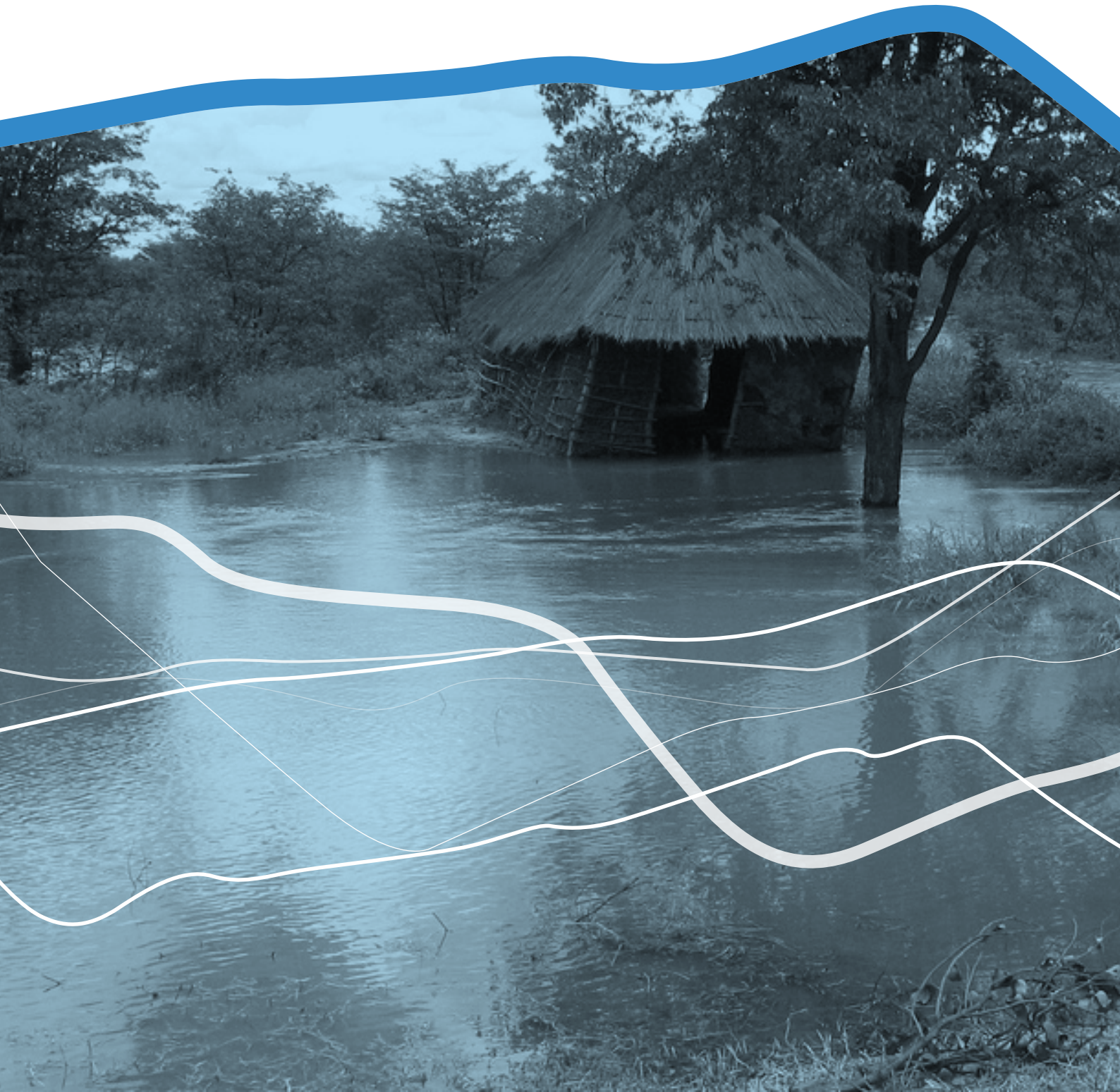




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Disaster Risk Assessment in Mozambique

A Comprehensive Country Situation Analysis



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Disaster Risk Assessment in Mozambique

A Comprehensive Country Situation Analysis

January 2011

Project Participants

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Executive Summary

This report was commissioned to examine the status, issues and challenges, strengths and weaknesses of Disaster Risk Assessment (DRA) in Mozambique and to recommend ways of implementing a National Risk Assessment (NRA) (scope, governance, etc). The approach was of implementing a Systematic Inventory and Evaluation of Risk Assessments, after UNDP/BCPR/GRIP (2010).

The analysis draws attention to the fact that risk is differently conceptualized, and the reference concept of this report is that by the United Nations International Strategy for Disaster Reduction (UNISDR) (2009). Various projects under the umbrella of DRA have brought products (reports, maps and the like) of great value rather for emergency preparedness and disaster response, while purposes and objectives of risk assessment (evaluation of the probabilities of alternative consequences, i.e., potential losses, of different management actions within the geographic area that is subjected to extreme natural events – hazards) remain in need of better coverage.

Further analysis revealed that there are several institutions and organizations that exercise risk assessment; data for risk assessment are originated from institutions and organizations with competent mandate, which produce and maintain data in accordance with prescribed standards (national or international). Data are provided in agreement with the government. Expertise and skills of Mozambique suffice for implementation of an NRA of products of good standards, but international experience will permit, by the end of the NRA Program, country's knowledge and capacity enhancement.

An initial proposal of coordination mechanisms, centrally facilitated by the INGC, is presented and the coordinating role of the INGC for the NRA work is reaffirmed. The report

presents recommendations for the implementation of the NRA:

a) Governance

Memos of understanding between the INGC (Coordinating institution of the NRA) and institutions and organizations related to risk assessment, to support and protect institutional commitment for an active collaboration with the NRA Program.

b) Professional expertise and skills

Existing expertise and skills in risk assessment is to improve own experience by the completion of the NRA Program.

c) Capacity building

Training: a key element of the country's effort towards improving disaster risk reduction practices. The NRA Program could contemplate training sessions and workshops.

d) Country needs

Mozambique's major need is information about disaster risk – about probabilities of alternative consequences of different management actions – that is to use in various applications including planning, decision-making, mitigation and adaptation.

e) Challenges

- Commitment and collaboration of all stakeholders, the institutions and organizations related to risk assessment in particular, in the NRA;
- Strengthening the capacity to maintain and sustain the e-Library and to coordinate dissemination of quality risk assessment products to gain trust of different stakeholders.

f) Opportunities

- Reliable INGC capacity of coordination of multi-institutional participation in the NRA
- Baseline information on Mozambique that fully supports the implementation of the

NRA;

- Databases with basic datasets at national level, existence and availability of professionals of risk assessment and the possibility of cooperation with international expertise
- International recognition and national awareness of DRR needs;
- Willingness and strong support from policy and decision-making.

Acronyms and Abbreviations

ARA	Administração Regional de Águas ??
BCPR	Bureau for Crisis Prevention and Recovery
BRAMS	Brazilian developments on the Regional Atmospheric Modelling System ??
CAD	Computer Aided Design
CENACARTA	National Centre of Cartography and Remote Sensing
CHS	Community and Household Surveillance
CCPCCN	Conselho Coordenador de Prevenção e Combate às Calamidades Naturais
CSA	Country Situation Analysis
CVM	Mozambique Red Cross
DEM	Digital Elevation Model
DINA	National Directorate of Agriculture
DINAPOT	National Directorate of Territorial Planning
DINATUR	National Directorate of Tourism
DNA	National Directorate of Water
DNG	National Directorate of Geological Survey
DPCCN	Departamento de Prevenção e Combate às Calamidades Naturais
DRA	Disaster Risk Assessment
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
ECMWF	European Centre for Medium-Range Weather Forecasts
EDM	Mozambique Electricity Company
EIA	Environmental impact assessment
ENM	
FAO	Food and Agriculture Organization of the United Nations
FEWS NET	Famine Early Warning Systems Network
FIVIMS	Food Insecurity and Vulnerability Information Mapping System
GACOR	Reconstruction Coordination Office
GeoSFM	Geospatial Stream Flow Model
GFS	Global Forecast System
GIS	Geographic Information Systems
GPS	Global Positioning System
GRIP	Global Risk identification Programme
GTZ	German Technical Cooperation, now German Agency for International Cooperation
HFA	Hyogo Framework for Action
HRM	
IG	Insufficient Growth
IIAM	Mozambique Institute of Agrarian Research
INAHINA	National Institute of Hydrography and Navigation
INAM	National Institute of Meteorology
INAVE	National Institute of Veterinary
INE	National Institute of Statistics
INGC	National Institute for Disaster Management
LBW	Low Birth-Weight

MIC	Ministry of Industry and Trade
MINAG	Ministry of Agriculture
MIND	Mozambique Integrated Information Network For Decision-Making ??
MINED	
MISAU	
MOPH	Ministry of Public Works and Housing
NDO	National Disaster Observatory
NGO	Non-governmental organization
NRA	National Risk Assessment
NWP	Numerical weather prediction
PGA	Peak ground acceleration
PRSP	Mozambique Poverty Reduction Strategy
PSHA	Probabilistic seismic hazard
SETSAN	Technical Secretariat for Food Security and Nutrition
SIERA	Systematic Inventory and Evaluation of Risk Assessments
SWAS_UM-12	
UCB	Catholic University of Beira
UEM	Eduardo Mondlane University
UK Met-UM	Met Office Unified Model
UN	United Nations
UNDAF	United Nations Development Assistance Framework
UNDP	United Nations Development Programme
UNDRO	Office of United Nations Disaster Relief
UNICEF	United Nations Children's Fund
UNISDR	United Nations International Strategy for Disaster Reduction
UNOCHA	United Nations Office for the Coordination of Humanitarian Affairs
URA	Urban Risk Assessment
USAID	United States Agency for International Development
UTM	Technical University of Mozambique
WFP	World Food Program

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1. Introduction

1.1 Background: GRIP in Mozambique

The geographic position, location and size of Mozambique are especially important as related to disaster risk.

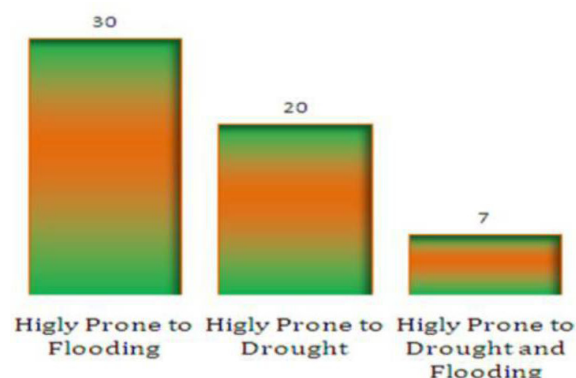
The country is located between 10°27'S and 26°52'S Latitude and 30°51'E and 40°51'E Longitude and has a total area of 799,380 km² (MINED, 1986; ENM, 2009). It stretches in the tropical and subtropical region, over an area of more than 16 degrees in latitude and 10 degrees in longitude, comprising thereafter tropical to subtropical climates, locally modified by effects of the location at the offshore warm-waters of the Mozambique Current and the distance from these waters, as well as by effects of the altitude.

On the one hand, the country, lying at the offshore warm-waters of the Mozambique Current, it is simultaneously situated near the path of tropical cyclones that propagate across the African continent stretching mostly from the north to the south of the country (Mavume et al., 2009). Of the total number of 128 districts of Mozambique, 57 are subjected either to drought, flooding or to both hazards. In overall, 48.2% of the population of Mozambique is vulnerable to one or both hazards (FAO, 2007; Figure 1).

On the other hand, Mozambique stretches at the Eastern African Plate, south the Eastern African Rift. The Rift makes up the boundary between these portions of the African Plate, which are in separation (the Nubian Plate and the Somali Plate), stretching over a length of more than 3,000km (from the Gulf of Aden in the North up to Mozambique in South). The Rift is reasonably developed in the north and the centre of Mozambique, where Lake Niassa and Lake Chirua are found (Mercês e Sousa, 2006). Several geological faults dissect the country, especially in the northern and central parts of the country. This geological setting explains the occurrence of earthquakes across Mozambique (Figure 2 and Annex A).

With this geographic position, location and size, Mozambique is unsurprisingly exposed to impacts of a variety of extreme natural events which, combined with the country's limited capacity to avoid damaging losses from such events, cause high levels of risk. Historical data on disaster events shows that Mozambique suffered 62 major events in 51 years (1957-2008), i.e., 1.2 events per year in average (INGC, 2009a; Figure 3). The largest disaster in Mozambique's recent history was from the cyclone Eline: In the year 2000 this cyclone deluged southern Mozambique and the neighbouring countries with water and led to widespread flooding. The World Bank es-

Figure 1: Number of districts highly prone to hazards



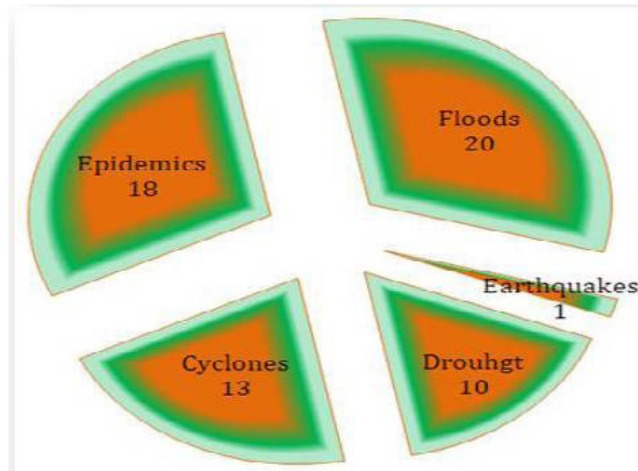
Data by FAO, 2007

Figure 2: The rift system installed during the Miocene through Eastern Africa



Source: Cumbe, 2007; http://pt.wikipedia.org/wiki/Grande_Vale_do_Rift

Figure 3: Numbers of disaster events in Mozambique, 1957-2008



Data by INGC, 2009a

estimated that losses, damage, and reconstruction costs from cyclone Eline were equivalent to 20% of the Mozambique Gross National Product (Cosgrave et al., 2007)

The potential losses from impacts of extreme natural events on sustainable development of Mozambique are now beginning to be systematically studied at the national level, under GRIP. GRIP is an international, multi-stakeholder initiative, coordinated by UNDP that seeks

for improving information on disaster risks and losses and facilitating the incorporation of that information into decision-making. The goal of the GRIP is to reduce hazard-related losses in high-risk countries and to promote sustainable development. It directly aligns with the Hyogo Framework for Action's Priority Area 2: Risk identification, assessment and monitoring.

Mozambique, a signatory of the Hyogo Framework for Action, was selected as one of the

Figure 4: Mozambique is one of the GRIP demonstration countries



Source: INGC et al., 2008

“pilot” countries for GRIP (INGC et al., 2008; Figure 4).

The GRIP activities in Mozambique are running under the Project no. 60256 “Strengthening Local Risk Management and Mainstreaming Disaster Risk Reduction, DRR”, which is part of the United Nations “Delivering as One” Joint Programme for DRR. This Programme, under the Human Capital Pillar of the United Nations Development Assistance Framework (UNDAF) 2007–2009, aims at strengthening national capacities to prepare for, respond to and mitigate the humanitarian impact of emergencies on vulnerable population groups (UN Country Team in Mozambique, 2008). It consists of three components of DRA:

- National Risk Assessment (NRA);
- National Disaster Observatory (NDO); and
- Urban Risk Assessment (URA).

The NRA component includes the establishment of a National Risk Information System and production of a National Risk Atlas, and while the NDO component encompasses the institution of a National Disaster Loss Observatory, the URA pursues the development of an

Earthquake Risk Assessment and the start of Pre-Disaster Shelter Planning for Maputo City.

The United Nations (UN) Joint Programme is aligned with the Mozambique Poverty Reduction Strategy (PRSP), with the ten-year National Master Plan for DRR and highlights the country’s commitment as a signatory to the Hyogo Framework for Action. The critical task of the Programme is the use of the component studies to revise and improve the National DRR Strategy.

1.2 The SIERA project: Rationale

During the 1980s and 1990s, the official policy to deal with disasters in Mozambique was to respond through the Conselho Coordenador de Prevenção e Combate às Calamidades Naturais (CCPCCN) and its executive arm, the Departamento de Prevenção e Combate às Calamidades Naturais (DPCCN) (Figure 5). In those times, the paradigm was one of response, and of viewing disasters as random, unavoidable events.

During the International Decade for Natural Disaster Reduction (1990s), risk management concepts and the notion of vulnerability were formalized. Mozambique transformed the DP-

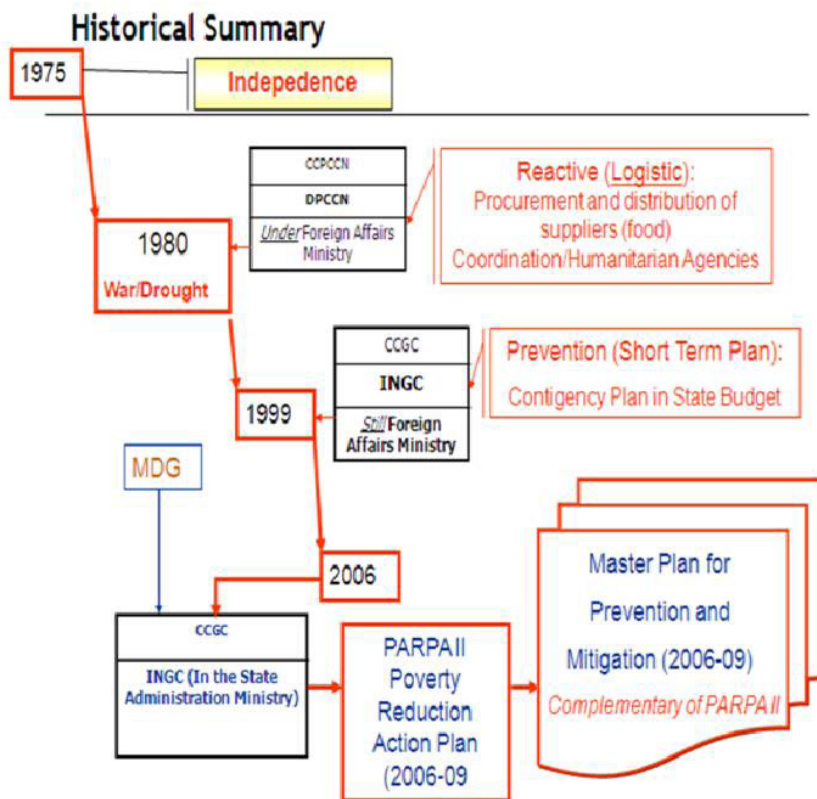
CCN into the National Institute for Disaster Management, INGC, in 1999 (Decree No. 37/99; Wiles et al., 2005). Policies also began to be re-shaped to incorporate risk management, and research institutions and organizations began to focus on Disaster Risk Management (DRM). In 2006, competent authorities endorsed the National Master Plan for Prevention and Mitigation of Natural Calamities.

Effective DRM in Mozambique presupposes knowledge about disaster risk across the country. In the context of the Joint Programme on DRR and Emergency Response, the NRA-component of GRIP in Mozambique necessitates information about the country situation of disaster risk assessments. The country situation analysis addresses issues such as disaster risk conceptualizations, disaster risk reporting and risk information needs and requirements, data availability and quality, professionals of risk assessment.

Risk assessment is something that in Mozambique has been done by several organizations and institutions, and the current situation is not known. This has justified the implementation of a systematic inventory and evaluation of risk assessments. The inventory and evaluation of risk assessments were carried out under the SIERA (Systematic Inventory and Evaluation of Risk Assessments) project. The SIERA project produced information on the status, issues and challenges, strengths and weaknesses of risk assessment in Mozambique. The outcomes of the exercise are valuable for the three components of the UN Joint Programme on DRR and Emergency Response and overall GRIP activities in Mozambique.

The implementation of SIERA is recommended to countries that have not yet implemented a comprehensive risk assessment and intend to do so. Mozambique, as a demonstration country of GRIP, is implementing a comprehensive disaster risk assessment approach including urban and national risk assessments and a national disaster observatory.

Figure 5: Historical summary of DRM in Mozambique



Source: <http://www.preventionweb.net/english/professional/contacts/v.php?id=580>

1.3 Purposes and objectives of the SIERA project

The purpose of the SIERA project was to collect and evaluate information about:

- Conceptual, methodological and institutional frameworks of risk assessments;
- Data sources, data availability and quality for risk assessment;
- Professional expertise and skills in risk assessment; and
- Risk information needs and requirements before, during and after a disaster.

The specific objectives of the project were:

- To produce a catalogue of risk assessment studies and projects, publications and reports on risk assessment, data sources, intermediate and basic data, organizations and institutions related to risk assessment as well as key professional expertise and skills in risk assessment;
- To evaluate studies and projects, publications and reports on risk assessment, data sources organizations and institutions related to risk assessment as well as key professional expertise and skills;
- To identify risk information needs and requirements;
- To document standards and methodologies for risk assessments of relevant hazards;
- To make recommendations for future studies.

1.4 Expected outputs of the project

- A comprehensive report on the status, issues and challenges, strengths and weaknesses of DRA, with an initial proposal for implementing NRA (scope, governance etc);
- An e-Library that provides access to the information identified and analysed (The e-Library is an initiate National Risk Information System);
- Multi-stakeholder involvement in the GRIP activities.

1.5 Organization of the report

This Report – Disaster Risk Assessments in Mozambique: A Comprehensive Analysis of the Country Situation – consists of eight chapters:

- Chapter One introduces the reader to GRIP in Mozambique and the rationale of the SIERA Project that produced it. It also contains the purposes and objectives of the project and expected outputs;
- Chapter Two says how this report is organized;
- Chapter Three presents the methodology and approach followed by the SIERA team to accomplish the stated purposes and objectives;
- Chapter 4 presents the project's key findings. The project findings are related to six aspects of DRA: institutional framework, data and information systems, information needs and requirements, methodologies and tools, national capabilities and practices in DRA;
- Chapter Five addresses issues and challenges in risk assessment in Mozambique. It deals with coordination and governance, knowledge and capacity enhancement, data sharing and integration, standardization of methodologies, and the e-Library and its future development;
- Chapter Six makes recommendations and suggestions;
- Chapter Seven is concerned with the implementation plan for the national risk assessment;
- Chapter Eight encloses the following annexes to the report:
 - Annex A: Epicentres of earthquakes and seismic activity (intensity zones);
 - Annex B: Drought risk and flood risk, by district;
 - Annex C: Flood risk areas and areas of cyclone risk;
 - Annex D: Drought hazard and drought vulnerability maps for probable maximum loss for maize and sorghum;
 - Annex E: Flood hazard and exposure and flood hazard map (flood depth and extent).

2. Methodology and Approach

In order to achieve the mentioned purposes and objectives, the SIERA was implemented following the methodology and tools by UNDP/BCPR/GRIP (2010), whereby, adaptations to the study area's context were made as it was deemed necessary.

The methodology and tools use seven categories (Figure 6) and a range of variables (See UNDP/BCPR/GRIP, 2010).

Figure 7 sketches SIERA process of work. The main steps of the work are:

Identification of organizations and institutions related to risk assessment

Organizations and institutions related to risk assessment are users or carriers of intermediate and basic data, and main holders of published and unpublished documents on risk

assessment. They also affiliate professional expertise and skills in risk assessment.

Inventory & interviews

The inventory covered documents on risk assessment (projects/studies, reports and publications). Informal interviews with individuals who are familiar with the situation of risk assessment in Mozambique were conducted to obtain information about data availability relevant to risk assessment and about institutional capacity (expertise and skills) in the field of risk assessment

Detailed reviews & compilation of data and information

It consisted in reviewing projects/studies, reports and publications, and compilation of data and information collected at organizations and institutions.

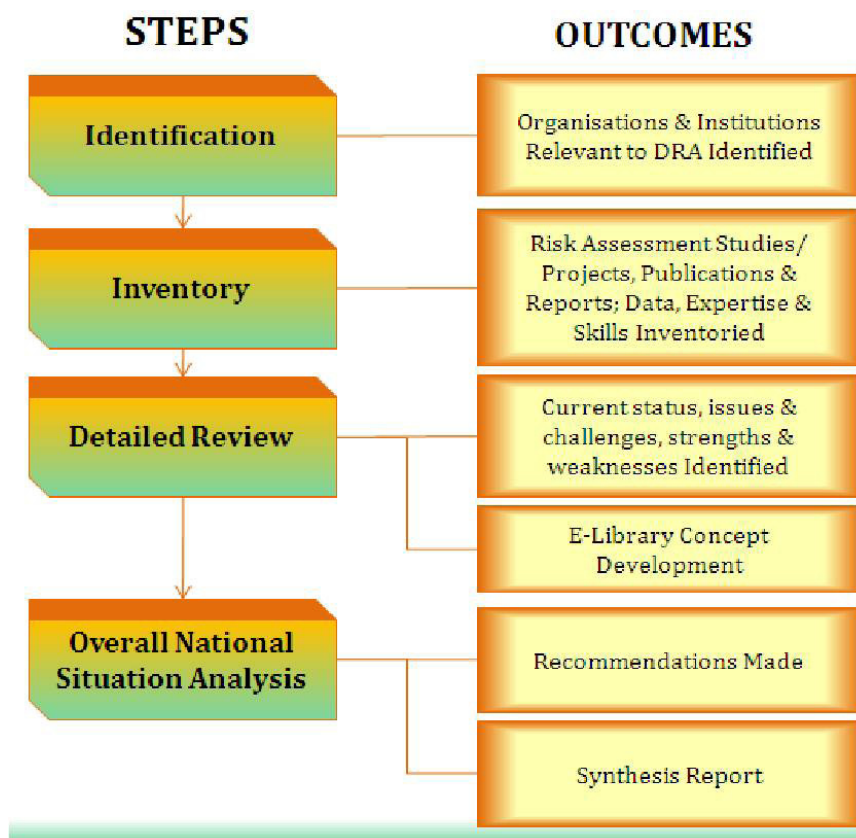
Figure 6: Inventory categories for assessment of a DRA country situation



Source: UNDP/BCPR/GRIP, 2010

Multi-stakeholder involvement
 Multi-stakeholder involvement in the GRIP activities was achieved through a series of interactions (interviews) to collect data, through a multi-stakeholder workshop for reviewing and validating project findings as well as for setting up the NRA process and making recommendations for future studies.

Figure 7: SIERA project implementation steps



Source: UNDP/BCPR/GRIP, 2010

3. Key Findings

3.1 Institutional framework

a) Institutions related to risk assessments

Risk is, according to UNDP/BCPR/GRIP (2010), potential losses associated with a hazard or extreme event, defined in terms of expected probability or frequency and consequences (damages or losses). The UNISDR Terminology on DRR (2009) defines risk as the potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period (UNISDR, 2009a; UNISDR, 2009b). Risk assessment is a step in DRM: it is the determination of quantitative or qualitative value of risk related to a concrete situation and a recognised threat (called hazard).

Institutions related to risk assessment in Mozambique are many. They stem from a paradigm shift: from a practice centred on disaster events (hazards) to efforts directed to risk reduction. The Office of United Nations Disaster Relief (UNDRO) Coordinator maintains a database on organizations that act in disaster management (disaster prevention, disaster preparedness) or in areas of coping with disasters (rescue services, humanitarian aid (UNDRO Coordinator, 1990). The database comprises non-governmental organizations (NGOs) based in Mozambique, working in various sectors (e.g., drought, floods, cyclones, famine and hunger), and geographic scales (provincial, district and community).

On the other side, the Regional Office for Southern and Eastern Africa of United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) has developed a database on organizations working in disaster management and in coping with disasters in Mozambique (<http://ochaonline.un.org/rosea/ContactDirectory/tabid/6331/language/en-US/Default.aspx>).

This study sought identifying institutions related to assessments of risk involving hazards relevant for Mozambique (droughts, floods, cyclones, landslides and earthquakes). For a drought- and flood-risk assessment at the national scale, Jayanthi and Bachu (2009) highlighted four institutions playing a key role including as data providers, namely, the National Directorate of Water (DNA), the Mozambique Institute of Agrarian Research (IIAM), the National Institute of Meteorology (INAM) and the National Institute of Statistics (INE).

The SIERA Project identified a number of institutions, distinguished as key institutions for conducting an NRA, based on whether the institutions are providers/producers of data relevant for assessment of risk associated with any of the relevant hazards for Mozambique (Table 1).

b) Risk assessment projects/studies

Risk assessment is an integral part of DRM. It is a management issue and has generally the purpose and objective to evaluate the probabilities of alternative consequences (potential losses) of different management actions within the geographic area that is subjected to extreme natural events (hazards). The purpose and objective are probabilistic statements about alternative hypothesis (states of nature). There are different methods to achieve this. Projects/studies under the umbrella of risk assessment commitment in Mozambique are many. A sample of twenty-five projects/studies was evaluated to understand the way specific objectives and scope are formulated, to learn about methodological procedures applied and data used as well as applicability, integratability and replicability of the outcomes.

The evaluations suggested that, in terms of objectives, risk assessment projects/studies generally aim rather at meeting emergency preparedness and relief needs. The FEWS NET

Table 1: Key institutions related to risk assessment in Mozambique

Institution	Key activities and mission
National Centre of Cartography and Remote Sensing (CEN-ACARTA)	<ul style="list-style-type: none"> - Institution specialized in the treatment of geographic information of Mozambique that is involved in the whole process from data acquisition (aerial photography, satellite imaging, Global Positioning System (GPS)) prior to analysis and mapping complex applications development. - Responsible for the direction, coordination and implementation of activities of geo-mapping and remote sensing at the national level, dissemination of remote sensing techniques in the country, the acquisition, handling, processing and distribution of images and geo-mapping data obtained via satellite - Reference topographic data
DNA	<ul style="list-style-type: none"> - Responsible for the country's water resources management, carries out surface water quality and groundwater monitoring. - Coordinates with regional institutions in the management of the international rivers - Operates own flood-forecasting model. Implements hydrology modelling and flood-risk assessments - Hydrological reference data
National Directorate of Geological Survey (DNG)	<ul style="list-style-type: none"> - It is the National Geological Survey of Mozambique - Responsible for all the research work in the field of geological studies (main activities: Conducting geological and mining surveys; Offering research projects to scholars and students; Conserving geological and mineralogical resources; Publishing journals and research papers related to geological studies) - Promotes studies in geological sciences and develops the geological base of the country's Official seismic data
Famine Early Warning Systems Network (FEWS NET) Mozambique	<ul style="list-style-type: none"> - An information system of the United States Agency for International Development (USAID) in Mozambique - Identifies problems in the food supply system that potentially lead to famine or other food insecurity conditions; to provide timely and rigorous early warning and vulnerability information on emerging and evolving food security issues - Collects, analyzes, and distributes national and sub-national information to decision-makers about potential or current famine or other climate hazard-, or socio-economic-related situations, allowing them to authorize timely measures to prevent food insecurity conditions; - Monitors and analyzes data and information in terms of its impacts on livelihoods and markets to identify potential threats to food security (http://www.fews.net/ml/en/info/Pages/default.aspx?l=en) - Reference data on vulnerability to food insecurity/famine
IIAM	<ul style="list-style-type: none"> - Ensures that technologies, land management practices and information on land resources are useful and accessible to farmers - Supports research collaborating with the government and interested organizations (including higher education institutions) in delivering results to address specific problems affecting the agricultural sector - Hosts the reference database on soil resources (http://www.iiam.gov.mz/index.php?option=com_content&task=view&id=136&Itemid=186)
INAM	<ul style="list-style-type: none"> - Coordinates the meteorological activity in all areas, chiefly in applied meteorology, with particular emphasis on climatology, agro-meteorology, aerospace, marine and air quality monitoring and encourages the exploitation of resources of climatic origin - Issues an opinion in the field of meteorology, international relations, and with regard to cooperation agreements and international conventions - Monitors weather events using regional and global numerical weather prediction (NWP) models such as BRAMS, HRM, SWAS_UM-12, the European Centre for Medium-Range Weather Forecasts (ECMWF), the Met Office Unified Model (UK Met-UM), and the Global Forecast System GFS. - Collects and exchanges meteorological data (drought, floods, and windstorms including cyclones) through GTS and its weather radars network with South Africa Weather Service (SAWS) radars - Reference meteorological data (http://www.inam.gov.mz)
National Institute of Hydrography and Navigation (INAHINA)	<ul style="list-style-type: none"> - Concerns navigation aid as a means of transport - Collects regularly, processes and analyses systematically data on tides, sea currents and bathymetric data for various applications - Together with data from other institutions, these data are required for the implementation of risk assessments, particularly to climate change.
INE	<ul style="list-style-type: none"> - Possesses the National Archives of Micro Data – a catalogue of surveys produced by INE but will also contain surveys produced by institutions belonging to the National Statistical System - Develops the National Data Archive with the purpose to promote the effective use of data from surveys and censuses and to encourage their use for analysis and research. - The National Data Archive accomplishes these objectives based on legislation on the National Statistical System and the United Nations Statistical principles according to which micro data cannot be disclosed due to confidentiality or other reasons.

INGC	<ul style="list-style-type: none"> - The disaster relief agency of Mozambique, geared toward coordination of all disaster management efforts (disaster prevention, disaster preparedness versus search/rescue, humanitarian aid) – Decree No. 37/99 - Responsible for conducting mitigation efforts (such as collection and analysis of data), undertaking preparedness measures (e.g. awareness campaigns), and coordinating disaster response (including distribution of food, tents, and other supplies) - Since June 2008, also responsible, through the Reconstruction Coordination Office (GACOR), for the resettlement of persons displaced by natural disasters - Prepares for and responds to both natural disasters (droughts, floods, and tropical cyclones) and man-made disasters (UNDP, 2006; UNICEF, 2007)
Technical Secretariat for Food Security and Nutrition (SETSAN)	<ul style="list-style-type: none"> - A multi-sectoral body across several ministries, coordinated by the Ministry of Agriculture (MINAG) and receives support from the United Nations Children's Fund (UNICEF), the Food and Agriculture Organization of the United Nations (FAO) and FEWS NET (www.setsan.org.mz) - Conducts regularly Food Security and Nutrition Assessments and promotes food and nutrition security, acting as facilitator through initiatives with the aim to improve availability and quality information on vulnerability and food and nutrition insecurity, for informed decision-making (Abdula and Taela, 2005) - Hosts Community and Household Surveillance (CHS) data and food insecurity data
Mozambique Red Cross (CVM)	<ul style="list-style-type: none"> - Assistance to vulnerable groups in collaboration with Government agencies (MINAG, MISAU and INGC), vulnerability reduction and disaster prevention - Implements, but prior to disaster, plans activities and focuses on promoting access to water and food; in post-disaster phases, supports the provision of health care - Empowers communities (program of Disaster Preparedness) with the abilities needed to reduce the negative effects of disasters and be able to better cope with the consequences of disasters when they occur (Abdula and Taela, 2005)
UEM; Catholic University of Beira (UCB); Technical University of Mozambique (UTM)	<ul style="list-style-type: none"> - Higher Education and Research (graduate academic programs that contains subjects related to DRM elements) - Offer Tailored courses (Remote sensing and Geographic Information Systems (GIS) applications in DRM) - Research initiatives in collaboration with other institutions related to risk assessment and risk management - Collaborative activities with key institutions related to risk assessments
World Food Program (WFP)	<ul style="list-style-type: none"> - With the mission to alleviate global hunger and poverty - Aims to reduce the vulnerability of people and communities suffering from food insecurity and to enable people to improve their livelihoods and resist future shocks, through: Food-for-Education, Livelihood protection and promotion, Social assistance to vulnerable groups, HIV/AIDS care and treatment, Nutrition rehabilitation for malnourished children, Assistance to refugees to achieve self-reliance and Post-disaster relief. - Also involved in the management of disasters through emergency operations and development, using food aid. - Collaborates with other national and international organizations in areas affected by drought (http://mz.one.un.org/eng/How-we-work/UN-Agencies/WFP)

MIND project, German Technical Cooperation (GTZ) Búzi project and the Study on Measuring the Economic Impacts and Associated Risks of droughts and floods can be considered key studies because of the impact of the outcomes on decision-making and on local communities.

The concept of risk in vogue differs clearly from that of the UNISDR Terminology on DRR (2009). In some cases, the approach to assess risk has been based on the direct GIS-assisted combination of the geographic coverage of a hazard and the exposed element.

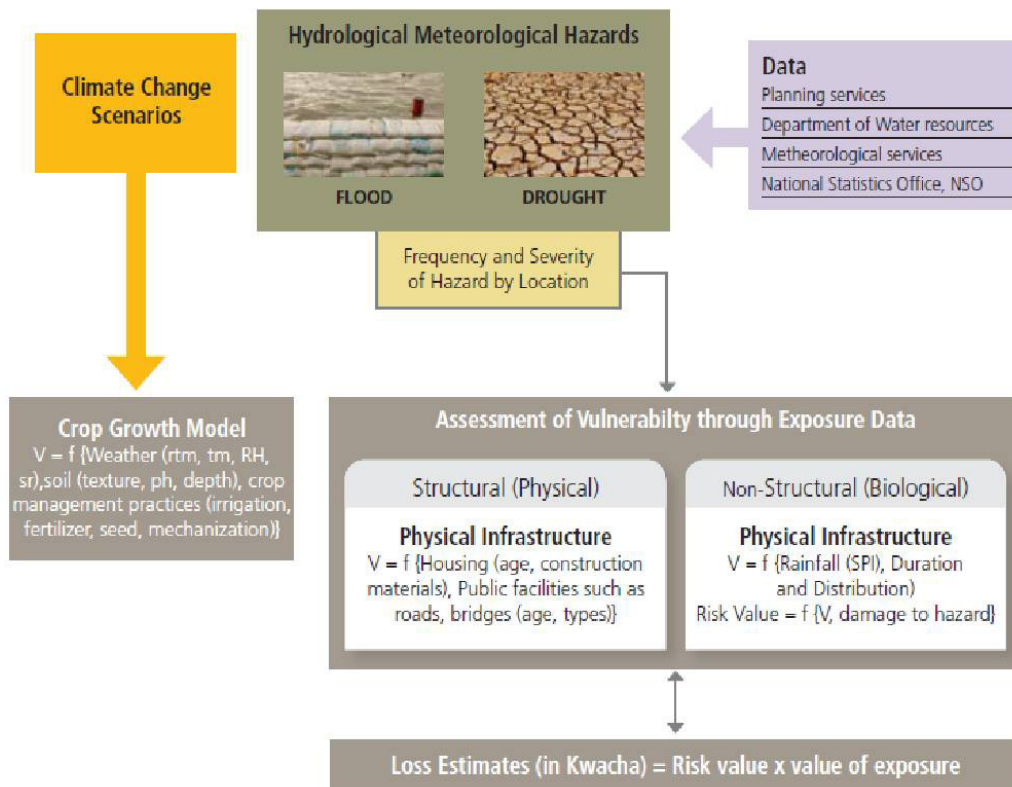
In other cases, risk is primarily defined and also estimated in terms of probability of exceeding specific levels of direct losses – in physical and monetary terms (Dankova et al., 2009). The key components in the probabilistic risk analysis and assessment are hazard, exposure, vulnerability, and loss modules. The perspectives combine physical science with geographical and socio-economic elements

that are relevant to support preparedness and relief, to recommend and carry out disaster risk reduction plans and to devise adaptation strategies (Dankova et al., 2009).

The flood risk model adopts a similar approach to the drought model in that hazard is assessed using estimates of the probability of occurrence for floods of different severities (Dankova et al., 2009). The probabilistic risk model is based on runoff, which means that observed flood discharges are used to identify floods and to estimate their probability of occurrence. Stochastically generated discharges are then routed through a Digital Elevation Model (DEM) of the affected floodplain to determine flood extents and depths at a detailed 90-meter resolution (Dankova et al., 2009; Figure 8).

c) Risk assessment products
The products of risk assessment include reports, publications and maps. These products do

Figure 8: Drought and flood risk modelling framework



Source: Dankova et al., 2009

not always come out with raw data used, as it would be desired, according to assessment methodology by UNDP/BCPR/GRIP (2010).

Of the total documents evaluated, the Atlas for the Preparedness and Response to Disaster for the Limpopo basin by INGC et al. (2003) is an exception. The Geospatial Stream Flow Model (GeoSFM), which was used in hydrological analysis and modelling, is also available as an extension of the ArcView GIS.

The database of the Atlas is publicly accessible. GIS-experienced users can use the same methodological steps with actual data on the study area (the Limpopo basin) and produce new maps (INGC et al., 2003; Asante et al., 2007). The study is easily replicable in other areas, as it is likely to happen for the Zambezi basin.

Cartographic products of risk assessment in Mozambique encompass hazard maps, which, in some cases are erroneously designated “risk maps”. These are of great significance for

emergency preparedness and relief tasks (as hazard maps).

Mozambique has made significant progress in hazard mapping. The technical capacity to use GIS tools including a combination of data layers to produce new information is widespread.

3.2 Data and information systems

3.2.1 Basic data and base maps

Institutions with mandate produce basic data and base maps of reference, following established standards and conventions. These institutions and organizations regularly collect raw data in the field, process and validate them, according to specific standards, cooperation agreements and international conventions.

Trained personnel maintain the databases. Data can be acquired in accordance with competent authorities (i.e., in agreement with the government).

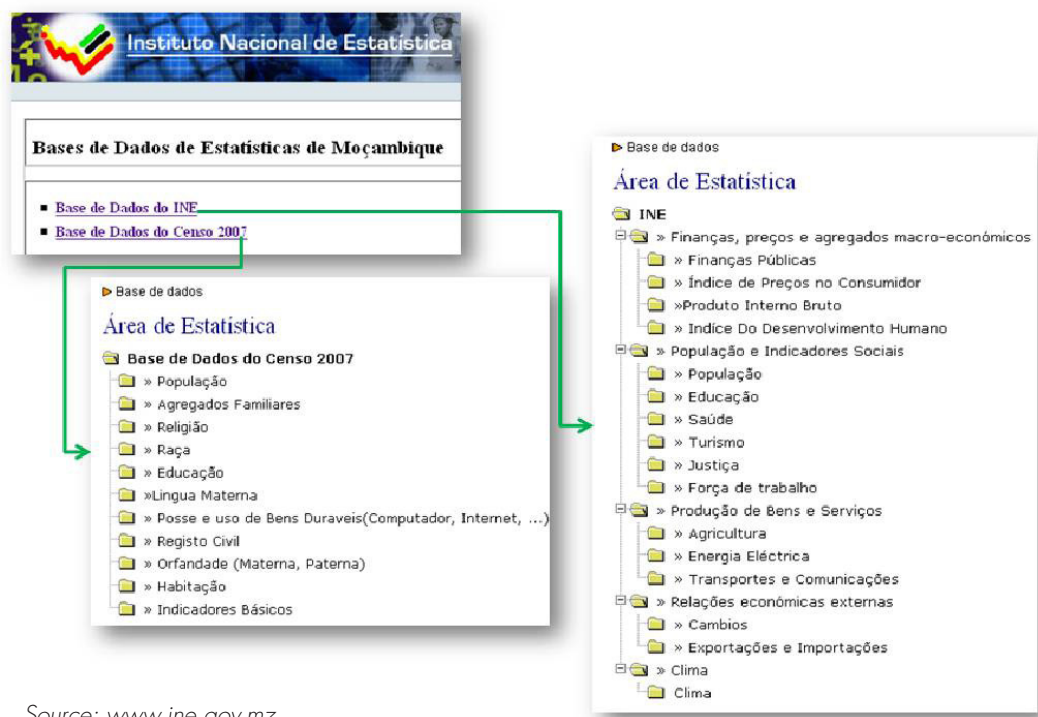
Basic data and base maps are available in different formats: shape-files, scanned (maps, tables), printed and/or analogue format. Spatial data are geo-referenced.

In most institutions, the building of databases is in its infancy. INE is building the National Archives of Micro Data. The National Archives of Micro Data is a catalogue of survey data produced by INE which also will contain data produced by institutions of the National Statistical System (www.ine.gov.mz; Figure 9).

Table 2 presents the basic data and base maps relevant for risk assessment, as available at CENACARTA.

On the other hand, Table 3 shows comprehensive information on the systematic and thematic cartography (base maps) and satellite images in Mozambique, at the CENACARTA.

Figure 9: Database statistics of Mozambique



Source: www.ine.gov.mz

Table 2: Basic data and base maps

Categories		Basic data and base maps	Who has the basic data and base maps?	
Hazard	Earthquake	<ul style="list-style-type: none"> - Topographic data - Geological map (1/1,000,000) - Geological maps at larger scale (1/250,000 and 1/50,000) - Seismic data (earthquake epicentres, geological faults) 	<ul style="list-style-type: none"> - CENACARTA - DNG 	
	Drought	<ul style="list-style-type: none"> - Soil resources database - Hydrological database - Rainfall amount, distribution, intensity 	<ul style="list-style-type: none"> - DNA - INAM - IIAM 	
	Floods	<ul style="list-style-type: none"> - Evapo-transpiration rate - Length of growing periods - Flooded area (extent), flood depth, flood duration 		
	Cyclones	<ul style="list-style-type: none"> - Wind direction and speed - Frequency and intensity of wind storms 		
Characteristics of the exposed elements	Population	<ul style="list-style-type: none"> - Population data (age, sex) - Occupation (income) - Education level 	<ul style="list-style-type: none"> - INE 	
	Human settlements	<ul style="list-style-type: none"> - Villages and location - Buildings (conventional or non-conventional) and location, in terms of residential, commercial, industrial, and public, high-rise building etc.; 	<ul style="list-style-type: none"> - National Directorate of Territorial Planning (DINAPOT) - Ministry of Public Works and Housing (MOPH) - Ministry of Industry and Trade (MIC) 	
	Livelihoods	Land-based livelihoods	<ul style="list-style-type: none"> - Farming (rain-fed and irrigated), in terms of area of farmland and location - Crop types - Livestock rearing (traditional and modern systems) - Cattle type - Other (fishing, etc) 	<ul style="list-style-type: none"> - INE - National Institute of Veterinary (INAVE) - National Directorate of Livestock - National Directorate of Agriculture (DINA) - National Directorate of Fisheries Economics - National Directorate of Tourism (DINATUR)
		Other livelihoods	<ul style="list-style-type: none"> - Industries (the number, location) - Community-based tourism (in terms of location) - Production, processing and marketing of various local products (in terms of location) 	
	Social infrastructure	<ul style="list-style-type: none"> - Healthcare centres (hospitals, clinics, basic health unit, etc.) – in terms of total number, capacity or other types of classes) - Educational institutions (university, college, school, etc.) - Commerce and Finance (warehouses, stockpiles, banks) - Police & fire stations 	<ul style="list-style-type: none"> - Department of Information of the Ministry of Health - INE 	
	Infrastructure	<ul style="list-style-type: none"> - Infrastructures, i.e. roads, bridges, airports, ports, railways, dams, telecommunication network, power supply, etc. (in a kind of classification or total number) 	<ul style="list-style-type: none"> - National Directorate of Roads and Bridges - National Directorate of infrastructures (Port, railway and road infrastructure; infrastructure sea, river and lake; airport infrastructure; infrastructure postcards; infrastructure for telecommunications; meteorological infrastructure, and infrastructure drivers) - Mozambique Electricity Company (EDM) 	

Table 3: Systematic and thematic cartography (base maps), satellite images (national coverage, otherwise as indicated), available at CENACARTA

Systematic cartography	Scale	Type
Product name		
Topographic map	1/25,000	Off-set & Vector
Topographic map Land use/land cover map	1/50,000	Off-set & Vector
Topographic map	1/100,000	Off-set & Vector
Topographic map Land use/land cover map	1/250,000	Off-set & Vector
Topographic map	1/500,000; 1/1,000,000	Off-set & Vector
Cartography of 5 Cities: (Maputo, Beira, Quelimane, Nampula, and Pemba) and Mozambique Island	1/5,000; 1/10,000; 1/25,000	-
Landslides characterization caused by rainfall in Ensenada, Baja California, Mexico, from landslides ravine physical model.	Ensenada	UAB.C.
Thematic cartography	Scale	Size
Administrative Division Map	1/2,000,000	A0
	1/1,200,000	>A0
	1/1,000,000	Zones
	1/750,000	>A0
	1/750,000 & 1/500,000	A0
Cartography of 5 Cities: (Maputo, Beira, Quelimane, Nampula, and Pemba) and Mozambique Island	1/5,000; 1/10,000	A0
	1/25,000	A1
General map	1/5,000,000	-
	1/8,000,000	A4
Map of provinces and districts	-	A1; A4
Geomorphologic map	1/5,000,000	-
Vegetation map	-	A4
World map	1/34,000,000	-
Africa map	1/15,000,000	-
Map of the structure of Maputo City	Various	A0
Municipal districts		A1
Map of the structure of other towns		A1
Map of the structure of other towns	1/6,000	
Ortho-photo plan	1/2,000; 1/5,000	-
Satellite images	Size	
Product name		
TM 5,7 27.5x27.5km	Sheet 1/50,000	
TM 5,7 110x110km	Sheet 1/250,000	
TM 5,7 185x185km	Complete N6	
SPOT P, 60x60km	1 Channel, N2B	
SPOT XS, 60x60km	3 Channels, N2B	
Others (very high resolution)	Contact the Diffusion Sector	

3.2.2— Intermediate data

Table 4 presents intermediate data and names of institutions, which have those data. Not all attribute fields of the data sets include all ideal information required for national risk assessment. The spatial and temporal resolutions of the data vary. Issues of accuracy and precision become more important with increasing spatial resolution.

There is regular updating of datasets, e.g., population and agro-livestock censuses. Projections are used.

The data production and compilation is checked before is made available to the public. Institutions provide validated basic and intermediate data.

Table 4: Intermediate data

Category	Data sets	Who has the datasets listed
Hazard	- Hazard zoning maps - Probabilistic seismic hazard (PSHA) maps - Peak ground acceleration (PGA) map	- DNG
	- Tsunami inundation maps - Flood inundation maps - Cyclone intensity maps	- DNA - INAM
Exposure	- Population, in terms of age, sex, income, ethnicity (e.g. caste, religion, language etc.), occupation, education, and settlement type (rural or urban);	- INE
	- Buildings, in terms of residential, commercial, industrial, and public, high-rise building etc.;	- MOPH - MIC
	- Livelihoods, i.e. livestock, crops, cattle, industries (the number, location and extent of exposure);	- INE - INAVE - National Directorate of Livestock - DINA
	- Critical facilities, i.e. healthcare (hospitals, clinics, basic health unit, etc.), educational institutions (university, college, school, etc.), warehouses, stockpiles, banks, police stations, fire stations, etc.;	- Department of Information of the Ministry of Health - INE
Exposure	- Infrastructures, i.e. roads, bridges, airports, ports, railways, dams, telecommunication network, power supply, etc.	- National Directorate of Roads and Bridges - National Directorate of Infrastructures (Port, railway and road infrastructure; infrastructure sea, river and lake; airport infrastructure; infrastructure postcards; infrastructure for telecommunications; meteorological infrastructure, and infrastructure drivers) - EDM
Vulnerability	- Vulnerable communities (food insecurity)	- SETSAN - FEWS NET

3.2.3 Information products

The number of reports and publications assessed is 119 in total (Figure 10).

The three major hazards in Mozambique are droughts, floods and cyclones as also confirmed by the highest number of disaster event reports and publications (39 reports and publications). Reports and publications on multiple hazards suggest that there have been attempts to and interest in gaining a comprehensive understanding of the compound impact areas of the various hazards: 14 reports and publications dealing with more than two hazards.

Extensive flood hazards, intense cyclones and windstorms as well as long and severe droughts mobilize national and international attention. According to INGC et al. (2003), big floods are terrifying because they come so quickly and with massive force, sparing nothing in their path. The death toll can be enormous. Floods are rapid onset hazards and perhaps the most difficult of all hazards to assess in terms of impact. The floods which occurred in 2000 required international assistance, but droughts are historically more frequent and impact more people than floods. As a slow onset hazard that often extends for more than an entire year, droughts also have the potential to

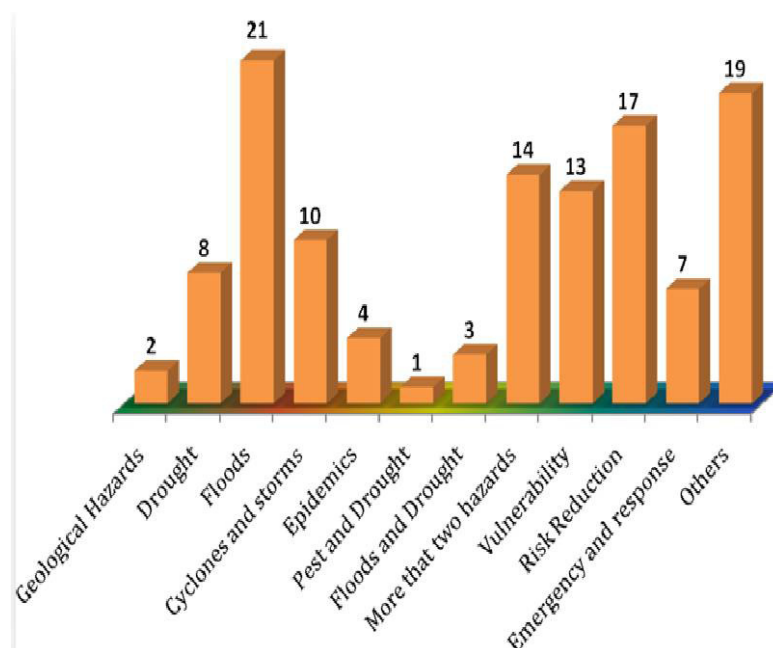
cause longer-term economic disruption than a rapid onset hazard (INGC et al., 2003).

Reports and publications on floods in southern (Limpopo river basin) and central Mozambique (Búzi, Púngoe and in a little extent, Zambezi river basin) are many. The “Mozambique Flood Risk Analysis Project” covered systematically eight river basins, namely Incomáti, Licungo, Limpopo, Maputo, Púngoe, Save, Umbelúzi and Zambezi, and produced an equal number of reports.

The number of reports and publications on drought events (impacts and risk), like those on geological hazards, is small.

Reports and publications under “others” include policy documents (situation reports to decision/policy-making, governmental resolutions, institutional situation reports, etc.), while documents under “emergency and response” are mainly post-disaster assessment missions reports. Reports and publications come with maps (Annexes A-E). These maps are produced using inclusively GIS and Remote Sensing Technologies.

Figure 10: Inventoried reports and publications



3.3 Information needs and requirements

Strictly speaking, there are no such things as natural disasters (UNISDR, 2002; Kelman, 2010). The UNISDR's (2007) terminology of basic disaster risk reduction terms does not include "natural disaster" (Kelman, 2010).

The focus on human actions, behaviour, decisions, and values leading to vulnerabilities which cause disasters, with the potential implication that disasters are never "natural", is now embedded in the disaster literature. The argument is that natural disasters do not exist because all disasters require human input (Kelman, 2010).

Nature sometimes provides input through a normal and necessary environmental event, such as a flood or volcanic eruption, but human decisions have put people and property in harm's way without adequate measures to deal with the environment. The conclusion is that those human decisions are the root causes

of disasters, not the environmental phenomena (Kelman, 2010).

Implementation of disaster risk assessment in the spatial location of production, housing and social infrastructure is not mandatory in Mozambique.

Nevertheless, the implementation of resettlement programmes coordinated by INGC throughout the country (on behalf of the Decree n° 29 of July 2008) has, as prerequisite, anticipated assessment of disaster risk in the projected resettlement area.

The Law of Spatial Planning (Law no. 19/2007 of 18 of July) and the Planning Policy (Resolution no. 18/2007 of 30 of May) do not mention explicitly disaster risk assessment as a requirement.

Risk assessment is done implicitly within the design, conception and implementation of major undertakings. Thus disaster risk has been

Table 5: Information needs for cyclones, floods and drought risk assessments

Cyclone, flood and drought risk assessments (INGC et al., 2003)	Extent of geographic area affected and number of people in that area
	Number of people who require rescue (*)
	Infrastructure and communications systems damage (*)
	Housing damage (*)
	Crop damage
	Temporary shelter needs (*)
	Water/sanitation needs
	Food needs
	Medical/health needs
	Material assistance needed
	Logistics information for transport and communications (INGC et al., 2003)
Food security assessment	Hazards: drought, floods, cyclones, prevalence of diseases in plants, animals, humans, landslide and earthquakes
	Underlying factors: Climate, poverty and fragile livelihoods, food reserves, markets, limited options, chronic malnutrition, limited delivery of services for health, water, and sanitation, increase in the effective dependence ratio and government policies
	Key population groups: Marginal households (very poor), low income labourers (poor households), households with lower dietary diversity (very inadequate diet), poor households in the peri-urban areas
Sanitary and nutritional vigilance	Hazards: Drought, floods, cyclones, prevalence of diseases in plants, animals, and humans; key population groups: children in disaster-prone areas; Variable of control: Insufficient Growth (IG); Low Birth-Weight (LBW);

Note: (*) Information that is required only in a sudden-onset event like a flood or cyclone

Source: INGC et al., 2003 and www.fews.net/mozambique

treated marginally, which does not permit understanding relevant alternatives of the consequences (potential losses) of different management actions for a given undertaking.

On the contrary, environmental impact assessment (EIA) is legislated:

- Law No. 20/97 of 1 October. Approves the Environment Act;
- Regulation on the Process of Environmental Impact Assessment, approved by Decree no. 45/2004, of September 29;
- Ministerial Decree No. 198/2005 of 28 September, concerning the sectoral coordination for effective implementation of the Regulation on the process of Environmental Impact Assessment;
- Order of the Minister for Coordination of Environmental Action of September 28, 2005, concerning the issuance of environmental permits.

Information needs and requirements vary significantly, including with the type of hazard, characteristics of exposure and of the exposed element (or exposure unit) and the end-users.

Information needs for generating information about cyclone, flood and drought risk to be taken into account in development planning are suggested in table 5.

3.4 Methodologies and tools

GIS and Geographic Positioning Systems (GPS) as well as Optical Remote Sensing have become popular tools in Mozambique.

The application of Microwave Remote Sensing data is incipient. Image Processing Systems in use include WINDISP and ArcGIS, the latter, being also a GIS package with the widest range of users. The tools are part of in-country higher education programs.

For cyclone monitoring and for monitoring varied atmospheric conditions, the Tropical Cyclone Warning System for Mozambique and the Atmospheric model BRAMS respectively are in use, while GeoSFM is applied for flood early warning and hydrological monitoring of

river basins. The systems are operational at INAM, DNA, ARA's and FEWS NET Mozambique.

SETSAN implements the Food Insecurity Warning System, for early warning of food insecurity onset and evolution. The System is based on a locally adapted version of the Food Insecurity and Vulnerability Information Mapping System (FIVIMS) model. It relies on the Food Security Framework that relates the key factors, entities, and relationships that affect food insecurity including population groups affected by food insecurity, underlying factors affecting food security and natural and other hazards (www.fews.net/mozambique; www.setsan.org.mz).

The Warning System and Prevention of epidemics is a Sanitary and Nutritional Vigilance System based on the Information System for Health which relies on the Subsystem of Epidemiological Monitoring and the occurrence of determinants for epidemics as well as the occurrence of epidemics in neighbouring countries.

The Ministry of Health, in accordance with the epidemiological surveillance activities under the Contingency Plan, monitors the nutritional situation in the affected districts.

Over the past 100 years, Mozambique has not had any precedence of a large-scale earthquake hazard like the 2006 earthquake (Manuel, 2006). Since then, Mozambique considers earthquakes as one of the natural hazards that may wreck havoc in the country.

Figure 11 shows flood forecasting using flood scenario maps, an approach presented by INGC et al. (2003).

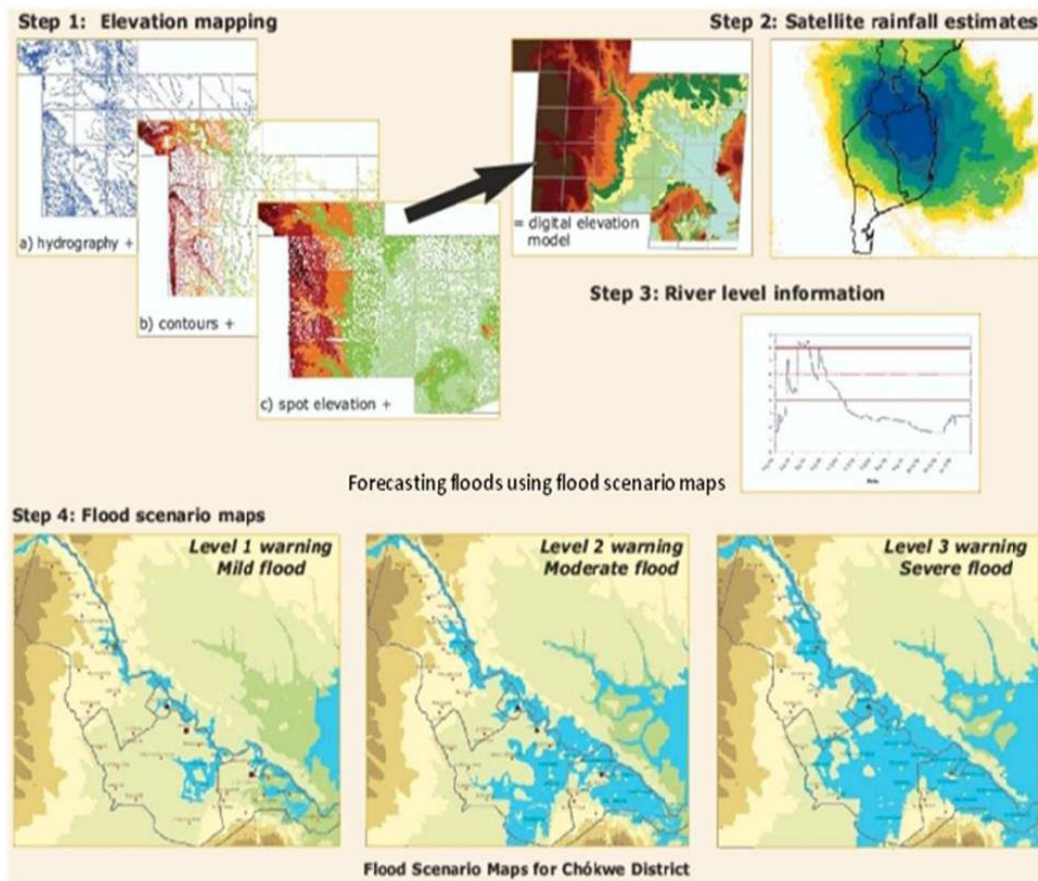
3.5 National capabilities

a) Key professionals and expertise

Figure 12 shows the numbers of people who are active in the area of risk assessment.

Risk assessment is a multi-disciplinary practice that involves many people specialized in different fields. An NRA team would be ideally

Figure 11: Forecasting floods using flood scenario maps



Source: INGC et al., 2003

composed of the following specialists (UNDP/BCPR/GRIP, 2010):

- Disaster risk management specialist;
- Geological hazard (risk) specialists;
- Hydro-meteorological hazard (risk) specialists;
- Structural engineers;
- Socio-economic experts;
- GIS specialists (UNDP/BCPR/GRIP, 2010).

Mozambique's situation in terms of expertise and skills in risk assessments is such that professionals of risk assessment are few. The various fields of expertise relevant for the NRA are differently covered. The situation is that existing expertise and skills (education, training, and experience in the specific sector, field or subject relevant to the NRA assignment) is adequate for a successful implementation of the NRA (Figure 13).

Professionals and experts in risk assessment have experience in the country (knowledge of culture, administrative system, government or-

ganization) and in languages (knowledge of a local language and English).

Mapping hazard (e.g. floods, cyclones and drought) has become an easy exercise that is carried out through the application of Remote Sensing and use of Geographic Information System Technologies.

Although Mozambique has local capability for an NRA, it is important that the NRA Program obtains benefits from the experience of other regions of the world, through collaboration with other experts.

b) Organizations and institutions
Academic institutions play a major role in capacity building. Public institutions still rely on hiring academic staff.

c) Data, tools and methodologies
There are several datasets and no single institution produces all the kinds of data needed in a risk assessment. The NRA Program will indubitably require the collaboration of many

Figure 12: Qualifications of inventoried professionals

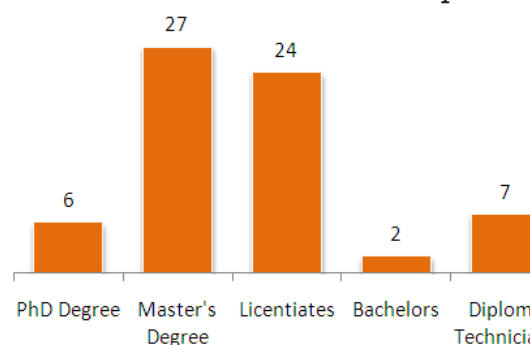
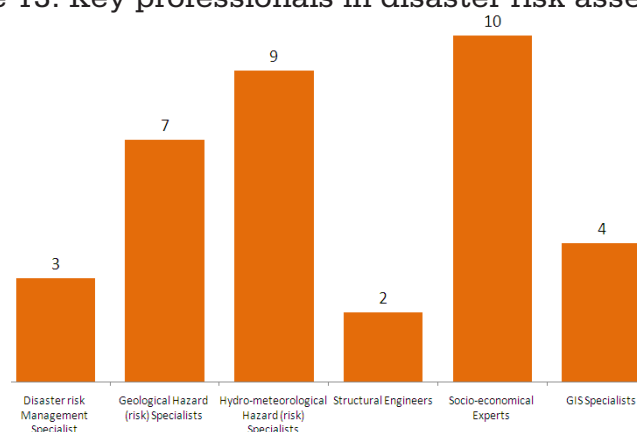


Figure 13: Key professionals in disaster risk assessment



institutions in data provision and in many other aspects.

Although there is no standardized risk assessment framework, there are tools used for timely warning and for monitoring the situation of human and environmental systems, permitting preparedness and response:

- Cyclone and Flood Early Warning Systems;
- FEWS NET Mozambique;
- Food Insecurity Warning System, based on a locally-adapted version of the FIVIMS model;
- Sanitary and Nutritional Vigilance System;
- Seismic risk monitoring (Manuel, 2006; www.fews.net/mozambique; www.inam.gov.mz; www.setsan.org.mz).

3.6 Relevant practices in DRA

Disaster risk assessment has been addressed as institutional issue. Institutions do assessment of risk for a specific hazard, normally, falling within the ambit of the institution's mission.

The mobility of professionals of risk assessment across institutions is notable.

Risk assessment has been dealt with as a one-time project and single hazard-oriented.

There are numerous publications and reports on risk, accessibility of which is not always easy. In consequence, there are situations of people working on DRA without knowing the work of others on the same field or concern. Information and experience sharing is limited or non-existent, leading to unnecessary overlap, repeating efforts and little progress.

4. Issues and Challenges

4.1 Coordination and governance

The 2005 Hyogo Framework for Action identifies legislation as a critical component of DRR, and calls upon States to “adopt, or modify where necessary, legislation to support disaster risk reduction, including regulations and mechanisms that encourage compliance to codes and that promote incentives for understanding risk reduction and mitigation activities” (HFA, 2005). The legislative framework for DRR is growing in Mozambique. Main documents are the following (INGC, 2008):

- The Decree n° 495 of October 1973 which approves the Legislation of Water Quality Standards;
- The Water Policy approved in August 1995;
- The Environmental Law approved in October 1997;
- The Decree n° 32 of August 2003, approving the Tools for Environmental Audit;
- The Decree n° 8 of February 2003 which approves the Standards for Management of Medical Wastes;
- The Decree n° 45 of September 2004, approving the Policy of Environmental Impact Assessment;
- The Decree n° 18 of June 2004, endorsing the Environmental Standards for Industrial Discharges;
- The Master Plan For Disaster Prevention and Mitigation approved in May 2006;
- The Poverty Reduction Strategy Plan approved in May 2006; and
- The Decree n° 29 of July 2008 introducing more competences to INGC’s Organic Status established by the Decree n° 57 approved in 2007 to lead and coordinate the implementation of the population resettlement programme (INGC, 2008).

The coordinating role of the INGC in all matters of disaster (risk) management, on behalf

of its statute, is definite. The paradigm shift in dealing with disaster, from a position where all efforts were directed to the disaster events to a position that risk reduction is more important, is under local conditions, a big challenge: legal documents and regulatory agendas need to be updated. This is of great difficulty for transversal issues where several institutions have to collaborate and coordinate efforts.

In the perspective of the NRA, this position of coordination of the INGC could be reinforced through clear and specific memoranda of understanding that support institutional commitments to make data and information accessible and deliver collaboration with all Working Groups of the NRA.

The NRA needs to be appropriated by all the stakeholders (including policy and decision-makers). Therefore also mobilizing and sensitizing key institutions related to risk is a flexible approach to raise awareness and may compound the conditions for achieving the best results.

4.2 Knowledge and capacity enhancement

Risk assessment is a process of inquiring and therefore of learning as well. The paradigm shift from dealing with disaster to a position that risk reduction is more important (Section 5.1) introduces needs for knowledge and capacity enhancement concerning disaster risk.

The NRA Program shall constitute an opportunity to generate new knowledge about the problems of disasters (of hazards and vulnerability) of management and decision-making, about the problem of how sustainability in the development process can be achieved.

Therefore, as the result of the implementation of the NRA, Mozambique shall have

enhanced its knowledge about disaster risks, and increased its capacity to determine how to reduce these risks. The latter aspect means enhanced capacity of conducting adequate hazard mapping and vulnerability assessment.

The suggested strategies to achieve this during the lifetime of the NRA Program include workshops and technical support.

Workshops

In the workshops, theory, concepts and methodology of risk assessment will be covered, with the facilitation of local and international experts.

Technical support program

For each critical step of the NRA Program, assessment of progress made will bring evidence for improving the Program achievement at the very specific level of Working Groups (See Figure 16).

The gains of implementing an NRA will accrue particularly to policy and decision-making, in an improved National DRR Strategy.

4.3 Data sharing and integration

Sharing of data involves more than simple data exchange, and requires the provision of usable datasets. It is specifically important at the national level (Montalvo, 2003).

The appropriate focus for sharing data is data integration. Data integration is a compelling reason for sharing data; it is the ability to share access to data sources or access common databases (Montalvo, 2003).

For the NRA, data integration faces some constraints such as heterogeneity and format. First, the datasets relevant to NRA are heterogeneous, due to cross-domain aspects and cross-organization nature. Data heterogeneity exists on syntactic, schematic and semantic levels. Each data source may model the real world in its own way and be incompatible with the others. Second, these datasets are from different domains and stored in a variety of systems and formats.

For example, the spatial data from the Computer Aided Design (CAD) and GIS domains are represented by different modelling methods and coordinate systems. Furthermore, datasets relevant to NRA are managed by different organizations and available at different locations.

Those who are concerned with DRR in Mozambique are worried that they are missing key data on the local events that take place daily in the hazard-prone areas.

Data needed for the NRA are available at different organizations and institutions related to risk assessment.

To facilitate the access and use of data for the NRA, legal instruments, such as memoranda of understanding as well as agreements upon data provision to the NRA Program can help to overcome the current situation of absence of data integration.

Above all, however, the work towards institutional awareness raising about the importance of data sharing is a relevant approach. Data carriers/producers must understand that their data become of utmost importance when they find application in the widest user community.

The value of NRA is very much dependent upon the data availability and quality.

4.4 Standardization of methodologies

Effective DRA is directly dependent upon the understanding of complexities, types and nature of risks faced by a community, determining the susceptible areas, and conceptualizing human vulnerability.

Risk is understood differently: some people understand risk in a purely scientific manner.

Risk is a concept of management, of decision-making. As such, risk assessment is a process of understanding the problem of hazards and

disasters, of underlying causes of non-sustainability in development.

Risk assessments (which can be represented for example in the form of a map, a report or publication, etc.) are based on the estimation of: hazard, exposure and vulnerability.

Reliable risk assessment products depend partly on clear, precise conceptualizations, but also on the methodology. The country's experience in mapping hazards and the technical capacity in usage of GIS-technologies is an advantage for the NRA Program.

Given the diversity of views to risk and the variety of hazards, a NRA requires standard concepts and methodologies of risk assessments. Standardization of risk assessment methodologies is necessary also in order to build a national research capacity to assume duties with requirements on:

- Conduction of risk assessments;
- Development of disaster management plans in an effective and efficient manner; and
- Setting standard operation procedures timely to effectively deal with emergencies.

The objectives of standardization of DRA methodologies includes the establishment of procedures that comply with the latest best practices for major hazards (drought, floods, windstorms and earthquakes) in Mozambique.

4.5 The e-Library and the future

The SIERA project produced a large quantity of data and information on the Mozambique situation in matters of DRA, comprising bibliographic material and information on organizations and institutions related to risk assessment (expertise and skills). These bibliographic materials are available in digital and analogue formats. The conditions of storage of some of these bibliographic materials have been difficult and some of the copies are limited in number. These resources have limited access and therefore limited use by the wider DRA community and the general public, due to various reasons, including the fact that very few people have known about the existence of these materials. In addition, numerous institutions and organizations were identified, with exper-

tise and skills in risk assessment, with precious experience of work.

Very few people know about the work carried out in Mozambique in the field of DRA, the value and experience achieved, existing needs and challenges. Many people are working in contributing to effective DRA in Mozambique. Few people know about existing capacity and expertise. This is in contrast with the high demand for data and information about disaster risks and for expertise and skills in risk assessment. Therefore the SIERA team tackled this issue of information and data accessibility and sharing of available data and information on DRA in Mozambique. The electronic Library (e-Library) on DRA in Mozambique is the concept encountered.

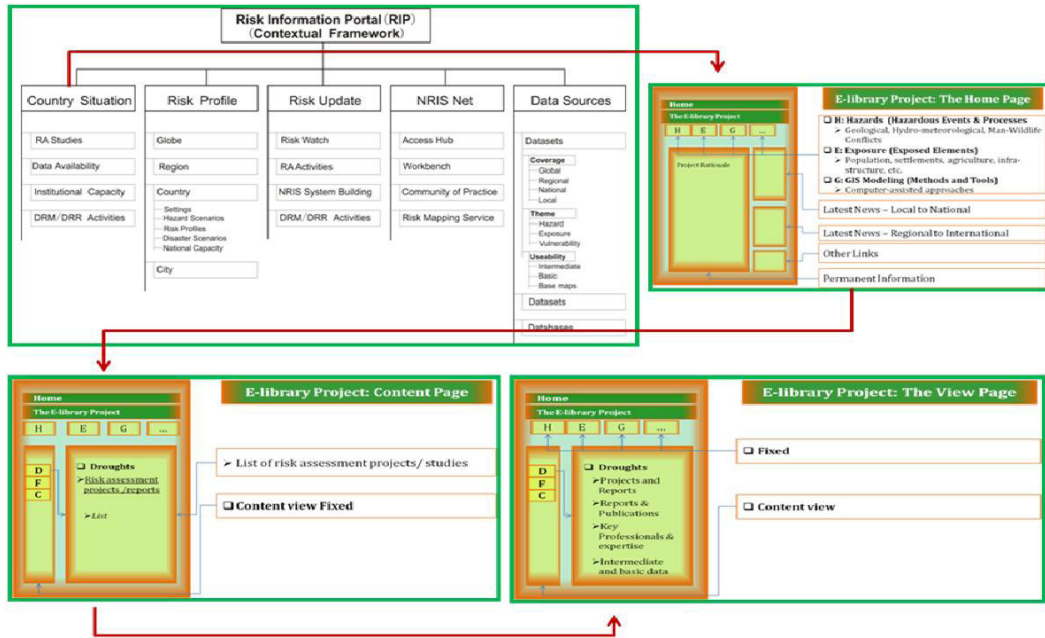
The e-Library is an Internet-hosted portal to permit easy accessing of information on DRA data and information. Besides bibliographic materials, the library will host information on actual risk in Mozambique and the activities of GRIP, including local organizations and institutions related to risk assessment and professionals in risk assessment (Figure 14).

The e-Library serves the whole risk assessment community including policy and decision-makers and the wide public.

In effect, sharing data and information on risk assessment (i.e., essentially where can be found what is related to risk assessment in Mozambique) increases the effectiveness of using such data and information, creates opportunities to experience flow through local institutions and organizations concerned with DRA in Mozambique. It involves more than one-time information upload on the Internet. As DRA evolves, more data, products and experience are generated which are required to be shared with the larger DRA community. The challenge is therefore how to develop the e-Library and, more demanding, how to maintain it updated. The strategies to achieve this include: (1) Establishing the portal in a process that also creates in the host institution the capacity to update the information on a regular basis; (2) Regular country situation analysis of risk assessments will produce updated data and information for

an electronic information database and (3) Establishment of a cross-institutional network (institutions related to risk assessment) that send, on a regular basis, updated relevant information (on risk assessment) for the library.

Figure 14: Risk information portal – Conceptual framework



5. Recommendations and Suggestions (Solutions)

A country situational analysis of risk assessment is relevant when considering the implementation of an NRA Program in countries where several institutions implement risk assessments and where no standard Methodology for Disaster Risk Assessment exists. In conducting such an analysis, existing concepts and methods are reviewed and assessed, data availability and quality, institutional capacity as well as existing expertise and skills are inventoried and evaluated with the view to gain information about the possible contribution of all these aspects to the NRA Program. It is especially required when the NRA Program is to be carried out with the most intervention of the local expertise.

The country situation analysis involves a participative process that as a result enhances the country's capacity of conducting risk assessment. Through a country situation analysis, the gap between the existing and the desirable conditions can be identified and ways to fill in those gaps determined and timely accomplished.

From the analysis of Mozambique's situation in matters of risk assessment, suggestions were produced on all aspects that during the analytical work deemed to be of utmost importance for the NRA. Some suggestions, in one way or another, reach the realms of the other components of DRA (NDO and URA) of GRIP activities in Mozambique.

Governance

Clear and specific memos of understanding between the INGC (Coordinating institution of the NRA) and the various institutions and organizations related to risk assessment can help supporting institutional commitment for an active collaboration with the NRA Program.

The NRA is to be appropriated by the country (to be looked upon as an endogenous process), i.e., by all the stakeholders (included policy and decision-makers), for which engagement of stakeholders is a key requisite.

Professional expertise and skills

Mozambique has some expertise and skills in risk assessment. The expertise and skills play the key role in the NRA Program and this is crucial for the country's capacity enhancement.

By the completion of the NRA Program however, the country shall have improved the existing expertise and developed capacity of conducting DRA on its own.

Capacity building

Training is a key element of the country's effort towards improving disaster-risk reduction practices. Suggested strategies for the NRA include a technical support program and workshops.

Country Needs

Mozambique's most important need is the availability of risk information for various applications including mitigation and adaptation.

Table 6: Risk information needs for disaster management

End Users		Local people/communities
Risk information needs and requirements	Before a disaster	<ul style="list-style-type: none"> - Precise level of risk - Risk perception and awareness
	During a disaster	<ul style="list-style-type: none"> - Location of rescue areas - Accessibility to rescue areas - Availability of transport & communications
	After a disaster	<ul style="list-style-type: none"> - Means for recovery - Areas of lowest risk - Next likely hazard event (risk)

Table 6 gives a general idea of information needs of local people/communities before, during and after a disaster. It shows that information needs vary over time and that to meet such needs different types of data and methods are required for applications such as: early warning, preparedness and response.

Challenges

- Commitment of stakeholders, the institutions and organizations related to risk assessment in particular, with the implementation of the NRA;
- Collaboration of all stakeholders, the institutions and organizations related to risk assessment in particular, in the NRA;
- Strengthening the capacity to maintain and sustain the e-Library and to coordinate dissemination of quality risk assessment products to gain trust of different stakeholders.

Opportunities

- Reliable capacity of coordination of multi-institutional participation in the NRA;
- Existence of baseline information on the country situation (CSA, URA, NDO) that supports the implementation of the NRA;
- Existence of interest of all stakeholders, the institutions and organizations related to risk assessment in particular, in the success of and therefore in the support to NRA;
- Existence of databases with basic datasets at national level, existence and availability of professionals of risk assessment and the possibility of cooperation with international expertise;
- International recognition and national awareness of DRR needs;
- Willingness and strong support from policy and decision-making.

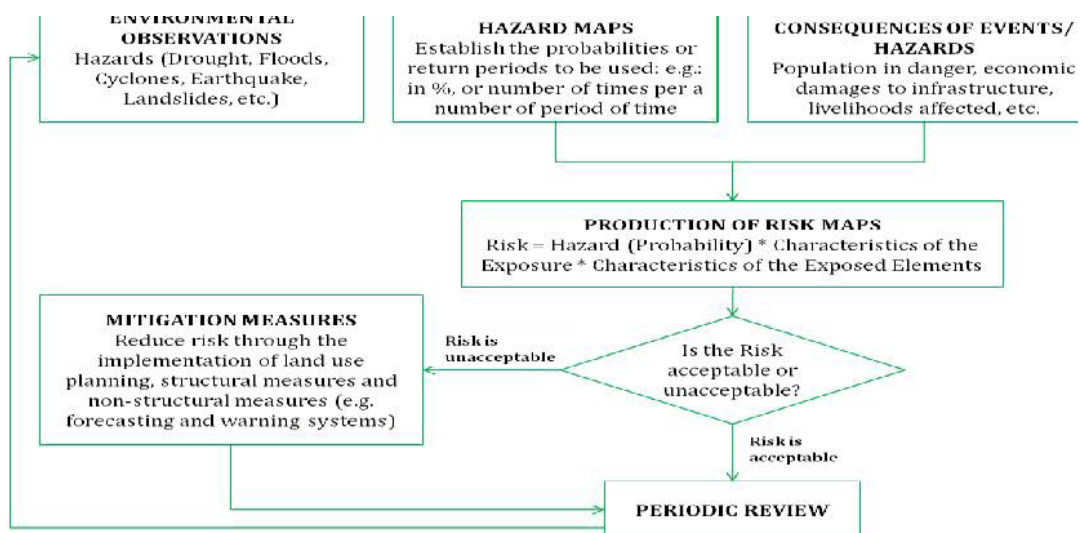
6. Implementation Plan for NRA

Risk assessment should be thought of as continuous process, not as a one-time project. The process is described as a set of steps that are continually repeated. At the outset, however, there is a start-up process that usually is not repeated (Figure 15).

Figure 16 presents the arrangement for the implementation of NRA, not the process as such.

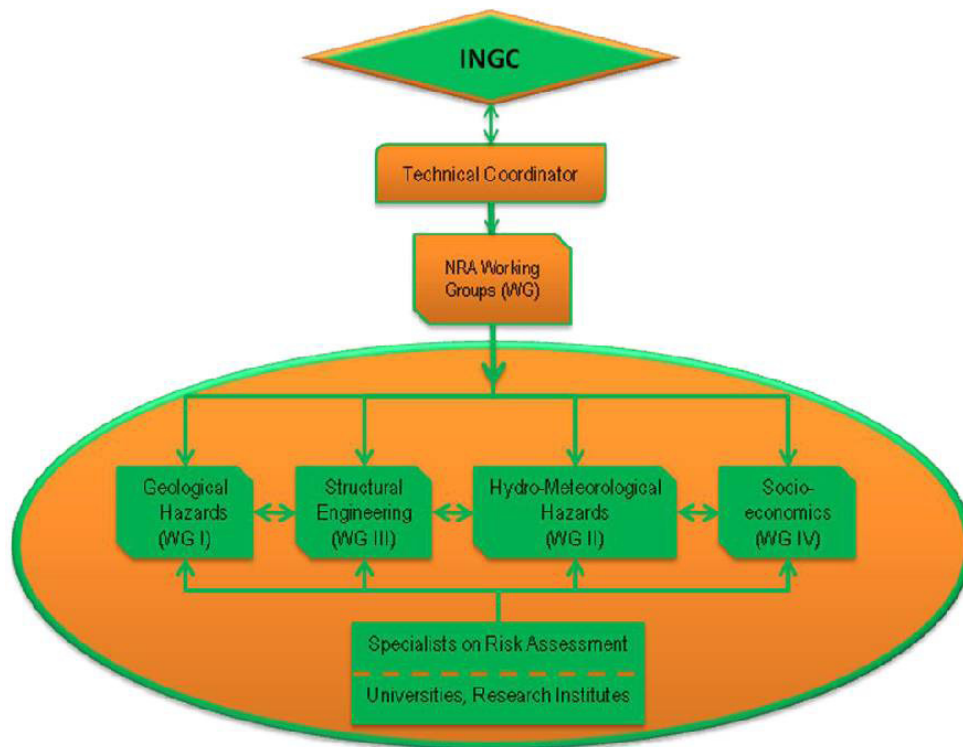
The overall coordination of the NRA is taken by the INGC. Four NRA-Working Groups are suggested, each covering a particular area. The Groups consist of risk assessment specialists and will have an overall facilitator, the Technical Coordinator. Each Group will have a Team Coordinator.

Figure 15: Risk assessment as a continuous process



Adapted from Dankova et al., 2009

Figure 16: Initial proposal for implementing the NRA, Mozambique

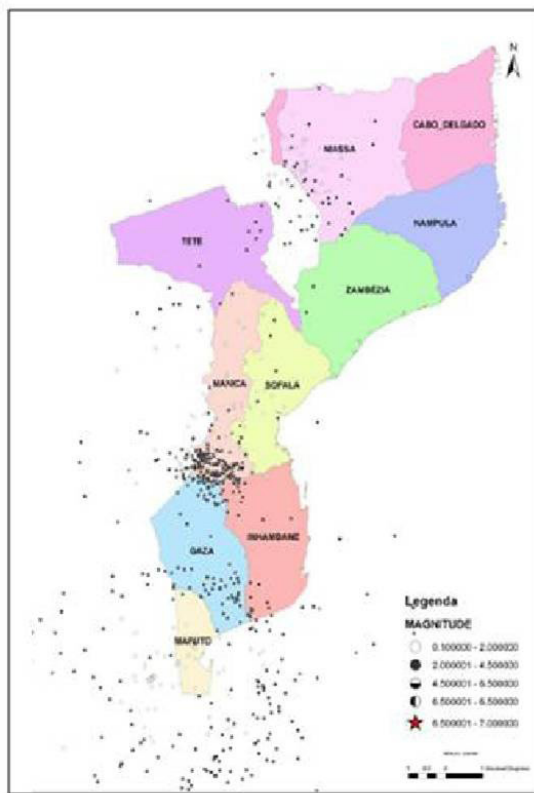


7. Annexes

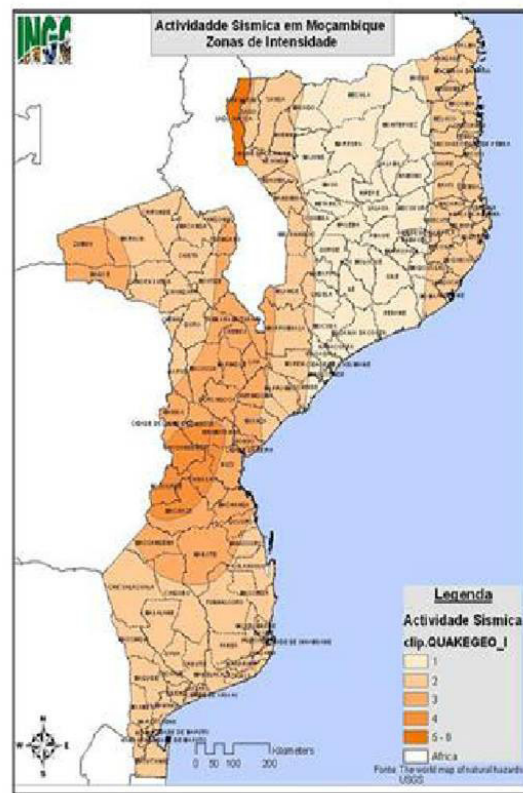
List of small scale maps: hazards (geological/seismic, meteorological, hydrological), exposed elements (population distribution, agriculture, infrastructure) and risk.

A. Epicentres of earthquakes and seismic activity (intensity zones)

Figure 17: Epicentres of earthquakes 1905-2008 (left) and seismic activity in Mozambique – intensity zones (right)



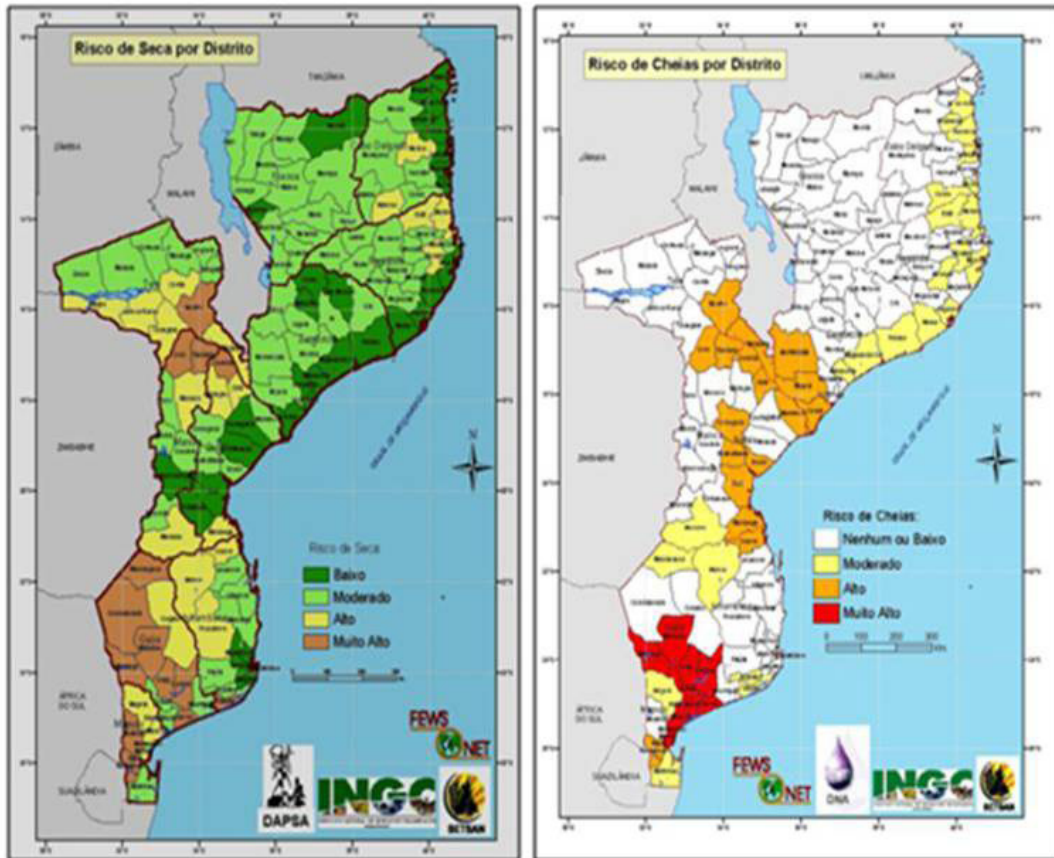
Source: DNG, 2008



Source: INGC, 2003

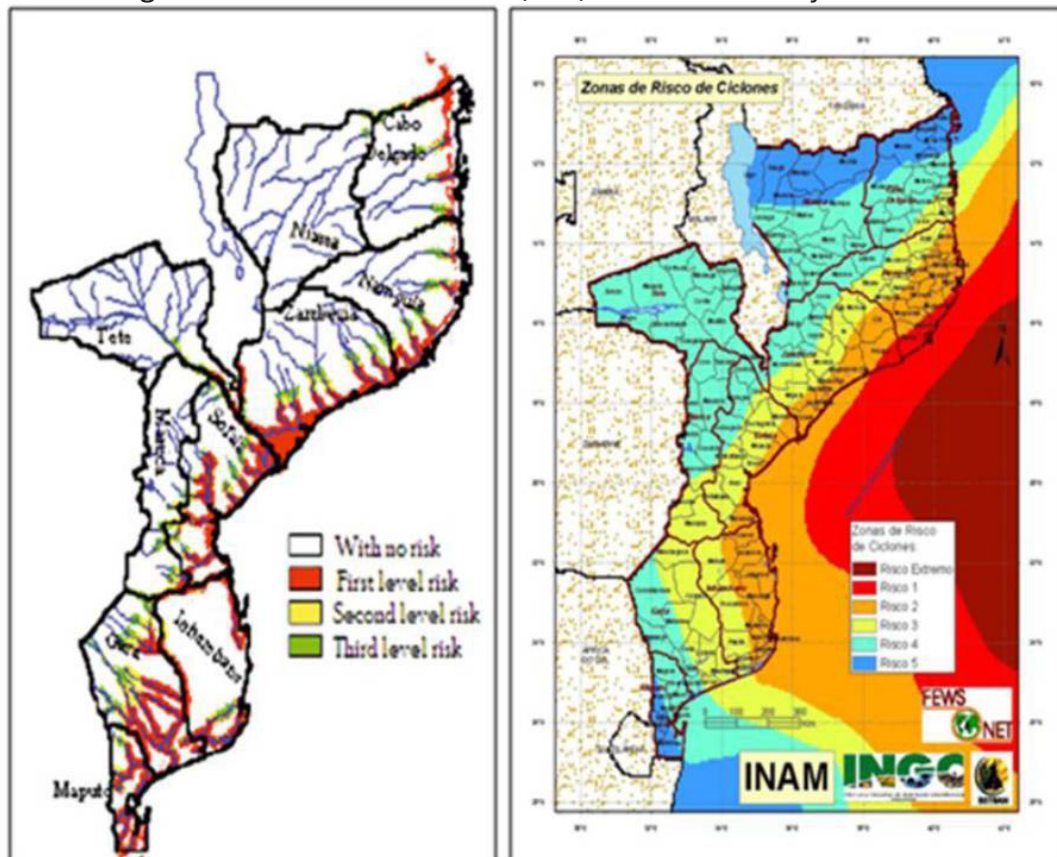
B. Drought risk and flood risk, by district

Figure 18: Drought risk (left) and flood risk (right) by district



C. Flood risk areas and areas of cyclone risk

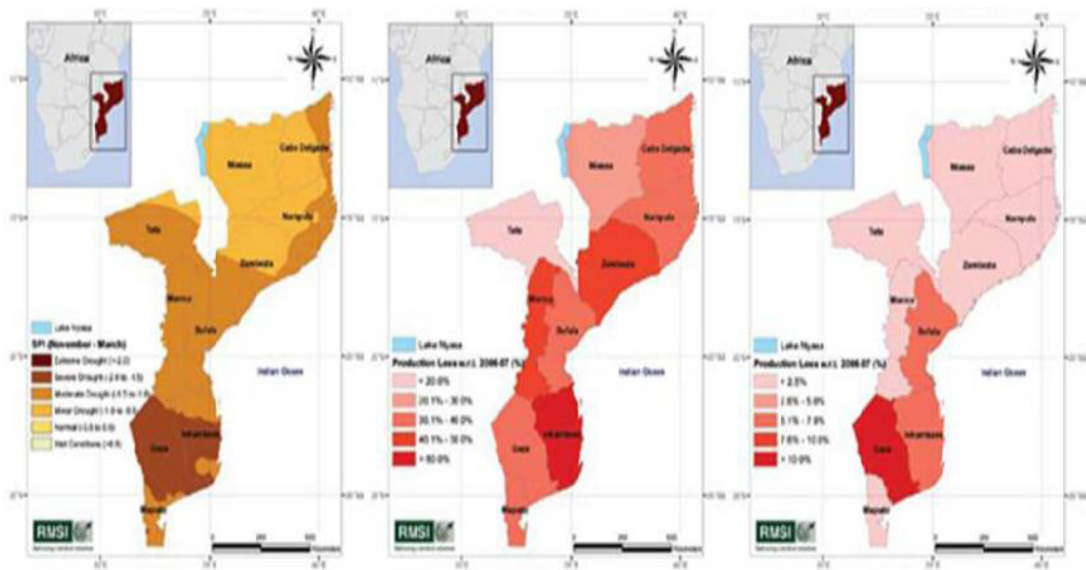
Figure 19: Flood risk areas (left) and areas of cyclone risk



Source: FEWS NET, INAM & INGC

D. Drought hazard and drought vulnerability maps for probable maximum loss for maize and sorghum

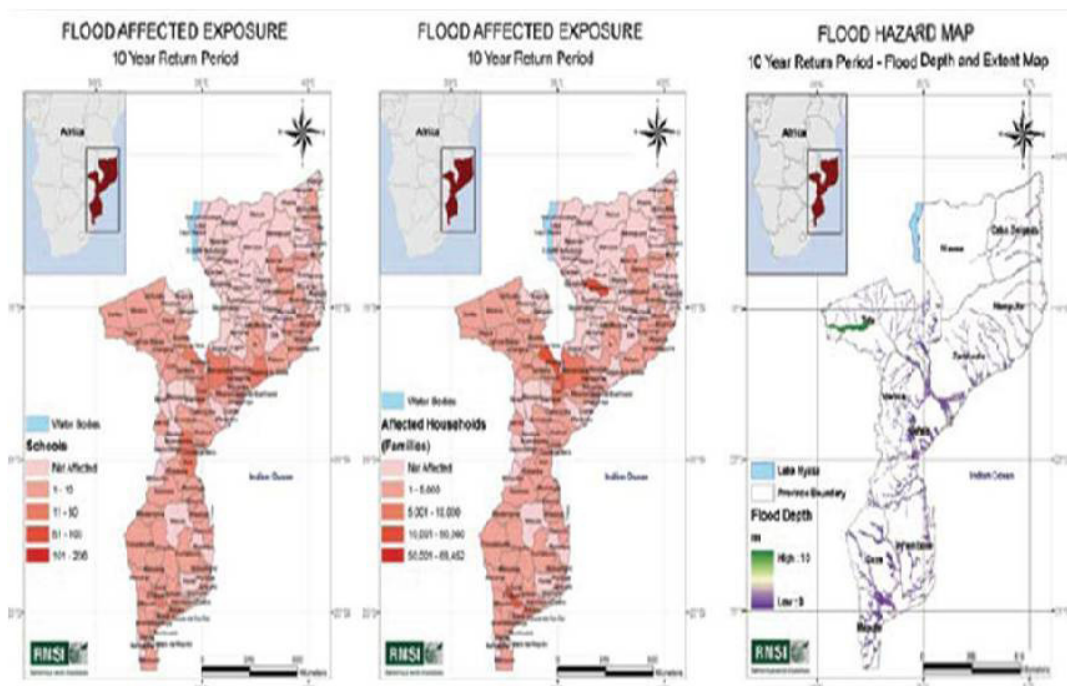
Figure 20: Drought hazard for a 1-in-5-year return period (the map on the left side) and 10 year return period loss for sorghum (the two maps on the right side)



Source: Dankova et al., (2009)

E. Flood hazard and exposure and flood hazard map (flood depth and extent)

Figure 21: Flood hazard and exposure (schools and households) for 1-in-10 year flood (the first two maps on the left side) and flood hazard map (flood depth and extent)



Source: Dankova et al., 2009

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