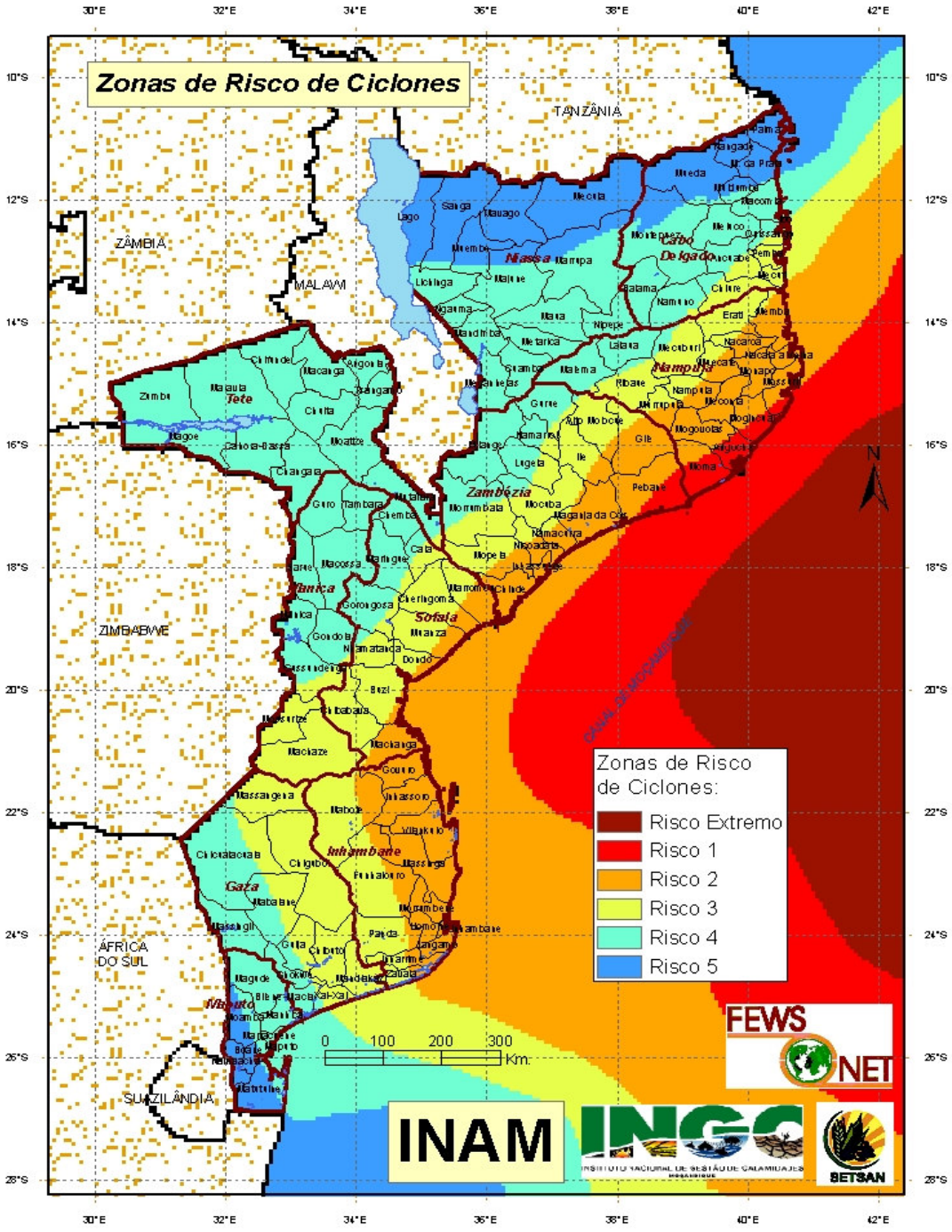

Figure 6: Map of cyclone prone areas in Mozambique.

The cyclone season is from October to April with the most intense storms occurring from February-April. Tropical cyclones are, among the meteorological events, the strongest and the most destructive globally. They occur in a cyclic manner, accompanied by strong winds and torrential rains. They can cause the destruction of infrastructure, the disruption of water, sanitation and electricity supply systems, the displacement of people, the loss of lives, the destruction of private property, the degradation of the environment, redistribute flora and fauna, and disrupt normal activities. However, these extreme events can also contribute to the water supply in drought stricken areas.

The country's relief agency, the National Disaster Management Institute (INGC), and Mozambique's National Meteorology Institute (INAM), are preparing the New Early Warning System/Warning of Tropical Cyclones in Mozambique. This program will outline the roles of different actors at various levels, with the aim to reduce the negative effects of cyclone events.

After the elaboration of the New Early Warning System, the following activities were identified as priorities for publication and implementation:

1. Production of publication material;
2. Teaching and learning programmes;
3. Civic education campaigns;
4. Involvement of mass media organizations;
5. Involvement of public institutions, community authorities and other influential people; and
6. Involvement of NGOs and civic associations.

The program would serve to warn the public of imminent cyclones so that communities can better respond. However, little progress has been made due to a lack of financial resources to implement the program.

Table 3 shows the areas that have been affected by floods, cyclones and droughts since 1970.

Table 3: Natural disasters in Mozambique since 1970

Years	Floods	Cyclones		Drought
		Name	**Affected area**	
1976	Incomati River	Claudete	Maputo and Gaza.	
1978	Limpopo River			
1979	Buzi, Pungue and Zambezi Rivers	Angelle	Nampula.	
1982/83				Gaza and I'bane
1984	Umbeluzi River	Demoina	Map, Gaza, Inhambane.	
1988		Filão	Zambezia.	
1991/92				Sofala
1994		Nadia	Nampula.	
1996	Limpopo River			
1997	Buzi, Pungue and Zambezi Rivers	Bonita	Zambezia.	
1999	Inharrime and Govuro Rivers	3 S	Inhambane.	
2000	Umbeluzi, Incomati, Limpopo, Save and Buzi Rivers	Eline	Maputo, Gaza, Inhambane, Sofala and Manica.	
		Hudah	Zambezia and Nampula.	
2001	Pungue, Zambezi, Chire and Licungo Rivers			
2002		Atang	Cabo Delgado.	Sofala
	Licungo, Melule, Monapo Rivers	Delfina	Cabo Delgado, Nampula and Zambezia.	
	Revubue, Mirahoto, Maguide Rivers			
2003	Save, Muare, Ripembe Rivers	Japhet	Inhambane, Manica, Sofala and Gaza.	Sofala
		Storm	Maputo City and Province.	

Source: INGC

2. Proposed Actions

This document outlines four actions which aim to reduce the negative impacts of extreme hydro-meteorological events through adaptation initiatives. All proposals utilize locally available resources and cost-efficient, environmentally friendly, sustainable technologies as a way to combat poverty. The strict and positive implementation of the initiatives presented below will contribute to the improvement of the quality of people's lives and to a consequent reduction of vulnerability to extreme events.

The proposed adaptation initiatives target various areas of economic and social development, and outline projects related to the reduction of impacts to natural disasters, the creation of adaptation measures to climate change, fight against soil erosion in areas of high desertification and coastal zones, reforestation and the management of water resources.

The management of the proposed initiatives require well-elaborated and planned activities, and inter-institutional collaboration for the prevention and reduction of natural disasters. It is also essential that the involved institutions have the required technical and fiscal capacities to implement effective environmental monitoring and research to better understand and interpret the phenomena that influence climate change impacts and vulnerabilities.

2.1 Project 1: <u>Strengthening of an early warning system</u>

Introduction

A proactive approach to natural disasters depends on in depth knowledge of the environment in which we live. The success of an early warning system to reduce the effects resulting from climate hazards is an important part of the management of natural disasters. The implementation of such a system depends on an understanding of impacts,

appropriate adaptation options and an effective communication plan. Public education and an understanding of potential adaptation measures are crucial in the management of climate-related disasters.

Rationale of the proposed action

There is a need for the timely communication of early warning system information, as well as the increased knowledge by users of appropriate actions to take in order to reduce the loss of human lives and to property. There is currently an extensive network of meteorological stations that the Ministry of Agriculture has built throughout the country; however there is a need to standardize these stations in order to improve accuracy and precision of meteorological readings. The collected data will help examine seasonal changes, and will also assist future climate studies. The standardized network of stations will also help improve the transmission of information.

Objectives

The main objections of this project is to strengthen the early warning system so that the information can reach the affected communities in a timely manner, in a format that targeted communities can use.. The specific objectives will be to:

- Evaluate the current state and functionality of the early warning system;
- Identify the local knowledge of forecasting climatic events and evaluate its adaptability to the early warning system;
- Evaluate the degree of vulnerability; and
- Monitor the functionality of the early warning system in order to identify any deficiencies in the system.

Expected Results

Due to the level of difficulty for each activity, the expected milestones can be categorized in to short-term results (0-2 years), and long-term results (from 2 to 5 years).

Long-term results I

Improved weather and seasonal forecasts, resulting in a reduction in the loss of human lives and damage to property.

Short-term Results I

An increased precision in the weather and seasonal forecasts as a result of the standardization of existing pluviometric stations. This would occur with the support of various organizations (e.g. Ministry of Agriculture, World Vision, Plexus, etc.) with the national meteorological network being supported by the National Institute of Meteorology.

Activities

1. Conduct a survey on the existing pluviometric stations at national level in order to integrate the stations into the INAM meteorological stations network to standardize the collection of meteorological data.
2. Survey of the present state of the national meteorological and hydrological network stations, and evaluate the need to install new stations in other local areas.
3. Install new meteorological and hydrological stations in identified local priority locations.
4. Standardize the collection of data from the pluviometric stations with the support of the Ministry of Agriculture, Fisheries, ARA's, INAM, World Vision, Plexus, and other organizations operating in the area.
5. Train technicians in charge of collecting data from the standardized stations.
6. Enable the meteorological services to update seasonal forecast every month.
7. Improve the quality of network and operation of pluviometric and hydro-meteorological stations through the use of modern equipment.
8. Reinforce the storage and processing of data, and the dissemination of hydrological information.
9. Create a permanent technical committee to monitor the information exchange between different water resource management stakeholders.
10. Strengthen institutional capacity in the collection, analysis, validation and monitoring of hydrological data through training courses.

11. Coordinate the continuous maintenance of used equipment in the stations to guarantee and quality of collected data.

Long-term results II

Early warning information is received in a timely manner by the affected Administrative Posts that are at risk.

Short-term results I

Risky and vulnerable areas are identified, classified and mapped down to the level of Administrative Post.

Activities

1. Select, on the basis of the existing information, the districts to be considered in the pilot phase.
2. Establish a social, economic and physical profile of the Administrative Posts that are vulnerable to drought, floods and tropical cyclones.
3. Map and classify Administrative Posts according to their degrees of vulnerability.
4. Resettle crowded populations from flood and cyclone prone areas.
5. Identify the places of refuge and evacuation routes in the Administrative Posts which are prone to hazardous hydro-meteorological events.

Short Term Results II

Develop a system to disseminate locally-relevant early warning information.

Activities

1. Identify and evaluate the local systems for the prediction of extreme events (e.g. the appearance of some birds in a specific season, colour changes in leaves of trees).
2. Identify, together with the communities and administrative bodies, necessary actions to improve local management of extreme events, including the installation of a system to receive and disseminate early warning information in a timely manner.

3. Support the improvement of communication infrastructure and access roads in the country, particularly in risky and vulnerable areas.
4. Strengthen the capacity and the involvement of media organizations in the dissemination of warning information and educate communities on climate change.
5. Use local (informal) communications channels, for example, religious, community and school authority networks.
6. Improve information exchange mechanisms for weather and seasonal forecasts between neighbouring countries.
7. Promote the creation of local community training on how to cope with climate related disasters.
8. Promote the exchange of experiences among local communities on local skills to manage extreme events, including actions carried out to minimize their negative effects.
9. Disseminate and encourage local communities on matters linked to climate change, causes and effects.
10. Monitor forecast trends taking into account possible changes that may occur during the rainy season.
11. Create a monitoring committee.

Long Term Results III

Improve inter-sector coordination for the use and dissemination of warnings, and the deployment of emergency assistance for communities.

Short Term Results I

Reduce the duplication of efforts and resources in activities that support communities who are vulnerable to extreme climate events.

Activities

1. Train technicians of relevant sectors (such as fisheries, water, agriculture, health, environment and disaster risk management) in the dissemination of early warning system, seasonal forecasts and risk communication information to communities.

2. Strengthen the capacity and involvement of the Mozambique Armed Forces in rescue operations.
3. Identify, map and evaluate the activities and/or mandates of different groups and/or integrated communities in risk management, natural disasters and climate change.
4. Establish synergies between the different committees/groups that deal with issues related to climate change and/or natural disasters.
5. Create a database of studies and implemented projects in Mozambique on climate change and/or disaster risk management, as well as a list of experts in these fields.
6. Train local bodies in data collection and analysis on natural disasters.
7. Produce radio and television programmes and other education tools (theatre, debates, and workshops) to educate the public on issues linked to climate change.
8. Hold regional seminars for publication and education.

Risks and Barriers

Peace and political stability are essentials for success in the implementation of any project. The identified risks and barriers that can hinder project's success are:

- Communications problems due to poor road conditions are factors that can hinder the functioning of the proposed action.
- Various factors can affect the ability to make accurate weather and season forecasts including a lack of capacity in data collection and technical knowledge, low densities of meteorological stations, and aging obsolete equipment.
- Low levels of education.
- Lack of communication between sectors.

Implementation

The implementation of activities for this project will be of the responsibility of INAM, INGC, Technical Committee for the Management of Natural Disasters (CTGC), MINAG, MTC, MEC, ONG's, MOPH (DNA, ARA's ANE), MPescas, MAE, INTC, media, research institutions, private sector and civil society in general.

Budget

Activities	Estimated cost in USD
Mapping and relocation of administrative posts and people	1,280,000
Rehabilitation or installation of pluviometric and hydrological stations	300,000
Training and capacity building	150,000
Education	100,000
Seminars (10 Provincial, 1 National)	105,000
Improvement of communications systems	100,000
Creation of data bank at district level on the occurrence and impacts of natural disasters	165,000
Creation of local disaster risk management committees	500,000
Total	2,700,000

The initial stages of the project will include the installation and/or rehabilitation of approximately 15 synoptic stations, which will be evenly distributed throughout the country. Mapping will be carried out in all administrative posts involved in the participative validation process (see Figure 3).

2.2 Second Action: Strengthening capacities of agricultural producers to cope with climate change

Introduction

Agriculture continues to be the most important sector of the Mozambique economy. According to estimates based on the 1997 population census and on the 2001-2005 plan

of action to reduce absolute poverty, Mozambique has a little over 17.5 million inhabitants and, according to the same sources, approximately 80% of the economically active population is linked to agricultural production, of which 70% live under extreme poverty conditions.

The results of the TIA 2002 show that in 2000/2001 the agricultural and livestock sector is dominated by small scale agriculture, constituting 99.7% of the country's agricultural activities and occupies 96.7% of the cultivated land area. This mainly consists of subsistence agriculture, with little income generation. There is little use of raw-materials such as manure and pesticides, irrigation and mechanized equipment in agricultural production.

The five year (2005 – 2009) government programme objectives for the agricultural sector are to:

- contribute to self-sufficiency and food security in basic foodstuffs;
- increase agricultural productivity;
- guarantee the supply of raw-materials to the national industry; and
- promote and support the development of the family, cooperatives, the private sector and job creation.

The government intends to stimulate increases in production in the area of commercial agriculture and promote agro-industrial development in rural areas, which will add value to the country's agricultural products for the national market and for export.

One of the main challenges faced by PROAGRI is to provide necessary and sufficient support for farmers who continue subsistence farming, while at the same time develop a more market-oriented agricultural sector.

In addition to previously described challenges, agricultural production is limited by drought conditions resulting from climate change. The country has experienced a deficit in food security in some areas due to drought over the years.

Changes in precipitation, air temperature, atmospheric humidity and radiation – essential elements for the production of organic matter and for basic activities of plants such as photosynthesis, growth and development – have been affecting the country's agricultural productivity. Therefore, actions must be taken to cope with this situation that continues to aggravate the poverty situation of the rural Mozambican people.

Rationale of the proposed action

Agriculture in the country is important firstly as a source of food, and secondly as the basis for development. Despite its importance, agriculture is practised on unirrigated lands and with few investments due to the weak financial capacity of the rural communities.

Support for agricultural infrastucture, raw-materials, and the construction and/or rehabilitation of irrigation systems will reduce the loss both of animals and crops during the dry season and will consequently increase the capacity of people to deal with climate change.

Objective

Develop capacities of agricultural producers to deal with climate change and climate variability.

Expected Results

Long Term Results I

A reduction of losses in crop production and livestock in regions prone to drought, floods, cyclones, tropical storms and other climatic events.

Short Term Results I

Increased availability of agricultural and livestock foodstuffs

Activities

1. Promote associations among farmers, cattle and goat breeders, and fishermen.
2. Build infrastructure for the collection and conservation of rain water for subsequent use in the drought season.
3. Drill wells or water boreholes.
4. Install small scale sustainable irrigation systems, and explore the use of renewable energy to power the agricultural system.
5. Build and/or rehabilitate tanks and administer vaccinations.
6. Encourage applied research on drought and disease resistant crops, as well as the use of crops that have short growing cycles.
7. Promote the value of sacred forests for eco-tourism purposes.
8. Disseminate and encourage the use of drought tolerant crops.
9. Promote the certification of seeds sold in agricultural fairs.
10. Encourage the local production of seeds.
11. Promote agricultural fairs in vulnerable areas.
12. Promote the use of hays for cattle feed.
13. Evaluate quarterly the implemented activities together with communities in the first 12 months by the NAPA Team members.

Long Term Results II

Reduce the degradation of soils due to inappropriate agricultural practices.

Short Term Results I

Reduced degraded areas.

Activities

1. Identify, classify, map degraded areas caused by inappropriate agricultural practices.
2. Promote the use of renewable energies, mainly biofuels, in proximity to cattle breeding communities.
3. Encourage the use of conservation agriculture.

4. At a national level, monitor erosion after the rainy season.
5. Promote community reforestation activities aimed at producing bio-mass for energy consumption and forest conservation activities particularly within river basins.
6. Promote community reforestation activities using native species.
7. Promote community activities for fire management.
8. Promote community activities for erosion management. .

Long Term Results III

Established alternative forms of subsistence

Short Term Results I

Increase family income

Activities

1. Promote simple technologies for the processing and conservation of food and seeds.
2. Encourage the cultivation of cash crops.
3. Promote the financing of small scale businesses.
4. Promote the sustainable use of natural resources.
5. Promote the planting of species used in the production of biofuels in arid and semi-arid areas.
6. Encourage the diversification of agricultural activities (pisciculture, apiculture, handcrafts etc.).

Risks and barriers

The identified risks and barriers that can hinder the action's success are:

- Weak involvement of local communities;
- Weak coordination amongst stakeholder involved;
- Delays in allocating funds;
- Weak network of extension services capable of providing technical assistance and the transfer of necessary and adequate technologies to the production system;

- The lack of access to infrastructure and rural markets for the purchase and sale of agricultural tools and products in a timely manner; and
- Lack of capacity of the agricultural research network to be responsive to the multiple problems affecting the agricultural sector.

Implementation

The implementation of activities of this action will be of the responsibility of the following institutions: MINAG, ME, MOPH, DNA, MIC, MF, MIREM, MIDefence, ARA's, INAM, MITUR, MAE and DINAGECA, with the collaboration of the private sector and civil society.

In the first phase, it's proposed that these activities be developed in the districts of Magude and Moamba (Maputo), Mabalane and Massangene (Gaza), Funhalouro and Mabote (Inhambane), Chemba and Muanza (Sofala), Machaze and Tambara (Manica), Angónia and Changara (Tete), Mueda and Macomia (Cabo Delgado), Chinde and Morrumbala (Zambezia), Moma and Memba (Nampula) and Sanga and Cuamba (Niassa). These districts were chosen on the basis of the degree of vulnerability to drought (i.e. the most drought-prone provinces), the degree of vulnerability to floods (i.e. the most flood prone provinces), poverty levels and the availability of agricultural extension activities. Therefore, it does not mean that all activities will be developed in all selected districts. Depending on the characteristics of each, only activities that will have the highest impact in the communities will be selected and developed.

Figures 7, 8, 9 and 10 show the distribution of the evapotranspiration, precipitation, total production of maize in 1999 to 2001 and 2003 to 2004 by district. The Figures also identify the selected districts for the proposed project implementation in phase one.

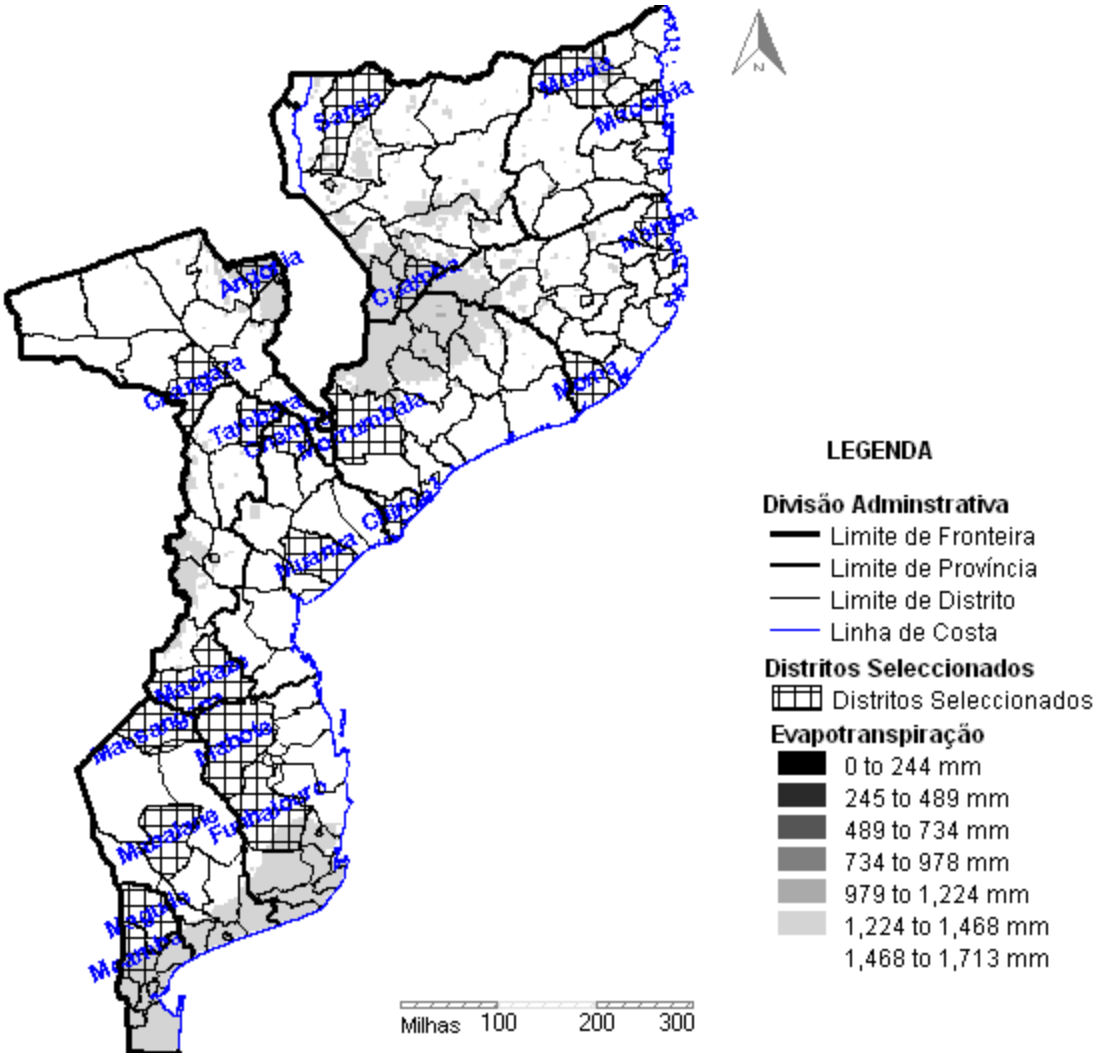

Figure 7: Map of evapotranspiration in the country.

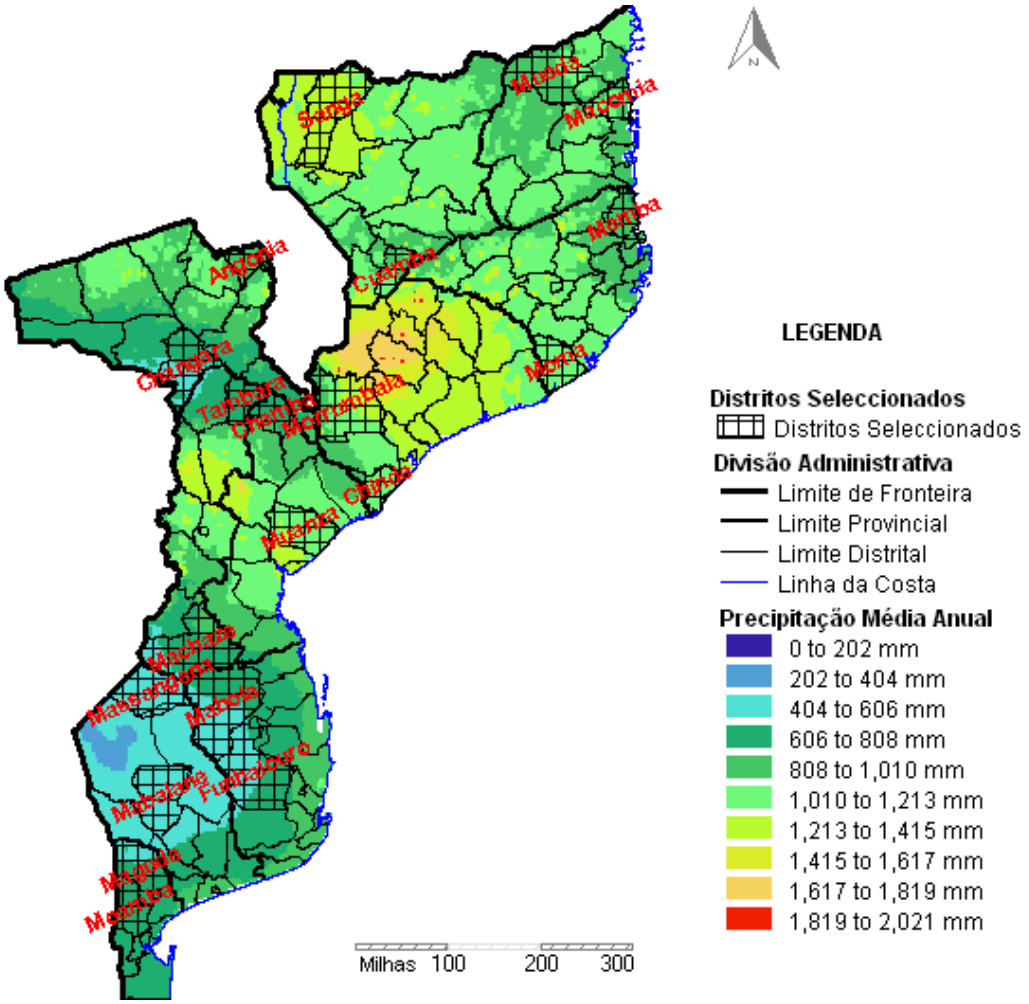

Figure 8: Distribution of precipitation.

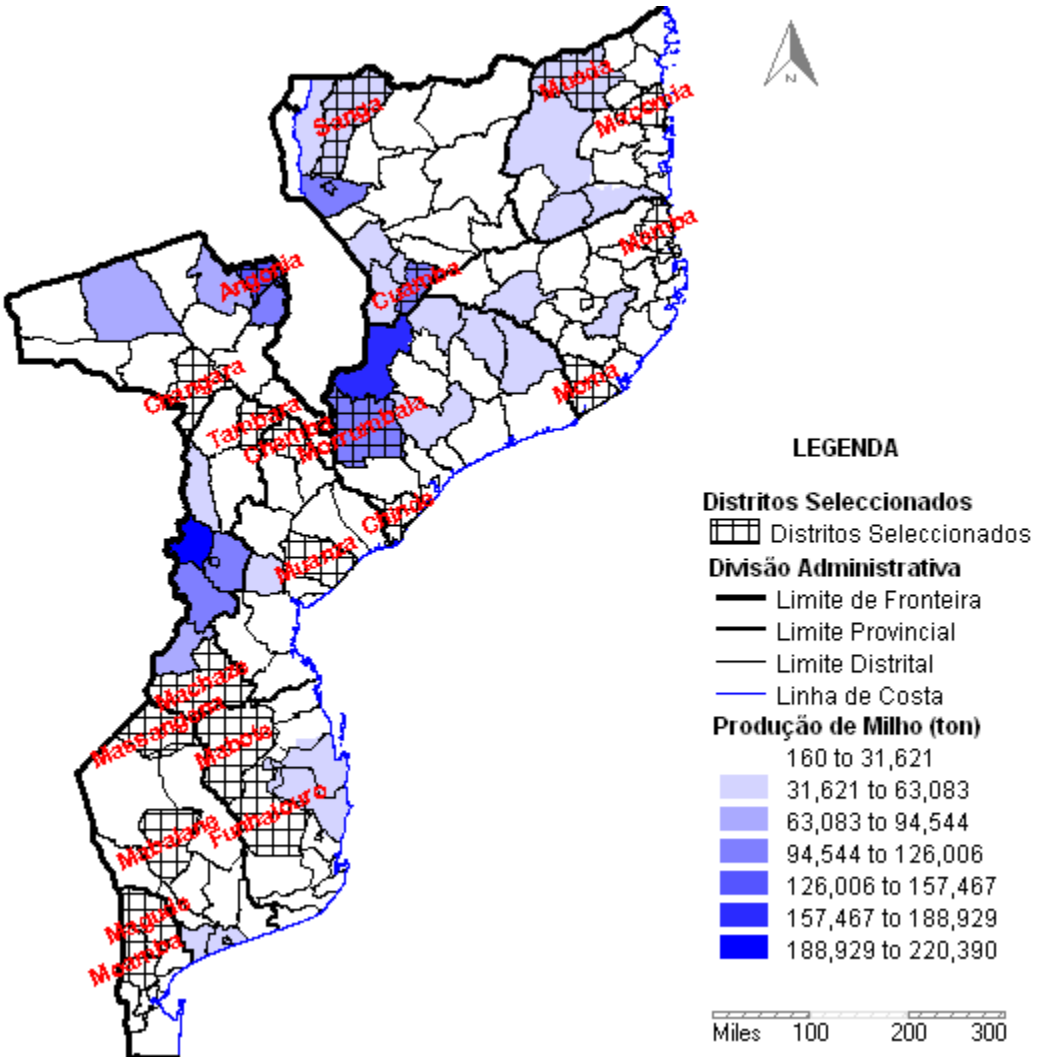

Figure 9: Distribution of total production of maize in 1999-2004 per district.

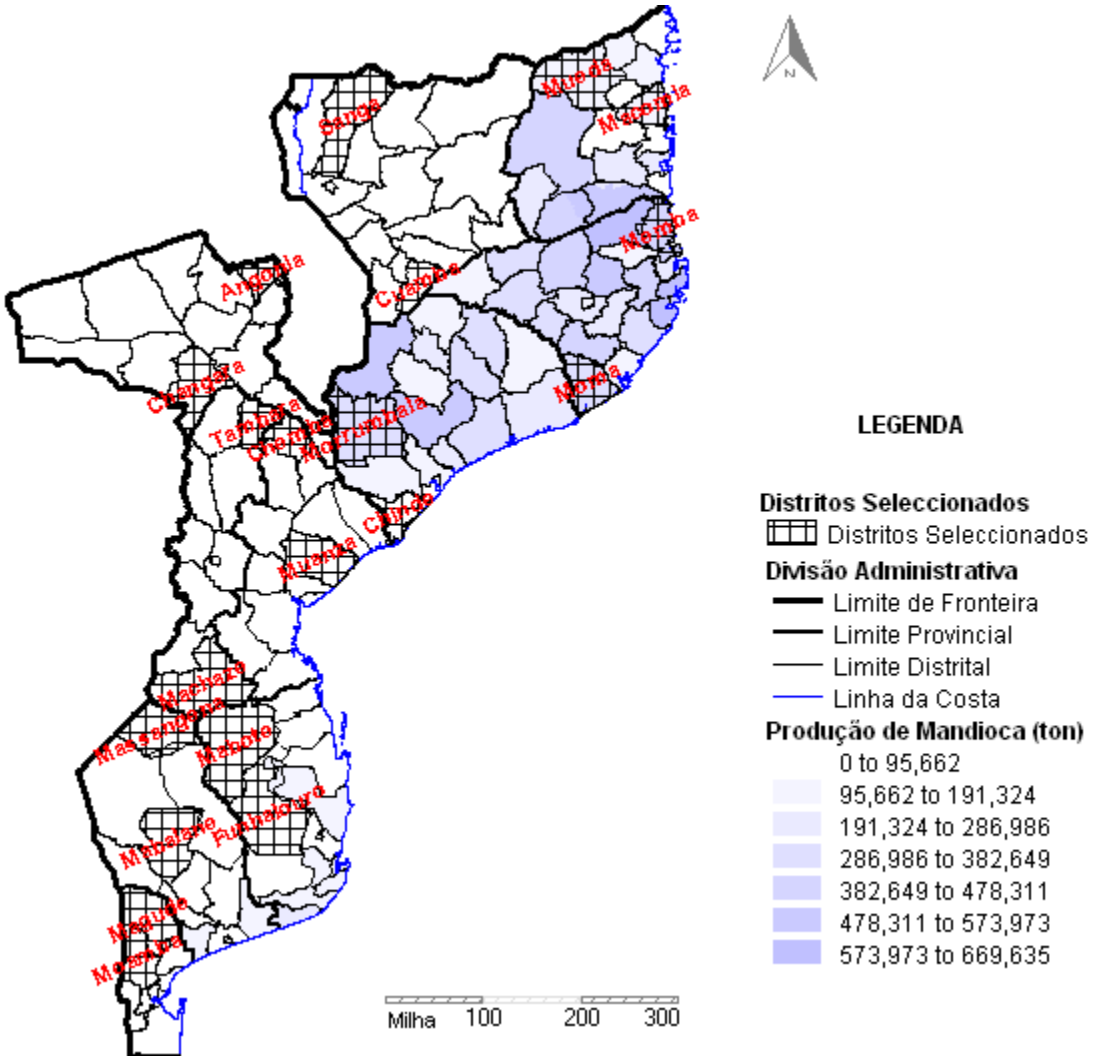

Figure 10: Distribution of total cassava production in 1999 - 2001 per district.

Budget

Activities	Estimated cost in USD
Reduce soil degradation caused by inappropriate agricultural practices	1,000,000
Reduce loss of crops and animal populations in regions prone to drought, floods and tropical cyclones	1,000,000
Establishment of alternative subsistence activities	500,000
Total	2,500,000

2.3 Third activity: Reduction of climate change impacts in coastal zones

Introduction

Mozambique has the third longest maritime coast in the African continent extending about 2,700 square kilometres, characterized by a vast variety of ecosystems such as estuaries, dunes, mangrove forests, coastal lakes, banks and coral reefs, marine weed and swamps. These ecosystems represent critical habitats for various species of ecological importance and economic value.

The social and economic activities being developed along the coast such as fisheries, port exploitation, tourism and sports as well as mining, oil and gas which are still under development, represent a significant value. These activities sustain over 60% of the people residing in the first 50 kilometres of the country's continental coastal zone.

On the other hand, the land based activities in coastal cities such as the manufacturing of raw-material along regional rivers, are lowering water levels and increasing sediment content, which is contributing significantly to the reduction of water quality and quantity. This is having a negative impact on transportation, erosion, marine invertebrate's productivity, the fishery sector and ecological tourism. These problems are further exacerbated by the lack or inefficient treatment of industrial and domestic wastes, which are often discharged directly into rivers and seas.

Many marine and coastal ecosystems are sensitive to human interference and have a low resilience which can result in a progressive and irreversible degradation of the coast. The coastal line is one of the most dynamic features of the planet, changing continuously at different time scales (daily, seasonal, decadal, secular and millenary). The Mozambican coast line is affected by a considerable number of factors, some natural in origin and intrinsically related with coastal dynamics (like wave actions, dispersion of sediments,

winds, tides, currents and tropical cyclones), and others related to human activities in the coastal zone (like agriculture, building construction, port activities, river flow diversions, mining and other activities). The action of extreme climate events such as tropical cyclones and heavy rains occur frequently along the country's coast are natural phenomena responsible for significant changes of the coast line as a result of their strong erosive action.

Due to the above identified factors, the coast line has been suffering from erosion. It is estimated that 90% of the erosion is caused by natural forces, and 10% caused by human factors, mainly in the coastal areas that are occupied by coastal cities. These urban and suburban areas are experiencing the most critical levels of erosion.

In the coastal region of southern Mozambique, the average erosion rate of the coast line has been 0.11 and 1.10 metres/ year between 1971-1975 and 1999-2004 in sheltered and exposed beaches respectively. However, in certain areas anthropogenic causes of these processes are dominant and include urban and port expansions, and more recently the expansion of tourism. For example, the Ponta d'Ouro beach shows an erosion rate of 0.95 to 1.75 metres/year.

Most of Mozambique's cities and towns are vulnerable to environmental hazards due to its population growth combined with ineffective land-use planning which have led to erosion, brought about by heavy winds and rains, forming deep ravines and in certain cases and causing landslides. As well, there have been cases of floods partially reaching cities and towns. These have been reported mainly in the southern region.

The centre of high vulnerability to erosion is around 20º latitude. This region is characterized by a delta and mangrove forest in the north and high vegetated dunes in the south. Its interior is characterized by plain area which is often prone to floods during extreme climate events. These are extremely fragile systems that have been heavily impacted. For examples, the coastal dunes suffer from increased pressure from tourism development and urban expansion In the area between Save and Zambezi rivers, erosion

has been aggravated in the past years by the logging of mangroves and from the reduction of water volumes from the Zambezi river after the construction of the Cahora Bassa hydro-electric dam.

Erosion rates in the northern region of Mozambique are less intense since the area is protected by coral reefs which form an almost continuous perimeter. However, these reefs are under a strong threat from intense extractive activity, over-fishing and sea level rise.

Rationale of the project

Mozambique is a country where about 60% of the population lives in the coastal zone. Activities such as tourism and recreation, mining, oil and gas industry, and aquaculture all occur in the coastal zone. These activities are vulnerable to a variety of disturbances. The logging of vegetation and mangrove trees, the destruction of dunes, and the destabilization of the coastal sand and islands contribute significantly to erosion. This is noticed chiefly in large coastal urban centres and suburban areas. These areas are experiencing rapid population growth, inadequate, sporadic land-use planning and limited financial funding. Therefore, the control of land-use in the coastal zone and the development of strategies for the protection against erosion are becoming urgent. The country has a lack of policies to control and regulate coastal erosion caused by anthropogenic factors. In addition, few studies related to adaptation to erosion caused by climate change have been carried out. Therefore, the task of integrating adaptation strategies to climate change and the reduction of the impact of disasters must occur via the restructuring of the current land use practices, elaboration of programmes to develop scientific knowledge on erosion, the incorporation of policies and strategies into sectoral plans, and the regulation and assessment of social and economic development.

Strategic integration

The PARPA (2005-2009) states that the improvement of environmental conditions depends on adequate planning measures in urban areas, namely the development of a land registry and soil characterization, and the planned development of transportation infrastructure, drainage and water supply. Activities must also consider the environmental priorities of Mozambique, which focus on: (i) sanitation; (ii) territorial coordination; and (iii) the prevention of soil degradation. Activities need to also consider issues related to environmental governance, as well as recognition of the relationships between the environment and poverty with a focus on environment education, tourism, mining, fisheries, management of coastal and marine areas, technology, and vulnerability to natural disasters etc.

The government's 2005-2009 five year programme considers research and testing of appropriate practices and technologies for the fight against erosion, drought and for the conservation of biodiversity as one of its strategic objectives.

General objectives

Contribute to the sustainable development of the coastal area through the reduction of social and economic climate change impacts via coastal integrated management systems based on the community needs, and increased education of state officials and community institutions on coastal zone vulnerabilities.

Specific objectives of the project are to:

1. Identify, characterize and map the eroded land and coastal vegetation;
2. Identify rehabilitation techniques for dunes and mangroves to mitigate the effects of erosion;
3. Identify participative actions for erosion mitigation;
4. Develop strategic actions to sensitise and disseminate good practices in coastal communities.

Expected Results

1. Eroded areas and those prone to erosion will be categorized and mapped. The main causes of erosion will be identified, and social and economic impacts evaluated.

2. Technical and scientific measures to deal with erosion will be identified, and a workplan and associated costs will be developed.

3. Adequate techniques for small, medium and long-term interventions will be identified that include stakeholder participation.

4. Practical knowledge and techniques for erosion control are disseminated to affected communities.

5. Gaps in the legal and institutional framework on erosion control are identified. Recommendations and amendments are made that are inline with the current reality.

6. Methodologies for the effective transmission of knowledge on erosion prevention and mitigation are identified and tested. Communities begin to adopt these processes.

Long term results I

Adaptation measures to respond to climate change are adopted in local strategic and development plans, thereby minimizing or eliminating the effects of coastal erosion on the region's social and economic development. Adopted plans have positive impacts on agriculture, water availability, sanitation, human settlement, coast line protection and biodiversity.

Short term results I

Eroded areas and coastal vegetation are identified, and dunes and mangroves are restored.

Activities

1. Prepare maps of eroded areas.
2. Evaluate the state of erosion and identify it Evaluate the legal and institutional framework to control and mitigate erosion; and it´s causes and consequences.
3. Prepare recommendations for erosion mitigation.
4. Prepare maps on coastal vegetation.
5. Inventory and describe the species of vegetation, their distribution and abundance as well as their use as a resource.
6. Identify deforested areas, as well as the causes and consequences of the deforestation.
7. Prepare recommendations on adaptation interventions.
8. Plant native trees in the mangrove zones which have been logged.
9. Evaluate the level damage
10. Evaluate the legal and institutional framework to control and mitigate erosion; and to dunes, and establish objectives for their rehabilitation.
11. Establish a dynamic monitoring system for dunes, beaches and mangroves through the collection of different types of data to measure topographic, oceanographic, chemical and biological indicators.
12. Characterize water flow changes and erosion that are caused by the damming of rivers in estuaries.
13. Describe changes of the coast line, vegetation and land use in the cities of Maputo, Beira and Nacala through the use of remote sensing. .
14. Propose a number of environmental, social and economic approaches to adapt to the impacts of coastal changes.

Long term results II

Development and establishment of infrastructure based on ecological zoning and local sectoral plans and projects aimed at tackling short, medium and long-term actions to control erosion. This will occur with the involvement of local communities and the private sector in implementing the plans and projects.

Short Term Results I

Methodologies for erosion control are developed through tested and documented prescriptive actions.

Activities

1. Areas are zoned according to their present use, potential and ecological value (including conservation/reforested value, firewood and charcoal, agriculture, livestock, etc.).
2. Establish general norms to be observed in micro-zones.
3. Identify and implement participative alternatives to develop coastal natural resources.
4. Construction of protection barriers in densely populated areas with erosion problems.

Long term results III

Elevate the level of awareness of the local communities, the private sector and other stakeholders on the effects of coastal erosion and its social and economic impacts.

Short term results I

Educate the communities on the processes of coastal erosion and erosion control.

Activities

1. Elevate the state of knowledge of communities and users of the coastal zone on the integrated management of coastal natural resources for the purposes of climate change adaptation.

2. Increase the knowledge of communities who use coastal zones on the impact of erosion and deforestation in relation to climate change within the region. .
3. Involve local communities in discussions on good practices in fighting and preventing erosion.
4. Encourage the population to abandon fisheries techniques that contribute to the destruction of sensitive eco-systems such as coral reefs, etc.
5. Evaluate the capacities of communities in implement recommended activities.

Risks and Barriers

- The population's habits, attitudes and inertia for change relation to emerging problems can constitute a bottleneck for the effective implementation of activities.
- Extreme adverse climatic events occurring during the construction of protection barriers.
- The loss of access to beaches for local communities and tourists.
- Conflicts over the implementation of setback zones with land owners and the general public.

Implementation

The implementation of activities for this project will be of the responsibility of MICOA, through the Sustainable Development Centre for Coastal Zones and the National Directorate for Environmental Coordination, in partnership with the fisheries sector and academic institutions.

Budget

Table 4: Proposed budget (USD 2,000,000) by expected result.

ITEM	Expected Result	Personnel expenses	Goods	Services	Capital expenses	Total costs
1.1	Knowledge on eroded and erosion prone areas are categorized and mapped and the social and economic impacts of the are evaluated	67,000	251,250	125,000	42,000	**485,250**
1.2	Technical and scientific framework to fight erosion is developed, along with program workplans and costs.	52,720	131,800	125,000	19,000	**328,520**
2.0	Small, medium and long-term intervention techniques are developed, which include participative techniques,	52,720	263,600	250,000	14,000	**580,320**
3.0	Practical knowledge is disseminated and techniques to combat erosion are shown to communities. .	82,480	41,240	25,000	6,000	**214,720**
4.0	Methodologies for knowledge dissemination are identified and tested on the causes of erosion, as well as erosion control. .	102.720	77.040	25.000	56.000	**260.760**
	Total Group	**410,360**	**804,470**	**575,000**	**211,000**	**2,000,830**

Table 5: Proposed annual budget per expected results.

ITEM	Expected Result	Year 1	Year 2	Year 3	Year 4	Year 5
1.1	Knowledge on eroded and erosion prone areas are categorized and mapped and the social and economic impacts of the are evaluated	145,575	109,181	84,919	72,788	72,788
1.2	Technical and scientific framework to fight erosion is developed, along with program workplans and costs.	98,556	73,917	57,491	49,278	49,278
2.0	Small, medium and long-term intervention techniques are developed, which include participative techniques,	174,096	130,572	101,556	87,048	87,048
3.0	Practical knowledge is disseminated and techniques to combat erosion are shown to communities. .	64,416	48,312	37,576	32,208	32,208
5.0	Methodologies for knowledge dissemination are identified and tested on the causes of erosion, as well as erosion control. .	78,228	58,671	45,633	39114	39,114
	Total Year	**600,249**	**450,187**	**350.145**	**300,125**	**300,125**

2.4 Fourth action: Management of water resources under climate change

Introduction

Mozambique has a reasonable potential for both superficially and underground water resources. The country has approximately 103 river basins, 13 of which have a drainage area of over 10,000 km^2, namely Rovuma, Messalo, Lurio, Ligonha, Licungo, Zambezi, Pungoe, Buzi, Gorongosa, Inharrime, Govuro, Limpopo, and Incomati. Other relevant basins with drainage areas below 10.000 km^2 are Montepuez, Monapo, Save, Umbeluzi and Maputo. In addition, in all 9 river basins are shared with other neighbouring SADC countries, of which Mozambique is downstream of all of them.

According to available data, the total available flow is about 216 km^3/year, of which 100 km^3/year (46%) is generated within the country, and the remaining 116 km^3/year originates from neighbouring countries. The largest quantity of water draining superficially through rivers come from outside Mozambique, that requires the strengthening of management or regulations in order to better manage river resources with neighbouring countries.

According to available information, significant progress has been recorded from the installation of early warning systems close to the Umbeluzi, Inkomati, Limpopo, Buzi, Pungoe, Zambezi and Licungo rivers in identifying flood prone river basins. Relationships between institutions linked to natural hazard management have been established, but they still do not meet the country's urgent needs. Presently, the hydrometric network under operation is made up of 100 stations. Water quality monitoring is only done in the country's southern region and is sporadic elsewhere.

Saline intrusion occurs in low lying areas prone to drought, which increases soil salinity, negatively impacting agricultural and livestock activities, and resource conservation. Low

river levels can also led to vegetation loss, leaving soil exposed and therefore more susceptible to erosion.

In events of high superficially flow (i.e. floods), soils are fertilized due to the displacement of nutrients by the water. However, flooding events can disrupt various activities, such as agriculture, livestock fisheries and transportation.

The pollution of river waters has also had negative impacts. The pollution of river waters represents a risk for the conservation of biodiversity. During a strong rainfall, superficially water flows containing solid particles and other dissolved particles leave river water polluted and unfit for human consumption, deteriorating the living conditions of communities that use the water for various activities. During the dry season the available water for various community activities is scarce, resulting in loss of crops and animals, shortages of water for cooking, dish-washing, personnel hygiene, etc.

The Southern Regional Water Board, ARA-Sul, in its 2004 Business Plan, recognizes the lack of both human and institutional capacity to monitor the environmental quality of water resources. The National Water Policy (PNA) approved by the Mozambican government in 1995 introduced various reforms to the integrated management of river resources. The inclusion of water management aspects in environment, land, mining, fisheries, forestry and wildlife laws are examples of the impact that the National Water Policy brought about. The policy has been reformulated and the new version emphasizes flooding issues, with the objective to prevent human losses and minimize the negative social and economic impacts of floods (such as the loss of goods, damage in public and private infrastructures and disturbances to the social and economic life). In relation to drought, the policy outlines the following objectives: to prevent hunger and the shortage of drinking water in rural areas resulting from drought conditions, and minimize the impact of drought on the water supply for urban areas, agriculture and cattle. Concrete actions are proposed for the achievement of these objectives.

Mozambique is situated downstream the main river basins that cross through it. The quality and quantity of water that reaches the country depends on the activities carried out in the upstream countries. These factors place challenges to Mozambique. Mozambique has a limited capacity for water storage for use in the dry season, technical and institutional capacities to manage flooding, drought and actively participate in negotiations of shared water resources. There is a clear need for sufficient water flows to maintain ecosystems, as well as infrastructure for early warning systems. In international negotiations, it's advisable that consideration be given to the climate change given that the impacts of climate change have been predicted by the IPCC to potentially lead to conflicts over climate sensitive resources.

Rationale of the proposed action

Mozambique has been suffering from the effects of extreme climatic events, caused by low or high levels of superficially water flows through river basins that cross the country. The magnitude of the effects of drought and floods are extremely frightening due to the high impacts and limited control over river flows through the country.

According to existing studies, most of the river basins in the country's southern region are characterized by low water levels during the dry season and high levels during the rainy season. In the central and northern regions, the river water levels are generally regular. This shows the influence that climate factors have on the availability of water resources via weak or strong rainfall patterns. In this context, the control and evaluation of the available water quantities in and for the country are of paramount social, economic and environmental importance. This information is key for adequate decision-making for the mitigation of natural disasters.

The control of water level variations in river basins requires an extensive network of hydro-meteorological stations, as well as trained technical workers. The analysis and evaluation of water availability, taking into account climate variability, require a long, continuous series of hydrologic and climatic data. The 100 stations that are currently

operational within the country show that the current data collection is poor. There is therefore a need to expand and increase the density of the hydrometric stations and improve the sharing of information related to water management among the various development sectors according to the National Strategy for Water Management (ENGA). Ideally, stations should be expanded from 100 to 300 hydrometric stations and from 800 to 1,000 pluviometric stations.

There are only four dams build in Mozambique in the southern regions, which have been built to control floods and supply people with water, including irrigation. However, there is a lack of qualified personnel to deal with the control and evaluation of river levels through the use of modern technology. Capacity building initiatives will enable better assessments of river related hazards, and will enable the reduction of negative impacts from changes in water levels.

Different sectors within the country require the availability of water resources for their sustainability; therefore it is of paramount importance to involve different sectors in the management of water resources, especially when considering extreme hydrological events.

Objectives

To improve the level of control and evaluation capacity of river water flows for the purposes of reducing the impacts of droughts and floods within hydrological basins. This project aims specifically to:

1. Evaluate the monitoring systems of river water levels for a greater precision in forecasting drought and floods.
2. Promote the improvement of the river water level control systems through technical capacity building of personnel linked to the collection and processing of hydrological data.
3. Improve the systematic control of river water quality.

Expected results

Long term results I

Human and material damage from floods in river basins due to climatic variability are minimized.

Short term results I

Control of river water levels are improved, taking into account the water levels in neighbouring countries.

Activities

1. Measure the amount of sediment transport within Mozambique's main river basins in order to monitor morphological changes.
2. Develop hydrological monitoring methods in all key river basins.
3. Establish and calibrate hydrometric stations.
4. Promote the creation of basin committees in the country's biggest river basins, with particular attention for those where irregular water levels are often recorded.
5. Identify and prioritise the training needs in different areas such as: negotiation techniques, vulnerability analysis and the integrated management of rivers.
6. Train technicians according to prioritised needs.

Short term results II

Hydrologic infrastructure is improved and updated.

Activities

1. Identify the various conditions and needs along the rivers and identify their specific solutions.
2. Build river water level protection and control dikes in proximity to the river basins in flood and drought prone areas.
3. Build protection barriers against saline intrusion in proximity to estuaries.

4. Rehabilitate hydrologic infrastructures.
5. Begin the construction of new infrastructures in areas that have already been identified as areas of need..
6. Reinforce the capacity of equipment operators for dam monitoring and maintenance.
7. Develop and implement infrastructure maintenance activities.
8. Elaborate regulation instruments on the security of the dams and other hydrologic infrastructure.

Short term results III

Improved system for information dissemination

Activities

1. Facilitate access to the website for water board authorities (ARA's) and other potential users.
2. Extend the use of community radios for the dissemination of information in the appropriate format at the community level.
3. Create an exchange mechanism of information between SADC-HYCOS and other transmission stations with the database system of the ARA's.
4. Promote civic education campaigns for different groups, particularly those that carry out activities in the basins.

Short term results IV

Improved sharing of water resources between Mozambique and other neighbouring countries

Activities

1. Identify and prioritise river basins in which vulnerability and adaptation evaluation studies are to be carried out.
2. Carry out studies in at least three river basins and develop integrated management plans for each.
3. Evaluate signed Agreements of Shared Resources.

4. Create a network and transborder hydrologic models.
5. Harmonize the collection and format of data for a database with neighbouring countries through regional seminars.
6. Formulate comprehensive agreements for water use in shared river basins under the guidelines of the SADC protocol.
7. Promote a continuous negotiation, for the establishment of regulations and agreements for shared water courses between countries in southern Africa.

Long term results II

Biodiversity is protected within the main river basins.

Short term results I

River water pollution is controlled.

Activities

1. Prepare a national inventory on humid areas and riverside ecosystems, in order to develop a baseline for their long term protection.
2. Evaluate the environmental status of some river basins where evasive species occur and propose recovery measures.
3. Establish the minimum ecological river water level in all river basins;
4. Conduct continuous evaluations of water quality and weeds.
5. Identify sources of water pollution and formulate appropriate control measures.
6. Strengthen effective water quality control measures.
7. Ensure that environmental impact studies for water use projects are conducted according to Mozambican Environment Law (LAM).
8. Develop more detailed, comprehensive emergency plans on water quality and the protection of riverside ecosystems.
9. Promote a community engagement campaign to promote activities that do not harm the ecological environment of hydrologic basins.

10. Consolidate institutional collaboration between the regional water boards, or ARAs, and MICOA for the elaboration and monitoring of measures to protect water resources.

Risks and Barriers

The success of this project depends on:

- The active participation of various stakeholders including different sectors and communities;
- The timely allocation of necessary resources for to implement the identified activities;
- The level of responsibility and professionalism of workers in the stations and hydrological data processing centres; and
- The strict collaboration between stakeholders.

Implantation

The implementation of listed activities in this action will be up to the DNA and ARA's, since these organization are already responsible for the management of water resources, the installation and monitoring of hydrometric stations, and the design and selection of appropriate models for water resources evaluations.

The National Institute of Meteorology (INAM) will be responsible of installing and monitoring hydro-meteorological stations, particularly the pluviometric component. It will also be the entity responsible for the collection, processing and analysis of climate data.

The control of water quality and water pollution, the protection of riverside ecosystems biodiversity, expansion of policies and programmes to regulate the control of water pollution, and guarantee its implementation will be of the responsibility of MICOA

(UGA and DNGA), MOPH, MAE, MCT, MINT, MEC, MINAG, MDefense, MFisheries, NGO's, and research institutions.

Budget

The budget is estimated at about 2,000,000 USD based on outlined activities and operational costs.

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