Funding information

FATHUM is funded by the UK 'Science for Humanitarian Emergencies and Resilience' (SHEAR) research programme

Grant number NE/P000525/1

Forecasts for Anticipatory Humanitarian Action (FATHUM)

MOZAMBIQUE COUNTRY-SPECIFIC RISK AND VULNERABILITY PROFILE REPORT

Rui da Maia, Benedita Nhambiu, Joaquim Cuna, Uneiza Amid, Agostinho Vilanculos, Júlio Machele

DRAFT REPORT

JULY 2019

Acronyms and abbreviations

ARA-Sul: Administração Regional de Águas Sul

CCGC: Conselho Coordenador de Gestão de Calamidades

CCPCCN: Conselho Coordenador de Prevenção e Combate às Calamidades Naturais

CENOE: Centro Nacional Operativo de Emergências

CIF: Climate Investment Funds

CLGRC: Comité Local de Gestão do Risco de Calamidades

CPT: Climate Predictability Tool

CVM: Cruz Vermelha de Moçambique (Mozambique National Red Cross Society)

DJF: December - January - February

DNGRH: Direcção Nacional de Gestão de Recursos Hídricos

DPCCN: Departamento de Prevenção e Combate às Calamidades Naturais

FATHUM: Forecasts for AnTicipatory HUManitarian action

FbF: Forecast based financing

FMA: February - March - April

GACOR: Gabinete de Coordenaçãoda Reconstrução

INAM: Instituto Nacional de Meteorologia

INGC: Instituto Nacional de Gestão de Calamidades

JFM: January - February - March

NCOF: National Climate Oulook Forum

NDJ: November - December - January

NGO: Non-Governmental Organization

PDPMCN: Plano Director para Prevenção e Mitigação das Calamidades Naturais

SARCOF: Southern Africa Regional Climate Outlook Forum

SMS: Short Message Service (text message)

SOPs: Standard Operating Procedures

UDM: Universidade Técnica de Moçambique (technical University of Mozambique)

UNAPROC: Unidade de Proteção Civil

Table of Contents

Acronyms and abbreviations 1

Table of Contents ..... **Error! Bookmark not defined.**

Table of Tables 5

Table of Figures 5

EXECUTIVE SUMMARY 6

2 INTRODUCTION 7

3 OVERVIEW OF MOZAMBIQUE AND SELECTED STUDY SITES 7

3.1 Selected study sites 8

3.1.1 Introducing Chibuto District 9

3.1.2 Introducing Chókwè District 11

3.1.3 Introducing Guijá District 13

4 OVERVIEW OF METHODOLOGY 15

4.1 Phase 1: Secondary data collection on disaster risk profile and history of the study sites .. 15

4.2 Phase 2: Primary data collection 15

5 FIELDWORK 18

6 DOCUMENTING THE HISTORY OF FLOOD RISK IN MOZAMBIQUE: 2010-2018 22

7 UNPACKING THE RISK DRIVERS 23

7.1 Biophysical/environmental drivers of risk 23

7.2 Economic drivers of risk 26

7.2.1 Salinization of irrigated soils 27

7.2.2 Land degradation 27

7.3 Social and cultural drivers of risk 27

7.4 Political drivers of risk 29

8 DISASTER RISK GOVERNANCE 29

8.1 Institutional frameworks guiding disaster risk decision-making 29

8.1.1 Territorial and administrative governance 29

8.1.2 Key actors and organisations 30

8.1.3 Overview of forecast-based action and financing 33

8.2 Early warning systems 33
8.2.1 Siren network 33
8.2.2 Community Sensors 34
8.2.3 Other Early Warning Systems 34
8.2.4 Efficiency of Early Warning Systems 34
8.2.5 Recent improvements in Early Warning Systems 35
9 CONCLUSIONS 36
9.1 Summary of findings 36
9.2 Recommendations for further research 37
10 BIBLIOGRAPHY 37

Table of Tables

Table 1 Chibuto villages and coordinates 10
Table 2 Chókwè villages and coordinates 13
Table 3 Guijá villages and coordinates 14
Table 4 Guijá district field work and findings 19
Table 5 Chókwè District fieldwork and findings 20
Table 6 Chibuto district fieldwork and findings 21
Table 7 Timeline of main disaster affecting the study sites from 2008 to 2018 (http://glidenumber.net) 22

Table of Figures

Figure 1 Map of Chókwè, Guijá and Chibuto Districts 8
Figure 2 Map of Chibuto District 10
Figure 3 Map of Chókwè District 12
Figure 4 Map of Guijá District 14
Figure 5 CLGRC receiving "preparedness kits" 16
Figure 6 Methodology flowchart 17
Figure 7 CVM-sponsored CLGRC headquarters in Mubangoene 18
Figure 8 Average rainfall in Limpopo Basin 24
Figure 9 Relief map of Limpopo Basin 25
Figure 10 Satellite-detected flood waters along the Limpopo River 25
Figure 11 Flood information points 26
Figure 12 Institutional framework for disaster risk management (Source: INGC presentation in the Workshop of National Platforms, Davos Switzerland, 2008) 31
Figure 13 Hydrometric scale as an early warning sensor in Chókwè 34
Figure 14 EWS battery operated sensor 35
Figure 15 Hydrometric scale as a EWS 35
Figure 16 Schematic representation of an early warning system established by GIZ 35

EXECUTIVE SUMMARY

This report summarizes the results of a study designed by a transboundary three-party team of researchers, carried out by UDM's *Centro de Investigação e Extensão* from 2017 to 2019. The report describes the biophysical drivers of risk (disaster risk profile and history), the local disaster risk management capacity and institutional arrangements as well as the established early warning systems.

The purpose of the study was to determine the relevance of these factors in the implementation of Forecast based Financing (FbF) for supporting flood early actions in the region addressing the following questions:

1) What are the underlying drivers of flood risk in the study sites, the Mozambican districts of Chibuto, Chókwè and Guijá, located in the Lower Limpopo Basin?
2) What flood events struck the region, in the period of 2008 to 2018?
3) What are the local, subnational and national institutional arrangements for disaster risk management in the study areas?
4) What early warning systems are in place in the study sites?

The report summarizes the answers to the above questions.

The study has found that:

a) The subject populations retain knowledge transmitted from generation to generation, that allow them to forecast climatic events;
b) Along the times the populations have developed an attachment to their social territories because they guarantee survival and social reproduction, however, the floods of 2000 reduced that attachment, especially in scenarios where it is necessary to leave the dwelling;
c) The people of the study area have their perceptions about the risk of floods;
d) Information on extreme weather events can be found at INGC-Gaza, District Government, ARA-SUL UGBL and District Services. Some of the information can also be obtained from non-governmental organizations (NGOs) working with government;
e) The local leaders have heard about FbF but they seem to be uncertain about concept;
f) National authorities do not seem to have grasped the essence of FbF;
g) FbF was not effectively implemented in any of these localities although geographic vulnerability was factored into the selection of this area for Phase two of the FbF project.

In order to determine whether the local context is relevant to the effective implementation of FbF, further research must be conducted in near future, when the Forecast-based Financing Protocols are developed for Mozambique.

1 INTRODUCTION

In the previous decade, the Early Warning Early Action plan prompted interest in climate services, forecast information, and communication protocols around the world. Accordingly, lives and livelihoods have been saved in times of danger, especially in cyclone-prone regions. In any case, the maximum capacity of early action has not yet been achieved; a significant number of catastrophic events were forecasted before they caused severe impact. The worldwide network has resolved to turn around this pattern. Nations have resolved to reinforce Early Warning Systems in the Sendai Framework on Disaster Risk Reduction. They have guaranteed to lessen the dangers of extreme events in their Nationally Determined Contributions to the Paris Climate Agreement, and they have promised to address disaster risk reduction as a cross-cutting need to accomplish the Sustainable Development Goals.

Forecast based Financing is an instrument to satisfy these duties by focussing on the gaps between forecasts and action. This instrument has two main parts: (1) creating Standard Operating Procedures that connect specific forecast triggers to a set of early actions, and (2) making available assets important to execute those activities when triggering forecast is issued (Red Cross Red Cresent Climate Centre, International Federation of Red Cross and Red Crescent Societies, & German Red Cross, n.d.)

2 OVERVIEW OF MOZAMBIQUE AND SELECTED STUDY SITES

Mozambique is a country facing several threats. Due to its morphology and geographical conditions, the country is exposed to extreme events related to the climate, with the most frequent being floods, cyclones, and droughts. The country is ranked tenth in terms of countries most vulnerable to disaster risk. Over the last 30 years, at least 14% of the population has been affected by drought, flood or tropical storms. More than half of the events (53%) that have resulted in recorded disasters, since 1970, have occurred in the last two decades.

Vulnerability to disasters with natural triggers results from several factors: Mozambique's location at the mouth of nine international rivers; the existence of arid and semi-arid zones; the long extension of the national territory in the zone of intertropical convergence, subject to losses and excessive gains of humidity; the extensive coastal zone, influenced by tropical cyclones and the existence of active seismic zones.

Over the past 20 years, the high frequency, alternation, and intensity of extreme natural events, aggravated by climate change, became a major threat to national development efforts. Together they act as a brake on economic growth and are eroding gains already achieved.

Between 2000 and 2001 Mozambique suffered the consequences of one of the biggest disasters. Between October 1999 and January 2000, rainfall had reached levels of 70% above normal in Maputo and 26% above normal at the mouth of the Limpopo River. In neighbouring South Africa, the rains were also intense, increasing the flow of rivers that cross the Mozambican territory towards the Indian Ocean. On January 2000, the Incomati, Umbelúzi and Limpopo rivers overflowed causing deaths and destroying infrastructure and agricultural fields. When, on February 2000, river flows began to decline and rainfall showed signs of slowing down, the centre of Mozambique was affected by Cyclone Eline, with winds of 192 km/h. On the night of March 14-15, tropical cyclone Idai landed near the city of Beira, Sofala province, in central Mozambique. The cyclone brought torrential rain and wind to the provinces of Sofala, Zambézia, Manica and Inhambane. The storm caused strong winds and heavy rainfall in the districts of Chimanimani and Chipinge, causing river flooding and flash flooding and subsequent deaths, destruction of livelihoods and property. In Mozambique alone, Idai left more than 600 people dead and about 1.85 million people in need. On 24 April, tropical cyclone Kenneth hit the northern island of Ngazidja in the Comoros. On the night of 25 April, the cyclone landed in Mozambique between the districts of Macomia and Mocimboa da Praia in Cabo Delgado province. With wind gusts of up to 220 km/h, tropical cyclone Kenneth became the strongest cyclone to hit the African continent. Cyclone Kenneth left 374,000 people in need. Tropical cyclone Kenneth is said to

have caused three deaths, at least 20 injured and major damage to homes across the archipelago. Estimates indicate that at least 1,000 people were displaced, mostly children.(OCHA, 2019)

The combination of flooding, flash floods and cyclone had a devastating impact with about 700 deaths, 500,000 displaced people, and about 12% of the cultivated area destroyed. Estimates made at that time showed a total loss of $ 600 million, causing a dramatic drop in gross domestic product growth rates from 7.5% in 1999 to 1.6% in 2000. While Mozambique was emerging from the 2000 destruction, 2001 was also marked by floods and floods in the Zambezi Basin. (Governo de Moçambique, 2017)

2.1 Selected study sites

Gaza province is in the South of Mozambique with its capital, the city of Xai-Xai, about 210 kilometres to the North of the national capital, Maputo. With an area of 75,334 km², this province is divided into 14 districts. Gaza is crossed by the Limpopo river, being its vital centre. It is this river that gives importance to this Province from different points of view: agriculture, politics and development.

Gaza had only 16.31 inhabitants per km². According to data from the 2017 Census Report this province has 1 388 039 residents.

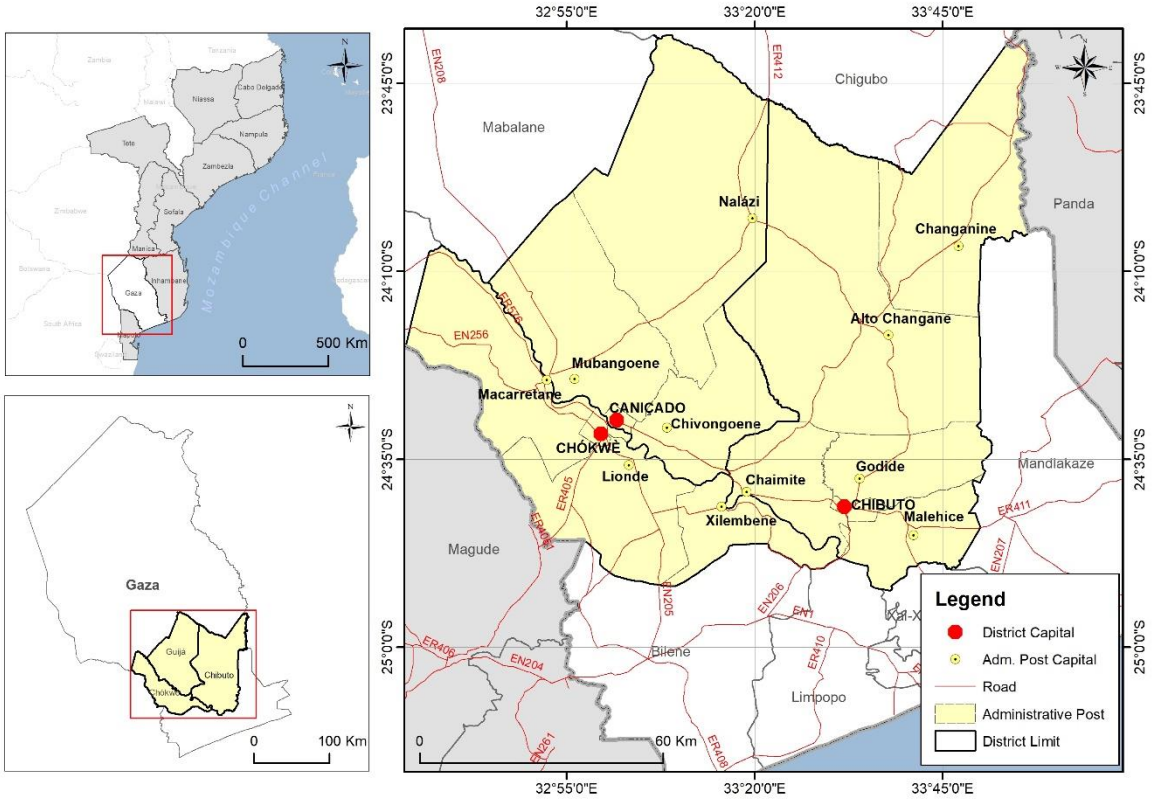
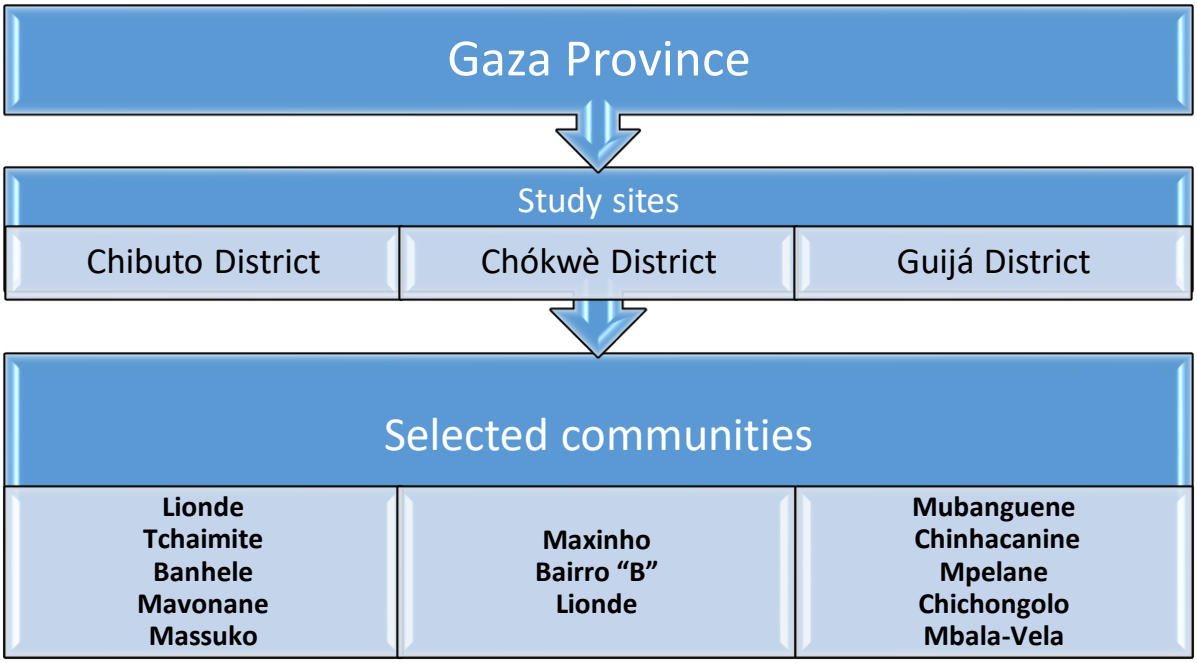


Figure 1 Map of Chókwè, Guijá and Chibuto Districts

The study sites are communities of three of Gaza Districts. Chibuto District was initially considered the target of the survey, but historical and geographical factors led to the extension of the target areas to two other districts also located on the shores of the Limpopo. Three districts of Gaza province located in the Limpopo basin were thus defined: the districts of Guijá, Chókwè and Chibuto. In these districts we concentrated on the communities most prone to floods.



Communities of Chókwè and Chibuto districts have already had conversation on the FbF model while those in the district of Guijá have not yet been exposed to the FbF concept.

2.1.1 Introducing Chibuto District

The district of Chibuto is in the southern region of Gaza Province, very close to the confluence of the Limpopo and Changane Rivers. To the North, it borders with the district of Chigubo and through the Nwaluezi River with the district of Panda-Inhambane. To the South, it borders the districts of Bilene-Macia and Xai-Xai; to the East with the district of Mandlakazi and to the West with the districts of Guijá and Chókwè.

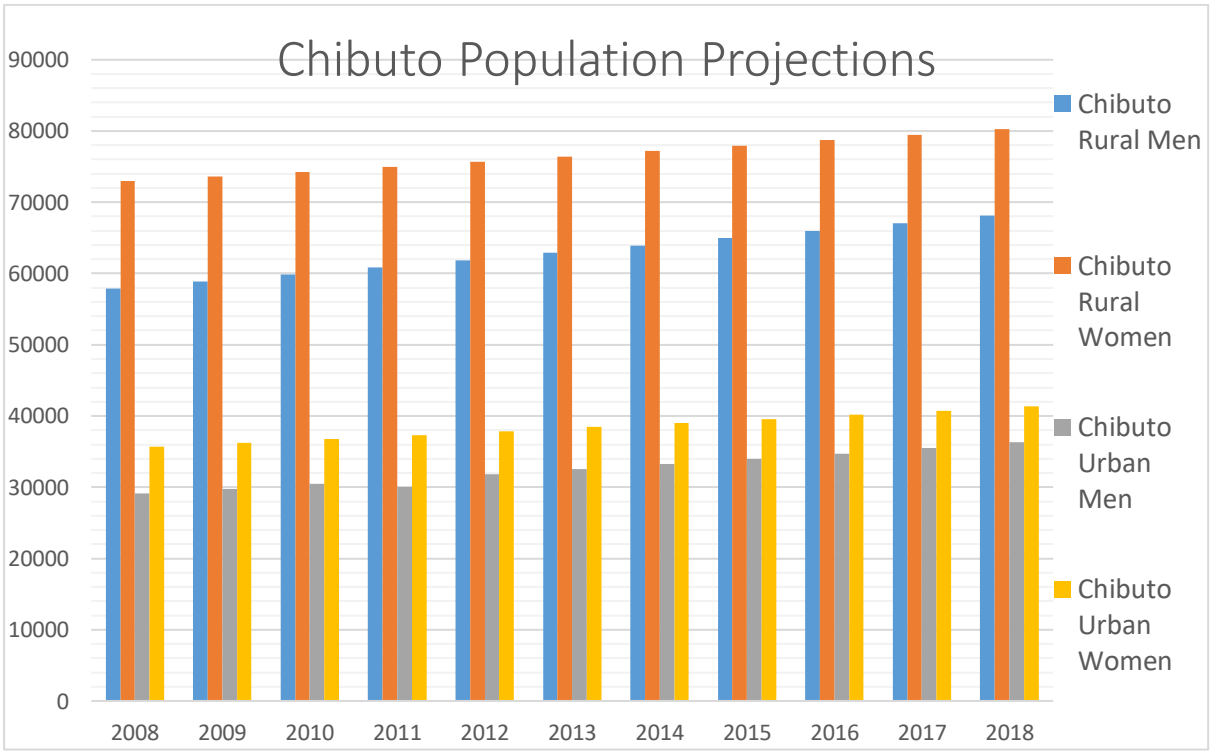


Figure 2 Annual estimates of the rural and urban, male and female population in Chibuto (Instituto Nacional de Estatística, 2010)

With a surface area of 5,653 square kilometers and a population of about 229,329 in 2017, the Chibuto district has a population density of 41 inhabitants per km^2. The potential economic dependency ratio is approximately 1: 1.3, ie, for every 10 children or elderly there are 13 people of working age. The population is young (43%, under 15 years of age), mostly female (masculinity rate 46%) and rural matrix (urbanization rate 34.5%).

Chibuto District headquarters are in the Cidade de Chibuto.

The climate of the district is generally characterized by low and irregular rainfall, increasing as we move to the coast, in an average range of 400-600 mm per year, covering the coastal zone influenced by the sea currents. The inner zone has very low annual precipitations.

The Limpopo River is of extreme importance to the district's economy, making much of its surface good for farming and livestock farming. The district is also bathed by some temporary rivers, such as Changane, Chégua and Jatingué. The district has an agrarian potential of its good soils and a zone of forests with some species of considerable economic value, including sandalwood.(Ministério da Administração Estatal, 2012)

The communities visited in this district were Tchaimite, Banhele, Mavonane and Massuko.

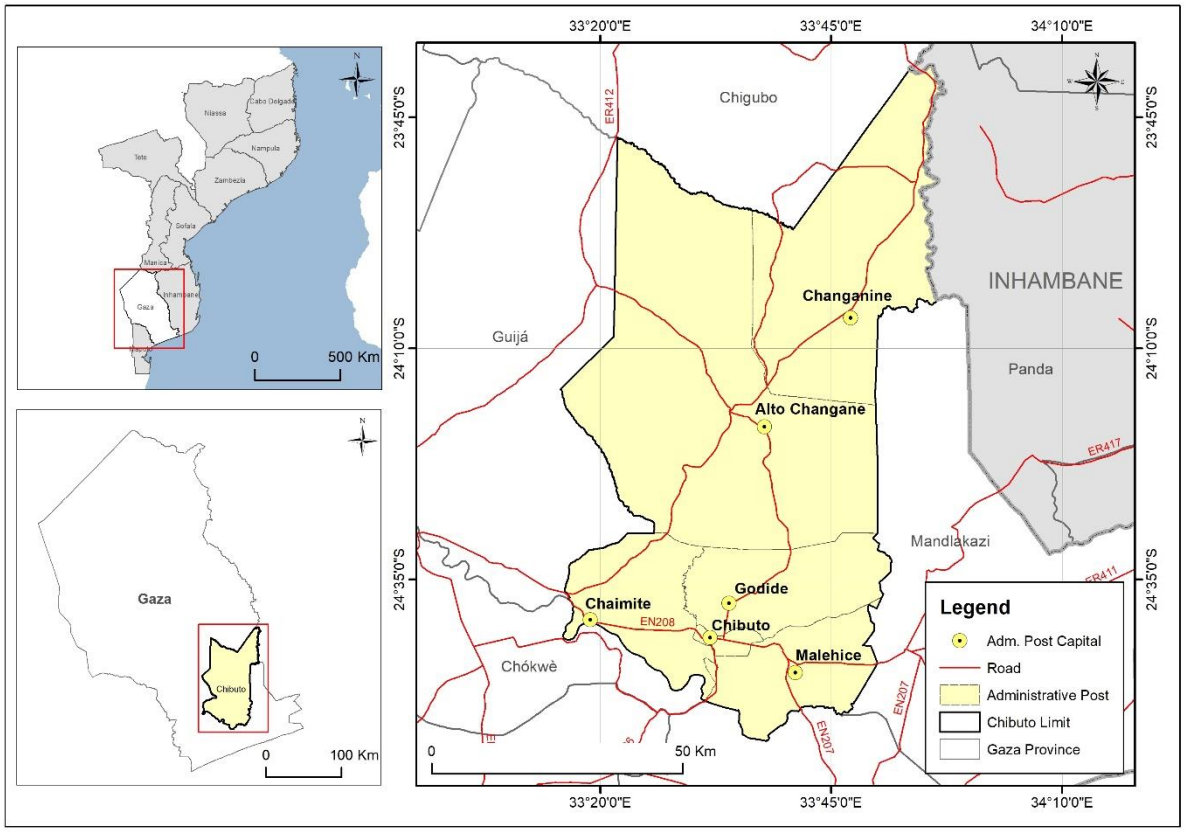


Figure 3 Map of Chibuto District

Table 1 Chibuto villages and coordinates

Locality	Longitude	Latitude
Cidade de Chibuto	33,53207	-24,68820
Tchaimite	33,31543	-24,65595
Banhele	33,27806	-24,60417
Mavonane	33,5803	-24,8164
Massuko	33,47238	-24,75990

2.1.2 *Introducing Chókwè District*

The district of Chókwè is situated to the South of the Province of Gaza, in the average course of the Limpopo River. It is limited to the North by the Limpopo River, that separates it from the Districts of Massingir, Mabalane and Guijá; to the South by the District of Bilene and the Mazimuchope River which separates it from the District of Magude; to the East it borders with the districts of Bilene and Chibuto and to the West with the districts of Magude and Massingir. (Figure 3) With an area of 2,466 km2 and a population of 219,033 inhabitants, the district of Chókwè has a population density of 89 inhabitants/ km^2. The potential economic dependency ratio is approximately 1: 1.3, ie, for every 10 children or elderly there are 13 people of working age. The population is young (44%, below 15 years of age), mostly female (45% masculinity rate) and rural (urbanization rate 45%).

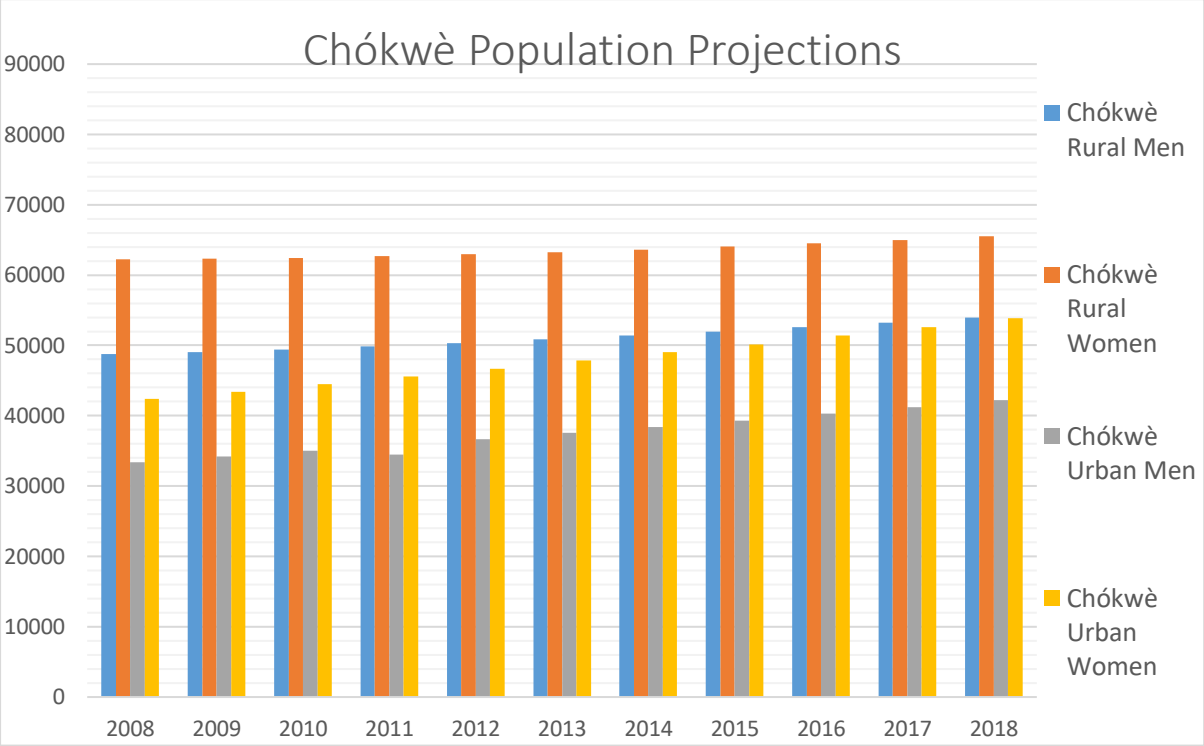


Figure 4 Annual estimates of the rural and urban, male and female population in Chókwè (Instituto Nacional de Estatística, 2010)

The climate of the District is dominated by the semi-arid type (savanna dry), where precipitation varies from 500 to 800 mm, confirming the coastal gradient inland, while the potential evapotranspiration of reference (ETo) is in the order of 1400 to 1500 mm. Average annual temperatures range from 22 °C to 26 °C and the average annual relative humidity from 60-65%. The low rainfall, coupled with the high temperatures, results in a marked water deficiency. The irregularity of the rains causes drought and frequent droughts, even during the rainy season.

The whole district of Chókwè is a plain less than 100 meters high and composed of alluviums along the Limpopo River, that cross the whole district in the NW-SE direction, and by undifferentiated deposits in the rest of the district. Terraces occur in the southeastern end of the district, near the district of Bilene. In Macarretane, in the area of Matuba, red clays occur. The district has a great hydrographic potential, being bathed by the right bank of the Limpopo River and by the Mazimuchope River. It also has the ephemeral streams of Ngonwane, Munhuane, Chuezi, Nhambabwe and the Chinangue, Ngondzo, Nha-nhai, Mbalambe and Khokhotiva lagoons. The Limpopo River is, after the Zambezi, the largest river in Mozambique, and serves the country's largest irrigation system, crossing the Chókwè district along its entire length, NW-SE, establishing the border with the districts of Mabalane, Guijá and Chibuto.

The total catchment area of the Limpopo River is 412,280 Km^2, spread over four countries, along its 1,461 km. The Limpopo starts at the confluence of the Marico and Crocodile rivers in South Africa, in

a zone northwest of Pretoria. After joining the Notwane River from Botswana, this river establishes a border between Botswana and South Africa and flows to the Northeast. At the confluence with the Shashe River, coming from Zimbabwe, the Limpopo turns east and runs along the border between Zimbabwe and South Africa before entering Mozambican territory in Pafúri. In Mozambique, the Limpopo runs 561Km, before flowing into the Indian Ocean at Zongoene, 60km from the city of Xai-Xai.

The Elephants' river and its tributaries form the second catchment area of Limpopo, of which 84% is located in South Africa. The third catchment area of Limpopo, with 43,000 km^2 in Mozambique, is connected to the Changane River, which drains an area of low precipitation and is dry most of the year. The flow of the Limpopo is characterized by a considerable flow variation, being, some years, dry for some months. It is estimated that only 10% of the measured flow in Chókwè is generated in the Mozambican part of the catchment area of the river. Its flow rates are very low during the dry season and are greatly reduced in the Lower Limpopo (from the Macarretane dam to the mouth of the river in Zongoene), due to the construction of reservoirs and dams in the upstream countries.

The waters of the Limpopo River tend to be highly mineralized (saline) due to several reasons, namely: (a) the fact that the river drains an arid catchment area; (b) the inflow of the saline water drained from the various irrigation systems existing along its margins, which increases the conductivity and concentration of salts in the downstream direction; and (c) the river's gradient is low in the dry period, with penetration of seawater (salty) inland, up to 80 km from the coast. As for the Elephants river, although its flow fluctuations are lesser than those of the Limpopo, they are significant, being the Massingir reservoir essential for its regulation and to allow the intensive use of water in the Lower Limpopo.

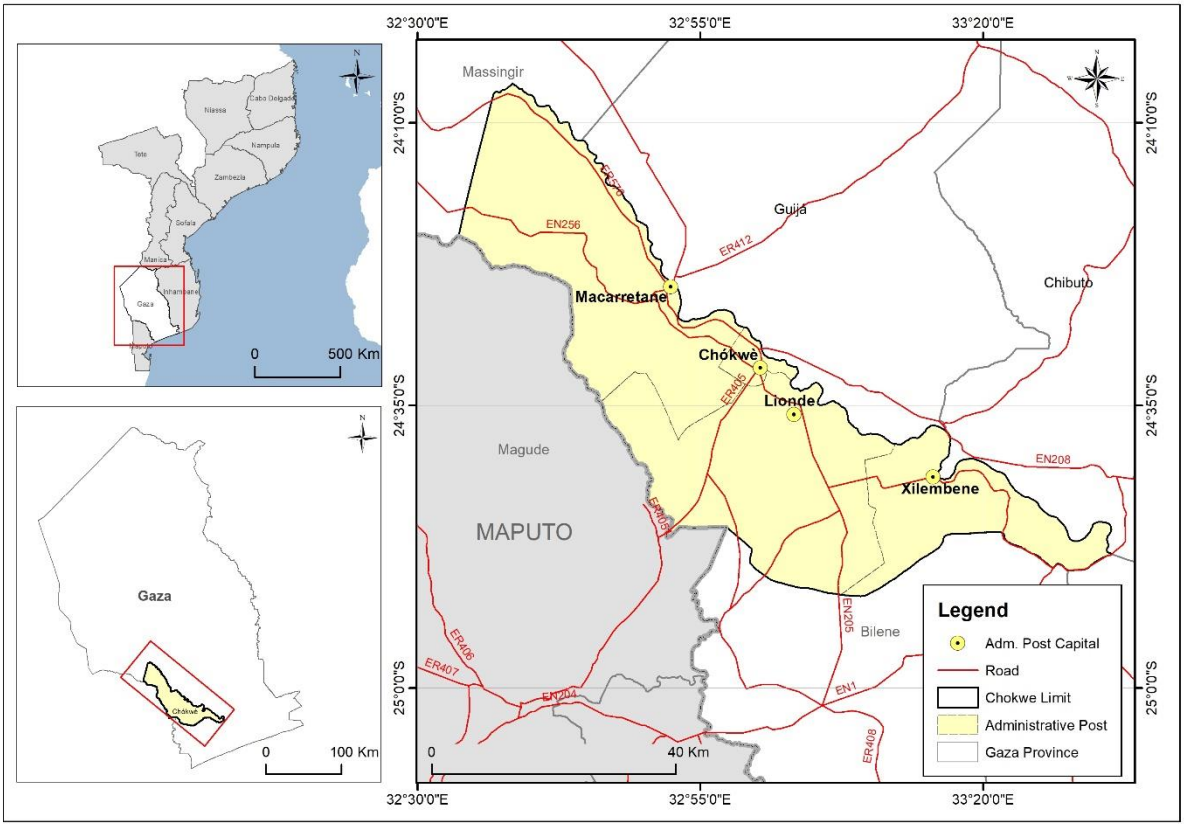


Figure 5 Map of Chókwè District

Most aquifers in the Chókwè district are deep (more than 100 meters), ranging from high productivity and good water quality (in the town of Chókwè, Lionde and most of Macarretane), low productivity and mediocre water quality (in a part of Macarretane). The eastern part of the district (Chilembene) has aquifers up to 20 meters with high productivity and good water quality. More than 2/3 of the

district's territory has areas with occurrences of brackish water. Water in the district of Chókwè, including the city of Chókwè, is obtained mainly through boreholes that exist in the localities. Areas outside the irrigation system do not have access to improved water sources, and during the dry season their residents are forced to travel long distances in search of water.(Ministério da Administração Estatal, 2005a)

Table 2 Chókwè villages and coordinates

Locality	Longitude	Latitude
Cidade de Chókwè	33,00514	-24,52744
Maxinho	32,71383	-24,22219
Bairro "B"	33,00514	-24,52744
Lionde	33,06670	-24,58330

2.1.3 Introducing Guijá District

The district of Guijá is located southeast of the province of Gaza and lies between the parallels 23 ° 50' and 24 ° 50 'South, and between 32 ° 25' and 33 ° 40' East. It is bordered to the North by the District of Chigubo, the Northwest by the District of Mabalane, the South by the District of Chókwè and the East by the District of Chibuto. With an area of 4,207 km2 and a population of 104,550, the district of Guijá has a population density of 25 inhabitants per km^2. The potential economic dependency ratio is approximately 1: 1.4, i.e. for every 10 children or elders there are 14 people of working age. The population is young (42%, below 15 years of age), mostly female (46% masculinity rate) and rural matrix (urbanization rate 6%).

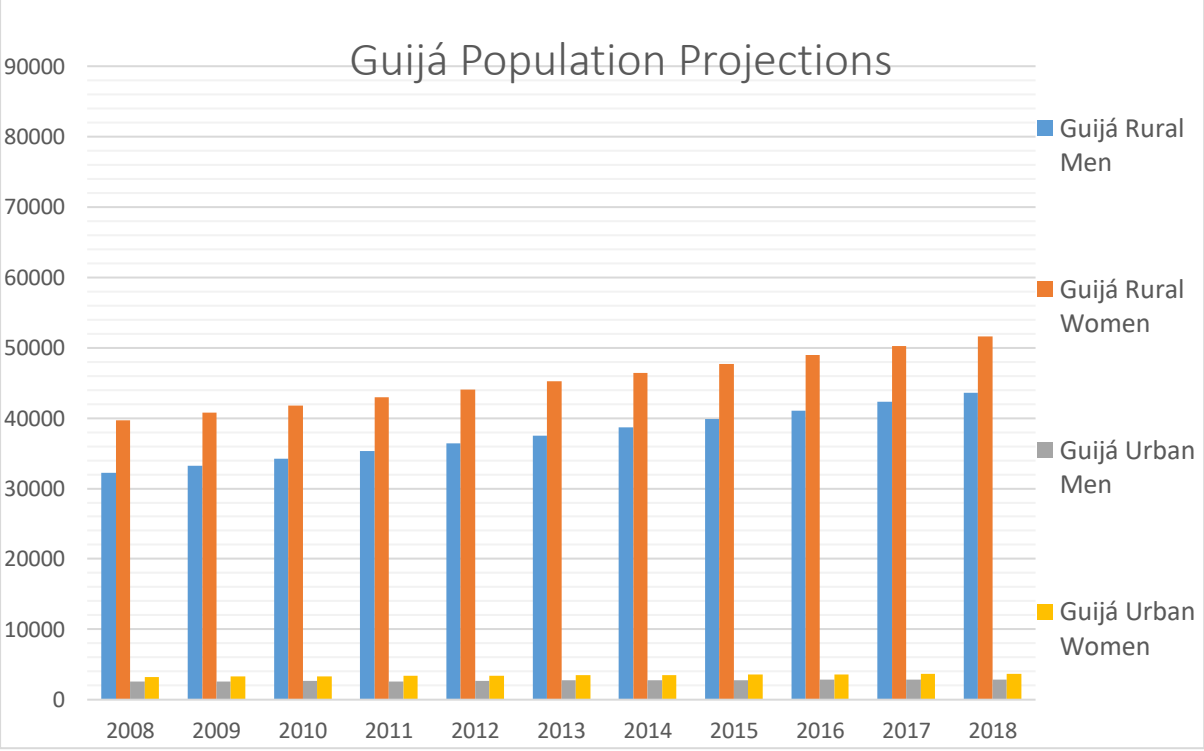


Figure 6 Annual projections of the rural and urban, male and female population in Guijá (Instituto Nacional de Estatística, 2010)

The climate of the district is dominated by dry semi-arid zones, with average annual temperatures between 24-26 °C, characterized by low and irregular rainfall, making rainfed agriculture a risk activity. The annual rainfall is between 400 and 600 mm (see Fig 11), showing a relative increase in rainfall from North-West (Nalazi administrative post) to Southeast (Chivongoene administrative post). The annual plant growth period increases from 60 to 90 days from West to East. The District is located on

the left bank of the Limpopo River, and is also crossed by the Nandjote, Piane, Chichacuane and Balabala streams, which join in Chibuto to form the Changane River. These streams, periodic, require some investment in infrastructure for water retention. In addition to these rivers, the Bambeni and Figueze lagoons stand out. (

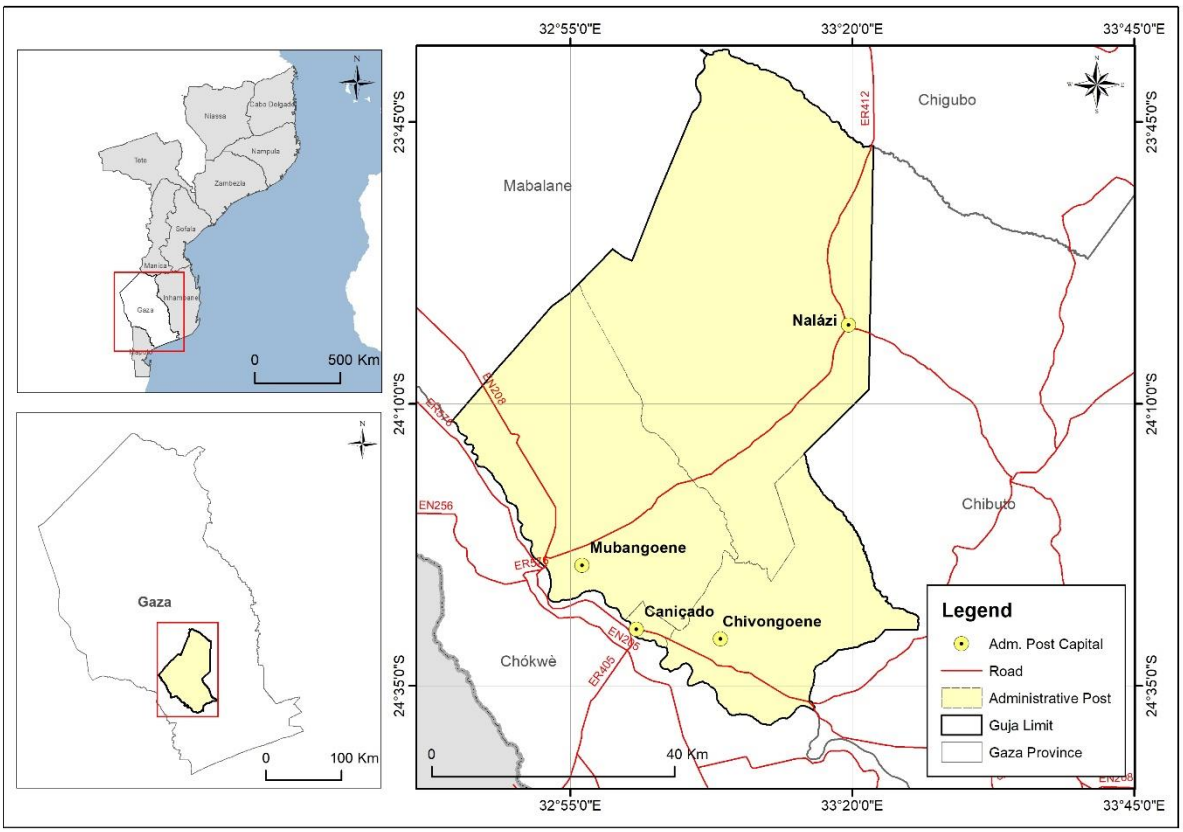


Figure 7 Map of Guijá District

The district of Guijá is in a plain with an altitude of less than 100 meters. In geological terms, it is composed of undifferentiated deposits, except for the Limpopo Valley area, which runs all along its southern border, where alluvial deposits occur. To the North of the village of Caniçado (Mubangoene) occurrence of sandy soils and in the Southeast part (Chivongoene), red and plastic clays. As for morphology, accumulation plains, formed by clayey and alluvial-proluvia materials, are found mainly in the northern half (Nalazi) and low fluvial-sedimentary lowland plains in the southern half (Mubangoene and Chivongoene). Along the Limpopo River there are valleys that are lowered with alluvial deposits, good for agriculture. In the North, there are small patches of swamps, occupying mobile beds with proluvial deposits, and in the Southeast (Chivongoene), there are the bottoms and slopes of the valleys of the Piane and Balabala rivers with terraces (Ministério da Administração Estatal, 2005b).

Table 3 Guijá villages and coordinates

Locality	Longitude	Latitude
Caniçado	33,01437	-24,49922
Mubanguene	32,94111	-24,41361
Chinhacanine	32,90330	-24,36280
Mpelane	32,83667	-24,24000
Chichongolo	33,00139	-24,31611
Mbala-Vela	33,10833	-24,28222

3 OVERVIEW OF METHODOLOGY

The main objective of the study "Mozambique Risk Profile Report" (conducted by UDM's FATHUM WP2 members) is to describe the risk profile of Mozambique as a foundation for the research "The relevance of local context in the implementation of FbF" carried out by FATHUM's Work Package 2. A research methodology was developed across South Africa (Stellenbosch University), Mozambique (Technical University of Mozambique, UDM), and Uganda (Makerere University), who are conducting research for the FATHUM project. The three parties produced country-specific risk profile reports, which will afterwards be used to compare risk profiles across the three countries in an integrated report. This report will serve as a foundation for exploring the relevance of local context in the implementation of FbF, in order to interrogate the effectiveness of FbF/A activities and the potential for situating FbF/A within local, longer-term resilience-building and short-term humanitarian response.

Methodology for this study was developed from July 2017 to June 2018 in meetings among the three parties, a process depicted in Figure 9.

Three research themes were identified as foundation for the research questions:

1. Disaster risk profile and history
2. Existing DRM capacity and institutional arrangements
3. Existing early warning systems and FbF activities

From a pool of ten data collection tools proposed, the following tools were agreed upon as ways to gather information on the themes above:

a) Review of existing studies;
b) Socio-demographic info for each site;
c) Policy analysis and summary;
d) Historical disaster timeline and
e) Focus group guide – for communities and local disaster management committees.

The five tools were applied in each of the three country sites, with contextual modifications.

In Mozambique work was conducted in three phases using the tools listed above.

3.1 Phase 1: Secondary data collection on disaster risk profile and history of the study sites

This phase consisted of qualitative research aimed at understanding the following:

- What are the main risks affecting the study sites in Mozambique?
- What are the disaster management institutions and policies in Mozambique and how to they work in practice?
- What early warning capacities (scientific) are in place in the study sites?

For this phase the research team conducted a documentary review of policies, legal and planning instruments, published and unpublished reports and articles as well as newspapers and internet sites. The main challenge encountered was lack of recorded information at local level (localities, communities) and scattered and oftentimes contradictory information at subnational level.

3.2 Phase 2: Primary data collection

Phase 2 consisted on field work aiming to interview KIIs and FGs in selected communities of Chibuto district that had had any FbF /A intervention and do the same in communities that never had any such intervention (Guijá). Informants targeted at district level and community levels were District Government officials, District services (SDAE, SDPI CTD), community leaders, CLGRC and community

members. The research time found out that contrary to the original perception, CVM had not yet initiated FbF/A in any community. They were distributing preparedness kits to only CLGRC members.

Figure 8 CLGRC receiving "preparedness kits" from CVM

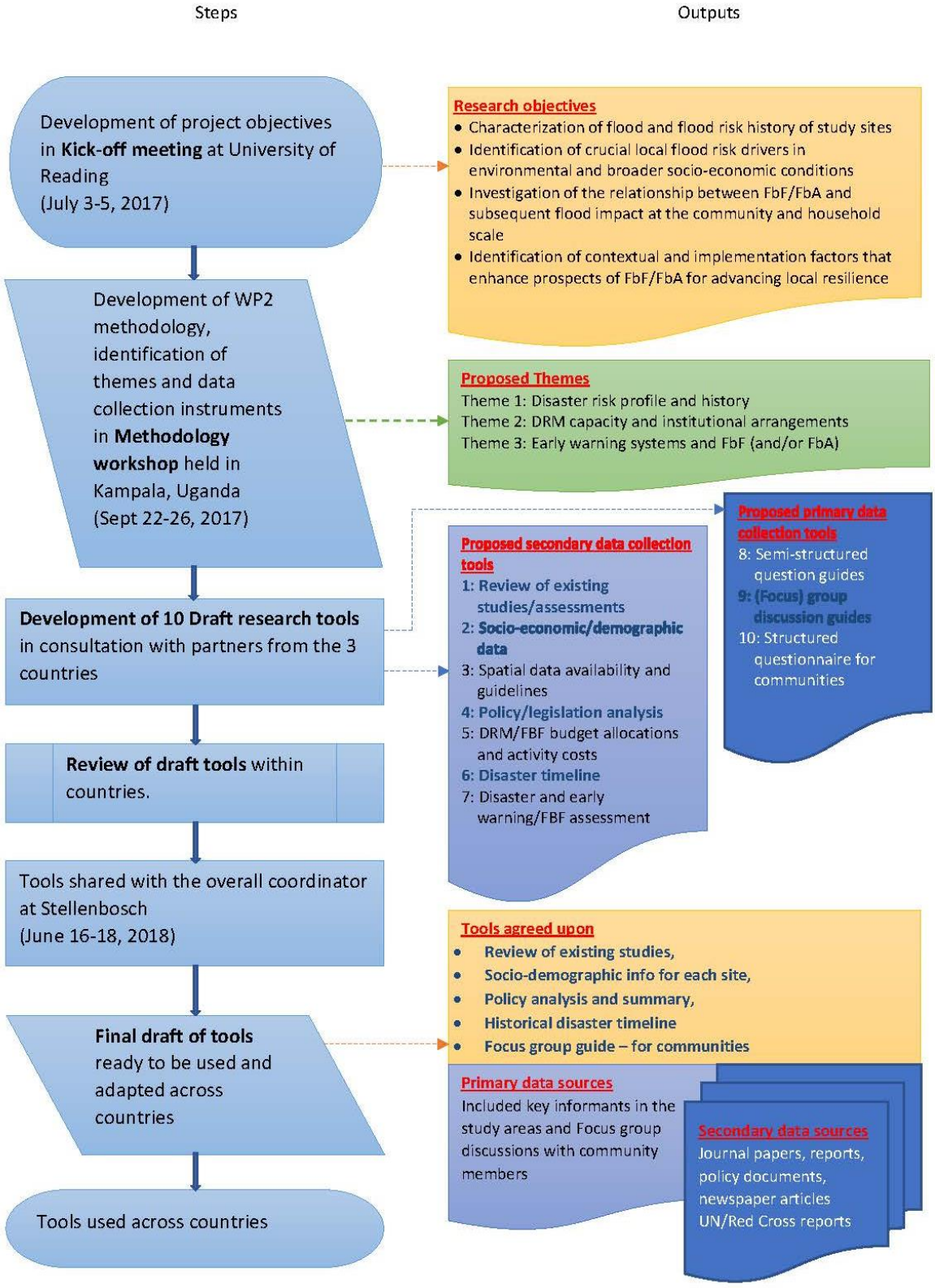


Figure 9 Methodology flowchart

4 FIELDWORK

Fieldwork was conducted from 31st July to 9th August of 2018 in communities of Chibuto, Guijá, and Chókwè districts and involved local stakeholders like district state officials, local disaster management committees (CLGRC, *Comités Locais de Gestão do Risco de Calamidades*), and community leaders. CLGRCs were interviewed using as a guide a semi structured questionnaire, a modification of "form 9", developed in earlier stages of definition of the methodology. Sixteen CLGRCs with an average of six members were interviewed and whenever necessary individual interviews were carried out and. Another questionnaire was made to state officials whose activities are related to disasters triggered by natural conditions. Similarly, in this case, where necessary, questionnaires and interviews where combined with conversation that was afterwards noted. Surveys administered to state officials essentially captured the official responses to floods as well as the identity of partners and their interventions. Altogether, six state officials, three in Chibuto, two in Guijá and two in Chókwè. Tables 4, 5, and 6 summarize data collected in the three study districts during fieldwork. In all cases, participants' anonymity, confidentiality and willingness to participate was ensured.

Contrary to the original information, none of these communities had FbF interventions so far.

Figure 10 CVM-sponsored CLGRC headquarters in Mubangoene

Table 4 Guijá district field work and findings

District	Locality Longitude Latitude	Population	Infrastructures/ Services	Livelihoods	Vulnerability to extreme weather events	DRM	NGOs	EWSs	Interviews
Guijá	**Caniçado** 33,014370 -24,499220						CVM World Vision Save the Children		1
Guijá	Mubanguene 32,941110 -24,413610		• Shops (2) • Clinic (1) - 20 km away • Primary schools (1)	• Agriculture (grain, Vegetables and tubers) • Cattle breeding (cows) • Poultry	• Houses destruction by cyclones • Roofs removed by cyclones • Floods (worst in 2013) • Hunger due to drought (2015-16)	CLGRC (1)	INGG WFP CVM	• Radio • No traditional WS	3
Guijá	Chinhacanine 32,903300 -24,362800		• Water wells (NC) • Market (1) • Primary school (1) • Clinic (1)	• Agriculture (grain, vegetables and tubers) • Cattle breeding (cows and goats) • Poultry	• Cyclones	CLGRC (1)	INGC CVM	• Radio • Community leaders • No traditional WS	1
Guijá	Mpelane 32,836670 -24,240000		• Primary school (1) • Clinic (1)	• Agriculture • Charcoal production • Small cattle breeding (cows and goats)	• Cyclones • Storms • Dry spells	CLGRC (1)	WFP FAO CVM	• SMS • Radio • No traditional WS	4
Guijá	Chichongolo 33,001390 -24,316110		• Water wells (1 rig drilled and several hand drilled) • Market (1) • Primary school (1) • Clinic (1)	• Agriculture (grain, cassava and sweet potatoes) • Low level cattle breeding (water scarcity) • Poultry	• Cyclones • Storms • Dry spells (2015 - 2017)	CLGRC (1) DTC	CVM		2
Guijá	Mbala-Vela 33,108330 -24,282220	20100	• Primary school (1) • Police station (1) • Water system (1) • Hand drilled wells	• Agriculture • Forestry • Cattle breeding	•		CVM		1

Table 5 Chókwè District fieldwork and findings

District	Locality Longitude Latitude	Population	Infrastructures/ Services	Livelihoods	Vulnerability to extreme weather events	DRM	NGOs	EWSs	Interviews
Chókwè	**Cidade de Chókwè** 33,005140 -24,527440						• WFP • Save The Children • World Vision • Auxílio Mundial • Caritas • CVM • Religious congregations		2
Chókwè	Maxinho 32,713832 -24,222193	2800	• Water wells (14) • Primary school (1) • Clinic (1)	• Agriculture (maize, beans and vegetables) • Cattle breeding (cows and goats)	• Floods • Cyclones • Storms • Drought	CLGRC DTC	INGC CVM	• Messages by CLGRC • Radio • Observation of animal behavior • Observation of meteorological conditions	1
Chókwè	Bairro "B" 33,005138 -24,527439	9907	• Has access to all Chókwè city utilities (piped water, electricity)	• Agriculture (kale, lettuce, tomato, carrots, onions) • Cattle breeding (cows and goats) • Poultry (ducks and hen) • Cattle breeding (cows and goats)	• Intense floods (located on the Limpopo embankment) • A few cyclones • Drought (2015-2016) • Water borne and lack of sanitation diseases (Malaria, Diarrhea)	CLGRC INGC	Save the Children	•	1
Chókwè	Lionde 33,066700 -24,583300	16141	• Paved roads • Schools (20) • Clinics (13) • Police station (1)	• Agriculture • Cattle breeding • Food processing • Agri business • Markets	• Floods (causing deaths, damage and loss) • Cyclones (destroying houses)	CLGRC (1) DTC		• Messages by CLGRC • Siren system • Deep knowledge of traditional warning systems	1

Table 6 Chibuto district fieldwork and findings

District	Locality Longitude Latitude	Population	Infrastructures/ Services	Livelihoods	Vulnerability to extreme weather events	DRM	NGOs	EWSs	Interviews
Chibuto	**Cidade de Chibuto** 33,532070 -24,688200						• CVM • World Vision • Save The Children • UNICEF • UNHABITAT • WFP • Dores Sem Fronteiras • Reencontro • Pfuneca • Tsembeca • Tchemulane		1
Chibuto	Tchaimite 33,315430 -24,655950		• Unpaved roads • Clinic (one)	• Agriculture • Cattle breeding • Small scale informal business	• Floods • Drought	CLGRC (1)	• World Vision • CVM	• Messages from CLGRC	0
Chibuto	Banhele 33,278056 -24,604167	500+	• 2 community rooms • One water well • Clinic (one, 3 km away, in the locality of Chibabel)	• Low productivity agriculture • Cattle breeding	• Floods	CLGRC (1) DTC	• Hunger Project	• Messages from CLGRC	1
Chibuto	Mavonane 33,580331 -24,816423		• Unpaved roads • Clinic (one)	• Agriculture • Cattle breeding	• Floods • Drought • Strong winds		• World Vision • CVM	• Radio • SMSs • Old empirical knowledge (ants, toads)	1
Chibuto	Massuko 33,472377 -24,759895		• Unpaved roads • Clinic (one)	• Agriculture • Cattle breeding • Small scale informal business	• Floods • Drought • Strong winds		• World Vision • CVM	• Messages from CLGRC	2

5 DOCUMENTING THE HISTORY OF FLOOD RISK IN MOZAMBIQUE: 2010-2018

Mozambique positions third among African nations most exposed to numerous climate related risks and experiences periodic cyclones, droughts, floods, and related epidemics. Dry season happens mainly in the southern region, with a recurrence of around seven droughts every 10 years. Floods happen each two to three years, with higher levels of risk in the central and southern districts. (https://www.gfdrr.org/en/mozambique). On Table 7 Timeline of main disaster affecting the study sites from 2008 to 2018 (http://glidenumber.net) there is a listing of main disasters that have affected the study region from 2008 to 2018. Floods occur mainly towards the end of the wet season DJF (Chapman & Parker, 2014).

Table 7 Timeline of main disaster affecting the study sites from 2008 to 2018 (http://glidenumber.net)

Event	Date	Affected People	Affected areas
Flood	January 30, 2017	70 000	Maputo (Districts of Matutuine, Boane, Namaacha, Manhiça, Marracuene, Moamba, Magude, Cities of Maputo and Matola), Gaza (Districts of Bilene, Guijá, Chibuto, Mabalane, Massingir, Massagena, Chibuto, Chicualacuala, Chigubo, Cities of Chókwé and Xai-xai), Nampula and Sofala provinces
Drought	April 22, 2016	380 000	Chigubo (Gaza Province)
Flood*	January 20, 2013	450 000+	Southern and Central Mozambique
Tropical Cyclone Funso / Tropical Storm Dando	January 15, 2012	NA	Maputo, Gaza and Inhambane Magude, Chokwe and Zambézia
Flood	January 25, 2011	NA	Maputo, Incomati, Limpopo, Save, Buzi, Pungué and Zambezi River Basins in the southern and central provinces of Maputo, Gaza, Inhambane, Manica, Sofala and Zambézia
Flood	January 1, 2008	NA	Southern Africa

*Corrected figures based on local data

Over the past 10 years, the floods that have had the most impact and are well documented are the floods of 2013. There have certainly been flood scenarios over the past 10 years they but did not culminate in floods comparable to those in 2013. These floods “have appeared” in different ways in the areas visited, and the actions taken to deal with them varied with each location at the time, the existing knowledge to deal with floods, the degree of preparedness and the existence of certain infrastructures that could act as shelters to the populations, and unimpeded evacuation points.

Some areas were caught off-guard with the floods of 2013. Beyond the issue of location, there was a lack of forecasting information as well as the inability or lack of interest in exploring certain signs of nature. Grasshoppers that appeared on the shores were most likely fleeing from flooded areas further upstream the Limpopo River. Unable to find vegetation in flooded areas they moved to areas not yet flooded. The history of the province of Gaza and Mozambique in general is full of scenarios of "locust plagues" that even flying seemed like a cloud that created a great shadow and devastated all the vegetation they encountered.

Therefore, populations, even when living in areas that are easily flooded, know places in the village or in homes that are not easily flooded. This knowledge seems to be also held by livestock which, for

example, in Chokwe, were saved by staying in certain high places1. The knowledge of highlands allowed to save the residents of Mbala-Vela who with their animals went to settle there until a rescue in terms of food products brought by means of a helicopter in the floods of 2013.

As noted in the Guijá, Chókwè and Chibuto districts have never been passive victims of floods. They were able, in an autonomous way, to identify the high zones, the ways of evacuation, to rise in trees and roofs, to use buildings, to abandon definitively or partially the zones of easy flooding, etc.

The populations around the Limpopo valley were, as shown above, caught off guard. They did not have time to move to their highlands with permanent residences or save part of their animals, especially cattle. Chókwè in District "B" provides us with an interesting example of the ability to adapt and exploit existing infrastructures to escape the fury of the waters. The Chókwè Agrarian Institute (Instituto Agrário de Chókwè), a three-storey building, served as a shelter for the populations struck by floods that had their escape routes cut off. They were able to use this building to save goats and pigs as well as some poultry (chickens and ducks). They were also able to carry some of the food to the upper floors of the building.

In other areas, as in Lionde's case, a solidarity network was formed allowing some people to be moved to Chihaquelane where they have plots of land. People of good faith with vehicles, in some cases sponsored by INGC, made available their vehicles to save the people. It was reported that in Lionde they were able to virtually evacuate their animals through previously identified paths.

Private boats are currently scarce. In the community of Massuco, in the downtown area, they lamented the fact that a local private boat was not operating, which once provided much help. Locally existing canoes have proved to be quite useful for evacuating people. The use of *xiley* (sleigh) pulled by oxen allowed some families to collect their goods in the highlands if the escape routes were clear.

Previous flood events, in the years of 1977 and 2000 allowed the populations to gain new settlements in highlands. They have profitably exploited the double life made between the "new" upper and lower zones, *nyaka* where they develop agriculture. The places identified as escape routes are the results of these experiences gained over time. Children, in most cases, live in upland areas where they have access to education, although some share this with livestock grazing. The exception is in the village Mondiane, near the Limpopo river, which in most cases live with the children and claim for a primary school. Sanitary units currently exist in the highlands.

6 UNPACKING THE RISK DRIVERS

6.1 Biophysical/environmental drivers of risk

Mozambique's case study sites are in the Chibuto District, Gaza Province in the lower Limpopo Basin. Despite being a semi-arid region (Figure 11), it is prone to extensive floods due to its flatness with altitudes ranging from 0 m to 100 m (Figure 12). Most of the precipitation occurs during the summer months, from October to April with the highest peaks in December to February.

[1] It is certain that there was loss of some bovine cattle that was dragged by the water. Some owners have recovered part of their cattle already in some high points of the district of Guijá

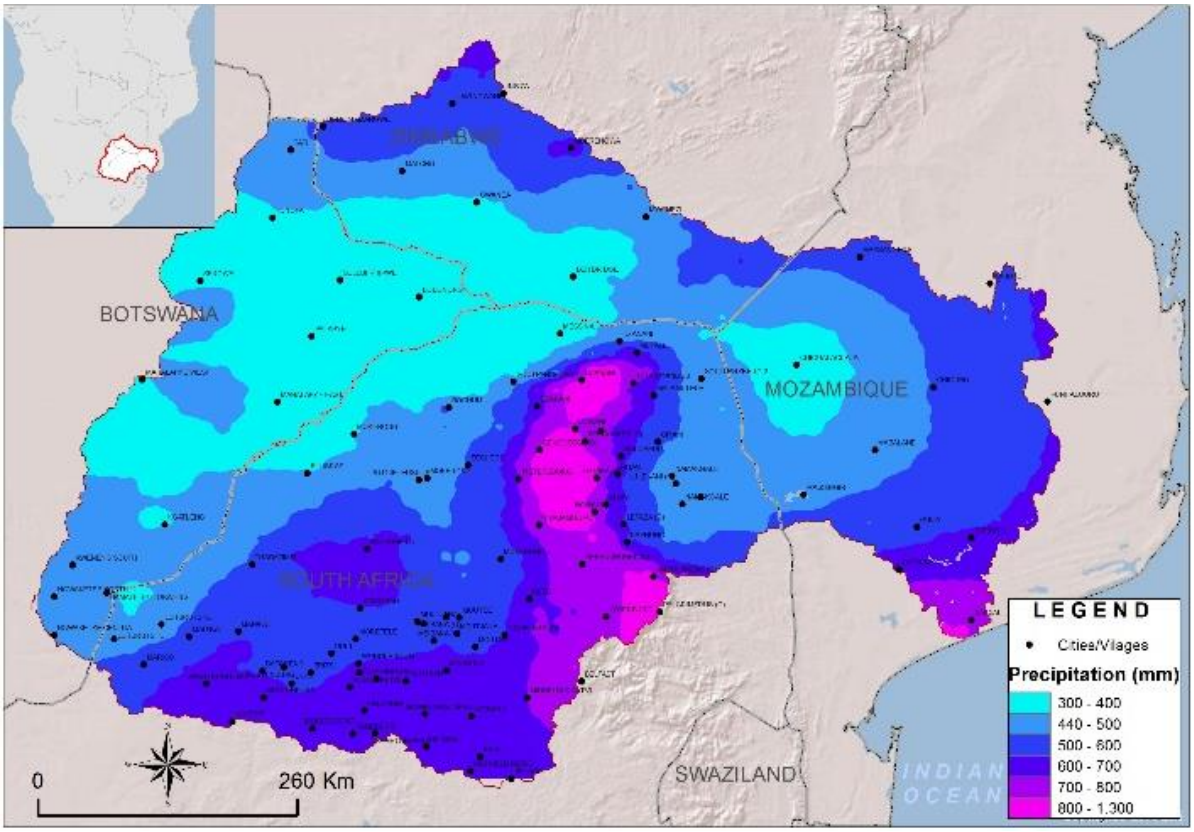


Figure 11 Average rainfall in Limpopo Basin

Community members of these regions have their lives are closely linked to experiences with floods For older people these experiences go back to the colonial period, but, according to them, the difference is that before the dam there were no floods because water had its way to circulate and that people did not interfere much with water courses.[2]

[2] This issue was strongly emphasized during a collective interview

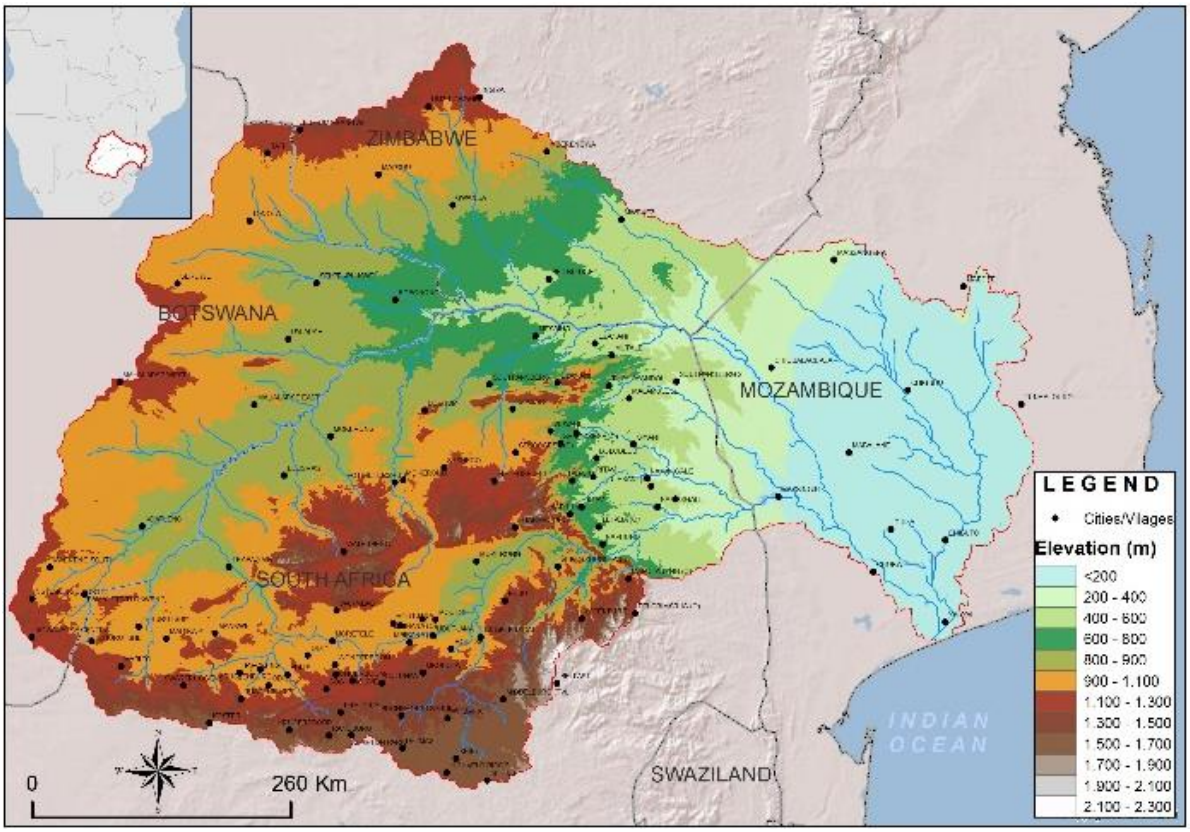


Figure 12 Relief map of Limpopo Basin

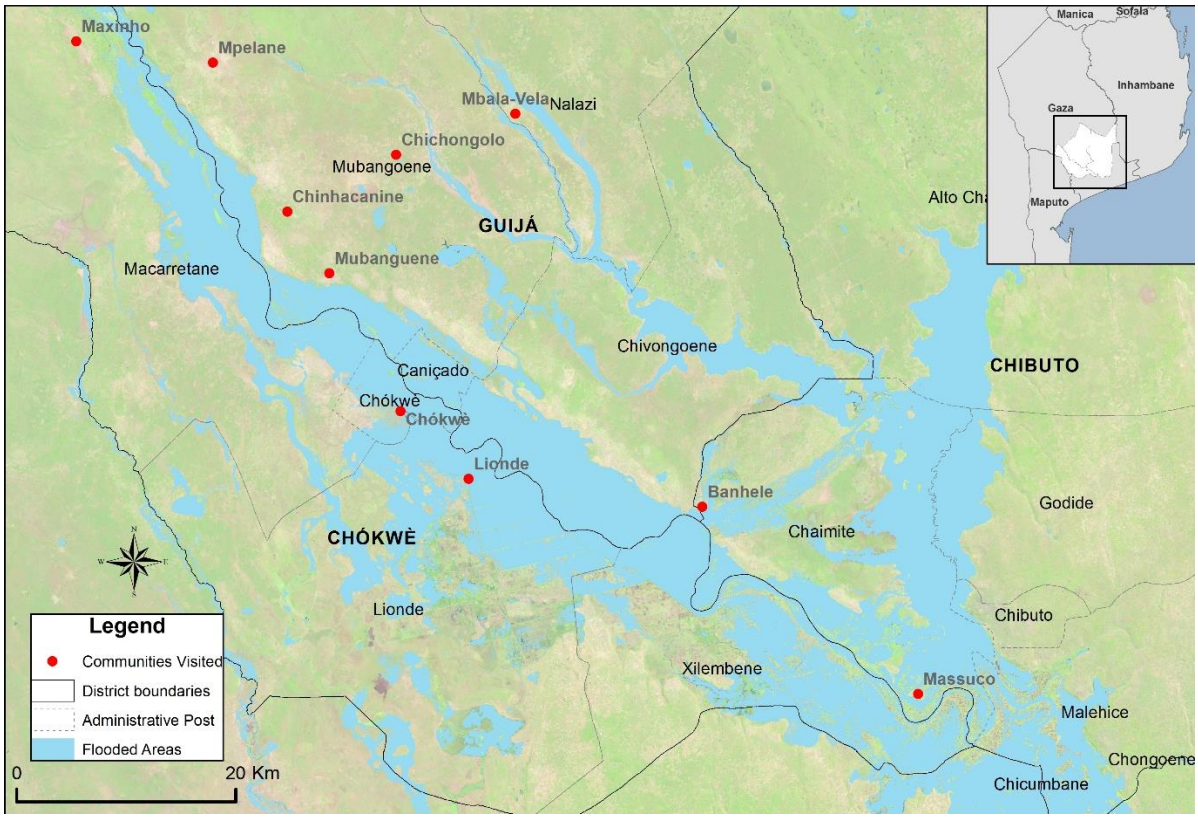


Figure 13 Satellite-detected flood waters along the Limpopo River

Four stations give flood information, as shown in Figure 14: Pafúri, Combomune, Massingir and Chibuto.

Main causes for flooding in Limpopo (Vilanculos, 2018) are the following:

a) Rainfall intensity concentrated in very few months (November to March), which increases dramatically, from upstream to downstream (Lower Limpopo) causing widespread and devastating flooding.
b) The rapid response of upstream sub-basin (Shashe, Luphalala, Mzingwane and Olifants) against rainfall events impacts on quick peak flow flowing from Upstream to Downstream (Lower Limpopo).
c) Topography characterized by low elevation and slop which impacts on the velocity of river flow when it reaches at Lower Limpopo.
d) Predominance of clay soils, characterized with high values of the soil moisture holding capacity, makes the Lower Limpopo prone to occurrence flood, so the water has less infiltration capability.
e) Due to lack of sedimentation measurements in the study area, this was not conducted. The Water Regional Management Entity (ARA-Sul), has not historical data on sedimentation characteristics of the river.

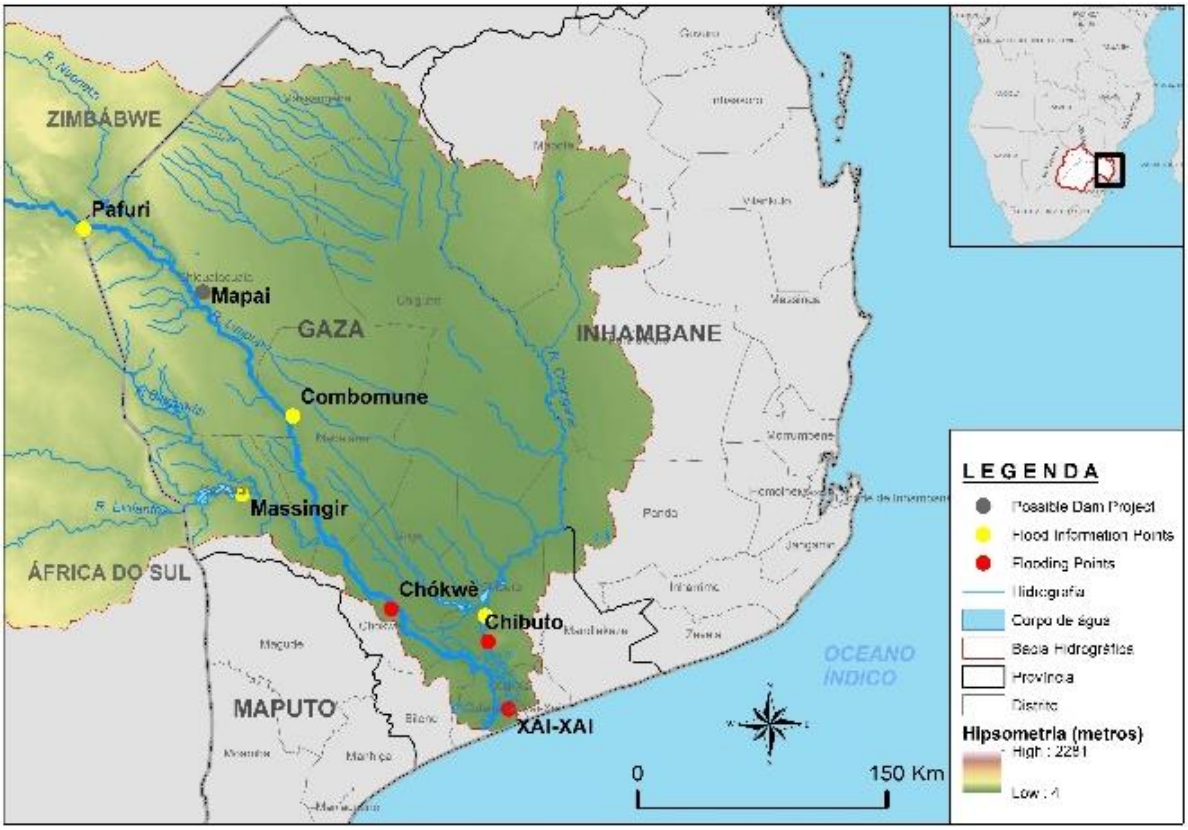


Figure 14 Flood information points

6.2 Economic drivers of risk

Most families living in the Limpopo Basin are small subsistence agriculture farmers and cattle herders with farms ranging from 1,1 to 1,5 ha, producing mainly food crops These families have the potential to produce 50 to 60% of their basic needs. This is supplemented by cash remittances from workers in South Africa and informal trade (Kim, 1995).

Subsistence and commercial activities (in particular agriculture) and several cities are located in lowland zones near the river, where the land is most fertile and the proximity to the river reduces the need for water infrastructure. Due to their flatness, highly variable rainfall and the presence of cyclones along the coastal area, floods are common and can be severe. Climate change is exacerbating this vulnerability with increasing intensity and changing frequency of floods / rains.

6.2.1 Salinization of irrigated soils

Inappropriate irrigation techniques have caused saline soils, and in the worst cases, the formation of Solonchaks[3], characterized by high salinity. Salinity may be a major issue limiting the usage of land developed for irrigation in the banks of the Limpopo River, in Mozambique. Saline soils as much as seventy percent in the lower Limpopo River Basin, where the Chókwè irrigation system is found.

The Chókwè irrigation system is that the largest in Mozambique and was built in the early 1950s. It worked well before independence, however, has suffered badly from lack of maintenance. By 1992, it was able to irrigate barely half of the designed area thirty three thousand hectares (Tanner, Myers, & Oad, 2010). Afterwards the irrigation system suffered serious physical injury throughout the large-scale flooding in February-March 2000.

The problem of salinity is aggravated by the lack of adequate water management skills and by the poor drainage systems. Some river areas are too saline for complete reclamation to be economic.

6.2.2 Land degradation

Forests cover about 40% of Mozambique's area and more than 80% cent of the country's energy needs come from woodlands and forests (Mcdonald & Mutandi, 2018). Annually 220 000 ha of woodlands and forests are lost due to fuel wood collection, forest fires, too much logging and corruption. Using as indicator a deforestation analysis performed using remotely sensed land cover data from 2001 to 2012 from the National Aeronautics and Space Administration (NASA) the WFP HQ GIS unit (World Food Programme, 2015) indicates that deforestation in these three districts, however, is not above 7% over the period. Another source (Global Forest Watch, 2018) refers that "In 2010, Chibuto had 43.9kha of tree cover, extending over 7.8% of its land area. In 2018, it lost 65.7ha of tree cover, equivalent to 6.52kt of CO_2 of emissions". The same source says that Chókwè, in 2018, it lost 16.0 ha of tree cover while Guijá lost 12.9 ha of tree cover from 2010 t0 2018. None of these three districts has intact forest.

6.3 Social and cultural drivers of risk

The origins of all the villages visited is related to floods. These villages are a product of resettlement programs initiated in 1977 after Limpopo floods and within a national program of communal villages. This project had wide acceptance because the villagers had just suffered from flooding. Afterwards, new floods in 2000 and 2013 originated new villages. In these villages people usually own two homes, one in lower grounds, the *nyaka*, where they practice agriculture and produce their crops, and another built in a more robust way, in higher grounds, where the social infrastructures like schools and hospital are also built. Normally, parents dwell in the *nyaka* while children and those who have not active participation in agriculture stay in higher ground. When in 2013 the water level increased suddenly, people in the *nyaka* used their knowledge of evacuation paths and were able to flee to safe grounds taking with their cattle. These people, especially the older ones have knowledge of "Nature's behaviour", be it trees or animals, as a way to predict floods.

People know how to recognize the types of clouds and their association with rain. They also recognize that the *nyingitimo* wind is often associated with rain. The smell, temperature and direction of the wind also allows them to identify that in a certain area it is raining and that it is not long before this rain reaches the place where they are living. In pragmatic terms they know how to recognize the behaviour of the Limpopo River when it shows signs of flooding. They are also aware of the beneficial effects of flooding through humus and other nutrients but are never induced by the fact that they are associated with losses.

As we could observe this is knowledge acquired over time and passed down from generation to generation. However, on the prediction and even on the induction of climatic events several elders

[3] Reference Soil Group of the World Reference Base for Soil Resources (WRB). It is a pale or grey soil type found in arid to sub humid, poorly drained conditions.

reported that in recent times they no longer sit with the younger to transmit this knowledge. Rain induction after a severe drought and is done using the traditional religion (*ku phahla* – to propitiate the spirits) and using prayers in the different churches, a fact more common in the last days according to those consulted.

For the induction of rain, they made references to the usage of trees and animals. Birds such as *mantengo*, *mfuneno*, *mapamu*, *sesane*, *mbandzu*, *hlalana* and *mapamu*. According to a certain type of behaviour that these birds adopt it was (is) possible to forecast rain, floods and wind, but also bad omen (bird *hlalane* and *gongondzana* (woodpecker). Likewise, when oxen are agitated (running from one side to another) and raise their tails, this was a sign that there will be rain in a short time, a week at most. This behaviour is also noted in pigs. When ants (*madzendze*) cut grass and put it in their holes it is a sign that rain will come because they understand that they will not be able to escape to the surface at the time of the flood. There are other types of ants that abandon lowlands in rows towards the highlands that are used as means of forecasting. When ducks perch flapping their wings in the sand as if they were showering was (is) a sign that rain is coming. When frogs are croaking in a certain way is also a sign that the rain is approaching. The presence of higher than normal flowering intensity in certain trees was and is indicative of good amounts of well-distributed rainfall in the following season.[4]

The hegemonic project of modernization was the cause of loss of this knowledge. The establishment of the colonial empire, and especially of the colonial administration in the twentieth century, played a significant role in this epistemic. Policies of assimilation that required people to abandon their practices and to "portugalize" themselves were also corrosive to this traditional knowledge. To close the cycle the newly independent government with its project of creating the "new man" free of "retrograde", traditional, and obscurantists practices came to take the final blow. There was much exaltation of modernization practices that led to "traditional" ways of dealing with people's surroundings being eclipsed. Populations know the agricultural cycle. They know when it is time to clean the fields to plant, but even if these "natural" signs appear to indicate a flood probability they do not pay attention. They rely more on modern means of forecasting.

As noted, the communities visited in the context of this research have their origin closely linked to floods. In the previous places, prior to communal villages and in conjunction with floods in 1977, populations had developed territorial ties, not only as a space that ensures survival through cultivation and rearing of domestic animals, fruit trees, but also because of the sacred face such spaces have acquired over time either because the ancestors were buried or because there are some sanctuaries as well as because there are sacred trees. These scenarios made people much attached to these territories. The collapse of communal villages in other parts of the country was partly due to the lack of respect for social territorialities.

A social territory guarantees social survival and reproduction, and, as in the animal kingdom, it is protected by all possible means. The families of the province of Gaza are patriarchal where not only the man is the head of the family but also the woman leaves her family of origin to live with the husband in a new house or even in the house of the relatives of the husband. In this new dwelling there socially and culturally constructed rules that guarantee survival and social reproduction. The spaces of the woman and the man are clearly defined. There are also certain behaviours expected from a woman. Little or no participation in public spaces has always been regarded as *kuhlonipa* (showing respect to her husband and his relatives) and not subordination.

In families where the husband was absent working outside the country, normally in South Africa, since temporary or permanent relocation or change of residence required permission of the husband or his parents or siblings if they had the authority to so. Belonging to a space that will also be the last dwelling

[4] This forecast was also found in a study in Zimbabwe(Enock, 2013)

place after death, where you will share with the relatives already dead has been, throughout history, determining in relocation.

The resistance faced in the floods of 2000 had, in part, to do with these determinants. People died because they did not want to leave their social territories. The floods of 2000 were instrumental in changing the way floods are dealt with. The high level of devastation showed the victims that it was necessary to rethink the messages, the warnings given by various media about the floods and take concrete actions not to be swallowed by the waters.

"Stubbornness" scenarios, as some interviewees pointed out, were scarce or non-existent in the floods of 2013 because of the experience they all had with the floods of 2000. This confirms that what is conventionally called "tradition" is not static. People adapt, readapt, negotiate and renegotiate their relationship with their environment. What was once taken as a taboo, as leaving the house without husband's consent ceased to be. What's more, members of the CLGRC are trained to convince and evacuate people who resist.

6.4 Political drivers of risk

According to *Plano Director para a Redução de Risco de Desastres* (Master Plan for Disaster Risk Reduction)(Governo de Moçambique, 2017), approved by the Council of Ministers on the 17th October 2017, the level of vulnerability of people and infrastructures is still high and unsustainable because many of the actions that should have been carried out were not due to several constraints among which stand out:

- The absence of a methodical and systematic monitoring process did not allow the gaps that existed in the process of implementing the PDPMCN to be discovered and corrected in a timely manner;
- The length of the process of decentralization and consolidation of the emancipation of local authorities and communities, which is part of the national context in which these processes are taking place, as well as the scarcity of human and financial resources did not allow the acceleration of certain planned activities, especially in resettlement processes;

Recent events in Beira also showed lack of coordination between disaster management actors, exacerbated by coexistence of political forces of different colours in the same arena.

7 DISASTER RISK GOVERNANCE

7.1 Institutional frameworks guiding disaster risk decision-making

7.1.1 Territorial and administrative governance

7.1.1.1 Provincial level

Most of the Mozambican part of the Limpopo basin lies in the Gaza province and the water bodies run through eight districts (Chicualacuala, Massingir, Mabalane, Guijá, Chókwè in the upper and medium Limpopo; Bilene, Xai-xai, Chibuto in the Lower Limpopo) and 5 municipalities (Chókwè, Xai-xai). Even when provincial authorities have great autonomy, they remain subject to an administrative central tutelage (Uandela, 2010). The governor (which is nominated by the President of the Republic) nominates the provincial directors which are being proposed by their respective Ministry. Five provincial secretaries have activities related to water: *Direcção Provincial das Obras Públicas e Habitação; Direcção Provincial do Plano e Finanças; Direcção Provincial para Coordenação da Acção Ambiental; Direcção Provincial de Agricultura; Direcção Provincial das Pescas*.

7.1.1.2 District level

Below the *Província* we have the districts that are divided into administrative posts, localities, villages and settlements (*posto administrativo*, *localidades*, *aldeias* and *povoações*). At these level (community), different types of authorities can be recognized as community authorities (*autoridade comunitária*) such as traditional authorities as is the case of land chief or representatives of the

administration (village chief, neighborhood secretary - of the party, block chief) (*régulos*, *chefe de terras* and *secretários de bairros*). Until 2003, village secretaries were appointed by the ruling party until local election were undertaken to appoint community authority as part of the decentralization process (Ducrot, 2011).

7.1.2 Key actors and organisations

Disaster Management in Mozambique is an activity deeply embedded in its history as since its independency this country has been plagued by disasters with natural triggers, due to its geographical location. The institutional framework for DRM in Mozambique is as follows (UNHABITAT, 2010):

The National Council for Disaster Management Coordination (*Conselho Coordenador de Gestão das Calamidades – CCGC*): including several ministries, is the highest political body dealing with disaster-related issues in Mozambique. Its mandate is: to ensure multi-sectoral coordination for disaster prevention, assistance to the victims and rehabilitation of damaged infrastructures;

The Technical Council for Disaster Management (*Conselho Técnico de Gestão de Calamidades - CTGC*): it regroups technical staff from the concerned departments of the different Ministries represented in the CCGC, as well as partners from the UN system. Its mandate is: to assist the CCGC in deciding about strategical measures for prevention, mitigation, response and rehabilitation;

The National Disaster Management Institute (*Instituto Nacional de Gestão de Calamidades* – INGC), under the Ministry of State Administration (*Ministério da Administração Estatal* – MAE), coordinates the CTGC and reports to the CCGC. Its mandate is: i) to coordinate disaster prevention and mitigation activities; ii) to lead the government's response to emergencies; iii) deal with arid and semi-arid areas, reconstruction and resettlement. It works very much as a knowledge and reference center, providing free access to its products in the web. The structures of INGC go down to the 3 regions (Southern, Central and Northern Mozambique) and 11 Provinces both politically and technically: inter-sectoral technical committees for disaster management organized at the provincial level dealing with CLGRC; Ministry for Environmental Affairs (MICOA): it is responsible for coordinating action under climate change adaptation and coordination; it oversees the implementation of the National Adaptation Plan.

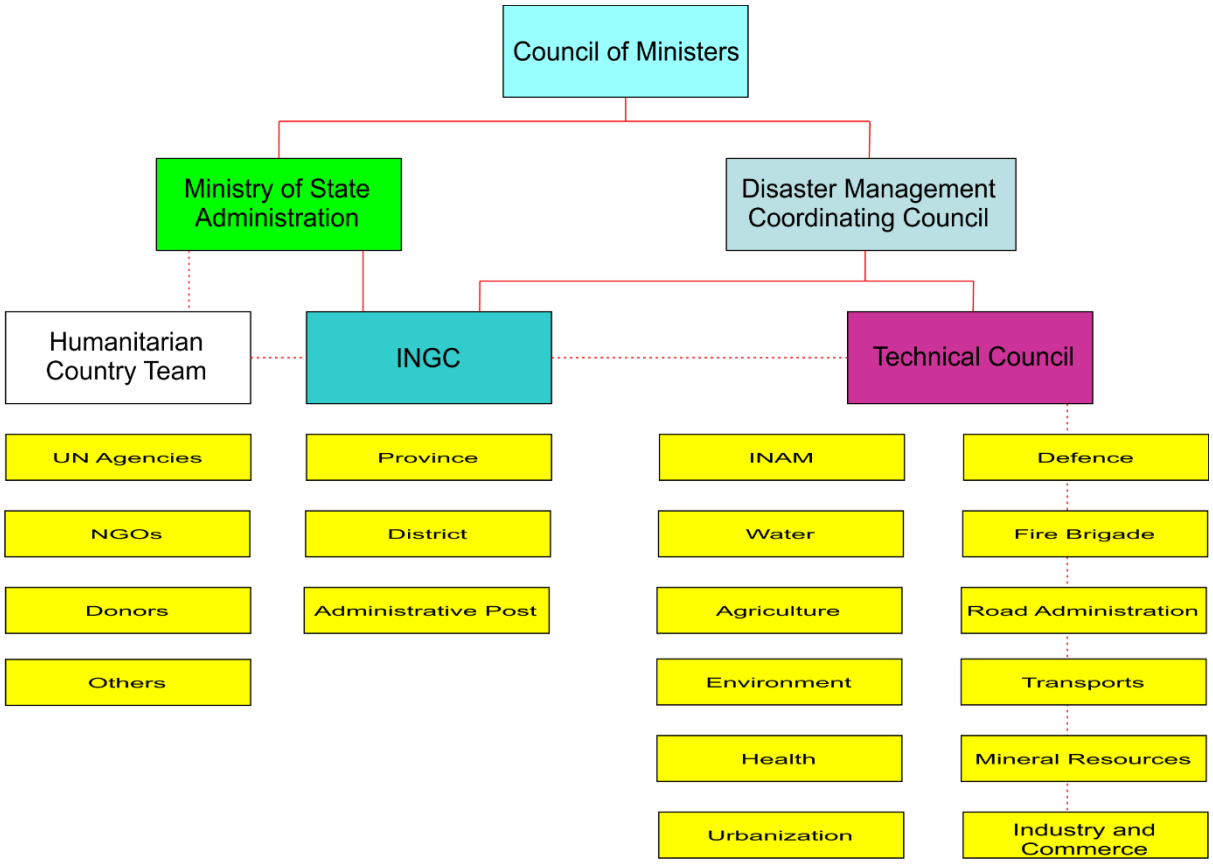


Figure 15 Institutional framework for disaster risk management (Source: INGC presentation in the Workshop of National Platforms, Davos Switzerland, 2008)

INGC, under the Ministry of State Administration, is the coordinating institution, with the following mandate:

a) Management and coordination of disaster management, regarding actions to prevent and assist victims of disasters;
b) Reduction of the vulnerability of people, infrastructure and assets exposed to the negative effects of disasters;
c) Ensuring the post-disaster rehabilitation of human tissue and infrastructures quickly and efficiently;
d) Coordination of the implementation of the Master Plan for the Prevention and Mitigation of Disasters approved by the Government;
e) Designing, formulation and proposal of specific socio-economic development plans for arid and semi-arid zones to the Government;
f) Coordination of the activities of the Technical Council for Disaster Management;
g) Mobilization of financial resources for the implementation of projects and programs related to vulnerability reduction;
h) Monitor the degree of implementation of the Master Plan in its various components.(Governo de Moçambique, 2017)

The relationship among national institutions involved in disaster management in Mozambique is depicted in

Figure 15.

7.1.2.1 Instituto Nacional de Gestão de Calamidades

The Coordinating Council for Preventing and Combating Natural Disasters (*Conselho Coordenador de Prevenção e Combate às Calamidades Naturais*, CCPCCN) was created soon after independence by Presidential Decree Number 44/80 of September 3, 1980. Its executive arm, the Department of Prevention and Combat of Natural Disasters (*Departamento de Prevenção e Combate às Calamidades Naturais*, DPCCN) was mandated to provide humanitarian assistance to refugees, internally displaced persons and people affected by the drought.

In 1999, with the promulgation of the National Disaster Management Policy, the DPCCN was replaced by the National Institute for Disaster Management (*Instituto Nacional de Gestão de Calamidades*, INGC) under the Ministry of Foreign Affairs. This reflected the country's reliance on foreign aid to ensure the implementation of recovery actions. Even though floods were known to be a hazard in September 1999, human and financial resources for readiness and recovery were limited. Mozambique did not have a national technical team trained in preparedness at the time. This situation required staff mobilization from inside and outside the country for this purpose, as the situation worsened.

The INGC was relocated from the Ministry of Foreign Affairs to the Ministry of State Administration in 2005. This allowed it to develop closer collaboration with the relevant ministries and with the province governments during emergencies and in the recovery phase. INGC was restructured, focusing on two main areas: emergency response and reduction of vulnerability. In 2006, INGC was structurally authorized to set up a National Emergency Operational Center (CENOE). The aim of this body is coordinating emergency operations and humanitarian support in general. The Civil Protection Unit (UNAPROC) was also set up with the primary responsibility of carrying out search and rescue operations. At the same time, INGC's legal basis of work was strengthened through its organic statute (2007 and 2008) and approval of the internal regulation by the Council of Ministers (2009). Between 2005 and 2009, INGC gained credibility as a leader and manager of emergency situations, particularly following the demonstrated response capacity of effective response operations during the 2007/8 floods in the central zone of the country, in the Zambezi, Búzi and Save River Basins.(GFDRR, 2014a)

CENOE operates at four different alert levels: (GFDRR, 2014b):

Level 1 (green alert) - The CENOE functions as a sector of the INGC, monitoring possible disaster risks, providing technical training and organizing simulation exercises for populations preparedness. This is neither an alert phase, nor is it related to any emergency.

Level 2 (yellow alert) - when there is an impending emergency and institutional actors are on alert and stand-by for the response.

Level 3 (orange alert) - INGC coordinates CENOE in the preparation of the contingency plan for impending disasters in coordination with other government agencies. At this stage communities receive regular alerts and are encouraged to move to safe places. The Council of Ministers is also regularly briefed on alert levels through the CCGC.

Level 4 (red alert) - When an emergency is declared, INGC proposes that the CENOE be expanded, coordinating the emergency activities of the Ministries and specialized agencies, and search and rescue through the Civil Protection Unit (UNAPROC) and the local governments where the disaster occurred. Depending on the magnitude of the event, emergencies are managed at the district, provincial or national level. During district-level or provincial-level emergencies, INGC acts as a technical advisor. The CENOE may be coordinated by its own National Director or by the General Director of INGC, as justified by the magnitude of the disaster in question. In extreme cases where it is necessary to declare a state of national emergency, there is a provision that the President of the Republic will coordinate the CENOE.

During emergencies, CENOE can meet up to twice a day, with the participation (by teleconference) of technicians at district and provincial levels. These meetings serve to review the events of the day and plan the next Actions. The entire community involved in the emergency response participates in these meetings. In the response phase (Level 4), when the CENOE is in the process of decommissioning, it has the responsibility to identify and report on the activities carried out and recovery activities still pending as part of the final report on the operation response to a specific disaster. CENOE members and focal points also have the duty to transmit information specific to their respective sector to their own Ministries.

When CENOE returns to level 1, focusing on reducing vulnerability and mitigating disasters, it reassumes its position as a sector of INGC. Institutionally, this flexibility allows INGC, as a permanent institution, to respond to disasters of different types and magnitude. In addition to its responsibilities in relation to the CENOE, INGC also coordinates the implementation of multi-sectoral recovery programs that are not explicitly covered by the relevant ministries. To respond to the reallocation needs of populations affected by disasters, the Reconstruction Coordination Office (GACOR) was created in 2007 to work with sectoral ministries, provincial and district governments and other partners.

The main role of GACOR is to coordinate the resettlement of vulnerable populations. Actions include support for the reconstruction of homes, land-use planning, provision of basic services and construction of social infrastructure in newly established communities, support for people in the development of livelihoods and infrastructures for water supply and provision of sanitation. When a disaster or emergency occurs, INGC reports to the Disaster Management Advisory Body - the Disaster Management Coordinating Council (CCGC), of which its own Ministry (Ministry of State Administration) is a member. The CCGC is a high-level body of the Council of Ministers chaired by the Prime Minister who meets regularly during emergencies to make policy decisions on disaster management.

7.1.2.2 Instituto Nacional de Meteorologia

Instituto Nacional de Meteorologia (INAM) is the national meteorological agency. It has the primary responsibility for the generation of weather and climate information.

INAM is a public Institute, under the Minister of Transport and Communication. Among other activities, it provides climate monitoring and forecasting through its Research Department. At the beginning of the rainy season, INAM prepares a seasonal forecast using the Climate Predictability Tool

(CPT). This forecast is discussed in a regional forum called Southern Africa Regional Climate Outlook Forum (SARCOF) and a regional statement is produced. After the downscale, the forecast is sent to the stakeholders for the preparation of the Sectoral Outlook.

This process is followed by a pre-meeting for inter-sectorial outlook harmonization and interpretation. Afterwards, a unique document composed by a brief Climate outlook for the season is finally presented, in a public session of the National Climate Outlook Forum (NCOF), a forum where producers and users of climate information are brought together. The seasonal forecast is updated on a monthly basis for the periods NDJ, DJF, JFM, and FMA and it is disseminated through the Internet, email and media to different stakeholders. INAM also issues Alerts/Warnings of the possible occurrence of events like heavy rains and cyclones. This information is systematically updated to the public and to INGC through CENOE. CENOE oversees communicating to the people what to do to save their lives and properties.

Mozambique is implementing a project on climate resilience sponsored by the Climate Investment Funds (CIF). This project aims to transform hydro-meteorological services in Mozambique to deliver reliable climate information. Currently, only 25% of manned meteorological and rainfall stations report regularly, while 36% of river monitoring stations report regularly. Overall, only a third of the hydro-met monitoring network is functioning, indicating the urgency for substantial transformation.

Hydrometeorology services support resilient growth across a range of sectors, so accurate record of hydro-met data has strong economic and environmental implications (Winthrop, Kajumba, & McIvor, 2018).

7.1.2.3 Water management: ARA-Sul

ARA-Sul, is the water agency, overseen by *Direcção Nacional de Gestão de Recursos Hídricos* (DNGRH, National Directorate for Water Resources Management). ARA-Sul was established in 1993 and oversees the Maputo (1), Umbeluzi (2), Incomati (3) and Limpopo (4) basins as well as a part of Save basin (5), which is located at the provinces of Gaza and Inhambane.

This agency is responsible for the river basins in Southern Mozambique and the collection and management of hydrogeological data in the Limpopo River Basin. Data collection is sparse due to inconsistent accessibility to sample collection sites (due to flooding, physical distance from testing facilities, poor communication and lack of qualified human resources) and few operational hydrometric stations. Until recently, data was limited to water levels and stream flow, and does not yet include groundwater levels, water quality or sediment transport (Chapman & Parker, 2014).

7.1.3 Overview of forecast-based action and financing

According to information from the Red Cross, “for the time being, FbF will develop and implement early measures for the four provinces of Nampula, Zambezia, Inhambane and Sofala. In 2019, the area is to be extended.”(Deutsches Rotes Kreuz, 2019). As a matter of fact, although in the years of 2015 to 2017 contacts were started in six communities of the Gaza Province, namely, Machinho, Chinhacanine, Mbala-Vela, Mumbangoene, Mpelane, Caniçado, no further FbF work was carried out. This was due to priority being given to cyclone events that happened in other regions. Nonetheless in the communities above mentioned people have heard about FbF although they are not certain of its meaning.

7.2 Early warning systems

7.2.1 Siren network

The Chókwè district is currently implementing a network of sirens to reinforce the early warning system in the district communities. The system is connected to satellite communication, each tower being provided with a communication antenna.

The siren system broadcasts essentially in two modes. Each tower is provided with two sirens, one emits a buzz and the other emits voice. The district currently has four warning sirens, one located in the City of Chókwè, one at the Lionde Administrative Post (under construction), Marambajane and the

last one at Chiduachene. Apparently, people are organized and prepared to act if the siren begins to emit warning signals, if we are to believe in the ability to mobilize that was shown when the siren installed in Chokwe was triggered by accident: people understood the warning and reacted quickly gathering outside their homes.

Figure 16 Hydrometric scale as an early warning sensor in Chókwè

7.2.2 Community Sensors

In addition to the siren network, in some communities located in areas identified by the community as being at high risk, low-cost community battery-powered sensors have been installed.

These handmade sensors are basically sirens that emit an alarm from the house closest to the river when the water reaches the alert level. The sensor is usually placed where the community identifies it as the first point where the water reaches before reaching the residences.

7.2.3 Other Early Warning Systems

In addition to the sirens, community radios; television; Cellular Data-Winners, SMS, calls, and verbal messages via the COE District's local authorities and CLGRC are used.

7.2.4 Efficiency of Early Warning Systems

In recent years there have been many improvements in early warning systems: progress was made by INAM in the meteorological forecasts and by the ARA-Sul in the hydrological forecasts. Citing as an example the year 2017, where in the critical period (February), Rio Limpopo recorded waves that could compete for floods, and ARA-Sul made timely forecasts, which included aspects related to the speed, height and timing of flooding. In addition to improved forecasts, another important component is related to the assimilation of the message by the people: the community members are now more open to receive information about the occurrence of an event and to comply with the recommendations given. The scenarios lived during the last great floods (of the years 2000 and 2013) contributed significantly for community collaboration and reaction.

Figure 17 EWS battery operated sensor

Figure 18 Hydrometric scale as a EWS

7.2.5 Recent improvements in Early Warning Systems

From October 2013 to August 2017 a project led by GIZ implemented three parallel actions integrated early warning system. The system consists of:

- a hydrometeorological monitoring network;
- an institutional cooperation component for data analysis; and
- an efficient communication mechanism that triggers a range of responses or actions.

Figure 19 shows the interactions between the project components and the roles of the relevant project partners (LIMCOM, 2018).

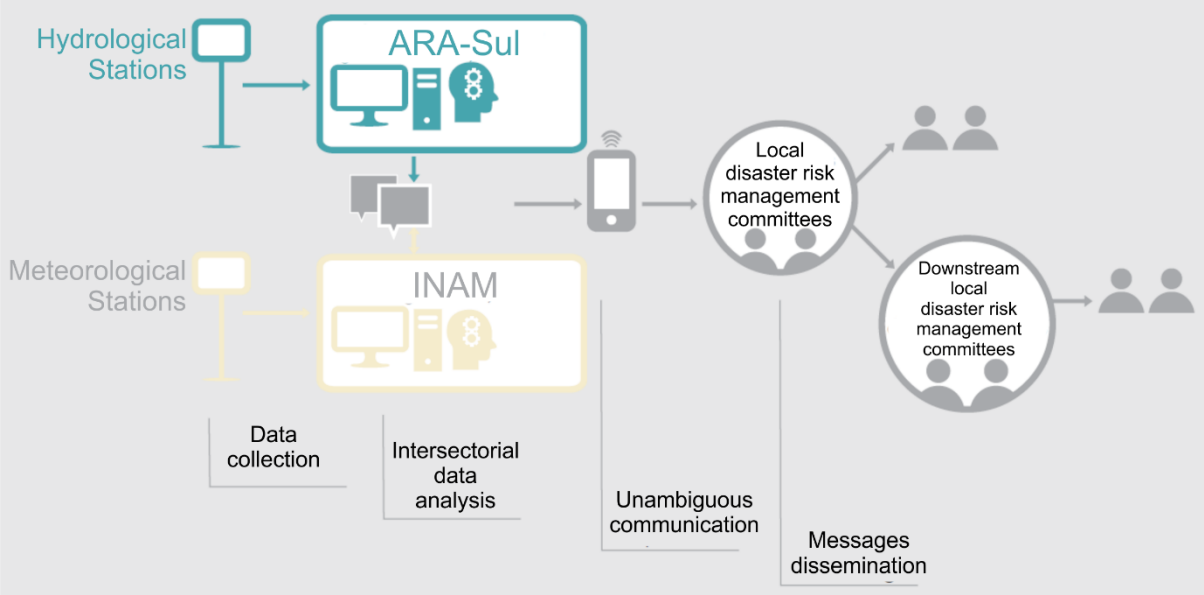


Figure 19 Schematic representation of an early warning system established by GIZ

8 CONCLUSIONS

This study sought to contribute to the understanding of how populations, government and non-governmental organizations (NGOs) respond to extreme weather events, especially in the Guijá, Chókwè and Chibuto districts.

Although new settlements have been defined as a result of the floods, these populations continue to live in the lowlands where they practice agriculture. They are populations whose economic activities other than agriculture are cattle raising, goats, pigs and poultry (chickens and ducks), informal trade, migrant labour and wage labour in the fields of some "advanced" farmers.

8.1 Summary of findings

These populations retain knowledge transmitted from generation to generation, that allows them to forecast climatic events using animals, trees and religion, although this knowledge lost the vitality it had in the past due to the modernization that caused its “death.” Populations know the agricultural cycle: They know when it is time to plough the fields to plant, but even if these “natural” signs appear to indicate a flood probability they do not pay attention. They rely more on modern means of forecasting.

Throughout their history, populations have developed an attachment to their social territories because they guarantee survival and social reproduction, and because there are socially and culturally constructed norms and also the sacredness of some spaces. Despite this, the floods of 2000 were instrumental in reducing attachment, especially in scenarios where it is necessary to leave the dwelling. The high level of devastation showed the victims that it was necessary to rethink the messages, the warnings given by various media about the floods and take concrete actions to avoid being swallowed by the waters. “Stubbornness” scenarios, as some interviewees pointed out, were scarce or non-existent during the flood of 2013, because of the experience they all had with the floods of 2000. This confirms that what is conventionally called “tradition” is not static. What was once taken as a taboo, like leaving the house without consent ceased to be such.

What's more, members of the CLGRCs are trained to convince and evacuate people who resist.

The people of the Limpopo Valley have their perceptions about the risk of floods. The dam, begun in the 1950s during colonial time, is perceived by some, especially the older ones as the cause of the floods because, according to them, the waters initially circulated in free paths.

Communities can do Community Risk Assessment (RCA). Moreover, as it turned out, communities know, by observing the river, to recognize the critical level, that is, the threat of floods and floods.

During the fieldwork it was possible to verify that the communities developed, in collaboration with the district services and NGOs, mainly the Red Cross of Mozambique (CVM) monitoring systems. There are, in fact, manual meters scattered along the river. Regarding the Early Warning System (SAP) siren antennas were installed in Lionde, Chokwè, as well as a complex system installed by GIZ, which involves INAM and ARA-Sul.

Information on extreme weather events can be found at INGC-Gaza, District Government, ARA-SUL UGBL and District Services. Some of the information can also be obtained from non-governmental organizations (NGOs) working with government. In addition to the government, the Red Cross of Mozambique, the World Food Program, World Vision, Save the Children, I.O.M. which act in the area of disasters. As far as floods are concerned, their interventions are, to some extent, similar except for the CVM, which has a broader action.

The local leaders have heard about FbF but they seem to be uncertain about concept.

National authorities also seem to have not grasped the essence of FbF

8.2 Recommendations for further research

Further research should be carried out in areas where FbF has been effectively established and SOPs in place. This would allow to determine if FbF does indeed reduce humanitarian impact of extreme weather events – suffering, losses and damages – when implemented correctly.

9 BIBLIOGRAPHY

Chapman, B. P. A., & Parker, A. M. R. (2014). *Risk , Vulnerability & Resilience in the Limpopo River Basin*.

Deutsches Rotes Kreuz. (2019). *Forecast-based Financing*. Retrieved from forecast-based-financing.org

Ducrot, R. (2011). *Land and Water Governance and Pro-poor Mechanisms in the Mozambican part of the Limpopo Basin*. (December), 68.

Enock, C. M. (2013). Indigenous Knowledge Systems and Modern Weather Forecasting: Exploring the Linkages. *Journal of Agriculture and Sustainability*, *2*(1), 98–141.

GFDRR. (2014a). *A recuperação de cheias recorrentes 2000-2013*.

GFDRR. (2014b). Mozambique: Recovery from Recurrent Floods 2000-2013. *Recovery Framework Case Study : August 2014*, (August). Retrieved from http://www.recoveryplatform.org/assets/publication/GFDRR/countryCS2014/Mozambique August 2014.pdf

Global Forest Watch. (2018). Forest monitoring designed for action | Global Forest Watch.

Governo de Moçambique. (2017). *Plano Director Para a Redução Do Risco De Desastres 2017-2030*. 1–52.

HABITAT, U. (2010). *Housing, Shelter & Basic Infrastructures Resistant to Disasters in Southern Africa: Mawi, Mozambique, Madagascar*. 1–106.

Instituto Nacional de Estatística. (2010). *Projecções Anuais da População Total, Urbana e Rural, dos Distritos, 2007-2040 (volumes correspondestes às 11 províncias)*.

Kim, S. (1995). Distribution of Economic Activities : *Europe*, (November). Retrieved from http://www.limpopo.riverawarenesskit.org/LIMPOPORAK_COM/EN/PEOPLE/SOCIOECONOMICS_IN_THE_BASIN/DISTRIBUTION_OF_ECONOMIC_ACTIVI/MOZAMBIQUE.HTM

LIMCOM. (2018). *Uma linha de vida contra as inundações* (pp. 1–24). pp. 1–24.

Mcdonald, L., & Mutandi, R. (2018). Republic of Mozambique: Country strategic opportunities programme. *Ifad-Eb 2018/123/R.4*, (April), 16–17.

Ministério da Administração Estatal. (2005a). *Perfil do distrito de Chókwè, Província de Gaza*. 57. Retrieved from http://www.govnet.gov.mz/

Ministério da Administração Estatal. (2005b). *Perfil do distrito de Guijá, Província de Gaza 2005*. 57. Retrieved from http://www.govnet.gov.mz/

Ministério da Administração Estatal. (2012). *Perfil do Distrito de Chibuto*. Retrieved from http://www.govnet.gov.mz/

OCHA. (2019). Cyclones Idai and Kenneth | OCHA. Retrieved June 3, 2020, from OCHA website: https://www.unocha.org/southern-and-eastern-africa-rosea/cyclones-idai-and-kenneth

Red Cross Red Cresent Climate Centre, International Federation of Red Cross and Red Crescent Societies, & German Red Cross. (n.d.). *Forecast-based Financing: Phase I*. 4. Retrieved from http://fbf.drk.de/fileadmin/Content/Manual_FbF/01_Manual/01_01_Fbf_strategy_phase1.pdf

Tanner, C., Myers, G., & Oad, R. (2010). Land disputes and ecological degradation in an irrigation scheme - a case study of state farm divestiture in Chokwe, Mozambique. In *Jacet全国大会要綱* (No. U.S. ISSN 0084-081 5; Vol. 49). Madison.

Vilanculos, A. (2018). *Ciclones Tropicais -Limpopo_Sub_Chapter*. Maputo.

Winthrop, M., Kajumba, T., & McIvor, S. (2018). *Mozambique Country Climate Risk Assessment Report*.

44. Retrieved from https://www.climatelearningplatform.org/
World Food Programme. (2015). *Integrated Context Analysis (ICA) Mozambique*.