Floods and droughts in Mozambique – the paradoxical need of strategies for mitigation and coping with uncertainty

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Abstract

Mozambique, a country under economic recovering efforts after long civil conflicts has been hit several times by natural disasters such as floods, droughts and tropical depressions. The historical floods of 2000 are not the only event that is still surprising the world about the uncertainty within the country, but also paradoxically the 2003 and 2004´s droughts that affected the whole Southern African region together with tropical depressions. Looking at the recent events it is quite clear that Mozambique, like other countries in the region, is urgently required to take strategic mitigation measures in order to prevent losses from natural disasters. This paper discusses the impact of both floods and droughts on the development of the country.

Disregarding the limitation of data, computer based simulation is applied over the national GDP projections by incorporating a natural disaster component in order to create an awareness in the policies and decision makers for the urgent need of the establishment of strategic measures for both coping and mitigating floods and droughts. The paradox of living together with floods and droughts has been identified as part of the strategic mechanism that has to been taken in mind as part of the new paradigm for the ex-ant process in dealing with natural disaster risk management.

Different frameworks are identified and discussed in this paper, but still there is a need to develop a local and/or a regional mechanism that can help both involved and affected stakeholders to deal with these kinds of risks. Regional efforts under the SADC coordination toward risk management have been taking place, nevertheless some kind of local mitigating and coping mechanisms to deal with both floods and droughts are still needed.

Keywords: floods, droughts, mitigation, uncertainty, risk, disaster, coping, decision- making.

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1 Introduction

The Southern African region is one of the many parts of the world that are frequently visited by natural disasters, and Mozambique leads the list of these countries as the mostly hit by these extreme events across the region with 53 natural disasters in the past 45 years what in average means 1.17 natural disasters per year. Extreme natural events illuminate one aspect of the complex process by which people interact with biological and physical systems. Every parameter of the biosphere subject to seasonal, annual, or secular fluctuation constitutes a hazard to man to the extent that his adjustments to the frequency, magnitude, or timing of its extremes are based on imperfect knowledge (White [1]). By definition, no natural hazard exists apart from human adjustment to it. It always involves human initiative and choice. Floods would not be hazards were not man tempted to occupy floodplains: by his occupancy he establishes the damage potential, and may well change the flood regime itself. Therefore when an event, such as earthquake, flood, or tropical cyclone strikes one part of the earth it may or may not disrupt and damage the society in that area. The effects of human adjustments will depend upon the particular combination of physical and social environment that prevail at the time. It is barely conceivable and highly improbable that a group of people could manage to live free of any distress caused by rare and unexpected events in nature. It is equally improbable that they could exist wholly at the mercy of every fluctuation around average conditions. Between these poles, a wide variety of response is made to risk and uncertainty in the natural environment (White [1]).

In Mozambique, among such events, the 2000 floods, triggered by an exceptional succession of cyclones, resulted in particularly damaging losses. With more than 500.000 people displaced, widespread destruction and damage of physical infrastructure, as well as massive macro-economic impacts, the combined losses of the 2000 flood/cyclone disaster were estimated at US$600 million. Worldwide, at least 70% of all disaster occurrences are weather related; and experts are expecting that continuing climate change and global warming will result in an increased frequency of extreme weather events. In this environment of increasing climate variability, hence, Mozambique can expect future intensities of droughts, floods and cyclones to rise.

In this paper we focus our analysis on the southern region of Mozambique, around the Limpopo basin, where both floods and droughts are frequent, and the aim of this research is to investigate to what extent Mozambique is prepared to deal with natural disasters given the higher risk exposure of the country and the chronic poverty combined together with the massive vulnerability to natural disaster risk.

1.1 Purpose and objective

The main objective of this paper is to raise awareness to policy and decision makers and other stakeholders for the financial risk of natural disasters by developing a model that shows the effects of natural disasters on the national

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economy. This is based on scenario analysis of the GDP's projections of the country by incorporating catastrophe component. The study is basically based on literature review on the field of natural disaster risk together with formal and informal information gathering from experts and other key stakes that can give a significant contribution to the process. This paper is part of the research that the author is carrying on in the field of natural disaster risk management and it was developed under the project Risk Modeling and Society (RMS) at IIASA - International Institute for Applied Systems Analysis - were the author spent three months as Young Scientist for the 2003 Summer Program.

2 Background and motivation

Mozambique, a new country with an independent status, is characterized by a set of difficulties derived from the historical processes and man-related events such as the armed conflict that devastated the infrastructures and other production facilities. Disasters related information about Mozambique is hardly found and few studies were carried out in this field, nevertheless the existence of field specialized institutions within the country.

Mozambique still one of the poorest countries in the world with about 70% of people live below the bottom line of poverty – est. 2000 and a prevalence rate of HIV/AIDS between 12 and 16 percent – est. 2001. Poverty, isolation, illiteracy, and disease characterize the everyday life of most Mozambicans, who often feel that the benefits of growth are not reaching them (Rep. Mozambique [3]). The year 2000 floods and continuous droughts and other frequent extreme events have undermined the rhythm at which the country was developing late in 90s, turning again to a dependent from external aid. According to the World Bank, the per capita cost of natural disasters in relation to GDP is at last 20 times higher in the developing world than in developed countries (Bayer and Amendola [2]). Despite the higher rate of poverty that characterizes the country, Mozambique it is also located in higher risk prone zone with about 2,470 km coastal line, highly exposed to tropical depression and typhoons. Statistics show that from 1965 to year 2000, about 60 natural disasters of different magnitude have occurred in various parts of the country, mostly floods; droughts; typhoons and tropical diseases.

3 Mozambique and natural disasters

The climatic conditions of Mozambique indicate that the country is subject to various types of events that can originate floods; droughts; cyclones and tropical depressions from the Indian Ocean and cold fronts from the south. Therefore, considering the extension of the country, the large areas of its major river basins and the climatic conditions, it is quite natural that floods of various degrees of severity occur repeatedly, sometimes with devastating effects. Another measure of the challenge is the number of international basins found in the country. More than 50% of the Mozambican territory is part of international river basins and

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Limpopo (415500sq m) is the second largest river in the country just after the Zambezi (1,388,200 sq. m), which ranks the second place in the continent.

The Limpopo basin is one of nine international rivers shared by Mozambique with an average population density (32 people per sq. km) and capacity to supply 716 m^2/year per person, it covers 4 large cities with above 100,000 people and there are 25 dams built along the river, and only one exists in the Mozambican territory. These characteristics of Limpopo are the main reason for floods of great magnitude in the country, especially when the rainfall covers the all region as happen early in 2000. Limpopo has historical flood related existence what have attracting settlement of millions people along the river, nevertheless few information is recorded in concern to floods.

The Limpoo basin has suffered a number of severe floods in the last 50years, particularly in 19551 1967, 1972, 1975, 1977, 1981 and 2000. the floods of 2000 were by far the worst, with water levels at heights not seen since 1848. the floods of 2000 were widespred, encompasing seven river basins in all, including the Limpopo basin. Flooding in Mozambique is caused by a number of factors, including heavly localized rainfall, tropical cyclone activity and poor manageent of upstream dams and waterlands in other parts of southern Africa (INGC [4]). Table 1 below shows the major tropical cyclones affecting the coast of Mozambique for the period 1984 –2000.

These particularities and differences between the basins also influence the analysis over the magnitude and impact the floods on each different river and their water flow. In Mozambique, usually different rivers have different time scale of floods, what most of the times cause a paradoxical constraint on disaster risk management through the country. It is quite usual to have floods in a certain region while the other part of the country is facing serious droughts.

Table 1: Major tropical cyclones in Mozambique.

Major tropical cyclones affecting the coast of Mozambique, 1984-2000			
Year	Name	People affected	People Killed
1984	Domoina	350,000	109
1988	Filao	90,000	100
1994	Nádia	900,00	52
1996	Bonita	200,00	11
1997	Lisete	80,000	87
2000	Eline	650,000	700 people killed in flooding caused in part by these cyclones
2000	Gloria	650,000	
2000	Hudah	11,00	

Source: Atlas for disaster preparedness and response in the Limpopo Basin.

Of all of the natural hazards affecting the Limpopo basin, drought is the most common and the most devastating. The unprecedented floods focused global

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attention on the Limpopo basin, but droughts are historically more frequent and impact more people than floods. As a slow onset hazard that often extends for more than an entire year, droughts also have the potential to cause longer-term economic disruption than a rapid onset hazard (INGC [4]). Droughts have been more devastating, by several order of magnitude. Drought and famine in 1980, 1983, 985 and 1992, exacerbated by ongoing warfare and political-economic instability, resulted in 100,000 deaths and affecting over 17 million people. The Limpopo basin has a high risk of drought because the rains are often erratic and unreliable. The rainy season often does not start when expected and total seasonal rainfall often occurs in the space of a few days.

This combination of hazard exposure and historical vulnerability has created a situation in which, from 1965 to year 1998, the annual average death toll due to droughts, floods, typhoons and epidemics was, 3,3000 people with an annual average total of nearly one million people affected (Rep. Mozambique [3]).

Severe droughts appear to occur every seven to eleven years within the basin, with less severe eventes occuring more regularly. The 1991-1992; 2003-2004 were the most severe in recent memory, affecting the entire basin and most of the Southern Africa region. Generally, there are strong indications that droughts appear on a cyclical basis in Southen Africa, but it is still not possible to predict them with a high degree of certainty. Scientists have descovered that there is a relationship between the El Niño Southern Oscilltion (ENSO) signal and drought in Southern Africa, but the correlation is not strong (INGC [4]).

EM-DAT provides annual disasters database that can lead to a certain reliable analytical point. Nevertheless, for Mozambique as a whole, from this source, little has been recorded on natural disaster and particularly on economic impacts. Even though, figure 1 below gives a representative picture of the frequency of events for the last three decades.

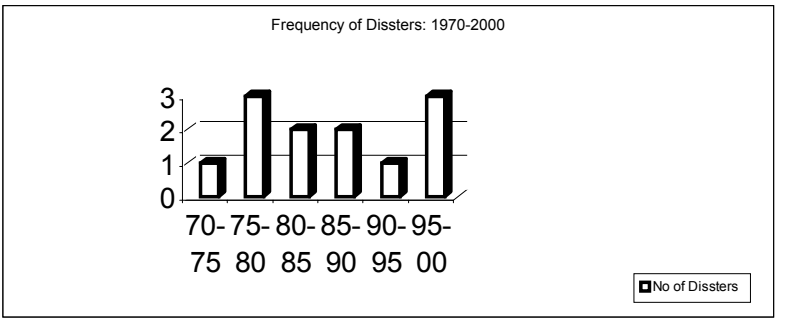

Figure 1: Frequency of disasters in Mozambique.

From the above chart (figure 1) we can see that during the period between 1995 and 2000 there were registered almost the same number of natural disasters with that between 1975 and 1980, but the difference lie on the magnitude and the number of rivers that were flooded during these periods. Different sources classified the year 2000 floods as a kind of a 100 to 150 years flood case. Other

assumption fall between the 1977 flood compared to that one of 1915, which is ranked as kind of 50 years flood. And the others can be assumed as regular as 10 years to 20 years ranking floods.

Catastrophe damages measurement is part of ongoing research process worldwide. The constraint is that this process is surrounded by uncertainty, especially for developing countries such as Mozambique where infrastructure have been dramatically damaged by war. Mozambique is at risk from several types of natural hazards: floods; droughts; typhoons and tropical depressions. A survey on economic damages caused by natural hazards show that the country will continue to suffer from these events. Heavy floods in 1971 and 1977 were comparable to this of year 2000, resulting in 300 to 500 deaths each and affecting half million people each.

4 The impact of natural disasters on national economy

The paradigm shift in poverty reduction programs, *characterized by income poverty to human poverty,* it seems to create motivation in the field of disaster risk management sector for a new mindset and hence also new paradigm shift. Poverty is a major cause of hazard vulnerability and natural disasters, in turn, can throw households into even greater depths of disasters. Poverty has also contributed to environmental degradation, with implications for the rate of incidence and severity of natural disasters (Benson [5]).

According to (Cannon [6]) it may not be true that most of the suffering in disasters is experienced by poor people it may not be the case that all poor suffer. Nor it only the poor who suffer, the impact of hazards may well be a factor in creating newly impoverished people. Poverty, as an indicator of lack of access to resources and income opportunities, is only one of the several dimensions of vulnerability. There is another aspect of vulnerability of the poor people, which is frequently ignored, that it is often local in nature. Disaster statistics collected and aggregated at provincial and national levels do not capture the miseries of the poor and the most vulnerable.

Released statistics, both from the World Bank and Centre for Research on the Epidemiology of Disasters (CRED) give different figures related to the damages caused by natural disasters in Mozambique. The most consistent figure is that related to the year 2000 whose sources are combined with national information released by the government of Mozambique for the Paris Club meeting, therefore an approximated figures are used for the other range of floods, using combined data from CRED, WB and other sources, such as Government agencies and entities and press; figure 2 below shows damages on national economy caused by natural disaster from 1970 to 2000 and the correspondent correlative percentage of GDP.

From the sub-chart "damage as % of GDP" we can see that to some extent natural disaster have affected on average above 2% of country's GDP whenever they strike and Mozambique it has been under a continuous and destructive was for the last 16 years. This situation does not only undermine the developing process of the country, also stresses the external dependency for the economic

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survival and relief programs in case of disasters. History has proved that the national capacity to deal with natural catastrophes is weak and lest has been achieved in terms of preventive actions specially to protect the economic infrastructures and other national assets.

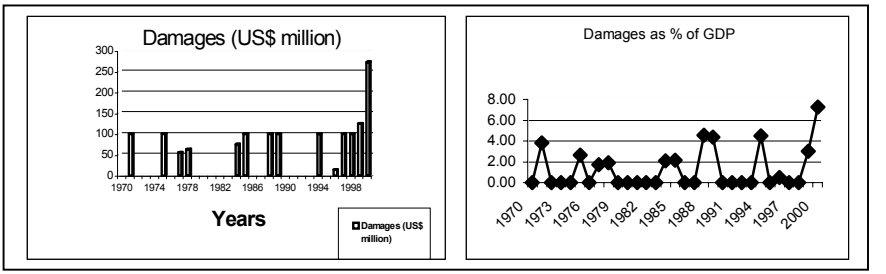

Figure 2: Total damages and Percentage of GDP.

The main challenge of this study is to build awareness on the policy makers about the need of developing new strategies for coping and mitigating with natural disaster risk management, given the country's exposure and the extent of vulnerability of the poor. An analysis of the past extreme events within the country it shows that the four (education, health, agriculture and rural development) out of the six major six area covered by the PRSP (Poverty Reduction Strategy Paper) were seriously affected; the figure shown below illustrates an extract of the GDP's projection under the enhanced HIPC under the PRSP strategy.

5 The disasters and modeling process

This section gives a brief explanation of the modeling process that constitutes the core part of this paper. The model was developed at IIASA by a team led by Professor Flug and its application to this research paper was coordinated by Dr. Mechler as the author's co-supervisor in the YSSP raining. Based on (Freeman et al. [7]) natural catastrophe inputs are stochastic, the catastrophe model applied in this study is solved in Monte Carlo and the results are expressed probabilistically. The scenario analysis is based on probabilistic simulation of percentage of GDP with the range variation from 1.96 to 6.68 and 10 year growth between –53 percent in the worth case and 59 percent in the best case. The illustration of these scenarios is given in figure 4 below. This figure gives an informative picture of what can happen in the case when an extreme event of a certain magnitude strikes in the country, given the exposure of national assets.

By comparing both figure 3 and figure 4 we can see that the projected trend of the percentage of GDP in the first figure reflects more or less the trend of the nominal GDP in figure 4 for the best case even with the catastrophe model, therefore the need of more reflective actions for both the decision makers at national level and international partners in order to take preventive measures and

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mitigation against natural disaster risk. The recent studies by Freeman and others [7], using the World Bank macro-economic country models, show how the infrastructural costs of disasters might be estimated in ways that improve post-disaster assessment. An important step forward would be to extend such quantitative economic investigations to consider both public expenditure and revenue implications of disaster shocks [8].

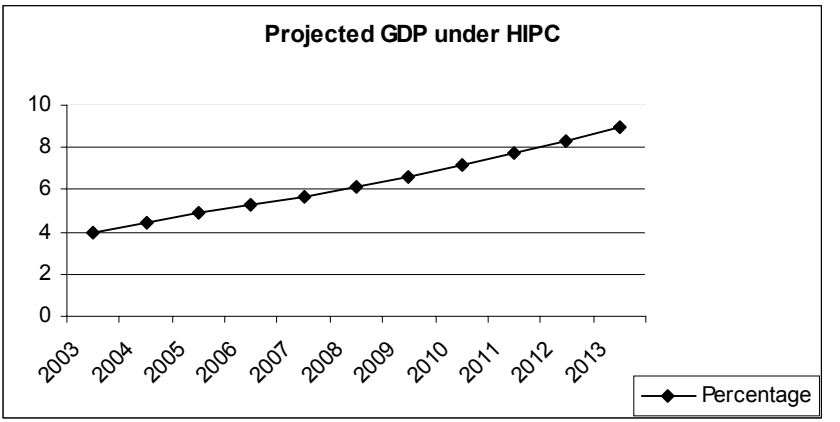

Figure 3: Projected GDP under enhanced HIPC.

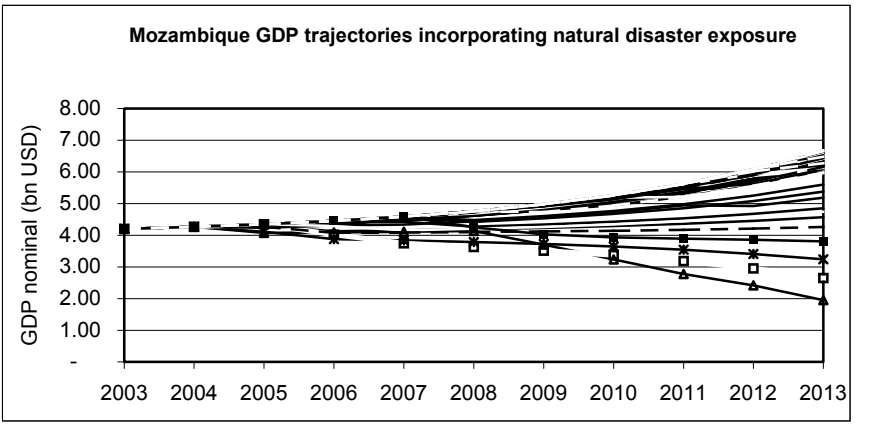

Figure 4: Mozambique's GDP with disaster simulation.

Figure 4 shows that in case of extreme event of such a magnitude that can lead to the worth case the country's GDP projections can tend to figures below 3 percent by 2011 what is not foreseen in the PRSP under the enhanced HIPC Initiative

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6 Finding concluding remarks

An overall analysis of this study shows that natural disaster risk management is a complex issue for both national and external stakeholders. It has proven that disaster risk management is a multi-sectoral activity, which requires a more holistic approach in order to deal with. Although this model does just reflect an assumption it is a quite representative case for planning purpose for countries like Mozambique, whose economy depends on external support and financial partnership. Events illustrated in the above figures can lead to a worsen debt situation with financial institutions for recovering programs, therefore there this study recommends more careful analysis on handling natural catastrophe risk.

Also we can see that the natural disaster risk management planners and decision makers are asked to reformulate the strategies for coping and mitigating these extreme events.

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