

# Flood Management in Mozambique



Aerial picture showing the impact of cyclone Jokwe when Zambezi river burst its banks at Vilankulos, Mozambique. Photo by DFID/UK

## **This case study:**

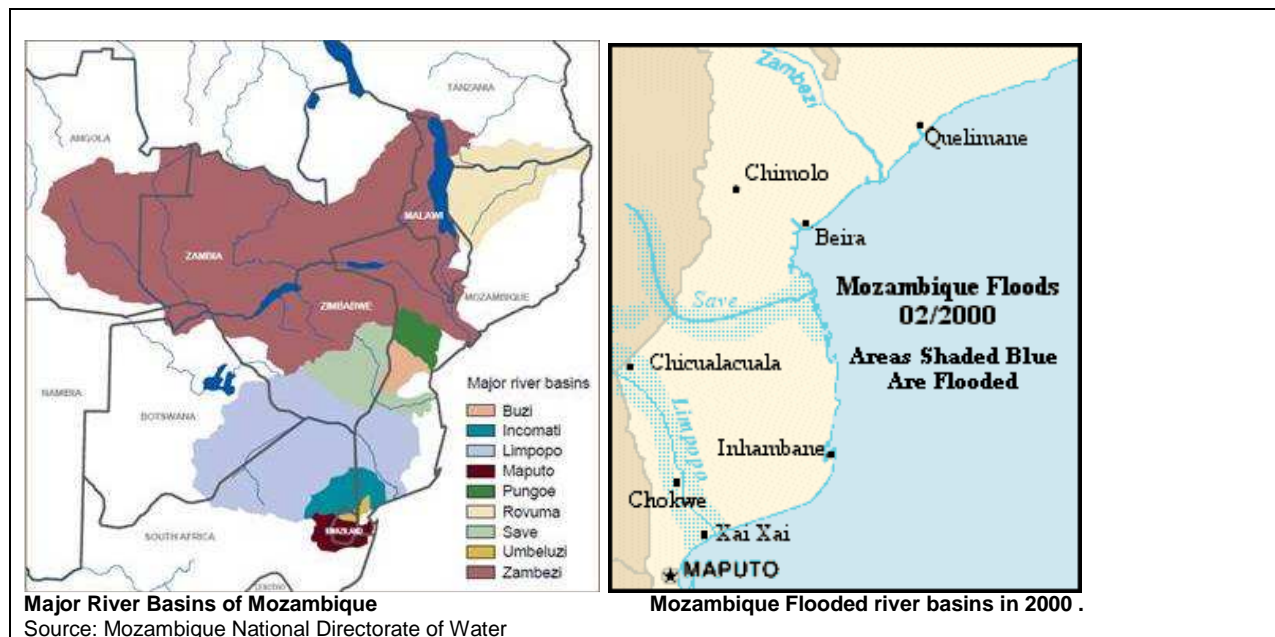
- **Highlights the key role of Mozambique's National Institute of Meteorology in Disaster Risk Management and the capabilities of the early warning system during the 2000 flood event in Mozambique.**
- **Shows importance of the National Institute of Meteorology strengthening skill through its relations with Harare - Climate Services Centre consensus climate guidance and the need to strengthen the national early warning system.**
- **Exhibits elements of the WMO Strategy on Service Delivery and the end-to-end generation of climate information ensuring disseminated information is usable and reaches vulnerable communities with user feedback for product improvement.**
- **The role of the National Institute of Meteorology as a team player in a multi-disciplinary team effort to manage a climate extreme event in the national and regional context.**
- **Highlights national ownership and commitment to strengthen the early warning system to manage future more frequent and severe floods effectively**

## **Background**

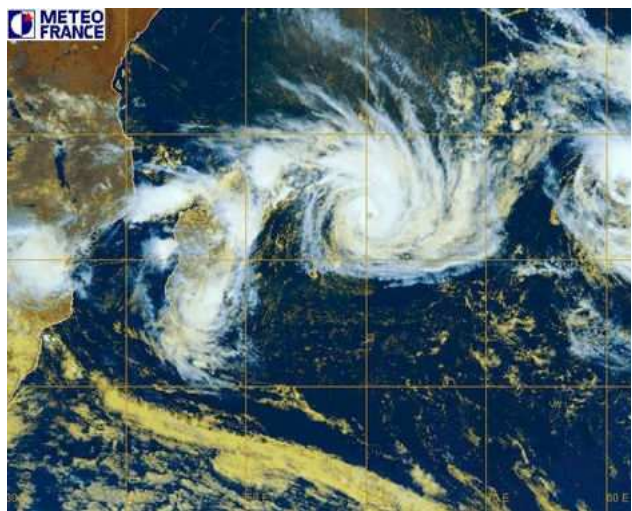
Mozambique's long-term challenge is to learn to live with floods and drought. Mozambique is one of the poorest countries in the world, with more than 50% of its 19.7 million people living in extreme poverty. Development has been compromised in recent years by these hydrometeorological disasters leading to economic growth rates decline from 12% before the 2000 floods to 7% after the floods.

Mozambique's high incidence of flooding is explained by two factors. First is the tropical cyclones that form in the south-western Indian Ocean and sweep towards the country's coast. While relatively few of these actually make landfall, an average of three or four get close enough each year to cause high winds and heavy rain, leading to flooding. Second, Mozambique is a 'downstream' country through which nine major international river systems that drain vast areas of southeastern Africa find their way to the ocean. Mozambique must thus manage the downstream effects of rain that falls far beyond its own catchment areas of an estimated 50% of water in Mozambique's rivers comes from outside the country. Floods in Mozambique have occurred every two to three years along the major rivers of Incomati, Limpopo, Save, Buzi, Pungue, Zambezi and Licungo. The severity of the flooding is decided by the rainfall both in the country and in the other catchments areas of these rivers outside Mozambique.

The floods of 2000 were one of the costliest disasters in Mozambique's history. The floods were caused by two successive cyclones: Cyclone Eline in late February 2000 and Cyclone Hudah in mid-April 2000. Heavy and persistent rain across southern Africa resulted for the first recorded time in the simultaneous flooding of the Limpopo, Incomati, Umbeluzi, Save, Buze and Pungoe rivers. At least 700 people died, 650,000 were displaced and 4.5 million were affected, totalling a quarter of Mozambique's population.



**Tropical cyclone activity in the south west Indian Ocean pose a threat to Mozambique**



Meteo-France/La Re-Union satellite picture on the left showing tropical cyclones developing south of the equator and intensifying as they move in a west-south-west direction towards Madagascar and the Mozambique Channel creating havoc along their path. The Tropical Cyclone Centre in La Re-union is a WMO Regional Specialized Center (RSMC) the primary mission to provide appropriate guidance information to the 13 Members of the RA-I Tropical Cyclone Committee (Botswana, Comoros, France, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Seychelles, South Africa, Swaziland, Tanzania, Zimbabwe) for all tropical disturbances occurring in its area of responsibility.

Extreme climate events brought about by the ENSO phenomena have disrupted the country's development and since 1980, there have been seven major droughts and seven major floods as shown in the table below:

**Extreme climated related events in Mozambique since 1980.**

Year	Event	Areas affected	Number of people affected
2002–06	Drought	43 districts affected in South and Central provinces	800,000 affected
2001	Floods	Zambezi river	500,000 affected; 115 deaths
2000	Floods	Limpopo, Maputo, Umbeluzi, Incomati, Buzi, and Save river basins, caused by record rainfall and 3 cyclones	More than 2 million people affected; 700 deaths
1999	Floods	Sofala and Inhambane provinces; highest rainfall level in 37 years; EN1 (major road) shut for 2 weeks	70,000 people affected; 100 deaths
1997	Floods	Buzi, Pungue and Zambezi rivers; no road traffic to Zimbabwe for 2 weeks	300,000 people affected; 78 deaths
1996	Floods	All southern rivers of the country	200,000 people affected
1994–95	Drought	South and Central parts	1.5 million people affected; cholera epidemic
1991–92	Drought	Whole country affected	1.32 million people severely affected; major crop failure
1987	Drought	Inhambane province	8000 people affected
1985	Floods	9 rivers in the southern provinces; worst flooding in 50 years followed by 4 years of drought	500,000 people affected
1983–84	Drought	Most of the country affected	Many deaths from drought and war; cholera epidemic
1981–83	Drought	South and Central provinces	2.46 million people affected
1981	Floods	Limpopo river	500,000 people affected
1980	Drought	Southern and Central provinces	No data available

This case study looks at the Disaster Risk Reduction (DRR) Strategies and the shift from reaction to preparedness strategy employed for dealing with flood events by the Mozambique government with particular focus on the flood early warning system based on the advisory information provided by the Mozambique’s National Institute of Meteorology (NMHS) with input from the WMO Regional Specialized Meteorological Centre RSMC/La Re-Union, and the SADC- Climate Services Center. Experiences are drawn from the 2000 flood disaster when the most severe floods in living memory affected large areas of the country. It examines the approach to Disaster Risk Reduction (DRR) actions by the Mozambique government and maps them to the WMO 8-Step Model for Capacity Development, and in particular on the best practice elements of the country’s Climate Risk Management (CRM) strategy for the 2000 floods to identify gaps in the early warning system. Key capacity development elements employed are identified to indicate the degree of sustainability of the early warning system in the context of the WMO Strategy for Capacity Development.

**Policy and planning for floods**

Recognizing the risks of climate-related disasters, Mozambique’s post-independence governments have made efforts to put in place structures for managing and mitigating their impacts. The Department for Combating Natural Disasters was established in 1977. In 1999, a new National Policy on Disaster Management was passed, and the Department for Combating Natural Disasters was replaced by the National Disaster Management Institute. This accompanied a change in approach to disaster

management, from reaction to preparedness and heavily relies on climate information and warning advisories by the Harare Climate Services Centre fed into the National Institute of Meteorology.

Under the new policy, preparedness for floods is facilitated by a flood early warning system. This provides forecasts of flood risk, detects and monitors flooding, and puts out flood warnings when necessary, paving the way for a coordinated response. The flood early warning system is coordinated by the National Directorate of Water, together with the National Institute of Meteorology and the National Disaster Management Institute. This collaboration reflects the essential integration of hydrologic and climate information needed to understand and predict floods and to manage an effective response.

From 1996 onwards, climate forecasts have provided the basis for early warning and contingency planning. The National Institute of Meteorology collects meteorological data and prepares a range of forecasts – seasonal (October to March), 4-day and daily forecasts. It is also responsible for monitoring cyclones with information from the WMO RSMC/ La Re-Union. Seasonal forecasts provided by SARCOF ahead of the rainy season, in October, informs a meeting of water resources experts, who assess preparedness for the predicted climate event. If flooding is expected, a flood team is mobilized. When flood occurs, the team's role is to monitor the situation, receive and analyze information, recommend responses, ensure collaboration between the different bodies involved, and coordinate activities at central and local levels.

Regional Water Administrations work at the river basin level, monitoring water levels and providing data to the National Institute of Meteorology. The latter also collects data from meteorological stations across the country, from radar equipment, and from satellites. It uses these data to update forecasts periodically.

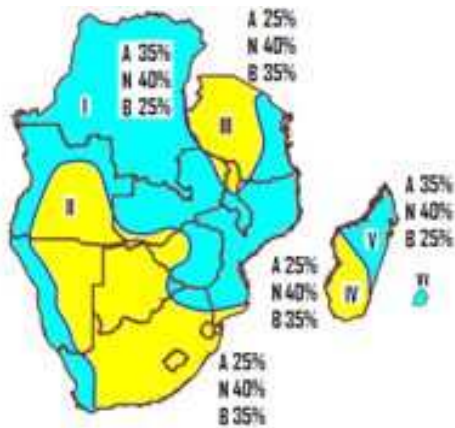
The Regional Water Administrations issue flood warnings when necessary, to district governments and local authorities and also to the media (radio, television, and newspapers). District governments and local authorities, in collaboration with the Red Cross and other non-government organizations (NGOs), are responsible for the dissemination of information, and in particular warnings, at the local level, and for the evacuation of people before the floodwaters rise.

A high-level committee of ministers chaired by the Prime Minister became the overall decision-making body in the event of a disaster. This was supported by a technical committee comprising experts from the Ministries of Public Works and Housing, Transport and Communications, Health, Agriculture, Environment, Defense, and Foreign Affairs. The committee met daily while the disaster lasted. The National Disaster Management Institute is responsible for the overall coordination of a disaster response.

**STEPS 1 – Requirements for an effective early warning system which enables effective management of floods were defined with plans ranging from the issue of a flood warning to the mobilization of response units set up by the National Disaster Management Institute,**

Mozambique thus has policies and structures in place for domestic flood management; but it cannot address its water-related climate challenges alone, since weather events outside the country often largely determine the internal situation. Regional cooperation is therefore critical, particularly for flood prediction and regional engagement with relevant neighboring countries is critical in addressing trans-boundary issues pertaining to the use and management of the river systems. This cooperation is facilitated by the Southern African Regional Climate Outlook Forum (SARCOF) organized by the Harare - Climate Services Centre, which comes under the umbrella of the Southern African Development Community (SADC).

SARCOF's role is to facilitate information exchange and interaction among forecasters, decision makers, and climate information users in the 14 SADC Member states. Seasonal Climate Outlook forecasts from the Harare Climate Services Center is downscaled to national specific situations and fed into the Mozambique National Institute of Meteorology flood forecast. This requires highly skilled staff to interpret and downscale regional climate forecasts issued by the Harare - Climate Services Centre to the specific national context of Mozambique as well as adequate infrastructure in the NMHS to perform this operation. The water authorities in the region also exchange data on a regular basis. Interestingly, the need for coordinated water management often transcends into political disagreements. Below is an example of a seasonal climate outlook product from the Harare Climate Services Center during a SARCOF session.



The seasonal outlook forecast – a SARCOF product indicates that most of Mozambique has a 35% chance of above normal rainfall.

SARCOF is a regional climate outlook prediction and application process adopted by the fourteen countries comprising the Southern African Development Community (SADC) Member States: **Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe** in conjunction with other partners. SARCOF is coordinated by the SADC Climate Services Centre in Gaborone, Botswana

### The floods of 2000

**STEP 2 – Capabilities of the NMHS to issue accurate and timely warning advisories with adequate time for preparedness were evaluated and a baseline was established,**

The SARCOF meeting of September 1999 warned that there was a high probability of above-average rainfall between October and December 1999 for most of Mozambique, although there was a 45% probability of normal rainfall in much of the Limpopo River basin. For the period January to March 2000, the forecast was for a 50% probability of above-average rainfall in the central region (Buzi and Save river basins), while southern Mozambique had a only 30% chance of above-average rainfall. The updated forecast in December slightly reduced the expectations for central Mozambique to a 45% chance, and increased the prediction for southern Mozambique to a 35% chance, for the period January to March 2000. The National Institute of Meteorology (NMHS) was not happy with this. In the previous year its scientists had noted a correlation between La Niña activity and high rainfall in southern Mozambique, conditions which appeared to be repeating themselves more forcefully. In addition, it was noted that 1999–2000 coincided with the cyclic peak of sunspot activity, which correlated over the past 100 years with exceptionally heavy rainfall periods.

On this basis, the National Institute of Meteorology raised the probability of above-average rainfall to 50% in their national forecast and warned that there was a high probability of floods. This was a brave move since, two seasons before, a drought had been predicted which had not materialized, putting the service's credibility in question. The government took the warning advisory issued by the National Institute of Meteorology seriously as part of the early warning system and disaster risk preparedness and was used to develop a multi-sector contingency plan, which was submitted and approved by the government. The credibility in question indicated here was related to the prediction of the 1997/1998 El Niño event when the outlook forecast did not materialize. To address this wrong forecast, the National Institute of Meteorology organized an international conference and invited top scientists to explain what had gone wrong. This was seen as a positive action, since the National Institute of Meteorology had not acted alone. The scientific community had recognized limitations in predicting impacts associated to El Niño. This helped in regaining the otherwise damaged credibility. The flood warnings by the National Institute of Meteorology and subsequent preparations coordinated by the National Disaster Management Institute proved to be fully justified when, between January and March, the worst floods in over 100 years affected three major river basins – the Incomati, Limpopo, and Save. The flooding was not the result of a single weather event but rather the cumulative effect of a succession of events. While each event was predicted and monitored with some success, the way in which they interacted was complex and not well foreseen, a major limitation in the capabilities of the early warning system.

**STEP 3 – Deficiencies for an effective early warning system were identified during the 2000 Flood in Mozambique and analyzed to determine how to meet the requirements for future more severe floods.**

#### **Areas Identified for Improvement/Gaps**

**GAP 1:** The river basin authorities and the National Institute of Meteorology lacked the capacity and equipment to carry out short-range real-time modeling and forecasting. This would have facilitated forecasting of the extent and severity of flooding, and hence better targeting of flood warnings to specific areas or villages. Modeling, supported by ground and satellite data, is a vital input to accurate short-term flood prediction. With the exception of the Limpopo, none of the country's river basins had calibrated models in place. Accurate prediction is in turn a prerequisite not only for the credibility of warnings to the public but also for the faith placed in the early warning system, and hence the resources allocated to it by the government. Communications between the different front-line groups proved, for the most part, good. Information and data were shared by telephone, radio, e-mail, and fax. Good relations built prior to the disaster, both within Mozambique and with neighboring countries, formed the basis of both formal and informal communications.

**GAP 2:** Differing information came from different sources, which caused some confusion. The government relied on government institutions and information from the Mozambique National Institute of Meteorology, but NGOs, aid organizations, and others received forecasts from the USA or other global sources. The need for a single voice to provide information to all stakeholder groups was a valuable lesson to emerge from the disaster. WMO's Public Weather Services Programme stipulates the NMHS is the single authoritative voice for issue of warnings at the national level to avoid such confusion.

**GAP 3:** Communication of flood warnings to the general public and vulnerable communities remained a challenge. The media did not have a defined role, and did not begin to report until the disaster was happening. It seems the risk was not fully understood by many people, who chose not to leave their homes finding themselves at great risk.

**GAP 4:** Resources both human and financial were limited both in preparing for floods and in dealing with them. Mozambique was not able to maintain a large corps dedicated to disaster management on stand-by, but instead had to mobilize personnel as and when the situation demanded. Donor agencies did not respond adequately to funding calls for pre-flood preparation, although substantial post-disaster funding was provided. Yet the strategy is to have adequate resources before the disaster rather than after.

**STEP 4 - A crisis management plan (rather than strategic) was developed to address the overwhelming magnitude of the 2000 floods in coordination with national planning authorities and partner organizations,**

The high level Disaster Committee, which normally meets just four times a year, started to meet fortnightly. In November the Committee released a national contingency plan for rains and cyclones during the 1999–2000 season. Provincial and local structures developed their own plans and conducted preparatory exercises. There were attempts to mobilize resources, but few could be spared, bearing in mind that a disaster was still merely a probability. For example, of 20 boats requested, only 1 had been provided when disaster struck. Leave was cancelled for key officials in December and January.

As predicted in the regional forecast, there were heavy rains in southern Mozambique and adjacent countries between October and December. Around the beginning of February, cyclone Connie over the Indian Ocean made land fall and caused further heavy rain in the Maputo area. The Limpopo, Incomati and Umbeluzi rivers were affected with water levels at their highest since records began. Three weeks later, cyclone Eline made landfall, moving inland and causing serious flooding of the Save and Buzi rivers in the center of the country, and aggravated the flooding of the Limpopo River, in the south. At the beginning of March a third cyclone out at sea, Gloria, came into the picture, contributing to further record flooding of the Limpopo, Incomati, Save, and Buzi rivers. And finally, cyclone Hudah followed Eline and made landfall in April. Flood warnings were issued as the flooding escalated. However, warnings were not always accurate, not always understood or heeded by the local communities. The mass media's interest increased as the disaster unfolded. Both national and international media began to report with dramatic stories of tragedy, and of heroic rescues. The magnitude of the floods far exceeded anything in living memory. The towns of Xai-Xai and Chokwe, on the Limpopo, and many other small towns and villages in the same region, were completely inundated and remained under water for about 2 months.

**STEP 5 – National commitment to the immediate crisis management plan was secured. In addition, national commitment for an effective national early warning system was secured and reflected in NAPA submitted in 2008 to the UNFCCC,**

<sup>1</sup>The submitted NAPA has prioritized the strengthening of the early warning system as being critical for Mozambique to manage floods and build resilience to the impacts of a changing climate in its economic sectors. This demonstrates national commitment to the strengthening of the national early warning system and associated capacities in the NMHS of Mozambique.

**STEP 6: Resources were mobilized. Both national and international support was provided, STEP 7: The crisis management plan was implemented as the government strove to contain the situation and coordinate rescue efforts.**

The government declared an emergency, mobilized its disaster response mechanisms, and made appeals for assistance and supported by extensive coverage in the international media. The first external teams arrived on 11 February from South Africa. Coordinated by the National Disaster Management Institute, a combined national and international effort resulted in about 50,000 people being rescued by boat and aircraft. The displaced, numbering 650,000, were accommodated in temporary centers, and public health measures were put in place which successfully avoided measles and cholera outbreaks. At least 700 people died as a direct result of the floods. An estimated 350,000 livestock also perished, and vast areas of agricultural land were devastated, with soils as well as crops lost. Some 6000 fishermen lost 50% of their boats and gear. Schools and hospitals were among the many buildings destroyed.

**BBC News: Tuesday, 29 February, 2000, 21:56 GMT**



Thousands of Mozambique flood victims spent Tuesday sitting in trees, on rooftops and on patches of high ground surrounded by swiftly flowing muddy water, waiting for over-stretched rescuers to pluck them to safety.

<sup>1</sup> ] [http://unfccc.int/cooperation\\_support/least\\_developed\\_countries\\_portal/submitted\\_napas/items/4585.ph](http://unfccc.int/cooperation_support/least_developed_countries_portal/submitted_napas/items/4585.ph)

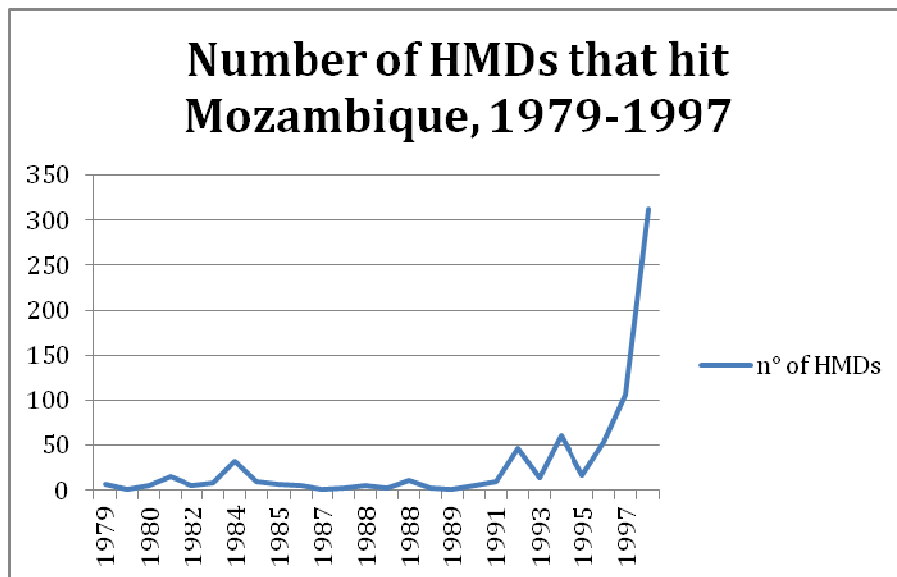
By Greg Barrow in Maputo

*“From above it looks as if a huge tidal wave of brown water has swept through the Save river valley. Trees have been uprooted, houses lie in ruins and debris is floating in the floodwater. Those who survive the flooding have been stranded on rooftops and in trees. Beneath them the bloated corpses of livestock float in the waters”.*

### Implications for CRM good practice in DRR

An effective flood early warning system depends not only on the technical and institutional capacity to produce a good risk assessment, but also on the communication of that risk to vulnerable groups and to the authorities charged with response. This aspect lays emphasis on user-driven services and effective service delivery systems with focus on vulnerable communities along the river systems of Mozambique. Efforts must be made for the development and delivery of user- focused services to vulnerable communities who should be able to use and derive benefits from the services provided.

Mozambique’s flood early warning system during the 2000 floods was an eye-opener for the government and shortcomings were revealed. For a very poor country, Mozambique’s policy and planning for flood events were good. Experience of previous floods, and the sheer magnitude of impacts generated by flooding and other climate-related shocks in the country, had led the government to set up flood management structures at various levels, from central to local, and there was active collaboration between these structures (The graph below shows the sheer rise in the number of Hydro-Meteorological disasters in Mozambique starting from 1994).



The graph shows the number of HMDs that hit Mozambique between 1979-1997, a notable hike starting in 1994<sup>2</sup>. Source: Arame Tall (DesInventar Mozambique/ GRIP-Arendal data).

<sup>2</sup> HMDs include: drought, floods, heat waves, alluvions, cyclones, strong winds, rains and tropical depressions, as well as disaster-related epidemics.



**STEP 8 – A thorough M&E plan was in place and metrics to measure success against the baseline were implemented in the plan. The process was used to recommend continuous improvement in the National Disaster Management Strategic Plan and the strengthening of the early warning system for future, more severe flood events in Mozambique.**

The magnitude of the floods was overwhelming, and the poverty of the majority of Mozambique's people added to their vulnerability. However, the country's flood planning and preparedness with climate information provided by the Mozambique National Institute of Meteorology and SADC-Climate Services Centre provided the framework for massive international support, and management of the disaster was an eye-opener to the complexities of disaster management of such a magnitude. Climate information was available before and during the floods. Climate information was available before and during the floods. Floods were forecast by the National Meteorological Institute with regional climate input from the SADC-Climate Services Centre and tropical cyclone warnings and advisories from the WMO RSMC/ La Re-Union. Their magnitude was not anticipated, but this is not surprising, since the floods exceeded all those since records began.

Much reflection and analysis was done after the floods of 2000 and as a result some improvements have been made to the flood early warning system and to flood management practices in Mozambique.

### **Improvements Since 2000 Floods**

#### **In the Year 2001**

<sup>3</sup>Immediately following the 2000 floods, a Lessons-Learned Workshop was held by Mozambique's National Institute for Disaster Management (INGC) in Beira on 26 and 27 July 2001, funded by the Office for the Coordination of Humanitarian Affairs (OCHA), to draw lessons from the rescue and relief operations during the 2000 floods in the centre of the country from January to May 2001. Some 130 delegates attended the workshop, including the governors of three of the four affected provinces, as well as district administrators and representatives of Government departments, UN agencies, donors, and NGOs. Major changes were made and the death toll was significantly reduced from 700 to 115.

The workshop had three specific objectives:

1. to review the 2001 floods and the role of the main players;
2. to draw lessons from the point of view of prevention, preparedness and response;
3. to propose adjustments to the Contingency Plan for the next rainy season.

The plenary session of the workshop considered the following areas for improvement:

1. Coordination, data gathering and processing, the press, training and response
2. Logistics, communication and food security
3. Health, water supply, sanitation and shelter
4. Warnings, public awareness, education and resettlement.

After comparing experiences in the response strategies in 2000 and in 2001 in the centre and south of Mozambique, the outcomes of the workshop indicated the following major improvements in 2001:

1. In 2000, the assessment and implementation in such a widespread affected area was more difficult, costly and time-consuming. The need was even greater for full cooperation and collaboration to serve vulnerable populations and save lives. In 2001, the assessment was immediate and conducted jointly with government agencies and partners using common

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<sup>3</sup> Mozambique Floods 2001. Lessons Learned Workshop in Beira.

assessment instruments and fed into a common database which all partners contributed to and utilized for collective impact. This avoided differing statistics, conflicting assessments, and competitive responses.

2. Improvements were made to many aspects of the rescue and relief operations in 2001, and specifically to national and provincial coordination and contingency plans. The Mozambican Government and the International Community improved substantially their management capacity during the 2001 year.
3. The contingency plan for 2001 was based on the accurate forecast of potential floods in January to April between Vilankulos in Inhambane province and Quelimane in Zambezia province.
4. The United Nations contingency plan, was fully integrated with the national contingency plan, and allowed the repositioning of equipment and goods in areas at risk before the floods struck.
5. The UN capacity for coordination was increased with the establishment of the UN Disaster Management Team (UNDMT), involving all UN agencies, Government, bilaterals, and NGOs.
6. An adequate response is highly dependent on availability of funds. The UN joint appeal raised over US\$10 million or 1/3 of the US\$30 million sought by the Government to respond to the disaster. OCHA was able to secure funding and experts to join the UN team to ensure a smooth and effective disaster response using a collaborative team approach.
7. The need to make disaster management an integral part of the planning process in each institution was emphasized since Mozambique is prone to cyclical disasters.
8. Regional efforts within the Southern African Development Community (SADC) for joint initiatives in disaster management that will improve warning systems and response capacity.

### In the year 2003

The Mozambique government signed several key transboundary water agreements including the Limpopo and Incomati, Save and Buzi river basins.<sup>4</sup>The [Agreement on the Establishment of the Limpopo Watercourse Commission](#) (LIMPOPO Agreement) recognizes the “spirit, value and objectives of the Revised Protocol on Shared Watercourses in SADC. As of 2003, eight SADC countries had ratified the Revised Protocol on Shared Watercourses in the Southern African Development Community: Botswana, Lesotho, Mauritius, Mozambique, Namibia, South Africa, Malawi and Swaziland. The revised protocol was expected to come into effect once two-thirds of the SADC countries ratify the protocol (SADC 2003a).



Source: Vogel 2010. Massingir Dam, Mozambique.



Macarretane Barrage on the main stem of the Limpopo River.

<sup>4</sup> Transboundary Water Management Regional Agreements \_ The Limpopo Agreement. <http://www.limpoporak.com>

## **In the Year 2006**

A National Disaster Management Strategic Plan was drawn up and was adopted in 2006. The plan links the need to reduce the risk of disasters with national priorities for poverty reduction. It has three main objectives: 1. To reduce the loss of life and property during natural disasters; 2. To consolidate the national culture of disaster prevention; 3. To introduce specific measures to prevent and mitigate disaster. The following improvements were made:

1. In 2006 the Government of Mozambique approved and began the implementation of the Master Plan for Disasters Prevention and Mitigation, as the only instrument to guide national actions to reduce disasters risk in the long-term. The Government of Mozambique established a set of political measures to ensure effective DRR. These included:
  - Review and reform of legal and institutional framework enhancing the mandate of National Institute for Disaster Management (INGC) to coordinate all disaster risk reduction activities, according to the decisions of the Technical Council for Disasters Management (CTGC);
  - Establishment of the National Operative Centers for Emergency (CENOE), at national and regional levels, integrating the National Unity for Civil Protection (UNAPROC), for search and rescue activities. This has enhanced the national capacity to coordinate and respond to emergencies
  - Strengthening national capacity for early warning to floods, droughts, cyclones, covering more territory with accurate information to disasters response and prevention to the local communities;
  - Decentralization of disaster risk issues to local levels through establishment and training of Local Committees for Risk Management (CLGR) in all vulnerable communities throughout the country
2. A community-based disaster risk management program was undertaken in the Buzi District of Sofala Province. The project involved raising awareness of risk and building capacity to reduce vulnerability and to respond to disasters. Communities participated in risk assessment and disaster simulation exercises. This effort is described below:

### <sup>5</sup>The Buzi Early Warning System

A “Mozambique flood warning” project has been initiated by the Munich Re Foundation and includes a simplified Búzi early warning system which was specially tailored to the needs of the local population. The system is based on an impressively simple structure. A number of villagers have been nominated for the job of measuring daily precipitation levels at strategic points in the Búzi river basin. Water levels along the river are also monitored using straightforward gauges. If there is particularly heavy rainfall or the water level becomes critical, this information is passed on by radio. Should reports reaching the central coordination point indicate widespread heavy rainfall, the alarm is raised. The gauges that measure the depth of the river are key elements in the controlling process. The people living in the area undergo special training to alert them to the dangers. A system of coloured flags is used to signal a flood warning. Pre-designated helpers are sent out armed with megaphones to raise the alarm and areas at risk are evacuated.

As a result of enhanced capacity of the local communities along the Buzi river to take measurements of water levels and report them, to understand and heed warning advisories, the death toll during floods was greatly reduced.

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<sup>5</sup> Munich Re Foundation: Flood Warning System Project in Mozambique. <http://www.munichre-foundation.org>



Measuring daily precipitation levels and training for local communities living along the Buzi River

The work on the Búzi flood warning system in Central Mozambique has been brought to a close. The system was handed over to Mr. Landa, the District Governor, in the autumn of 2006. Trials performed before the rainy season in the autumn of 2005 and 2006 show that the system has been understood and accepted by the people living along the river. The second phase entails installing the warning system on another river in Mozambique, the Save. Proof of replicability is an essential prerequisite to demonstrate that early-warning systems geared to the people at risk will also work successfully in other risk areas.

3. The crucial importance of regional cooperation was acknowledged with the approval, in 2005, of a regional water policy.
4. New agreements on the exchange of data on floods and droughts and the coordination of responses across national borders have also been signed with neighboring countries (see Limpopo Agreement above).
5. A regional project is installing 50 new gauging stations in the region's main river basins.
6. A flood risk analysis has been carried out in Mozambique's major river basins, to identify vulnerable areas and people. This found that 40 out of 126 districts are prone to flooding, and 5.7 million people in these districts are vulnerable. This is a valuable starting point for planning and implementing measures to reduce vulnerability. Following the analysis, some equipment has been upgraded and some new equipment installed, including two new radars and 15 new meteorological stations.
6. Between 2004 and 2006, the province's hydro-meteorological network was improved, from 6 to 14 stations and from a 1-month time lag between data collection and analysis to daily receipt of data.
7. In addition, Mozambique now has a tropical cyclone warning system, distinct from the flood early warning system. This early warning system informs people of the probable arrival of a tropical cyclone at least 48 hours in advance. Vulnerable populations are advised on the measures they should take. The following summarizes future requirements for flood management:
  - A balance between structural and non-structural measures is necessary for flood mitigation, i.e. both planning and physical measures. A good contingency plan is a prerequisite.
  - Strong institutional coordination that makes best use of the information and resources available is important. Effective cooperation at the regional level is also essential but sharing data at the regional level is still a challenge.
  - Vulnerable communities must be involved in flood preparation as well as educate them about the risks. Appropriate, clear, and timely messages during a flood situation are also vital.

However, inadequate and sporadic government financing is not sustainable for flood and early warning infrastructure such as weather radars and automatic weather stations alone and there is a need for a more focused engagement strategy by the National Institute of Meteorology to the Mozambique government which will be essential for adequate budget allocations to complement donor funding to meet

capacity development needs that would fully deliver the required DRR services for the safety of life and property for future flood events.

Nevertheless, it should be noted that as Mozambique continues to improve its DRR contingency plans and policies, adaptive capacity is continuously inbuilt into the Mozambique Flood Early Warning System and resilience is being accrued in mitigating drought and floods for future more severe impacts.

<sup>6</sup>The submitted NAPA for Mozambique has prioritized the strengthening of the early warning system as being critical for Mozambique to manage floods and build resilience to the impacts of a changing climate in its economic sectors. This demonstrates national commitment to the strengthening of the national early warning system and associated capacities in the NMHS of Mozambique.

The recent 2012 Floods in Mozambique after tropical cyclone Funso, a category 4 storm hit the Mozambique coastline between 20 and 22 January 2012 and affected 65,000 people in the Zambezia province. Only 40 deaths were reported which is a much lower number than in 2000 and in 2001.

6. A community-based disaster risk management program has been undertaken in the Buzi District of Sofala Province. The project involved raising awareness of risk and building capacity to reduce vulnerability and to respond to disasters. Communities participated in risk assessment and disaster simulation exercises.
7. Between 2004 and 2006, the province's hydro-meteorological network was improved, from 6 to 14 stations and from a 1-month time lag between data collection and analysis to daily receipt of data.
8. In addition, Mozambique now has a tropical cyclone warning system, distinct from the flood early warning system. This early warning system informs people of the probable arrival of a tropical cyclone at least 48 hours in advance. Vulnerable populations are advised on the measures they should take. The following summarizes future requirements for flood management:
  - A balance between structural and non-structural measures is necessary for flood mitigation, i.e. both planning and physical measures. A good contingency plan is a prerequisite.
  - Strong institutional coordination that makes best use of the information and resources available is important. Effective cooperation at the regional level is also essential but sharing data at the regional level is still a challenge.
  - Vulnerable communities must be involved in flood preparation as well as educate them about the risks. Appropriate, clear, and timely messages during a flood situation are also vital.

Nevertheless, inadequate and sporadic government financing is not sustainable for flood and early warning infrastructure such as weather radars and automatic weather stations alone and there is a need for a more focused engagement strategy by the National Institute of Meteorology to the Mozambique government which will be essential for adequate and sustained budget allocations to complement donor funding to meet capacity development needs that would fully deliver the required DRR services for the safety of life and property for projected future, more severe flood events.

However, it should be noted that as Mozambique continues to improve its DRR contingency plans and policies, adaptive capacity is continuously inbuilt into the Mozambique Flood Early Warning System and resilience is being accrued in mitigating drought and floods for future more severe impacts.

*Adapted from Climate Risk Management in Africa : Learning From Practice , International Research Institute for Climate & Society (IRI) Publication, 2007.*

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<sup>6</sup> [http://unfccc.int/cooperation\\_support/least\\_developed\\_countries\\_portal/submitted\\_napas/items/4585.ph](http://unfccc.int/cooperation_support/least_developed_countries_portal/submitted_napas/items/4585.ph)