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CAPACITY STRENGTHENING IN THE LEAST DEVELOPED COUNTRIES (LDCS) FOR ADAPTATION TO CLIMATE CHANGE (CLACC)

CLIMATE CHANGE AND HEALTH IN MOZAMBIQUE

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FOREWORD

This project was undertaken as part of the CLACC collaboration [Capacity Strengthening in the Least Developed Countries for Adaptation to Climate Change]. The health case studies were funded by the UK Department for International Development. Action Group for Renewable Energy and Sustainable Development (GED) would like to express its gratitude to the International Institute for Environment and Development (IIED) by providing financial and technical support in the production of this country report on climate change and human health in Mozambique. A special thanks goes for Dr Saleemul Huq, Dr Hannah Reid, Ms Beth Henriette from IIED, London. Also thanks to Sari Kovats for her technical and very helpful guidance throughout this study.

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Executive Summary

The Intergovernmental Panel on Climate Change on its Fourth Assessment Report indicates that the global average temperature will increase by 1.4° C to 5.8° C between 1990 to 2100 due to the increased concentration of greenhouse gases resulting from the burning of fossil fuels and other anthropogenic activities. Climate change will bring mostly negative impacts, which will be more felt in the developing countries. Mozambique is one these exposed countries, despite her insignificant contribution to the greenhouse gases in the atmosphere.

Mozambique is located on the Eastern Coast of the African Continent with an estimated population of 19 million - with 70% living below poverty line. The anticipated impacts of climate change may be manifested through increase in droughts, floods and cyclones in most regions of the country. Due to its location, Mozambique is highly vulnerable to climate change and climate variability. Floods are more felt in central and southern regions of the country with severe impacts on the country's economy and infrastructure such as roads, schools, and health centres.

The relationship between climate change and its effects on human health has been widely studied. Increases in temperature and variations in precipitation can exacerbate a number of human diseases including respiratory infections, malnutrition, vector and water borne diseases such as malaria and cholera. Besides all efforts undertaken by the Mozambican Government to reduce poverty and meet the MDGs targets, it is clear that climate change effects will influence negatively in meeting these targets. Damages caused by floods in Mozambique undermine economic growth rates of the country. Mainstreaming climate change adaptation into government policies would strengthen the capacity of the country to deal with climate change impacts.

Climate change is a reality and the impacts on health are great with the poor at most risk. Efforts must be done nationally at all levels to come up with a proactive approach since all actors in the Mozambican society are directly or indirectly affected. This must include clear policies and strategies to deal with impacts of climate change on health; inter- sectoral approaches for strengthening the implementation of these policies and a greater support from those wealthy in resources and knowledge for minimizing the risks and increase community's adaptation capacity.

The case study included in this country report highlights the relationship between climate change and human health through an analysis of malaria and cholera data taking the example of the 2000/2001 floods, which were considered the worst in the last fifty years. Adaptation practices and the adaptive capacity of the country during floods periods, policies and strategies are also discussed.

Contents of the Report

Section I

1 Introduction

1.1 Background

Mozambique is located in South-Eastern Africa, bordering the Mozambique Channel, between South Africa and Tanzania. The geographic coordinates are between 10°27' and 26°52'at South Latitude and 30°12' and 40° 51' East Longitude. The country emerged from nearly 500 years of colonial era and became independent in 1975.

Mozambique is one of the poorest countries in the world. Socialist mismanagement and subsequent civil war for 16 years exacerbated the situation. In 1987, the government embarked on a series of macroeconomic reforms to stabilize the economy. Since the peace agreement in 1992, Mozambique has been working hard to rebuild the country implementing a number of market-based policies combined with donor assistance and with the good political environment since the multi-party elections. All these factors have led to an increase in the country's economy with a Gross Domestic Product (GDP)-real growth rate of 7.2% in 2005 (The World Fact Book-Mozambique, CIA, 2006) and a reduction in the inflation rate of 7.8% in 2005.

Although Mozambique is considered to have one of the world's highest economic growth rates, it is still one of the poorest countries in the world with Human Development Index (HDI) of 168th (UNDP, 2005). Mozambique depends strongly on foreign aid for part of its annual budget.

The long civil war in the country resulted in increased migration of the population to urban areas, with adverse impacts on the environment and 35.6% of the population living in the cities. Poor infrastructure combined with lack of access to basic services such as water and sanitation has led to a number of health problems including malaria, diarrhoea diseases and cholera. The present mortality rate is about 21.2 per 1000; with a high rate of infant mortality of 145.7 per 1000 babies born alive. HIV-AIDS is also one of the major threats to the country's economy with 12.2% of the adult population aged from 15 to 49 years old infected.

2 Climate Change

The world's climate has always varied naturally but currently it has been accepted that humans are affecting the global climate due to emissions of greenhouse gases in the atmosphere, mainly carbon dioxide derived from burning of fossil fuels such as coal, petroleum and natural gas for energy production and other economic activities. Regardless of efforts to cut emissions, the concentration of greenhouse gases in the atmosphere has been increasing. The process of greenhouse gases is a physical process whereby gases in atmosphere absorb sun's rays, so that our planet does not became too cold. However, if the amount of 'greenhouse' gas retained in the atmosphere increases, as we are witnessing in our days, the earth will became very warm, engendering the so-called global warming. The greenhouse gases include carbon dioxide, methane and a number of chlorofluorocarbons (CFCs). The Intergovernmental Panel on Climate Change (IPCC) in its Third Assessment Report, drew evidence that most of the warming registered in the last 50 years is attributed to human activities and it predicts a rise of 1.4 to 5.8 °C in a global mean surface temperatures over the next 100 years.

2.1 Climate Change in Mozambique

Mozambique is very vulnerable to climate change due to its geographical location along Indian Ocean Coast and with some areas below sea level. High levels of poverty and poor infrastructure make it more difficult to respond to the effects of climate change/variability. Extreme weather events affecting Mozambique include floods, droughts and cyclones. Droughts are more common in the south region of Mozambique, while floods are frequent in the central and northern region and tropical cyclones can hit the whole country.

Since about 80% of the population depend directly on land and natural resources in Mozambique, the effects of climate change are likely to have a great influence on the peoples' livelihood and on the economy in general. The main sectors likely to be impacted by climate change according to the Mozambique's Initial Communication to UNFCCC include: agriculture and food security, water resources, costal resources, biodiversity, human health and infrastructures (MICOA 2006).

The Initial National Communication and the National Adaptation Plan for Action (NAPA) have identified the following expected major climate change effects in Mozambique:

Table 1: Climate change related impacts by sector

Hazard	SECTOR/AREA IMPACTED	IMPACTS
Floods	Agriculture, forest, water resources, health, livestock, coastal resources, tourism, ecosystems, infrastructure, flood plains of main rivers basin such as Limpopo, Incomati, Pungue, Save, Zambezi, Umbeluzi, Maputo and Buzi.	Loss of life, crops, ecosystems, property, human and animal habitats, outbreaks of pests and diseases, displacement of people, movement of land mines, destruction of infrastructure (communication network, schools, hospitals, houses, etc.), erosion, land degradation, etc.
Droughts	Agriculture, water resources, ecosystems, health, food security, livestock and low-lying areas.	Crop failures, water scarcity, drying of water reservoirs (dams, fish pond, lake, rivers), famine, loss of human and animal lives, stresses in the marine living organisms, loss of biodiversity, environment degradation, salt intrusion, erosion.
Tropical cyclones	Country wide, particularly along the coastal area, during rain season.	Loss of life from collapsing structures. Damage to structures (rural community houses, school blocks, hospitals, etc) due to sub-standard constructions. Destruction of crops, forest plantations & natural trees. Bush fire enhancement in the dry season.
Sea level rise	Coastal area, river water resources	Loss of land and infrastructures, increase erosion, salt water intrusion

Climate scenarios analyzed using meteorological data have projected an increase in mean air temperature by 1.8 and 3.2 ºC, a reduction of rainfall by 2 to 9%, an increase of the solar radiation from 2 to 3% and increase of the evapo-transpiration by between 9 to 13%. Computer simulations already indicate that the coastal area resources, water resources, agriculture and forests could be negatively impacted. Pastures seem to be the only sector where it would be possible to observe an increase of the foliage, but conversely, the reduction of the nutritional capacity due to the weak absorption of nitrogen, would counterbalance, in a negative way, the predicted increase in pastures.

Various sectors of the Mozambican economy are vulnerable to the effects of climate change, therefore there is need to adopt measures in order to lessen the impacts of climate change. Adaptation to climate change is the only option for countries like Mozambique. The response of the community to climate change is their capacity to adapt and this should be supported by national policies. The Government of Mozambique has recognized the problems that can arise from changes in climate and has shown its commitment to stabilize the greenhouse gases by ratifying the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.

2.2 Vulnerability to climate variability and natural disasters

In 1999, Mozambique was considered to be among the 10 countries to suffer most from the effects of sea level rise due to global warming, as 45% of the country is below the 100 m of altitude (UNEP, 1999). Thus, there is great urgency for the country to be prepared to deal with future (uncertain) climate change. In particular, the country should build its capacity to respond to extreme events in order to reduce the impacts of climate change in different sectors, including health. The frequency of natural disasters will increase due to climate change. Natural disasters have killed millions of people in Mozambique over the last two decades. Livestock, property and physical infrastructures are among the losses.

2.2.1 Droughts

Droughts usually affect the country on a 7 to 8 year cycle and are associated with the El Nino phenomenon, which affects Southern Africa. In the last 20 years for example there have been four severe droughts: in 1982/83, 1991/92, 1994/95 and 1999/2000 with more than 50% of the country being affected. The provinces of Gaza, Inhambane and Southern Tete are the most affected regions due to the action of thermal anticyclones. Poor water quantity and quality, loss of crops, food insecurity, and degradation of fertile soils are the main consequences of droughts. This leads to an increase in the prices of basic products and food aid. The number of deaths and outbreaks of disease increase during drought periods.

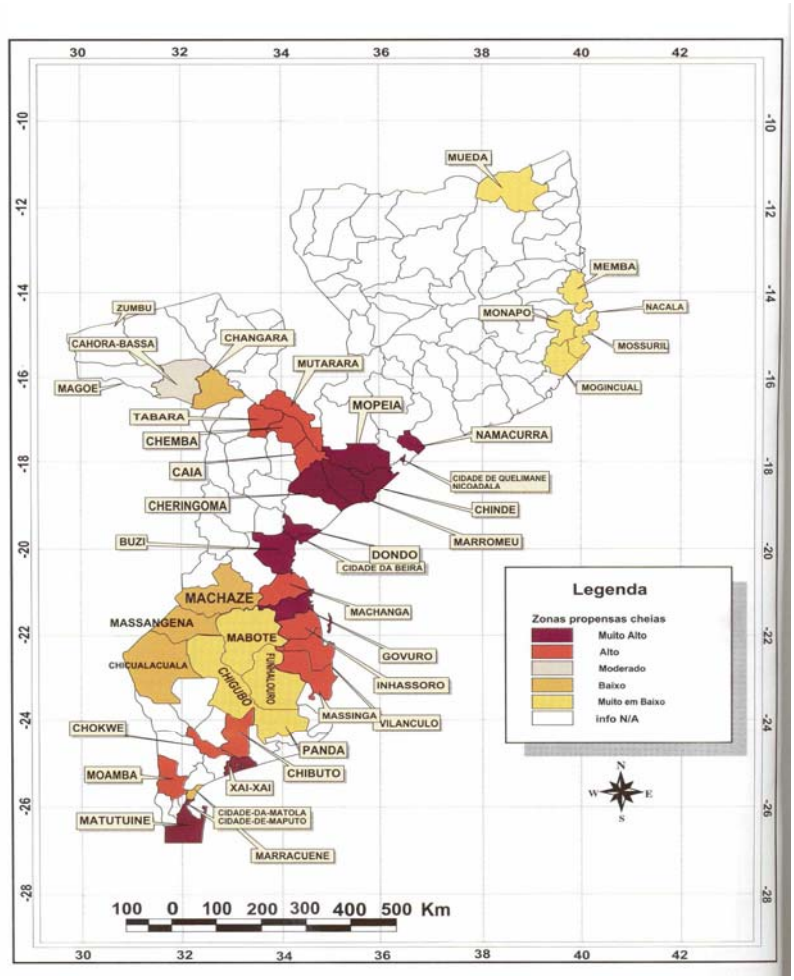
2.2.2 Tropical cyclones

Coastal regions of the country are vulnerable to cyclones from January to April, with heavy cost for human lives as well as damage to infrastructures including houses, roads and schools. The main recent cyclones that have occurred in Mozambique are the following: Claudete, in 1976; Angela in 1978; Nadia in 1994; Eline, Gloria and Huday in early 2000; and Favio in 2007. Some of the cyclones are associated with high winds and floods in the country. Provinces located on the coast are more vulnerable to cyclones.

2.2.3 Floods

Mozambique suffers from the effects of floods that are usually felt in the main river basins of the country. Its geographical location downstream of neighbouring countries has led to cyclical flooding in many districts. Some of these rivers cross Mozambique from neighbouring countries to reach the sea, thus management of these rivers also depend on suitable and effective management systems in upstream countries. Recorded database shows that Mozambique suffered floods in 1977/78, 1979, 1984/85, 1986, 1988, 1996, 1997, 1999, 2000 and 2001. Figure 1 shows the most vulnerable zones to floods in the country with shades of high precipitation and floods in the Central and Southern part of the country.

Figure 1 – Vulnerable zones to floods



3 Climate Change and Human Health

Scientific evidence has shown that climate change will impact negatively on human health. According to the World Health Organization (WHO), climate change may already be causing over 150,000 deaths per year (McMichael et al, 2004). Many diseases such as respiratory infections, cardiovascular illness and malnutrition are attributed to an increase in the frequency of extreme events, including heat-waves, floods and droughts.

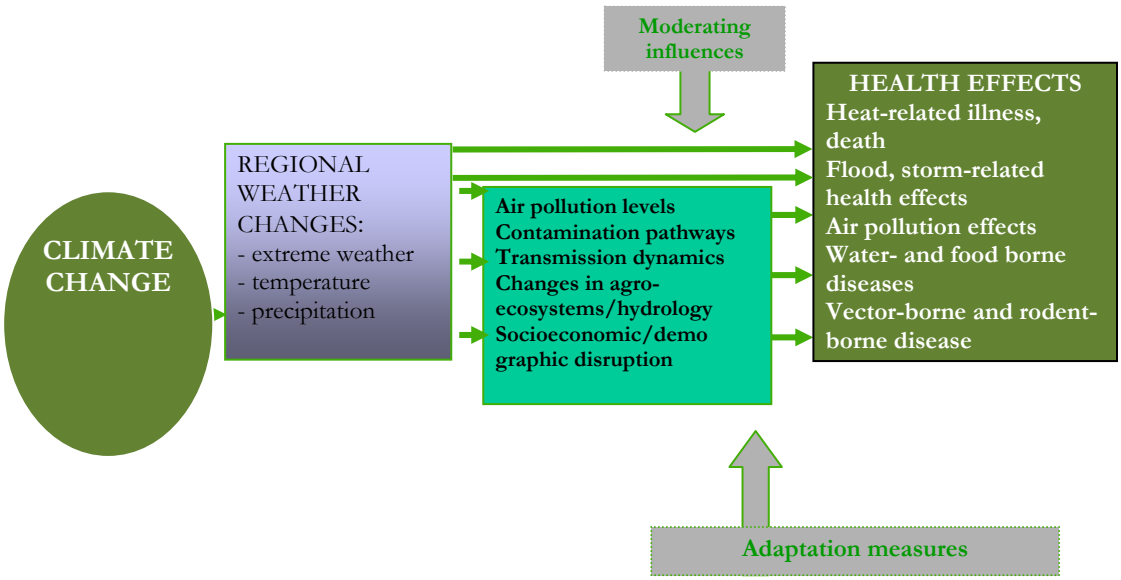
Health implications of climate change include non-infectious effects which result from changes in temperature such as the famous 2003 heat-waves in Europe. The heat-wave that occurred in August 2003 in Europe was unprecedented and caused the greatest instance of mortality ever reported in Europe (Kovats and Jendritzky, 2006). Heat-waves will be more frequent in the future, as the world will become warmer. According to Patz et al (2005), although most studies to date show clear vulnerability to heat in cooler temperate regions, tropical regions also show a similar sensitivity to location-specific temperatures rise.

Malnutrition derived from crop failures due to droughts remains one of the largest problems in the world. WHO estimates that about 800 million people are undernourished and most of them live in Africa. Climate change can exacerbate the impacts of droughts.

Spread of infectious diseases is also attributed to changes in climate. Infectious agents such as bacteria and viruses and their associated vector organisms including mosquitoes and sandflies are influenced by fluctuations in temperature (Patz et al, 2005). For example, malaria transmission in the highlands of Kenya has been associated with changes in temperature and some studies have begun to analyze the long-term trends in malaria incidence related to climate change in Africa. However, these studies have not found a link to temperature trends, emphasizing other determinants of malaria risk including drug resistance, human migration and immune status, inconsistent vector or disease control programmes and local land-use changes. Lack of long term diseases data in Africa make the studies controversial and uncertain.

Dengue fever and dengue hemorrhagic fever, which are transmitted by mosquitoes, are associated with climate variability. This mosquito is strongly affected by ecological and human drivers, particularly the density of water-bearing containers, but is also influenced by climate, including variation in temperature, moisture and solar radiation.

Figure 2 shows the relationship between Climate Change and Human Health, according to WHO.



Source: WHO (2003),Methods for assessing human health vulnerability and public health adaptation to climate change. World Health Organisation, Geneva.

Although poor countries' contribution to the global climate change is very low (in terms of greenhouse gas emissions) the health effects of these changes will be more severe in those countries. The impacts will be worsened by lack of infrastructure, including health centres and consequently no access to the basic health care and adaptation measures most needed.

Mozambique already experiences the damaging effects of climate variability through natural disasters such as floods, droughts and cyclones. The frequency of these disasters is likely to increase with global climate change.

Linking to diseases, the post-floods periods are characterized by disease outbreaks including malaria and cholera. Increasing frequency of natural disasters associated with climate change/variability worsens country vulnerability in relation to adverse health impacts.

An increase in extreme weather events will:

- affect a large group of inhabitants who are not able to go to work and to the market;
- many are exposed to several epidemics and who will suffer from shortages of products in the market and price increases;
- deprive inhabitants of social services because of damaged infrastructures, among other losses;
- as time goes by, some people, mainly in rural areas will be vulnerable to water scarcity, food and nutritional insecurity in view of the reduction of their local food production;
- increase illness, injuries and deaths particularly in urban and peri-urban areas where the majority of the population is concentrated, with the elderly, infants and poor being more vulnerable;
- increase outbreaks and spread of some infectious diseases carried by mosquitoes, including viral encephalitis, dengue fever, yellow fever and malaria;
- Increase outbreaks of some water-borne diseases such as diarrhoea and cholera.

The detection of such health problems related to climate change is, thus, a matter of statistical judgments, including the recognition of their attribution (Martens 1999 and Patz et al. 2000).

4 Mozambique and the Millennium Development Goals

Mozambique has made significant socio-economic progress since the peace agreement in 1992. The country's economic performance has been consistently robust with an average growth rate of 9% between 1995-2001. However Mozambique remains one of the poorest countries in the world with human development index rank of 170 out of 173 countries (UNDP 2002). Nearly 70% of the population lives below the poverty line. The incidence of poverty in the rural areas is 71,3% compared to 62% in the urban areas. Wide disparity exists at the provincial level. Figures range from 87.9% in Sofala to 47.8% in Maputo city. The government program to address poverty aims at reducing the incidence of absolute poverty from the current level of 70% to 60% in 2005 and to 50% by 2010. Emphasis is given to raising revenues from their current level of 12.4% of GDP to over 15% of GDP by 2015, and support from development partners is needed in line with priorities identified on the National Program of Poverty Alleviation (PARPA).

The under-five mortality rate declined from 277 to 246 per 1000 live births between 1994 and 1997 reaching 211 per 1000 live births in 2005. Nevertheless, the country is unlikely to meet the MDG 2015 target reducing under-five mortality by two thirds. The growing HIV/AIDS pandemic is likely to slow down, or even reverse, positive trends in child survival. Despite improvements in the health sector, urban / rural and provincial disparities are still evident. Under-five mortality rate (U5MR) in the rural areas is 63% higher than in urban areas, at 270 compared to 166. The differences between provinces are equally striking. In Maputo province, U5MR is 138; the rate is more than twice this level in three of 10 provinces all in the centre and north of the country, and is highest in Zambezi, at 322. Given the current trends, the possibility of Mozambique achieving the MDG target of halving the malaria mortality by 2015, may be seriously limited.

The HIV prevalence rate among adults (15-49 year-old) in 1992 was estimated at 3.3% and by the end of 2000 it had risen to 12.2%. Over 57% of persons living with HIV are women. The epidemic is projected to lower the life expectancy rate from 43.5 in 1999 to 36.5 in 2010 when the prevalence rate would reach 16.3%.

Poor environmental conditions, such as inadequate sanitation facilities, lack of water in quality and quantity, poor solid waste management system and vectors proliferation can be cited as direct and indirect causes of the high burden of infectious diseases (MISAU, 2002).

Table 2: **Selected demographic, health system, and mortality indicators for Mozambique** (WHOSIS, 2008)

Indicator	Metric
Population total	20 971 000
Population annual growth rate (%)	2.1
Population living below poverty line (% living on < US$1 per day)	36.2[D]
Population proportion under 15 years (%)	44
Children <5 years of age stunted for age (%)	47[C]
Children <5 years of age underweight for age (%)	21.2[C]
Environment and public health workers density (per 10 000 population)	<1.0[B]
General government expenditure on health as percentage of total government expenditure	12.6[A]
Adult mortality rate (probability of dying between 15 to 60 years per 1000 population) both sexes	477
Under-5 mortality rate (probability of dying by age 5 per 1000 live births) both sexes	138
Infant mortality rate (per 1 000 live births) both sexes	96
Deaths among children under five years of age due to diarrhoeal diseases (%)	16.5[E]
Deaths among children under five years of age due to malaria (%)	18.9[E]
Population with sustainable access to improved drinking water sources (%) Total	42
“ ” (%) Urban	71
“ ” (%) Rural	26
Population with sustainable access to improved sanitation (%) Total	31
“ ” (%) Urban	53
“ ” (%) Rural	19

All metrics from 2006 unless superscript: A= 2005, B=2004, C=2003, D=2002, E=2000

Section II

5 Case Study: Flooding and health in Mozambique

5.1 Aims and objectives

This study aims to raise awareness of key stakeholders on linkages between extreme weather events and human health using the experience of the 2000 / 2001 floods in Mozambique as a case study.

General Objective:

- To assess and provide information on the epidemiological situation using malaria and cholera data from 1998-2005 as a result of the 2000/2001 floods in Mozambique as a way of building database for supporting the government and other local agencies to plan disaster management services for its population.

Specific Objectives

- To analyze malaria and cholera trends as the main diseases related to extreme weather events in Mozambique that require acknowledgment, assessment and response among the key stakeholders;
- To identify the most vulnerable group exposed to these diseases;
- To describe strategies to increase resilience to extreme weather, particularly floods and make as preliminary recommendations to the relevant institution in Mozambique.

5.2 Methods and Data

The study was conducted by GED in Mozambique under supervision of CLACC. It took a period of six months, from February to July 2006, reviewing literature, consulting governmental organizations, NGO's and communities; assessing epidemiological and meteorological data.

The 2000 / 2001 floods were chosen as the relevant extreme weather events related to climate change to be discussed in this case study due to the impacts raised at all levels of the country's development. The review concentrates on those health effects that are specific to flooding, and not those that are applicable to disaster events in general. Therefore, malaria and cholera were chosen as the main health outcomes considered here being theoretically climate sensitive diseases, and also the main causes of morbidity and mortality in the country.

Malaria and cholera are also diseases related to temperature which is the key environmental factor that contributes to the decreased or increased incidence. This linkage is shown in the discussion section in order to understand the distribution of such diseases through the country.

Statistical epidemiological data of these diseases were collected at the Ministry of Health from 1998-2005 as a result of the daily notification system of these diseases in the public hospitals in the country. We recognize that the 2000 / 2001 floods had direct impacts at that time and in the following years, but start analyzing data from 1998 and continue to 2005 to see the trends before and after floods. Due to relatively few

epidemiological studies, we included all published evidence in Mozambique to strengthen evidence.

How the 2000 /2001 floods influenced the Millennium Development Goals is discussed below, considering health, well-being and the availability public services – both health-related and others - as well. Adaptation measures are the key means for avoiding more damage to Mozambican populations and these are also reported here.

Validity and reliability issues were addressed in the study through triangulating qualitative and quantitative information. Data was validated or rejected through cross checking with the data from written documents, observation and public opinions.

5.3 Key findings and discussion

The impacts of floods events in Mozambique are great. Flood disaster usually inhibits the productive capacities of communities and increases vulnerability to further disasters. It also increases poverty, leads to low levels of agricultural production, poor health conditions, environmental degradation and others consequences. In terms of disease the World Health Organization (WHO) reported that almost 800,000 people were at risk from malaria, cholera and other diseases and it was reported that 700 people died in the 2000 / 2001 floods, mostly by drowning.

Malaria

The incidence of malaria in Mozambique was expected to increase by a factor of 1.5-2.0 in the years after the 2000 / 2001 floods (Kondo et al. 2000), because of the creation of new mosquito breeding sites as the water receded, and the bringing together of large numbers of people which would favour transmission. Epidemiological data from the Ministry of Health (2006) show that malaria cases have doubled from 1998 to 2005, although the mortality rate has decreased by 10% comparing 2001 to 2005. The highest mortality rate was observed in 2002 with 9.2 deaths per 10^4 cases although the highest number of cases was observed in 2005 (Table 3).

Table 3- Malaria cases and deaths in Mozambique from 1998-2005

Years	Number of cases	Number of deaths	Crude mortality rate per 10^4
1998	196533	72	3.664
1999	2336640	1528	6.539
2000	3438051	2039	5.931
2001	3955504	3400	8.596
2002	4581607	4199	9.165
2003	4963961	3577	7.206
2004	5610884	4150	7.396
2005	5896411	4209	7.138

Malaria is transmitted via an insect vector, a female Anopheles mosquito. These vector organisms are cold-blooded and therefore sensitive to the local weather conditions. At higher temperatures, the pathogen develops more quickly inside the vector, thus, the chance of an infective bite increases. As well as temperature, rainfall has an important effect on malaria distribution, because rainwater remains in puddles and pools thereby providing a good environment for mosquito's abundance. Rainfall also affects relative humidity, hence the longevity of the adult mosquito.

According to the Ministry of Health (2005), the peaks in incidences of malaria in Mozambique occur in both April and December. These months are hot and mark the beginning and end of the rain season. The minor alterations observed in relation to the endemic line, can be explained by the fact that in the last years variations on climate and temperature have been observed. During the cold and dry seasons the average temperatures registered have been higher than 15°C and the relative humidity 70% to 80%. Although these conditions are not ideal, they contribute to the breeding and surviving of anopheles mosquito species.

The curve showing cases of malaria in Mozambique for the years 1998-2005 is based on data taken from the health centre setting from the district up to the provincial levels. This data does not therefore include all cases of malaria in the country as not everybody with malaria will seek medical attention; conversely it is also important to notice that the improvement in notifying systems through the weekly epidemiological bulletin and an expansion of health centre networks within the country can also contribute to the increase of registered cases.

Looking at the geographical distribution, all the provinces are vulnerable to malaria infection, but Gaza, Zambezia and Nampula are provinces with a particularly high proportion of notified cases from 1998 to 2005, while Niassa province has the lowest number of cases.

Considerable increase of notified cases in Gaza and Zambezia may be associated with floods contributing to an increase of breeding by mosquitoes coupled with the concentration of people in the accommodation centres, some of which had poor health care facilities.

The 2000/2001 floods on the other hand did not affect Nampula but a neighbouring province from Zambezia. During the floods most people migrated to Nampula, perhaps some carrying the malaria parasite with them. According to the Ministry of Health and the National Institute of Meteorology by the time that the floods occurred and the emergency situation was declared the local authorities, provincial directorate of health and other institutions were not prepared to respond to the disasters making the situation even worse.

The lower proportion of malaria cases registered in Niassa can be related to the cold weather characteristic of this province, thus conditions which are not favourable to the breeding and development of the vector (such as temperature and humidity). Poor registering information systems, deficient notification, the low affluence of people along with prohibitive distances from their residences to healthcare infrastructures, can explain the lower malaria cases in Niassa province.

Cholera

Cholera is another disease classified as climate sensitive. Outbreaks of cholera were also analyzed in this study. Cholera outbreaks in Mozambique show strong correlation with big climate anomalies like the El Nino of 1982-1983 and 1997-1998. After independence in 1975, the first outbreak occurred in 1983 and more than 10,000 people were affected. In the following four years no cases of cholera were registered.

From 1989 to 1994 the epidemic period had started and in the first three years there was an increase in cases of cholera. In 1993, the first major cholera epidemic occurred and more the 20,000 people were affected. The proportion between infections and clinical cases were higher when the epidemic was caused by biotype EL Tor.

Looking at the epidemiological data from the Ministry of Health, cholera cases have been reduced from 1998 to 2005 although in 2002 significant increases were seen. The highest mortality rate was observed in 1999 with 420.348 deaths per 10^4 cases and not after 2000 / 2001 floods as was expected (Table 4).

Table 4- Cholera cases and deaths in Mozambique from 1998-2005

Years	Number of cases	Number of deaths	Mortality rate per 10^4
1998	42745	1197	280.033
1999	34638	1456	420.348
2000	18557	273	147.114
2001	12288	164	133.464
2002	32741	460	140.497
2003	14606	114	78.05
2004	20839	117	56.145
2005	2079	21	101.01

The last outbreak for this period was in April 2000 and the number of cases reached 54,000 people and in 2003-2004 significant numbers of cases appeared in Maputo City, Gaza and Sofala Provinces, while few occurred in Inhambane and Manica provinces.

Attributing these precise number of cholera cases to the floods is not so easy, however. Only a proportion of cases are reported to health centres, and this proportion is likely to have been smaller during the disruption caused by the floods, when health centres were inaccessible or submerged. Moreover, the differences in incidence between 1998 and 2005 illustrate the variations between years that occur in the normal course of events. Taking as a baseline the means of the incidences in 1999 and 2001, the floods appear to have caused the numbers of cases shown in Figure 5. The related causes for the cholera outbreak include deficient water supply and sanitation systems in Mozambique characterized by low coverage levels, poor service delivery and weak sustainability.

An assessment of the status of water supply and sanitation service coverage among and within provinces and communities revealed a large proportion of the population as having no access to improved sanitation facilities and safe water supplies as reflected below:

- 75% of the rural population and 60% of the urban and peri-urban population do not have access to adequate sanitation facilities;
- 71% of the rural population and 64% of the urban population do not have access to safe water supply;
- No national or provincial programs to promote sanitation and hygiene behaviour change for the rural population;
- Existing water supply systems in urban and peri-urban areas are operating way beyond their original service level design capacity; Flood events in 2000/2 damaged and / or destroyed water supply systems in the main rivers such as Incomati, Limpopo and Zambezi river valleys further exacerbating the situation;
- In real terms, access to water supplies and sanitation services is barely keeping pace with population growth rates.

No less important, other reasons for cholera outbreaks in Mozambique are related to poor health reported by communities, degradation of boreholes, poor waste management system, poverty, disorganized migration, disorganized urbanization and increase in population density, and natural disasters itself. Therefore, the cases of cholera that are reported are likely to be the more severe and life-threatening ones, with a higher case-fatality rate than that in the community at large.

5.4 Conclusions

Generally the cases of the diseases presented in the study are increasingly annually. Apparently the efforts of the health sector do not seem to result in reductions of outbreaks in the country. The increase could be as a result of the improvement in data collection and increased areas covered by the data collection.

Although HIV-AIDS and poverty were not considered as indicators in the study, they contribute to the increase in community's vulnerability to climate events. As such government and stakeholder intervention is crucial to reduce the impacts of climate change vulnerability.

But difficulties remain in producing a comprehensive analysis of such implications due to the lack of information with regard to human activities, climate change predictions, adaptation capacity, resources available and the interaction between these factors. However, an effort has been made in order to bring this short assessment at this stage.

Section III

6 Lessons learned

With the 2000 /2001 floods the Mozambican society has gained experience and capacity in disaster management. Since the 1980s there had been a Government department to manage natural disasters and the associated relief efforts, but in July 1999 it was replaced by the National Disaster Management Institute, under the oversight of a Coordinating Council, chaired by the Prime Minister and including the Ministers of Foreign Affairs, Public Works, Transport, Health and Agriculture. In 1999, for the first time, contingency planning for disasters such as floods was built into the planning process at national, provincial and district level. Each district was asked to produce a contingency plan, though the quality of these plans varied widely. Many districts provided little more than details of their early warning systems and assembly points, if any. The Institute's National Contingency Plan was launched in November 1999.

Meanwhile, the Institute organized workshops and training exercises. Fire brigades and the police were involved in these, as well as boy scouts, the Red Cross and religious bodies. The INGC has recognized the need to empower local communities to reduce risks through community-based initiatives following the major floods of 2000 and 2001.

The national society has made strides in capacity building of its human resources through training of staff and volunteers in various disaster management modules, including empowering communities in disaster awareness as well as disaster simulations. Training of volunteers and dissemination of early warning systems for tropical cyclones has been undertaken. With the support of stakeholders, emergency stocks have been purchased and propositioned in disaster prone areas and the national society has been able to respond to disasters effectively in the past two years.

The Technical Committee of the Institute normally meets just four times a year, but by September 1999, following a general warning of high rainfall from local meteorologists, it was meeting fortnightly. In the following months, the warnings grew a little more specific and the pace of preparations quickened. The Red Cross was invited to join the Committee and began its own preparations. In November, the Ministry of Health instructed Provincial Health Directors to prepare for possible floods and cholera epidemics; to assist them, medicines due for distribution in 2000 were distributed in late 1999. Senior health officials were sent out to the Provinces to motivate staff and ensure that enough tents, stocks of drugs and other material were available for cholera treatment centres.

To raise awareness, the Institute produced a calendar for 2000 with photos of the damage caused by the 1999 Inhambane floods, and distributed it to local leaders. However, the Institute had only very limited resources (for example, only seven boats in the southern half of the country) and organization in the affected provinces was weak. Its preparations appear to have made little impact on public awareness, though the institutional set-up and the training were probably helpful in the emergency phase. However, nothing in living memory could have prepared people for what was to come.

7 Key vulnerabilities

Although there are few results from mathematical modelling, the cause–effect relationship concerning climate change and public health in the country, the recent variations in precipitation and the consecutive droughts and cyclones, and the

subsequent damages to public health services, suggest that the country is likely to continue suffer the effects of climate change for years to come. It is urgent that Mozambique develops actions in order to deal with unpredictable climate change, through response measures to reduce the impacts of climate change in the health sector.

According to the Health Strategic Plan 2001-2005 (2010), the Ministry of Health developed a new vision for its malaria control program. The vision rests upon the Africa Roll Back Malaria (RBM) initiative, which aims to mobilize interested parties to come together and form an alliance and to form a unified malaria control strategy. It is basically designed to fit the country's specific circumstances, needs and to help communities to reduce the consequences of malaria. The RBM movement includes active participation of the government, development agencies, private and public commercial organizations, professional associations, civil society, research groups and media. The target groups of this strategy are children under five years of age and pregnant women.

Government policy, for example, influences the cost of mosquito nets, introduction of free malaria treatment and poverty reduction strategy. These measures are equally important in controlling the disease.

The Government has also expressed a commitment to create the right environment for progressive participation of all the national and international stakeholders in fight against malaria.

Limitations to combating vulnerabilities include:

- Poor coverage of the present health services. The National Health Service is not able to reach many rural populations (an estimated 60% of the populations have no access to the health services). The health infrastructure is still insufficient, and some of it was destroyed during the 16 year-period of civil war causing a weak linkage between the community and the health services.

- Poor access to first line, anti-malarial drugs at the community levels coupled with lack of adequate drug distribution mechanisms.

- Rising levels of chloroquine resistance have prompted the Ministry of Health to review their first line treatment for malaria.

- Shortage of skilled human resources at all levels in the health system. Experience from the past and current health programs shows that one of the major barriers to the adequate implementation and supervision of health programmes is the inadequate staff / human resources at the district level.

- Inadequate indoor residual insecticide spraying program. Spraying programs have been limited to some urban areas in the country, and these spraying operations some times are not critically focused.

- Low level of disease knowledge and widespread illiteracy. Health education, information and communication often do not reach the target populations, and do not function optimally. The population has limited capability to recognize important symptoms and warning signs, and has harmful cultural practices.

Regarding cholera challenges are described in two discreet areas:

- At the policy and planning levels there is a lack of an implementation strategy despite good guidance development; incomplete decentralization process for improving water and sanitation system; weak institutional capacity leading to poor management of resources.

At the level of implementation there is lack of involvement of users in design and implementation of projects; lack of empowerment of women as powerful agents of change in hygiene practices; lack of emphasis on technicians in social issues related to water systems; under utilization of NGOs and the private sector; strong cultural taboos and beliefs interfering with behaviour change and difficulty in implementing the Demand Responsive Approach in the poverty context of the country.

8 Policy recommendations

The pressure caused by climate change in the country shows that there is need to develop an effective system in order to respond to the events related to climate change including droughts, floods and cyclones.

In order to tackle the problems mentioned in the present study, Mozambique should establish a well-planned system with an inter-sectoral strategy to prevent and reduce the adverse impacts of climate change. The capacity of different sectors including health, need to be strengthened with technical and financial resources to take into account the environment aspects.

Education and awareness-raising are also important for specific issues including early warning systems, environmental protection and best agricultural practices.

Improvement in environmental management will result in better quality of life and consequently poverty reduction.

9 Research recommendations

Research is crucial in order to understand the factors related to climate change as well as vulnerability and assessment studies. Currently, climate change adaptation studies, especially those related to communities' experiences, are almost non-existent in Mozambique.

Research should be carried out in order to identify adaptation measures, modelling the impacts of climate change through various scenarios especially those independent factors such as demographic, urban planning, new technologies, information, and Industrial and economic development.

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