UNIVERSITY OF ZIMBABWE

FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING


COPING WITH DROUGHTS AND FLOODS IN THE MIDDLE ZAMBEZI VALLEY: A CASE STUDY OF KANYEMBA, MBIRE DISTRICT

By

BOLA BOSONGO

A thesis submitted in partial fulfilment of the requirements for the Masters of Science degree in Integrated Water Resources Management

HARARE, JUNE 2011

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In collaboration with

WATERnet

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By

BOLA BOSONGO

Supervised by:

Collin Mabiza

Krasposy Kujinga

Jaqui Goldin

HARARE, JUNE 2011

DECLARATION

I declare that this research is my own work. It is being submitted for the degree of Master of Science in Integrated Water Resources Management to the senate of University of Zimbabwe. It has not been submitted before for any degree of examination in any other University.

BOLA BOSONGO Gode…….....
(Signature of the candidate)

……day of……..2011

DEDICATION

I dedicate this work to God for His glory and the great thing He has done. I also dedicate this work to my parents, my family, Annette and the people of Kanyemba.

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Above all, I would like to thank my God for his untold and all time grace that gave me enthusiasm to start and finish this work.

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ABSTRACT

Water related extreme events like drought and floods have become recurrent in Kanyemba. Low rainfall totals, combined with intra-season dry-spells, are responsible for low yields. Heavy rain within a short period and reservoirs operation also affect households through loss of land planted due to floods. In this environment, households which rely on agriculture have to adjust their activities to cope with such events. This study investigated the perceptions of households on the pattern of rainfall, droughts and floods over 23 years, the impacts of floods and droughts on households and how households cope with these events. The research was conducted in Kanyemba which is in Lower Middle Zambezi Valley's Manyame catchment in Zambezi river basin. The area is a rural ward in Mbire district in Zimbabwe's Natural Region 5, which is semi-arid and receives on average 450-650mm of rainfall per annum. The research was conducted using both quantitative and qualitative research techniques. A case study approach was taken. Data collection was done using semi-structured interviews, focus group discussions and structured questionnaires which were administered to 144 households. To substantiate this data, an analysis of rainfall variability and Cahora Bassa water level over 23 years was performed. The study found that perceptions of households are that total amount of rainfall received in the area has gone down, while the frequency of dry-spells and flood events has increased in the last two decades. Rainfall variability analysis revealed that the amount of rainfall between 1988 and 2011 has not changed but the frequency of dry-spells and floods has increased. Floods occurrence was linked to heavy local rain and backflow from Cahora Bassa dam. The study found that from 1988 to 2011 Kanyemba experienced flooding six times. About 70% of crop season have been affected by the dry-spells of 20 days. Dry-spells and floods, which occur during the crop-growing period reduced crop production by about 65%. The study found that households have adopted a number of strategies to address droughts and flood impacts. Vegetable farming and crop production in the floodplain, wage earning locally, planting late and livestock disposals were common coping strategies. Some households also resorted to out-migration on a daily basis to Zambia or Mozambique. The study concludes that coping mechanisms used by households were not sufficient to cope with floods and droughts impacts. The study recommends the implementation of adaptation measures such as the use of drought-resistant crops varieties, irrigation and off-farm employment opportunities to enable households to deal with floods and droughts.

Key words: Droughts; floods; coping mechanisms; perceptions; vulnerability.

Chapter 1

INTRODUCTION

Background

Water-related hazards, such as floods and droughts are major features of natural disasters world-wide (Kundzewicz *et al.,* 2001). Floods and droughts are associated with excess or insufficient rainfall, river overflow, climate change and human activities (UN-WATER, 2005). Human activities and climate change can alter the intensity and frequency of floods and droughts (ISDR, 2003). According to IPCC (2001B) water hazards are likely to get worse, as there is a confidence that the magnitude and frequency of floods and droughts will increase during the 21st century due to changes in mean or variability of climate change. Between 1991 and 2000 over 665,000 people died in 2,557 natural disasters of which 90% were water-related events (IPCC, 2004). In 2003 alone, over 254 million people were affected by natural hazards, an increase of 180 per cent compared to 1990 (IPCC, 2004). During the two El Niño years of 1991/92 and 1997/98, floods in China affected over 200 million people in each year (Dilley, 2000). Losses stemming from water hazards have greater impact in developing countries as compared to developed countries (Kamara *et al.,* 2009). More than 95% of all losses caused by water hazards occur in the developing countries (World Bank, 2000). This will increase the vulnerability of households that depend on rainfed agriculture and livestock production for their livelihoods (Smucker and Wisner, 2008). In Southern Africa, agriculture accounts for 70% of regional employment and 35% of gross national product (IPCC, 2007). Up to 90% of crop production is rain-fed, and therefore susceptible to floods and droughts (POST, 2006; IPCC, 2007). Additionally, the majority of households in the region do not have access to mitigation measures such as irrigation or early warning and the cost of setting up these measures are not affordable, which leaves households' livelihood vulnerable to water hazards (Lankford, 2009). In the dry regions of Southern Africa, rural communities have been affected by floods and droughts which reduce crop production and led to famine (OFDA, 2000; Gommes and Petrassi, 1996). Recent examples include the devastating floods over southern Mozambique and north eastern South Africa in early 2000 and the intense drought over much of Zambia, Malawi, Zimbabwe and northern South Africa in 2001–04 (Meason and Jury, 1997). Given its large rural population

dependent on rain-fed agriculture, Southern Africa is vulnerable floods and droughts (Mulenga *et al.*, 2003).

Communities in Zimbabwe have experienced major climatic events which included the droughts of 1991-1992, 1994-1995, 1997-1998 and 2002, the El-Niño that resulted in the floods of 1997-1998 and the more recent droughts of 2002 (Dilley, 2000). For instance in the 1991-1992 drought, the income of poor rural communities in Zimbabwe dropped by 50 percent (World Bank, 2000). Floods and droughts create new burdens for those communities already poor and vulnerable.

Due to damages caused by floods and droughts, numbers of coping strategies have been used as a means to sustain livelihoods (Third World Water Forum, 2000). In the developing countries, rural communities employed local knowledge to reduce damage caused by droughts or floods (Rahmato, 1991). Coping mechanisms of communities based on local knowledges are closely linked to the resources available in their environment and these resources determine how well communities can cope with stress such as droughts and floods (Schröter *et al.*, 2004; Malone, 2009). As found by Folke *et al.*, (2002), a stable community is a community which has the ability to cope with the effect of an extreme event that may cause harm using local resources. IPCC (2001a) noted that the negative impacts of droughts or floods that include declining harvests, deaths, displacements, damage to infrastructure, spread of disease and loss of livelihood, have led communities to develop diverse means of coping. Over the centuries, communities in Sub-Saharan Africa have developed capacity to cope with floods and droughts (IFAD, 2010). Tribes in the Turkana region of northwest Kenya, for example have adopted a nomadic lifestyle to cope with drought conditions (POST, 2006). In Zambia frequent floods have impacted negatively on food production systems of Tonga people, making them vulnerable. However, the Tonga people responded positively, exhibiting resilience by adopting shifting cultivation, including nomadic lifestyle (Kajoba, 2006). Rockström (2003b) argues that the coping mechanisms used by communities were adequate because traditional options such as nomadic life style, shifting cultivation and free access to natural resources allowed people to keep pace with environmental changes. Conversely, in some communities these options have been reduced and with time, societies that earlier could absorb environmental shocks, have now become vulnerable to even small environmental disturbances such as droughts and floods (Rockström, 2003a).

Located in lower Manyame subcatchment, which is in Zambezi river basin's middle Zambezi valley; Kanyemba is exposed to two types of hazards (Oldreive, 1993). The first hazard consists of rainfall induced floods and also floods which are caused by the operation of

Kariba and Cahora Bassa Dams. The Kariba Dam is located upstream while the Cahora Bassa is downstream of the area (Madamombe, 2004). The second risk is drought and prolonged dry-spells which result in crop failure and food shortages (Fritz *et al.,* 2003). Thus, Kanyemba is vulnerable to floods and droughts.

1.2 Problem statement

Several studies (Tiffen, 1995; Vogel, 1995; Fauchereaus *et al.,* 2003) have observed that Southern Africa is one of the regions estimated to be most at risk from floods and droughts. The widespread poverty and the fact that a large share of Africa's economies depend on climate- sensitive activities mainly agriculture, render the continent especially vulnerable to the impacts of drought and floods (ECA, 2007). Drought and floods account for 80 percent of loss of life and 70 percent of economic losses in Sub-Saharan Africa (Wold Bank, 2000). In Kenya, the drought of 1999-2001 cost the economy some 2.5 billion dollars of foregone development and the drought of 1990/1991 in Zimbabwe resulted in 62 percent decline in the value of the stock market (ECA, 2007). Vogel (1995) points out that while much is known about the causes of droughts or floods, little is known about the coping strategies in poor rural areas and the way that indigenous knowledge and practices address floods and droughts. This study seeks to make an investigation on the perceptions of households on the pattern of floods, droughts and rainfall, and how they cope with these events

1.3 Hypothesis

Local communities in Kanyemba have over the years managed to cope with the environmental changes such as droughts and floods.

1.4 Research questions

1. What are the local perceptions on droughts, floods and rainfall during the last two decades?
2. How are local communities affected by droughts and floods?
3. How do communities in Kanyemba cope with droughts and floods?

1.5 Objectives

1.5.1 General objective

The general objective is to analyse how local households in Kanyemba cope with droughts and floods

1. 5.2 Specific objectives

1. To explore the local perceptions of rainfall, droughts and floods;
2. To investigate the impact of droughts and floods on livelihood activities;
3. To establish coping mechanisms used by local communities to cope with droughts and floods.

1.6 Justification

Rural communities' agriculture production faces the challenge of floods and droughts and threat food security for households. Households are considered particularly vulnerable to floods and droughts since their livelihoods depend on resources that are highly sensitive to fluctuations in rainfall. In sustaining their livelihood, households draw on what knowledge and skills they have available on their own, as well as the resources they can access. This study on how households cope with floods and droughts in the Lower Middle Zambezi Valley will help to identify good practices which sustain household's livelihood in semi-arid environments. The study will provide valuable information for improving coping mechanisms to better support and build households' capacity to cope with weather hazards.

1.7 Scope of the study

This study focused on floods and droughts impact and coping mechanisms used by rural communities of middle Zambezi valley, in Mbire district particularly in Kanyemba communal land.

1.8 Definition of concepts

The following definitions are found in Disaster Risk Training Course held on June 2002 at Asia Disaster Preparedness Center.

Community is groups of people linked by common identity, geography, commitment, interest, or concern.

Coping is means of managing resources in difficult situations. It includes finding ways to solve problems, to handle stress or to develop defence mechanisms.

Hazard is a natural or human-made event, which may cause damage or loss and sometimes disaster.

Household is key unit of production and consumption, a core group of relatives who live together, work on the same fields and eat from the same pot, even in situations where social obligations are observed by an extended family.

Livelihood is comprised of the capabilities, assets and activities required for a means of living. A livelihood is sustainable when it can cope with stresses and shocks and maintain and enhance its capabilities now and in the future, while not undermining the natural resource base.

Mitigation is measures that aim at reducing the impact of a hazard by minimising losses, damage and human suffering.

Response is an aim at meeting the immediate and basic needs of the population to ensure their survival.

Risk is the probability of something happening in the future, which has negative consequences.

Vulnerability is the presence of unsafe conditions, which negatively affect people's capacity to cope with the damage, loss and disruption due to a hazard. These conditions also affect people's ability to recover from those losses after the disaster.

1.9 Theoretical framework

Gunderson and Holling (2002) suggested that, the interactions of three factors such as ecological, social and economic are important for identifying the stability of communities in a particular environment. As long as communities in the study area depend on agriculture for their livelihood, we suggest droughts and floods as major factors that determine the stability of local communities in their trajectory of development. In this study we identify three alternative stabilities domains for communities in Kanyemba (Figure 2.1a). The first referred to as stable domain where droughts and floods are not impacting on communities' livelihood. Other domain, referred to as disturbed state where communities' livelihood is disturbed by one factor, either floods or droughts. The third domain refers to vulnerable state, the combination of floods and droughts impact place people in vulnerable domain.

The stability of communities is determines by the occurrence of droughts or floods along x-axis or y-axis (Figure 2). The first factor is drought placed in the x-axis, affecting crop production thereby reduces communities food consumption and agriculture derived income (Deverux, 2007). Communities can live in the right side of drought threshold depending on communities' responses at the onset of droughts (Figure 2.1a). Community can leave in the disturbed zone by planting drought resistant crops; develop irrigation schemes, use water harvesting techniques, rely on flood plain as natural irrigation or using traditional early warning as mitigation measures. Communities can also cope with droughts by using off farm activities such as causal labour, fishing and petty trade. The second factor is flood placed in

the y-axis, occurrence of flood in the communities affect crop production, impact on communities' valuable assets. Communities can live in the disturbed zone regarding their responses to flood events (Figure 2.1a). Local practices such as moving valuable asset away from flood areas, construction of platform to protect livestocks, planting crop that can resist against flood water, traditional early warning by combining of local knowledge related to floods can reduce the impact of floods in the communities (Dey and Singh, 2006).

In the disturbed zone communities can be affected by one factor while the absence of other factor gives them room to produce and sustain their livelihood. Communities can move to the vulnerable state when both droughts and floods impact on communities' livelihood and mitigations measures to prevent droughts and floods such as early warning, irrigation are absent while local coping mechanisms such as asset disposal, piecework wild production help communities to reduce at a subsistence level the impact of droughts and floods. Communities move from vulnerable state to emergency response (Figure 2.1b) where recurrent droughts and floods undermine people's coping mechanisms and make them living above floods threshold and beyond droughts threshold. Frequent droughts and floods, have exhausted communities' assets in such a way that communities' capacity to cope have been curtailed. Thus, external assistance is required for communities to survive during the crisis.

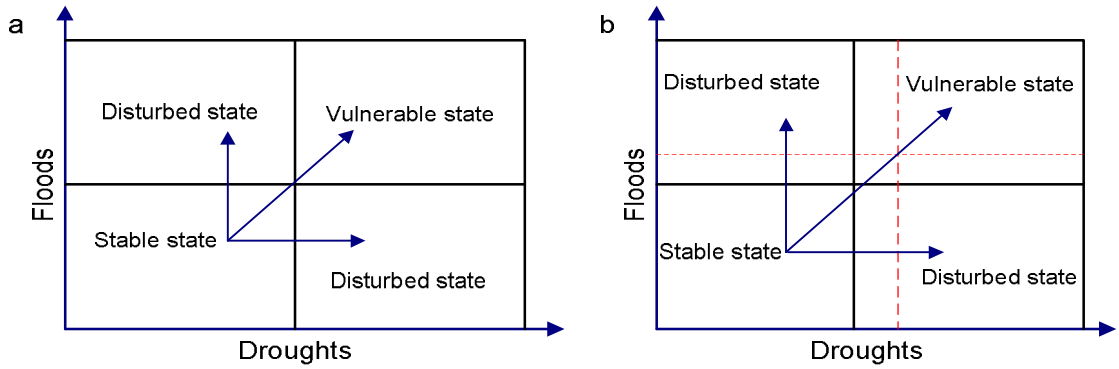

Figure 1. 1: Conceptual framework analysing stability of communities (Adapted from Enfors, 2009).

Chapter 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature concerning floods and droughts, response to floods and droughts, and coping mechanisms. Firstly, floods and droughts are defined. Floods and drought are among the most important risks which rural communities face, and these have a number of types and are defined in a several ways that will be discussed in the section. Secondly, it discusses the vulnerability to floods and droughts, impacts of floods and droughts. Thirdly, it presents the coping mechanisms. In this section it will be shown that rural households adopt different strategies to cope with the situations they face. The chapter lastly discusses the responses to droughts and floods.

2.2 Droughts and floods

2.2.1. Droughts

The climate and weather systems of the earth are constantly changing (Mulenga *et al.*, 2003). As part of these dynamic processes, extremes of temperature, rainfall, and air movement will naturally occur (Mulenga *et al.*, 2003). Periods of unusual dryness, such as droughts are therefore a normal feature of climate and weather systems in all countries, including those generally regarded as being wet and cold as well as those areas usually associated with the term drought the semiarid areas of the tropics (Borton and Nicholds, 1994). As part of natural dynamic process, droughts should not be regarded as being abnormal and, in fact, should be anticipated (Clay *et al.*, 1998). However, droughts of similar severity may have different impacts on different societies as a result of ecological, socio-economic and cultural differences. This, in turn, affects how drought is perceived and how the term is used (Lein, 2000). Generally, the Perception of droughts is that it is a hazard. Hazards are natural or human-made phenomena, which may cause physical damages, economic losses or threaten human well-being (von Kotze and Holloway, 1996).

Thus, drought is defines solely with regard to the physical event such as the reduction of water availability which impact upon society. Although drought has several definitions, the central element in these definitions is water deficit. This deficiency results in a water shortage for some activity, group, or environmental sector (ECA, 2007). Droughts are normally

classified into four types: meteorological, hydrological, agricultural and socio-economic drought. Meteorological drought describes a situation where there is a reduction in rainfall for a specified period below a specified amount, usually defined as some proportion of the long term average for the specified time period. Its definition involves only precipitation statistics (Watts, 1987). Hydrological drought involves a reduction in water resources below a specified level for a given period of time. Its definition involves data on availability and offtake rates in relation to the normal requirements of the system being supplied (Vordzorgbe, 2003). Agricultural drought is the impact of meteorological and/or hydrological droughts on crop yields. Crops have particular temperature, moisture and nutrient requirements during their growth cycle in order to achieve optimum growth. If moisture availability falls below the required amount during the growth cycle then crop growth will be impaired and yields reduced (Borton and Nicholds, 1994). Socio-economic droughts can be defined as failures in water supply when demands are not satisfied. Water planning and management use the hydraulic system together with estimations of natural water resources and demands to deal with shortages. Therefore, system failures are due to hydrological causes but also to water planning and management practices (Sánchez *et al.*, 2000). To limit the scope of the study to agriculture drought that impact on crop production, the definition of drought by Borton and Nicholds (1994) which refers to water deficit during the growth period of crop, is used in this study.

2.2.2. Floods

Floods are often understood as equivalent to out bank flow, this occurs when a channel cannot convey the total flow and water must spill beyond the channel, causing damage (Bronstert, 2001). There are several kinds of floods, each having different properties and each with a long history of human protective activities. Riverine floods occur when there is intense rainfall over a small subcatchment which responds to rainfall. In urban or rural areas where drainage is poor, the risk of localised flooding is high under intense rain (Bronstert, 2001). Widespread flooding and/or flash flooding, occurs following rainfall of high intensity or long duration over the whole or a large proportion of the catchment (D'Ercole and Pigeon, 1998). Flash flooding occurs within a few minutes to a few hours of excessive rainfall, a dam or levee failure, or a sudden release of water held by lake. In addition, localized surface or urban flooding occurs as the result of drainage systems that are incapable of carrying exceptional volumes of snowmelt and heavy rain runoff (D'Ercole and Pigeon, 1998). Floods are classified by Demuth (1999) depending on the level of community impact as follows:

- Minor flooding: This causes inconvenience such as closing of minor roads and the submergence of low lying areas.
- Moderate flooding: This causes the inundation of farmland in the low lying areas requiring the removal of stock and/or the evacuation of houses. Main traffic bridges may be closed by floodwaters.
- Major flooding: This causes inundation of large areas, isolating towns and cities. Major disruptions occur to road, rail links and crop fields. Evacuation of many houses and business premises may be required. In rural areas widespread flooding of farmland is likely. Regarding the scope of this study, moderate flooding referring to inundation of low lying areas is used.

2.3 Vulnerability to droughts and floods

2.3.1 Vulnerability

There is a number of ways in which this concept has been defined, depending on the context. Cutter (2006) reviewed definitions of vulnerability in studies between 1980 and 1995 and found 18 different definitions, showing that studies carried out from different perspectives viewed vulnerability differently. However, the common ideas is that vulnerability not only involves discussions on the physical environment (magnitude, intensity and frequency), but also social, social system's capacity to adapt, which is the social vulnerability (Weinstein *et al.,* 2000; Bankoff *et al.,* 2003). In this study, vulnerability is presented as a function of both the physical characteristics of stressors, and the social system's inherent sensitivity and adaptive capacity (IPCC, 2001b). Physical characteristic of vulnerability includes sudden upstting, pressure or risk to individuals, households or communities, and the social vulnerability is the internal side of vulnerability, such as lack of defence and tools to mitigate losses (Chambers, 2006).

2.3.2 Physical vulnerability

In the droughts and floods impact studies, human vulnerability to droughts and floods is primarily defined as a function of the character of the perturbation (Burton *et al.,* 2002). Focus is here directed towards the physical manifestations of water-related extremes events (drought and flood), the likelihood and frequency of its occurrence and the effects on human systems (Brooks, 2003). Risk to stressors lie in the probability of exposure to any floods or droughts events, which can occur with varying severity at different geographical scales, suddenly and unexpectedly or gradually and predictably, and to the degree of exposure (Stenchion, 1997). From this perspective the most vulnerable people to floods and droughts

are those living in exposed areas where sea-level rise, increased storminess, drier conditions or heavier flooding are predicted (Liverman, 2001a).

The rising exposure to hazards is becoming a commonly cited indicator of unsustainable development (Keith, 1996). More people have been settling in areas unsafe to hazards over the past several decades than ever before (Niasse *et al*., 2004). In urban and rural areas, the best land is taken-swampland, riversides, and steep slopes are now being settled. These are lands especially prone to floods, landslides and earthquakes (Whitcomb, 1995). Almost 2% of Europe's population is exposed to hunger due to their location in the drought prone areas (Sterr and Reese, 2000). Many areas in world, population, economic activity, and arable land are concentrated in coastal zones, which have led to a decrease in their resilience and adaptability to climate variability and change. Some coastal areas-such as much of The Netherlands, the Fens in eastern England and the Po River plain are already beneath mean sea level (Sterr and Reese, 2000). Along the coast of Marche Region, number of rivers flowing into the Adriatic Sea has flat, highly urbanised alluvial plains have led to frequent fluvial flooding and is accentuated by river channel engineering works (IPCC, 2001a). Extreme hydrometeorological events such as flooding and droughts are common across Africa. ENSO causes significant climatic disturbances in most parts of Africa, either inducing drought or flooding or increasing sea temperatures, leading to cyclones (Garanganga, 2003). These natural events become disasters because large numbers of people or infrastructure are located in unsafe areas, especially in urban centres and drought prone areas where 34% of Africa's population are living (Ambenje, 2002). Most cities and population in Africa lie in flat terrains and hence are generally devoid of natural drainage systems leading to floods during an intense rainfall (UNEP, 1999). One other important feature of the physiographic conditions of the African population is that they are mostly surrounded by highlands sometimes accentuated by unidentifiable and ungauged ephemeral stream channels which in times of intensive rainfall conduct torrential flash flows towards residential areas (Andah, 1988). The devastating effects of the floods caused by direct rainfall on the torrential flows in ephemeral stream channels on Population are responsible for most of the direct damages caused in urban centres during extreme events (Andah, 1988).

Overall, Africa has 2.4% of the world's large reservoirs, including dams, resulting in significant backflooding. However, reservoir development has disrupted the benefits of downstream flows for traditional agriculture, caused water pollution and increased disease incidence (Tumbare, 2000). The modification of the hydrological features of many rivers through damming has negatively affected floodplain livelihoods through high and prolonged

flood (UNEP, 1999). In addition, locating a number of large dams on the same river exerts cumulative impacts on flooding, water quality and other aspects of river system (Vordzorgbe, 2003).

2.3.3 Social vulnerability

The Flood Hazard Research Centre in a multi-annual flood analysis report based on social vulnerability of individuals or communities indicated that definitions of vulnerability all have their blind spots (Dwyer *et al.,* 2004). In the past, scholars believed that vulnerability was the characteristics of systems susceptible to damage, but the definition lacked consideration of human behaviour of the disaster (Cutter *et al.,* 2003). Later on, social perspectives and access to resources were included, viewing vulnerability as the result of interaction between economic and social systems (Steinführer *et al.,* 2007). Social characteristics and access to resources, therefore, became an important background factor of vulnerability (Steinführer *et al.,* 2007). Although everyone is vulnerable to environmental impacts of some kind, the ability of people and societies to adapt to and cope with change is very varied (Tsimplis, 2004). Between two and three times as many disaster events were reported in the United States in 1999 as in India or Bangladesh but there were 14 times and 34 times more deaths in India and in Bangladesh, respectively, than in the United States (UNEP, 2000a). The critical factor behind these statistics lies in the advantages enjoyed by United State citizens in terms of social equity and access to resources (UNEP, 2000b). The coping capacity of human society is a combination of all the natural and social characteristics and resources available in a particular location that are used to reduce the impacts of hazards (IPCC, 1996). These include factors such as wealth, technology, education, information, skills, infrastructure, access to resources and management capabilities (Bankoff *et al.,* 2003). These conditions are most extreme among the poorest people where a wide range of social and economic factors such as inappropriate housing, overcrowding, insufficient water supplies, and lack of rapid access to emergency services, poverty and inequality, and the availability of natural resources have direct and indirect bearing on human vulnerability to droughts and floods (Keith, 1996). Developing countries, particularly the least developed ones, have less capacity to adapt to change and are more vulnerable to droughts and floods, just because of poverty (IPCC, 2001b). In many African countries, up to half of the population suffers from absolute poverty. It is projected that Africa will be the only Continent to remain at the current level of poverty for another decade, this state limit poor people on their way of coping with extremes events such droughts and floods (Garanganga, 2003).

2.4 Impact of droughts and floods

2.4.1 Impact of droughts

Agriculture in Africa is important for food security in two ways: it produces the food for people; and it provides the primary source of livelihood for two-thirds of the working population in sub-Saharan Africa, the fact that a large share of Africa's economies depend on climate-sensitive sectors, agriculture render the continent especially vulnerable to the impacts of droughts (ECA, 2007). Agricultural production and food security in many African countries and regions are severely compromised by droughts (IPCC 2007). Episodes of prolonged droughts had adverse economic implications for both local and regional. Currently, most African countries are net importers, with over 50% of North Africa's food requirement and between 25% and 50% in sub-Saharan Africa imported (FAO, 2006a). Africa's cereal import bill, for example, estimated at about US$ 21.748 billion in 2008 and US$ 9.8 billion in Sub-Saharan Africa in 2008, represents a 30% and 35% increase over the 2007 level, respectively (Kamara *et al.*, 2009). The economic impacts of the floods and droughts in Southern Africa included GDP reduction of US$3 billion, reduced agricultural production, increased unemployment, further heightened government expenditure burden and reduced industrial production due to curtailed power supply (Clay *et. al.,* 1998). A decade later, the 1992-2001 La Niña-related drought in East Africa cost the Kenyan economy alone about US$2.5 billion. For instance, during 91/92 in Zimbabwe, a widespread drought reduced the national economic growth by 9.5 percent (World Bank, 2000). In Ethiopia, GDP loss from reduced agricultural productivity is estimated at US$130 million per year (ECA, 2007). The consequences are mostly borne by the large numbers of the rural poor people. In the region, rural communities in particular bear the greatest burden when land resources are degraded and when drought sets in (Mortimore, 1989). Crop failure during 2006/2007 agricultural season; have depleted household food stocks of drought-affected areas of western and southern Zimbabwe (USAID, 2007). Livestock mortality is one of the most serious effects of drought, between 1978 and 1983; the death of cattle was estimated at 36% of the communal land herds in Zimbabwe (Bratton, 1987). The effects of drought extend beyond the affected dryland areas. The level of vulnerability due to the combined impacts of droughts and socio-economic susceptibility increase, the greater the probability of human migration (Acosta-Michlik *et al.,* 2005). Drought is displacing people and forcing them to leave their homes and lands in search of better livelihoods (Mora and Taylor, 2006). Since droughts become more frequent as well as flood, livelihood security of rural community will weaken.

2.4.2 Impact of floods

Floods are the most taxing type of water-related natural disasters to humans, assets, as well as to cultural and ecological resources affecting about 520 million people and their livelihoods and claiming about 25,000 lives annually worldwide (IHP, 2004). The annual cost to the world economy of floods and other water-related disasters exceeds US$60 billion, whilst the cost of damage caused to cultural assets and natural resources is by no means quantifiable by economic scales (IHP, 2004). Whilst floods are not restricted to the least developed nations, it is the least developed nations that suffer the highest economic and human toll from the occurrence of floods (Dey and Singh, 2006). For example in Bangladesh, heavy monsoon rains in 1998 caused extensive flooding in two-thirds of the Country's 64 districts. Around 25 million people have been affected by the floods, with many thousands left homeless. Some 7,000 livestock were reported killed. More than 750,000 hectares of farmland were affected, with almost 500,000 hectares of rice and other crops being totally destroyed (FAO 1998a). In Africa, episodes of flood accounted for 26 per cent of total disaster occurrences during 1971-2001 with devastating effects (Vordzorgbe 2003). In North Africa, the 2001 disastrous flood in northern Algeria resulted in about 800 deaths and economic loss of about U$$400 million. In East Africa, the El Niño-related flood in 1997/1998 destroyed infrastructure and property worth about U$$1.8 billion in Kenya (Dey and Singh, 2006). In Mozambique, the 2000 flood reduced the annual economic growth rate from 10% to 4%, caused 800 deaths, affected almost 2 million people of which about 1 million needed food, displaced 329,000 people and destroyed agricultural production land, among other negative effects (Kundzewicz *et al.*, 2001). The single worst episodes of flood in Africa occurred in East Africa: one in 1997 which killed 2,311 people in Somalia and the other in 1999 which affected 1.8 million people in the Sudan (Vordzorgbe, 2003). The worst floods for four decades have devastated parts of Southern Africa, leaving thousands homeless and seriously threatening food supplies. Damage to housing, property and infrastructure has also been extensive (Mulenga *et al.*, 2003). Flood in the beginning of February in Mozambique, South Africa, Botswana and Swaziland, resulted in loss of life and severe damage to housing and infrastructure. Mozambique has borne the brunt of severe floods, where some 300 000 people have been affected. In South Africa, the number of people left homeless was estimated at 100 000 and in Botswana at 4 000 (FAO, 2006a). In Zimbabwe, OCHA (2007) reported that the 2007 flood affected almost 600 households in the flood prone areas of Tsholotsho and Masvingo. Gwimbi (2009) also found that, after flood the death toll was increased by survivors who

were left to suffer a lack of food and clean water and a malaria outbreak stemming from mosquitoes swarming and breeding in the floodwaters.

2.5 Coping mechanisms

Coping mechanisms have been defined by Davies (1993) as way in which people act within the limits of existing resources and range of expectations to achieve various ends. They are the means by which people or communities use available resources and abilities to face adverse consequences that could lead to a disaster. In general, this involves managing resources during crises or adverse conditions (World Bank, 2005). Under the change of their internal and external environment, communities and households develop progressively different livelihood patterns and subsequently the community coping methods evolve over periods of time to suit the local socioeconomic, cultural and political environment best (Watts, 1983).

The coping mechanisms are focussed on short term while undermining the basis of the livelihood in the long run without the actors being aware of the potential negative impact on existing resources and the social environment (Blakie *et al.,* 1994). The adopted strategies depend on households' perceptions of extreme events and the problem associated with it. Problems may include crop failure, concomitant decline in income and employment opportunities, low yields, and escalation of food prices, hunger and malnutrition, decrease in grazing land and fodder availability, and loss of properties (Wisner, 2002). Coping strategies for managing extreme events are often transmitted from generation to generation within communities and households (Devereux, 1997). The assumption is that disasters follow a common pattern and that people's earlier actions are the reasonable guide to withstand the impact of similar events (Kelly, 2001). Wisner (2002) argues that, coping does not always follow culture; but different groups can cope with disaster situation differently, which may fall into several categories such as:

- Identity: religion, migrant workers, ethnic minorities, lower castes;
- Ability: people with disabilities, economic status;
- Gender: women and girls;
- Generation: children and elderly people.

There is, therefore, no direct correlation between the occurrence of extreme events and the level of coping related to culture or group of people. In many instances, coping capacity that was adequate in the past has not kept pace with environmental change (Bantilan, 2002). This can happen when new threats emerge for which no coping mechanism exists, resources are

lacking, and skills are not available (Bankoff *et al.*, 2003). In due course, coping mechanisms may be destabilized or damaged resulting in failure to manage a disaster situation (Devereux, 2007). When people's coping strategy is inadequate to manage a disaster situation, the situation is called emergency state, which means external assistance is needed (Watts, 1983).

Coping mechanisms involve a number of sequenced measures, they can include preparation, mitigation, and response or rehabilitation measures (Chen, 1991). Chen (1991) attempts to categorise different mechanisms according to broad function:

- Preventive strategies, or mitigation strategies: these aim to reduce the adverse effect of a hazard on a community or to avoid disaster from happening, for example, by avoiding hazardous locations and time, evading seasonal disease vectors, choosing a safe location for a house.
- Impact-minimizing strategies, or preparedness strategies: these seek to minimize loss and facilitate recovery, such as through improving access to a minimum level of food, shelter, diversification of access to resources such as non-agricultural income sources, strengthening a social support network.
- Post event strategies or response: these are the mechanisms put into practice to address the immediate needs of the family.
- Recovery strategies: This will ensure temporary or permanent reconstruction and rehabilitation.

According to Corbett (1988), coping mechanisms vary according to the nature of extreme events. The strategies practiced to reduce vulnerability are classified into three groups:

Insurance mechanisms: In the first stage of responding to disaster situation, communities attempt to preserve their key productive assets (livestock, land, and farming tools) intact for as long as they can. In Watts' terminology this means that the first responses are those which involve the smallest commitment of domestic resources and are undertaken initially because they have relatively low costs (Watts, 1987).

Disposal of productive assets: Community comes in a point at which there is a shift in household responses and households take the decision to begin to dispose of key productive assets. As Corbett (1988) stated, it is at this stage of asset disposal that distress sales occur, in the sense that the cost to the household of this asset disposal is large and there may be little room for maneuver in selling at the time when the best possible price can be obtained. This stage of asset disposal will jeopardize the future economic welfare of the household, even if it helps to ensure its current survival (Corbett, 1988). According to Watts (1983) such disposal

of productive assets may signal that community have exhausted the range of possible actions open to them to sustain their livelihood at a lowest opportunity cost.

Destitution or migration: The third or terminal stage in these sequences of responses is that households are destitute or virtually assetless. In these circumstances a household's ability to generate income is severely diminished. Even the sale of its own labour power may no longer be as possible if household members are weakened by hunger or hunger-related disease (Corbett, 1988). At this point, migration of the whole household in search of relief may be the only option that remains (Deverux, 2002).

Strategies adopted to reduce vulnerability can be classified into common strategies for any extreme events in general such as migration and specific strategies linked to culture or group of people such as insurance mechanisms and asset disposal. Vogel(1995), based on his analysis of drought in South Africa argues that subsistence agrarian communities have developed what he calls a response level where he identified two levels of response: (i) The domestic level and (ii) the communities level. Vogel argues that the domestic level response to risk is through agriculture or wild production. Indeed, it is the failure of the agriculture or wild production that is particularly in understanding household's coping mechanism. At the community level, the typical responses to livelihood threat are the intra-family insurance; extend in group's reciprocity, gifts, exchange and mutual support (Vogel, 1995). A study on water hazards in India and Nepal by Banerjee *et al.*,(2011) indicated that the greater the degree of diversification of livelihood structure, the higher is the level of communities to cope with water hazards. A study by Garett and Ruel (1999) in Mozambique found that income level and household size affect household's coping mechanisms.

2.6 Responses to droughts and floods

In adverse and uncertain conditions a variety of strategies are adopted, disaster management literature generally attempts to categorise them into coping measures and adaptation measures (World Bank, 2005). Coping measures are a short-term response in securing livelihood system to periodic stress, are often aimed to respond to the immediate effects of disaster (Chen, 1991). While adaptive strategies are the way in which individuals, households and communities have changed their means of productive activities, modified their community rules and institutions over the long term in response to economic or environmental shocks or stresses, in order to meet the livelihood needs (Wisner, 2002).

2.6.1 Adaptation to floods and droughts

Adaptation to droughts impacts takes several forms. These may include structure adjustments, which depend more on technological fix such as the construction of reservoirs, boreholes and pipelines (Devereux, 2001b). Dry season irrigation also constitutes a major buffer mechanism in the event of low or scanty rainfall (Longhurst, 1987). Another way of adapting to droughts is through the use of seasonal climate forecasting. Communities may be in a better position to adapt to longer-term variability with the use of advance information on the future season's climate in addition to institutional systems put in place to respond to short-term changes such as early warning systems (McCarthy *et al.*, 2001). For instance, a seasonal maize water stress forecast for the primary maize growing regions of South Africa and Zimbabwe anticipates water stress six months before harvest time (Martin *et al.*, 2000). On the other hand, poor nations may adopt non-structure mechanisms with practices that can conserve soil water and groundwater resources such as growing drought-resistant crops, lowering numbers of grazing livestock, improving land-use (Whittow, 1996). In Zimbabwe, most farmers' single stands of maize was planted in rows based on the recommendations of extension service providers on soil water conservation (Bratton, 1987).

Flood protection measures can be structural or non-structural. Dams and flood control reservoirs, dykes, belong to the category of structural measures (Todoni, 2000). Constructing reservoirs where the excess water can be stored allows a regulated temporal distribution of streamflow and helps alleviate the flood problem by flattening flood peaks (Plate, 2001). Possible non-structural flood protection means include: Zoning, regulation for flood hazard areas, Flood mitigation systems of forecasting, flood insurance, indigenous knowledge and practices (Todoni, 2000).

2.6.2 Coping with floods and droughts

Seaman (1993) observes that in the current development jargon, Africans do not starve, they cope. It is thus known that people who are faced with extremes events make strategic decisions about how to cope. Case studies (Rahmato, 1987; Corbett, 1988) conducted in the 1980s showed that there is a common pattern in the nature and sequence of strategies adopted by rural people experiencing crisis. Based on these studies, three distinct stages on how communities cope emerged: insurance mechanisms, disposal of productive assets and migration behaviour or destitution. Assurance mechanisms are mechanisms that do not alter communities' livelihood, example, wild production, remittances from working relatives, waged employment, reducing food consumption, sharing of food with other (Corbett, 1988). Sharing food include vertical transfers, from wealthy family to poor and horizontal transfers between equally poor (Devereux, 2001a). Vertical transfers are purposely engaged in for

affection, duty or patronage without the expectation of reciprocity. Horizontal transfers are made in order to spread risk or smooth consumption over time with the anticipation that the assistance provided might be reciprocated in the future (Devereux, 2001a). Asset disposal are strategies that affect communities' livelihood (Krüger, 1999), for instance, livestock sales, disposal of agriculture material, sales of property (Hussein and Nelson, 2003). Households therefore decide to sell key productive assets and buy food. Asset disposal have implications for the future survival of households regarding the importance of such assets for communities' livelihood (Adger *et al.,* 2002). Migration strategies, however, are embarked on after the sale of assets as an action of last resort (Blaikie *et al.,* 1994). Migration is not always an effective strategy because it may lead to an increasing shortage of agricultural labour force in the rural areas (Devereux, 2001a). Communities may also cope by engaging in transfers such as interest-free loans or loans with interest between friends and neighbours (Mortimore, 1989). Such coping strategies show that rural people are able to respond and survive during crises triggered by droughts and floods.

2.6.3 Institutional interventions

Coping strategies are always subject to change related to the event, strong pressures can undermine the coping mechanisms and their effectiveness in such a way that communities have to rely on external assistance for their survival (Bankoff *et al.*, 2003). Supplementary supplies of assistances are made available by social organizations or government to help affected communities to recover from extreme events shocks (Swift and Hamilton, 2001). Devereux (2007) argues that, humanitarian responses to droughts and floods have been dominated by food aid, on the assumption that affected household have lost their access to food and need consumption support at least until the next harvest. Hoddinott *et al.,* (2003) note the importance of food aid in smoothing consumption and protecting assets among households facing food stress. One more general point often made in favour of food aid is that it can achieve improved nutrition better than cash because more food is consumed for equivalent values of transfer (Edirisinghe, 1998). For example, the Zimbabwean government instituted two-hunger assistance programmes. Namely, a monthly financial aid payment to indigent families and a children's supplementary feeding programme aimed at malnourished under age five children (Tiffen, 1995). The government also launched a programme of food aid in 1982, for the drought stricken south with the objective of reducing assets disposal among affected communities (Tiffen, 1995; Bratton, 1987). Krol *et al.*, (2000) shows that, Integrated Water Resources Management based on the concept of water as an integral part of the ecosystem can respond to water related extremes, Scientific support of integrated

management can provide a basis for coping in integrated water resources management, including coping with water-related extremes. Prominent examples of recent integrated research efforts to this end are vulnerability assessments, which evaluate the combined effects of multiple environmental stresses under global change and potential adverse outcomes for water resources, with focus on the river basin scales (Kulshreshtha, 1993).

Summary

People have always been subject to extreme of water hazards, droughts and floods have always forced people to act in order to cope with adverse weather conditions. Coping strategies are relevant due to the changing conditions and many coping mechanisms are observed to be close to culture, group of people and resources available. Increasing vulnerability to water-related disasters is due to growing exposure and socioeconomic factors such as poverty and access to resources. Floods and droughts have been a major concern since the dawn of human civilization and continue to hit every generation of human beings, bringing suffering, death and material losses. In Africa, Southern Africa region is highly vulnerable to weather and extreme climate events. Studies in the Sub-region suggest that losses due to droughts and floods have increased in frequency over the past two decades and have adverse effect on Communities and the economy of the Sub-region. Owing to the complexity of interacting pressures that cause water-related extremes, communities' responses call for integrated solutions, which consist of a mix of structure and non structures measures including infrastructure, local practices and institutions.

Chapter 3

STUDY AREA AND METHODOLOGY

3.1 Introduction

The chapter presents information on the study area. It further presents the methodologies used to gather data for the study. Techniques used to analyse data are also described. Finally, the methodology's associated problems and ethical issues are presented.

3.2 Study area

3.2.1 Location

This study was carried out in Kanyemba, which is located in ward 1 of Mbire district's 17 wards. It is within the hydrological boundaries of lower Manyame sub-catchment, which is part of the Manyame catchment. The catchment is in the Lower Middle Zambezi Valley. It is located at the confluence of the Zambezi and the Mwanzamutanda River in the North West of Zimbabwe in Mashonaland Central Province at 12.7^{o} south and 30.3^{o} east. Kanyemba is also bordered by two countries, which are Mozambique in the east and Zambia in the north. Upstream of Kanyemba is the Kariba dam and downstream of Kanyemba is the Cahora Bassa.

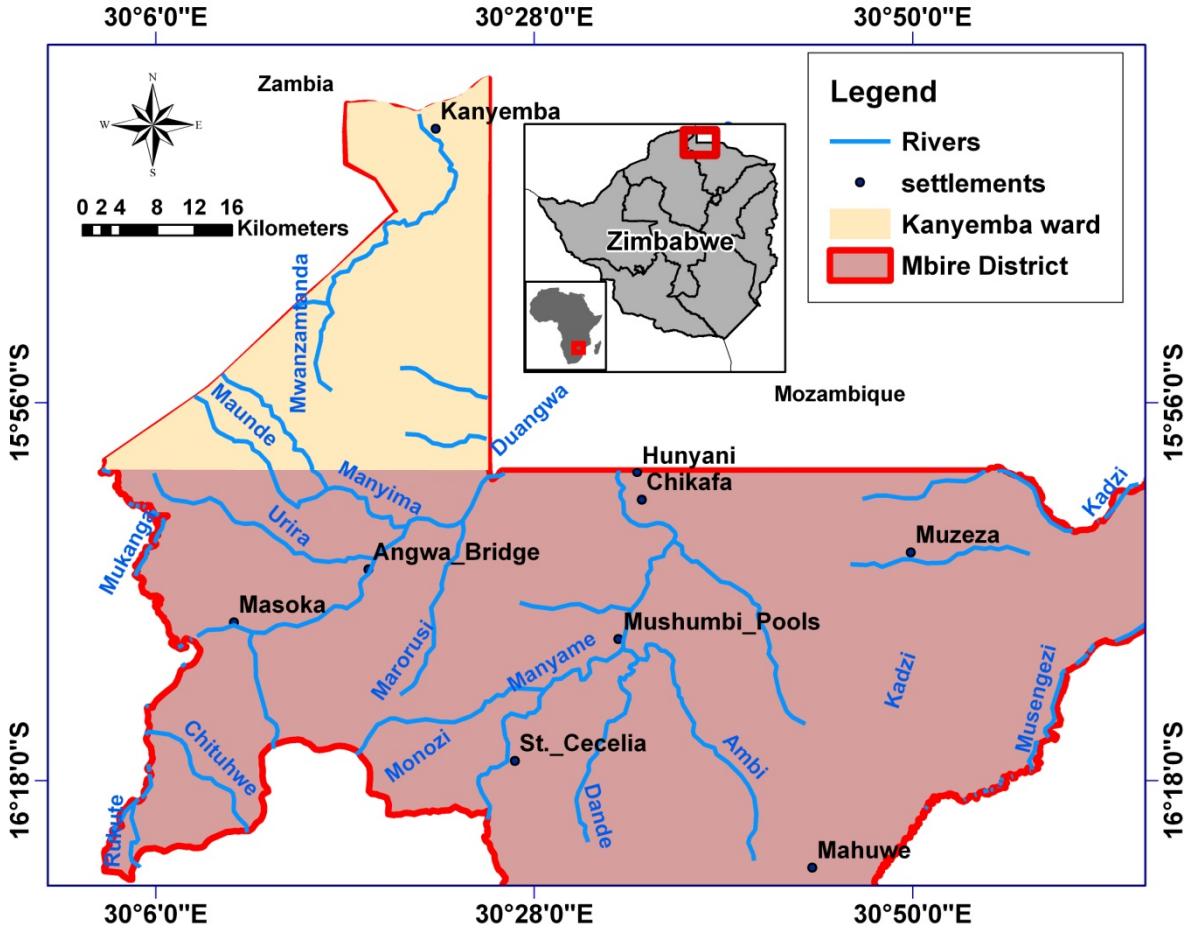

Figure 3. 1: Kanyemba ward in Mbire District

3.2.2 Topography and vegetation

Kanyemba is in a low-lying area with an average altitude of 4000m above sea level. Most of the ward is covered with woodlands, but along the Mwanzamutanda River a dense forest which supports wild animals. The vegetation in the ward is of biodiversity conservation interest and is an important refuge for wildlife (Fritz *et al.*, 2003).

3.2.3 Climate

The area under study is classified as natural region four according to rainfall regime of Zimbabwe. On average, the annual rainfall for the region is between 450-650 mm per annum and it reaches its peak in January or February (Fritz *et al.*, 2003). The highest rainfall period coincides with the period when rivers are at their peak and flooding is common, especially along the Mwanzamutanda River. However the area is characterised with highly erratic rains with severe dry spells and frequent seasonal droughts and the temperatures averaged 40^{o} in summer (FAO, 2006b).

3.2.4 Socio-economic profile

A study by Africa Wildlife Foundation (2010) found that ward's population of about 4500 people is spread across 24 villages. The population density is about 15 people per km^2 and the population growth rate is about 2% (AWF, 2010). The area has a secondary school, a health centre and retail shops. The main livelihood activities in the area are agriculture and livestock rearing, mainly goats. Crops such as maize, sorghum, millet, cowpeas, pumpkins, bananas and vegetables are grown in the ward mainly along the Mwanzamutanda flood plain. However, yields in both rainfed and recession agriculture are low mainly due to erratic rainfall, but also other factors such as high incidence of crop damage by animals like elephants and hippopotamus. In addition, the ward is prone to flooding which affects crop yields of farmers in the flood plain. Due to erratic rainfall, the ward is considered unsuitable for dryland cropping, ideally suitable for livestock production under extensive production systems and for wildlife production (FAO, 2006b). Tsetse flies are also another problem as they restrict farmers to work their fields with draught power (AWF, 2010).Tourism and wildlife management under Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) are the main economic activities in the area. Natural forest has been set aside for wildlife management such as elephants, lions and leopards and generates a substantial income for the area through hunting and tourism and the communities are benefiting trough the construction of school and hospital (Metcalfe, 1993).

3.2.5. Selection of the study area

The motivation for the choice of Kanyemba was based on its location between Kariba and Cahora Bassa dams and its characteristics. The zone is located in the low-lying areas in the northwest of Zimbabwe, characterised by severe dry spells during the rainy season and frequent seasonal droughts (FAO, 2006b). Furthermore, the area lies between Kariba and Cahora Bassa dams where dam management have led to floods (Tumbare, 2000).

3.3 Methodology

3.3.1 Research design

This study adopted both a qualitative and quantitative methodology approach. A quantitative approach to research mainly focuses on quantifiable data in terms of numbers and measures that can be analyzed statistically. "Quantitative researchers are more concerned about issues of design, measurement and sample because their deductive approach emphasizes detailed planning prior to data collection and analysis" (Neuman, 2000). In quantitative research validity is concerned with whether or not the study indeed measures that which it is intended to measure and reliability with whether the study can be replicated by another researcher in

the same context (Bartlett, 2001). In contrast, a qualitative approach to research, in collecting the appropriate data, is not interested only in numerical data that can be used for statistical analysis. In support of this statement, Neuman (2000) states that qualitative researchers are more concerned about issues of richness, texture and feeling of raw data because their inductive approach emphasizes developing insight and generalization out of the data collected. For the purposes of this study, the research decided to utilize both quantitative and qualitative research methods. A quantitative approach was used in the research because quantifiable data in terms of numbers and measures that can be analyzed statistically was collected. "Quantitative researchers are more concerned about issues of design, measurement and sample because their deductive approach emphasizes detailed planning prior to data collection and analysis" (Neuman, 2000). In contrast, a qualitative approach was used in this study research, in collecting the appropriate data, concerning about issues of richness, texture and feeling of raw data because their inductive approach emphasizes developing insight and generalization out of the data collected.

For the purposes of sampling, Cochran formula[1] was used (Bartlett, 2001) at 95% confidence. Out of 903 households in the ward, 144 households represented the sample size (16% of the population). To select number of households within a village, the proportion of 16% was taken (this was done for all 24 villages) and sampling interval[2] method was performed to select households to administrate questionnaire (Wunsch, 1986). The first household to be surveyed was selected randomly. From the first household, the surveyor walked by counting 6 houses between the first and the second household to be surveyed. Researcher continued on this sampling interval until they had surveyed the quota for the village. If a household on the path was empty when the interviewer knocked on the door, he skipped that household and moved to the next closest household. To increase the chance of meeting the respondent in the selected household, early morning and late afternoon was found to be the most appropriate time. In cases where the household respondent was not at home, a new household was found in the same village using the same interval selection process and select the house to the left or to the right of the selected household.

[1] n = $\frac{(t^2)(s^2)}{(d^2)}$, d = acceptable margin error at 95% confidence, t = value for selected alpha, s = variation in the population

[2] I = $\frac{N}{n}$, N = population size, n = sample size

A case study approach was adopted in order to produce a detailed analysis of the impacts of droughts and floods on local communities. According to Yin (1994), the case study approach is an appropriate way of capturing context specific and quality detail. Feagin *et al.,* (1991) defines a case study as "an in-depth, multifaceted investigation using qualitative research methods of social phenomena". The case study approach helped to draw out data using a semi-structured interview from the selected households. This method develops personal relationships with individual members of selected households. Through this approach, the respondents were able to develop a sense of trust. Case studies reflected those of livelihood activities, the impact of water-related extremes events on households and coping mechanism used to cope with droughts and floods. Those cases were selected mainly because of the perceptions of hazards have led to particular livelihood activities which turn have been affected by recurrent droughts and floods impacts thereby led to a particular coping mechanism in the communities.

3.3.2 Entry into the field

My first visit to Mbire district was at 10 .01.2011 with two principal investigators (Dr. Makurira, Mr. David Love and 6 students composing Eco-hydro project which I was participating). This was a familiarization visit with the study area. The councillor and the office of the District Administrator of Mbire had notified the principal investigators that they had approved the project to be undertaken in their district. The project team selected Kanyemba and Chidodo as the main study areas. We decided as a team of six students that we would be resident at Mushumbi during the period of fieldwork and from Mushumbi everyone could easily get in his study area. The Chief Executive Officer of the district secured accommodation for the project team at Agritex[3]'s office. During that short visit at the district I was introduced to the District Administrator and other officials whom I had to interact with concerning relevant issues related to my study area, Kanyemba.

I returned to Mushumbi to interact with the officials concerning Kanyemba in February 2011. After interacting with them, I went to Kanyemba where, the councillors of Kanyemba arranged meetings where I was introduced to the villagers. At these meetings I managed to outline the objectives of my research.

After a week in Kanyemba, I discovered that public transport was difficult. From Harare, there are only trucks as public transport which goes to Kanyemba twice or three times a week during the dry season and only once a week during the rainy season. For that reason, I decided to stay in Kanyemba as this was going to help me gather relevant information from

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the communities and from my own observation. I stayed at Kanyemba up to the end of my field work in May 2011. At Kanyemba I met Africa Wildlife Foundation (AWF) manager, who has been working in Mbire district for wildlife management. He took me to his place in Mozambique for two days for collecting more information on Kanyemba's crop production and human wild animal conflict. I became part of the communities within one month. I had the freedom to attend meetings gatherings such as funerals and different meeting organised by the councillor where I retain information on Non Governmental Organisation interventions.

3.3.3 Data collection

Data for this research was collected using a structured questionnaire, semi-structured interviews and focus group discussions from February to May 2011. These tools are appropriate for data collection about social issues in general, which are known to be specific to individual, and particularly to this study that investigates perceptions by, effects on, and mechanisms to cope local communities regarding floods, droughts and rainfall. A structured questionnaire contains a lists of questions to which an individual has to respond by choosing his/her best appropriate answer from the ones given by the researcher (Ogunniyi, 1992). Semi-structured interviews can be defined as a conversation with a purpose of gathering information (Behr, 1983). Focus group discussions involved the researcher being an observer in communities discussions with the hope of gathering more information on issues about droughts and floods.

Focus group discussions

Two focus group discussions were conducted in the area, one with local communities and the other with authorities in the ward (Councillor, Wildlife Manager, Traditional leader, Head of the village). Each focus group discussion was comprised of 3 women aged between 45 and 65 years old and 7 men averaged 60 years old (Appendix 1 for focus group discussion guide). This range of ages helped to get information regarding the changes that occur in the area since 1988 to 2011. Issues such as crop production, cropping pattern, flood hazards, rainfall pattern (past and present). Perceptions on impacts of flood, drought were emphasized in the focus group discussion.

Semi-structured interviews

Semi-structured interviews (Appendix 2 for semi-structured interview guide) were also found to be an appropriate strategy for the study because questions that were not included in the interview guide were asked. Semi-structured interview focused on abovementioned issues

took place face-to-face and a voice recorder was used to record all interviews in order to minimize information loss.

Household structured questionnaire

The survey questionnaires (Appendix 3 for survey questionnaires) focused on issues such as rainfall pattern, floods and droughts occurrence, floods and droughts impact on the livelihoods. The questionnaire was administered in order to capture the communities' opinions about issues such as droughts and floods, rainfall pattern, and households' information (duration in the area, household size, income source, sex and age). This technique collects also information from communities on coping mechanisms in relation to droughts and floods. Furthermore, the technique ensured the clarification of droughts and floods related issues such as crop production failure, food shortage and allowed an interpretation of the participants' responses by eliciting better rates of responses (Goddard and Melville, 2001). The households sampled were formed by household members of age greater than 21 years, and that was to conform to the criteria fixed in the study approach (Bryman, 2008). The duration of respondents in the study area averaged 23 years and the income source was mainly crop sale, the household size averaged 8 persons. The total number of respondents surveyed was 90 male and 54 female, respectively 62.5% and 37.5% of sampled households. The lower female number is mainly attributed to male dominance tradition, it is the male who is responsible to identify the stranger and give family information.

3.3.4 Collection of secondary data

Published literatures and other relevant sources were gathered from the relevant offices. Population survey documents and harvest data for 2008/2009 crop season were collected from Rural District Council (RDC). Precipitation data were collected from Zimbabwe Meteorological Office and Cahora Basssa water level from Mozambique Electricity Company to substantiate qualitative data related to perceptions on droughts and floods. Since much of rainfall data from Kanyemba station were missing, missing data were generated from Mushumbi rainfall data which is the nearest rainfall station to Kanyemba rainfall station.

3.3.5 Field observations

Field observation was conducted in the flood plain fields, irrigation project, upland fields, Kanyemba border post, Mwanzamutanda River and photograph was taken regarding some of the current socio-economic challenges and existing coping mechanisms.

3.3.6 Data analysis

The 2008/2009 crop production data collected from RDC Foundation and survey were quantitatively and statistically analysed using Statistical Package of Social Sciences and Excel. Precipitation of 23 years (1988-2011) time series was generated using double mass analysis method. The annual precipitation trends and water level were analyzed using Statistical Package for Social sciences (SPSS) and Excel software. Primary data was analysed using the thematic approach (Holton and Burnett, 1997). Themes included perceptions for droughts, floods and rainfall, livelihood activity and the impact of droughts and floods and coping mechanisms used by households to overcome the impact of droughts and floods. Descriptive statistics from Statistical Package for Social Sciences (SPSS) software were used to summarise data.

3.3.7 Experiences arising from the application of selected methods

During the focus group discussions respondents expected food aid after our research due to climatic event that hit the communities before the study. This expectation could have lead to wrong information from the communities. To focus on our research, I tried to make clear that even if we could not help them practically now, the result of the study will hopefully contribute to the scientific knowledge that may help for the future alleviation of the problem. When I went back to administrate questionnaires and interviews many people still remembered me, most of them would just say to me "you are back again to take more information from us just to enrich people in Harare". "What happened to all the information which you collected last month," I told them that the information I collected was purely for academic purposes but up to policy makers to implement our recommendations. The same question was asked at a ward meeting called by the councillor where I was introduced. At this meeting the traditional chief stood up after I had outlined the purpose of my research and said: "What are we going to get from your work? Are you going to put in place an irrigation scheme, give us cattle to use as draught power?". The councillor, Mr. Bambare stood up and explained that one of the core functions of the University of Zimbabwe was to carry out research for academic purposes and to offer recommendations to policy makers. He told them that failure to cooperate might cost the area development projects in future. The chief add by saying, "after all he is working with of our children". After the councillor speech, people agreed to cooperate with me during the period that I was going to be in Kanyemba. In one of the interview in Nyaruparo village with the head of the village, when I briefed the purpose of my visit, the chief was suspicious and said that I was one of those people who were being

sent by the white people to get information from them. The interview no longer took place the same day. I went back to the councillor and explain the situation. The councillor and I went to the village head the next day and the councillor calmed him down by explaining to him that I was only in the area to collect information that would be used for academic purposes. The chief then agreed that I go ahead with my study but warned me not to work with whites men.

3.3.8. Problems encountered

Shona being the most spoken languages in the zone, a field assistant from the local communities who knows English was employed. Field assistant translated and conducted the survey in Shona and translated in English. This further raised problems of more time being spent on each household surveyed. In addition, the interpretation might not be exactly the same meant than the respondent's thought.

3.3.9 Ethical issues

The research was done in conformity to ethics. Ethical issues in research are concerned mainly in balancing the right of people for privacy, safety, confidentiality and protection from deceit with the pursuit of scientific endeavour (Goddard and Melville, 2001). Confidentiality is an active attempt to remove the research records any elements that might indicate the subjects' identities. Thus, it was important to provide participants with a high degree of confidentiality. Researchers commonly assure participants that anything discussed between them will be kept in strict confidence (Kumekpor, 2002).

In doing this research, therefore, permission was sought from the District Authority and the ward's councillor. During the course of the study, the researcher assured the respondents that the study was being conducted for academic purposes. Furthermore, as mentioned, confidentiality and anonymity were assured.

Chapter 4

RESULTS AND DISCUSSIONS

4.1 Introduction

The chapter presents the findings of the study in three sections that correspond to the objectives of the study. The first part analyses the perceptions of the local communities on floods, droughts and rainfall pattern. The same section also compares these perceptions with the rainfall analyses using quantitative methods. Rainfall analyses will focus on the trends of precipitation, dry-spells and occurrence of floods related to the peak of rainfall period followed by the livelihood system of the communities. The second section analyses the impacts of floods and droughts on the livelihood system. The third section presents the coping mechanisms used to counter the impact of floods and droughts. To summarise the findings in the three sections, the analytical framework shows the state of local communities in face of floods and droughts.

4.2 Results

4.2.1 Perceptions on droughts, floods and rainfall

Community have different perceptions of the flood, droughts and rainfall. The majority of the respondents (80%) stated that rainfall patterns in the area have changed over the last 20 years. Last time they use to have much rain during the crop season but since 1980s they are recording less rain and the frequency of dry-spells has increased. Respondents indicated that local rainfall coupled with back water from Cahora Bassa in some case have resulted in floods in Kanyemba. Regarding the occurrence of dry-spells, they indicated that a significant increase in the frequency of long dry-spells was found during the crop season.

> "Last time we use to have continuous heavy rain in February, but now we are recording less rain" (Group discussion at Majaya shop, 05. 03.2011)

Trends of rainfall in Kanyemba

To validate the perceptions on floods and droughts, quantitative analyses of rainfall that was done revealed a high variability in both annual and seasonal rainfall (Figure 4.1 and 4.4). Despite the rainfall variability over the period (with coefficient of variation of 95 %), the total amount of rainfall did not change from 1988 to 2011(mean of 680.1 mm).

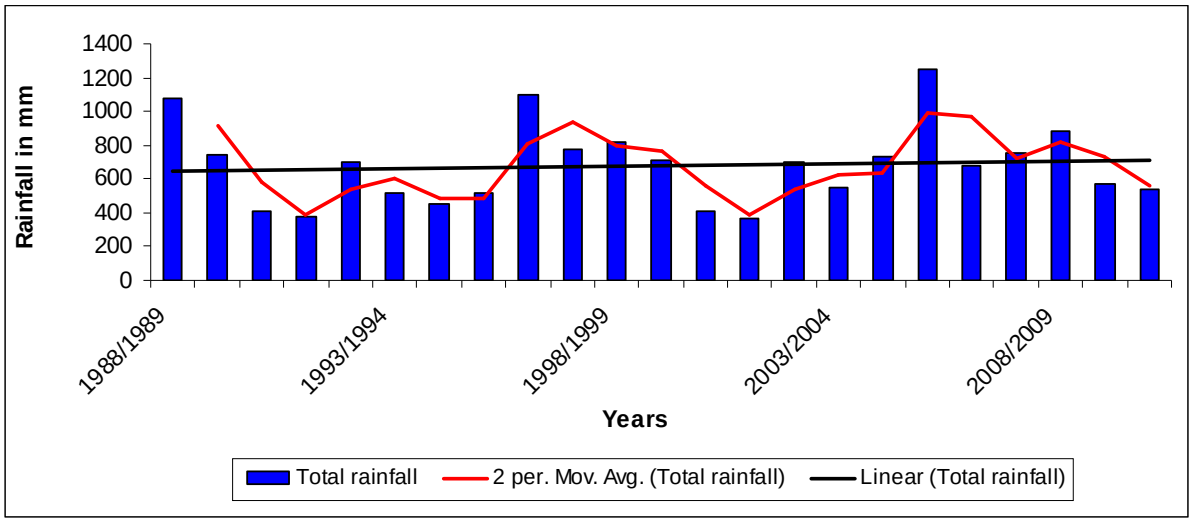


Figure 4. 1: Annual rainfall, Kanyemba Meteorological Station, 1988 – 2011

However, frequency of dry-spells has increased with high variability during the crop season from 1988 to 2011 having a coefficient of variation of 162% (Figure 4.2).

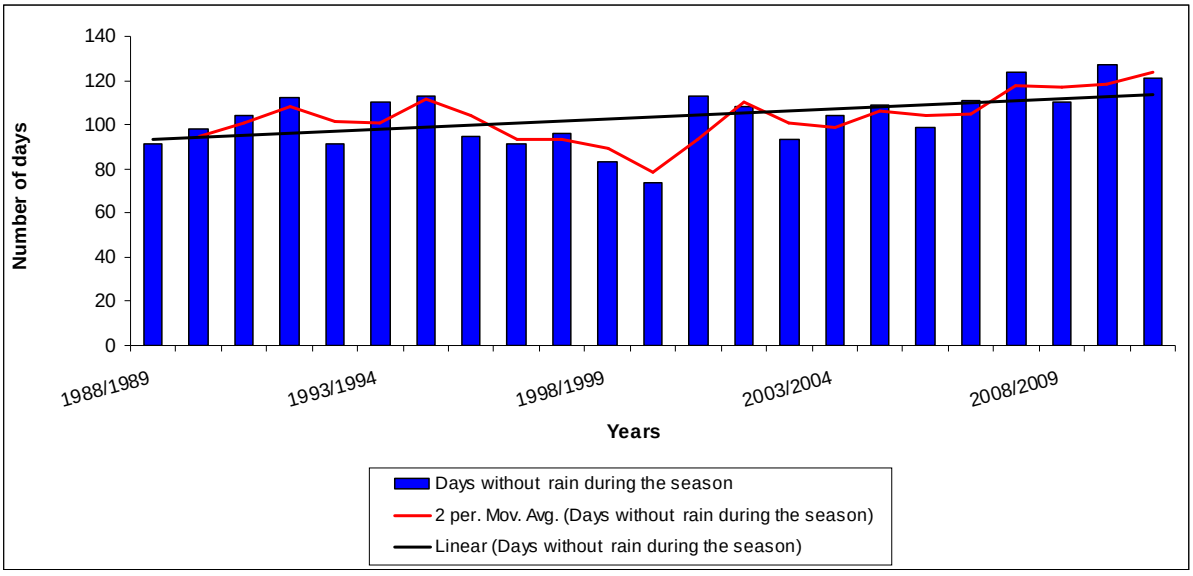


Figure 4. 2: Days without rain during the crop season, Kanyemba Meteorological Station, 1988 – 2011

Dry-spells occur more in one period within the season. As shown in figure 4.3, the dry-spells occur mostly early in the season (October and November), and coincide with the germination

stage when crops are sensitive to moisture stress. About 70% of the crop seasons were affected by the dry-spells of 20 days on average. The worst droughts and rain delay which the majority of the respondents (81%) identified was that of 2001-2002 and most recently 2009/2010.

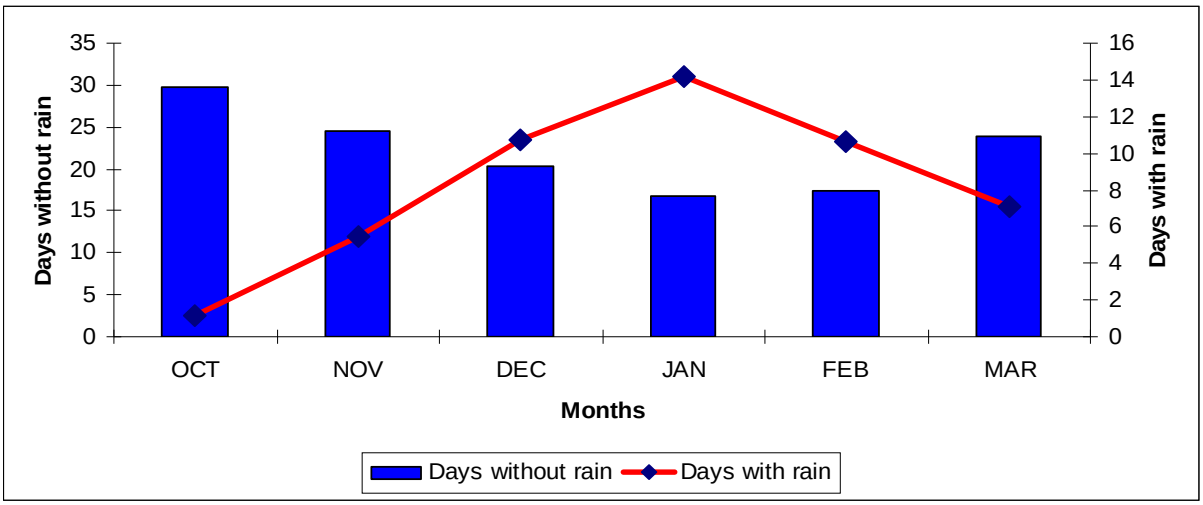


Figure 4. 3: Monthly average distribution of days without rainfall and days with rainfall during the crop season from 1988 to 2011, Kanyemba meteorological station, 1988-2011

The frequency and impact of dry-spells on crop and uneven distribution of rain during the crop season explains why local community feel that the rain is less today. In addition, the perception on rain is linked also to the idea on floods caused by heavy rain within a short period.

> "Just a few rains within a week can cause floods, which was not the case some time ago" (George, 30 years, Chansanto Village)

Floods occurrence in Kanyemba

Close to 90% of respondents indicated that floods frequency have increased in the recent two decades. Apart from the floods of 2010, three fourth of respondents said they have previously been affected by other incidents of flooding (1982, 1988, 1993, 1996, and 2007).

> "Some farmers during the floods use to harvest their crops by dugout canoes and then tried to dry them" Kitunga (42 years, Maringa village)

About three quarters of the respondents stated that there are two main factors which contribute to floods in Kanyemba. Firstly, backflow from Cahora Bassa dam coupled with local rain. Secondly, local heavy rains which occur mostly around January and February.

The rainfall analysis showed that from 1988 to 2011 floods due to local rain were linked with short period of heavy rain that occurs mostly in December, January or February at the peak of the rainfall input (Figure 4.4).

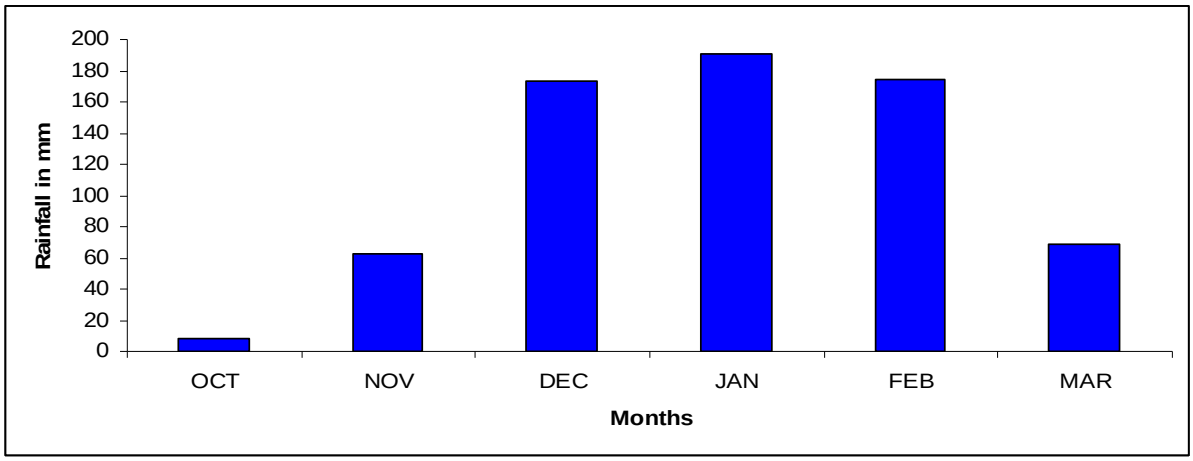


Figure 4. 4: Monthly average distribution of rainfall, Kanyemba meteorological station, 1988-2011

Maximum rainfall from 1988 to 2011 averaged 267.81 mm per day, with a standard deviation of 107.18 mm and 40% of coefficient of variation. The 1988, 1993 and 2007 floods related to local rain corresponded to the annual peak of rainfall in the season (Figure 4.5). These peaks represent a doubling of the average maximum rainfall.

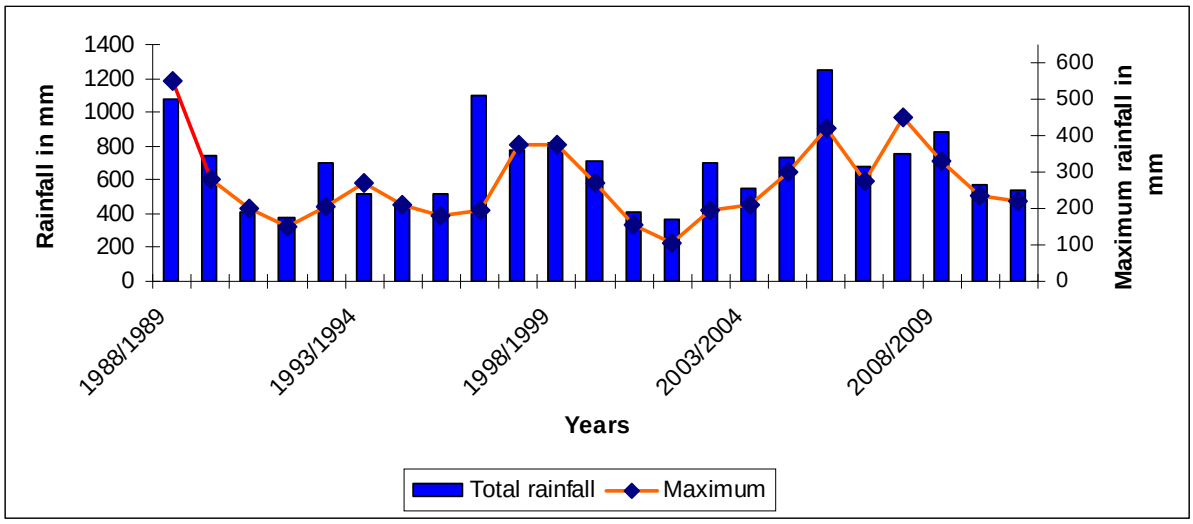


Figure 4. 5: Annual rainfall and maximum rainfall, Kanyemba Meteorological Station, 1988 – 2011

The 1996 and 2010 floods occurred around March when Cahora Bassa Lake reached its high level of about 300 m above sea level (Figure 4. 6) combined with local rainfall. Most respondents (60%) said that, when the Kariba dam rises, water is released from the dams while the backflow from Cahora Bassa increase substantially. Mwanzamutanda River will thus not be able to discharge in the Zambezi as result water begins to accumulate at the confluence of Mwanzamutanda and Zambezi leading to flooding in the area, this happen mostly around March or April.

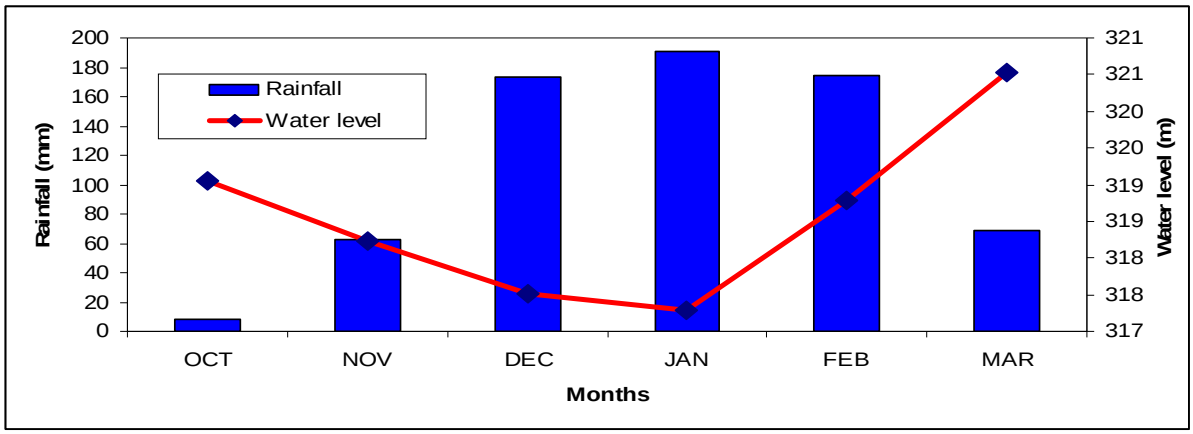


Figure 4. 6: Monthly average water level at Cahora Bassa Lake and rainfall, 1988 - 2010

Livelihood activities

Rainfed agriculture

Due to the perceptions on floods and droughts, households adopted different livelihood activities. Households not only practiced rain-fed farming in the uplands but also engaged in flood recession agriculture. Livestock mainly goats and chickens are raised to supplement household subsistence. Extensive agriculture is the common practice in the area, most household cultivate two to three fields totalling 2 to 4 ha. About 60% of household have two fields in the flood plain where they grow maize and groundnut, and one field in upland where they grow mostly groundnut and sorghum and groundnuts. Almost 20% of household have fields in both flood plain and upland but due to high rate of crop failure in the upland, households decide to grow their crop (maize, sorghum and groundnut) only in the flood plain. Almost 20% of remain households do have field only in the upland[4] where they grow maize, sorghum and groundnut Crop failure rate is high in these areas. The majority of the respondents (70%) reported that since 1990s due to recurrent droughts, crop fields in the uplands have expanded. Household have increased the size of fields. Almost 70% of household cultivate in the upland about 3 to 5 ha on which they grow maize, sorghum and groundnut. The intensification of agriculture through more land cultivated is thought of the community to increase the chance of harvesting if droughts do not affect the entire field. Respondents argues that from the practices the yields of maize, the staple crop, fluctuate annually but average between 300 and 400 kg/ ha. Maize, groundnut, sorghum and vegetables are the staple crop in the ward, cotton used to be a key cash crop in the area. However, due to inflation and the cost of labour, communities stopped growing cotton in the ward since 2008. Further, as communities practice a subsistence economy, roads of poor quality undermine their effort to develop economic alternatives. In Kanyemba, lack of public transport associated with high costs of private trucks, limit communities' access to local market and services. It takes 2 to 3 days of waiting for the communities to reach the nearest market at Mushumbi and this option is considered only in time of urgent necessity. The box 4.1 presents a case which illustrates household livelihood diversification.

[4] Upland production will refer to rainfed agriculture

Box 4. 1: Diversification of livelihood

Mr. Vincent is a teacher in Chapoto School. In 2003 he began growing maize in his up land field of 3 ha. At times he would harvest maize and sell it in Zambia or Mushumbi (which is very rare). During the crop season, he was making a net profit of 275 Zimbabwe[5] dollars every week. He made sufficient savings and bought four donkeys in 2006, Vincent used donkey to plough the land and transport. After acquisition of donkey, the production of Vincent grew. Around 2007 Vincent observed recurrent crop failure due to droughts; he decided to cultivate more land with maize, his field passes from 3 ha to 5 ha hoping that drought may not affect the entire field and leave him the chance to harvest what could help his family. From extensive cultivation Vincent was able to harvest 200 to 500 kg per ha during the dry period and 400 to 1000 kg per ha if the rainfall was good. Vincent was no longer making good profit from crop production due to recurrent droughts. He took this opportunity to engage himself in livestock rearing to supplement his income from crop sales. He started rearing two goats which he sold after sometime and earned 114,000 Kwacha[6]. From goats trade he bought a cow which he also sells milk from his cows to Zambia, rarely in his neighborhood. He sells each liter at 1900 Kwacha and earns 28500 Kwacha daily from the milk sells. Vincent is now venturing into a poultry rearing local chicken on a commercial basis because of the demand in Zambia. The income cover family expenses and build his house close to the main road where his planning to run a small business. Vincent is now working with Non Governmental Organization to assist communities on how to rear livestock for commercial purpose. His complain is about the isolation of Kanyemba to the local market which undermines local communities effort to diversify livelihood activities.

[5] The exchange rate for Zimbabwe dollar to the USA dollar was US$1 = Z55.

[6] The exchange rate for Zambian kwacha to the USA dollar was US$1 = K3800.

> "The bigger is the field, high is the chance to harvest at least something to eat with your family" (Group discussion, May 2011).

However, the expansion of land through agriculture has been restricted by the Department of Parks and Wildlife Management Authority. As the village is situated in a wildlife reserve, households are not allowed to clear more land for cultivation. This is meant to preserve grazing areas, water sources, and migratory routes for animals. Natural forest kept aside for wildlife is a source of employment (temporary or permanent), income and animal meat for the communities. Tourism in Kanyemba includes both hunting and photographic safaris, for instance hunting one buffalo bull cost 283,250 US$ and trophy fees for buffalo cow cost 1,100 US$ (AWF, 2010). Money earned from these industries is benefiting communities through construction of schools and hospitals, and meat from hunting (tourists) is distributed to household through the head of the village.

Recession agriculture

Uncertain rainfall and poor harvest characterise rain-fed agriculture. This has made households in Kanyemba community to adopt flood plain agriculture for their livelihoods. According to respondents (70%), use of the flood plain was closely adapted to the Mwanzamutanda flood dynamics, People know what period of the year floods come and when they can use flood plain for farming (which is not the case to day). The flood plain was important for both agricultural practices and for fishing. Community occupy and utilize the flood plain resources during different periods of the year. In the rainy season when the valley is inundated and fertilized by deposited material the fishermen moved their activities from the river into the flood plain. After the floods, when the water receded, flood recession farmers cultivated the flat terrain. At the beginning of the hot and dry seasons (April and May), the crops mainly maize, groundnut and sorghum are planted.

> "Farming in the flood plain is inheritance given by our grandparents for our livelihood, we use to have good harvest but now is day the flood plain is not doing well because of floods" (Rukomo, 52 years, village Nyaruparo).

The land-use rights in the flood plain are vested with plot-holders who are often the direct descendents of the original settlers. The title-holders often control large areas; too large to be cultivated by their own households alone. Landless people can borrow land if they want to cultivate or the land can be given by plot-holders to a relatives temporarily. This creates

obligations towards the plot-holder, which the landless sometimes repay by assisting the owners with some of their agricultural activities, such as weeding. Generally farmers cultivating borrowed land will not invest in the land. Households prepare their land around March or April, depending on what they would have harvested in the upland field. Household that harvest less in the upland start sowing in early March for them to harvest in August and avoid food shortages associated with the period between the dry and the rain season. The households that get good harvest in the upland fields start sowing in April because good harvest in upland can cover period before second harvest. Crops (mainly groundnuts, maize, sorghum, and millet) are produced on the arable soil flood plains. Due to floods from heavy rain coupled with dam operation-induced flood, high and prolonged floods caused a decline in flood plain agriculture. Thus, crop farming in the flood plain has a high failure rate attributed to flooding which wash away crop almost every year and livestocks in some cases. For this reason cultivation in flood plain is forbidden by the law and the government can impose penalties. To provide an alternative, the government provided irrigation schemes in the ward. Two irrigation schemes have been started in the ward but all have failed because of the water course agreement between the Zambezi basin's countries. The two schemes were located in Chapoto Ward, one near Chapoto village (which has 600ha) and the other on the western bank of the Mwanzamutanda River and would have relied on water from the Zambezi River(AWF, 2010).

Since the area is infested with tsetse flies, cattle and donkey as draught animals do not thrive as they are affected by rinderpest[7] caused by the tsetse flies. Communities adopted by rearing goats and chickens, on average household own 5 goats and about 10 chickens. Savings are normally invested in animal (goats) which are then sold when the family needs cash. The raising of animals makes up a significant proportion of livelihoods in Kanyemba.

> "Livestock is an important asset for the communities' livelihood, it why we are trying to teach and assist the communities on how to keep livestock" (Jumbo, 42 years, village Mariga)

However, in 2005, 7 households introduced cattle (8) and donkey (4) as means of improving livelihoods (in agriculture activities and transport) despite the presence of tsetse fly. From

[7]An infectious viral disease of ruminant, especially cattle characterized by fever and dysentery

2005 to date these draught animal seems to have adapted to the environment and are used in the agricultural as draught animals for transport and ploughing (Figure 4.7). Other households are willing to follow the example but they don't have the evidence on the survival of those draught animals the coming 5 years. Further, cattle cost on average 200$ at Mushumbi[8] which is not affordable by households.

Figure 4. 7: Draught animals used for transport

4.2.2 Impact of droughts and floods

Impact on crop production

Agriculture is the predominant livelihood activity for people in Kanyemba and the most important in terms of spatial extent. Agriculture is also the most affected livelihood activity due to the sensitivity of the sector to Droughts and floods. About 90% of the population is engaged in farming; the area planted per household averaged 5 ha including 1.5 ha for sorghum, 2 ha for maize and 2 ha for groundnuts. The relatively recent major climatic events that hit the community are 2010 drought and flood were combined effect destroys communities' standing crop (Appendix 4). Drought during the 2010 crop season affected crop production in Kanyemba. Drought damaged on almost 1.55 ha of crop per household (Figure 4.8).

[8] Mushumbi : Center of the District situated about 150 km from Kanyemba

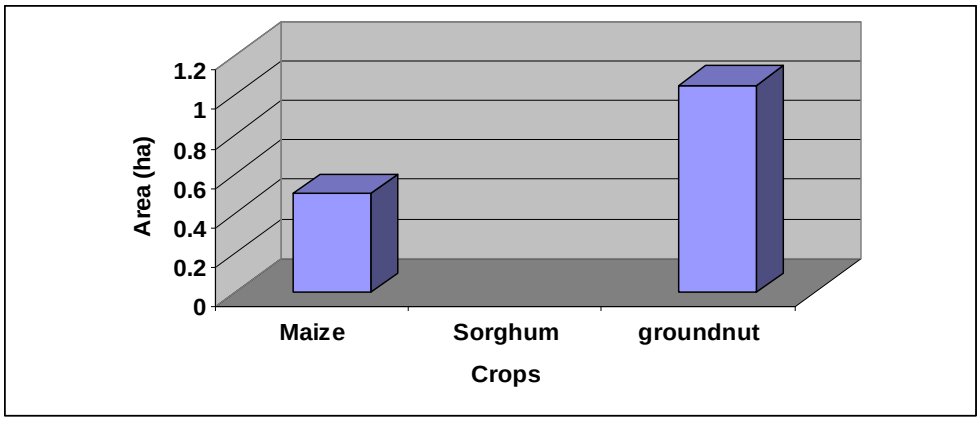


Figure 4. 8: Standing crops affected by drought (Survey, March 2011)

Groundnut is more affected than maize and sorghum simply because maize is mainly grown in the flood plain were there is a lot of moisture. Groundnut is grown in the upland because of its tolerance to drought. Drought damaged crops to varying degrees. All households interviewed reported that their crops had been damaged by drought, 20% of households affected by as much as a 90% decrease in expected output. In some cases the drought killed all the seedlings and 40% households had to buy additional seeds to plant. In addition to affecting the seedlings, the drought then reduced the overall crop yield and even prevented maize and groundnut from producing seed for 30% of the household. As a result of drought impact on their crops, none of the household was able to rely on rainfed agriculture for their livelihoods.

In the flood plain along Mwanzamutanda River, Kanyemba communities grow maize, sorghum, vegetable and groundnut. However, since 1982 communities has witnessed high and prolonged floods destroying crops. For instance the 2010 flood destroyed almost 2 ha of crops per household (Figure 4.9).

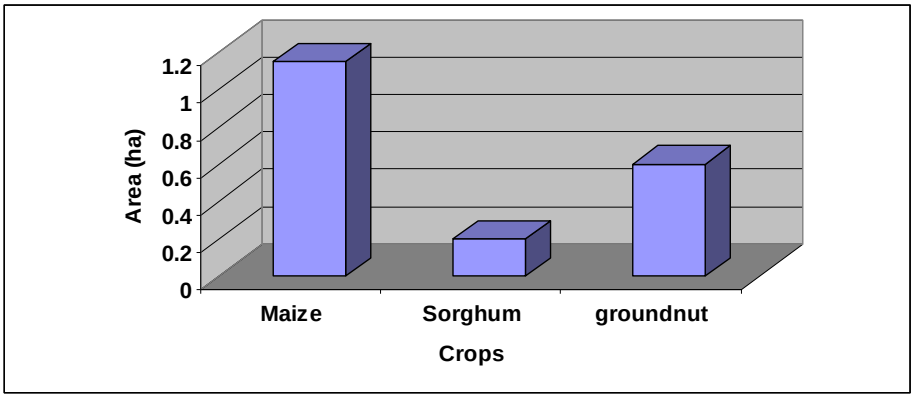


Figure 4. 9: Standing crops affected by flood (Survey, March 2011)

Since the cropping season in the flood plain start in November, almost 90% percent of households did cultivate the land before the onset of the flood which occurs in March. Households that had planted early lost their entire crop 11% of respondent reported that their livestock mainly goats were washed away by floods. Numbers of goats that households owned before and after the flood have changed from 5 goats to 4 goats per household. Additionally, Properties were affected with almost 80 families being rescued by Civil Protection Unit. Affected families were taken to Chapoto primary school and assisted with foods, blankets and other emergency products by Non Governmental Organisation such as Christian Care.

Socio-economic impact

The impact of the floods and droughts on the communities has been categorized into two components, namely leaving households food insecure because of reduction of crop production and economic costs. The economic costs involve indirect costs (affecting crop derived income). The principal livelihood which is agriculture was severely affected by the 2010 flood and drought. Crop production (maize, sorghum and groundnuts) averaged 1600 kg per household compare to 4500 kg for the year before flood and drought (Table 4.1). Comparison between two seasons shows the difference of 2900 kg which represent almost 65% of loss due to floods and droughts. About half of the respondents reported that, households without off farm activities such as piecework during floods or droughts are the most affected by hunger and have been assisted by Non Governmental Organizations (NGOs).

"During floods or droughts the most affected households suffered from hunger and use to look for food from relatives" (Motoyo, 35 years, Chiramba village)

Table 4.1: Average crops harvested per household in Kanyemba

Season	Event	Statistics	Crop production (kg/HH)			
			Maize	Sorghum	Groundnut	Cotton
2009/2010[a]	flood and drought	Mean	575	450	575	
		Standard dev.	1.98	3.85	2.51	-
2008/2009[b]	No flood and drought	Mean	1750	750	2000	667
		Standard dev.	2.5	5.89	3.01	10.05

a = Data from survey, Mach 2011

b = Data from Lower Guruve Development Association, survey 2008

Droughts and floods reduced household food availability, and agricultural income derived from crop sales. Households are engaged in selling crops in Zambia after harvesting. According to respondents (60%), crops such as maize, groundnuts and sorghum are sold respectively US$4, US$4 and US$2 per 20 kg each and the money earn is carefully used for buying goods such as sugar, soap, petrol and oil. Respondents reported that during floods and droughts household income is severely affected since the quantity of crops sold in Zambia is little due to crop failure and the money earn is unable to buy abovementioned goods. Furthermore, 90% households reported that during flood or drought the price of grain in the local market increase while the price of goats in both local and Zambia market decrease from 20$ to 10$. Kanyemba community have been affected economically and socially. Loss of crop derived income as well as food shortages were further exacerbated by droughts and floods.

Impact on social network

Households reported the erosion of social cohesion which they linked to adverse climatic conditions. More than half of the respondents (60%) stated that floods and droughts have impacted on social networks, especially the assistance they give each other in term of food. As a result, the relationships among village families have been deteriorated, especially when affected families visited their relatives and were not given assistance. Furthermore, at the onset of drought or flood households are no longer in a position to help each other. The fact is that 20kg of drought tolerant seed cost 30$ and most of the households are not able to afford it, as result some households (about 90%) plant local varieties of maize, and groundnut because they can not afford drought resistant which cost $30 in the shop to take account of the rains when, and if, they finally start, while 2% plant using drought resistant varieties of maize, sorghum, groundnut. Almost 12% of households do not have seed reserves or be in a position to purchase replacement seeds, failed planting. In this situation households which harvested try to keep grains as long as possible for three raisons: family consumption, seed for the next season and prevent future event. Households who fail to harvest are not welcome for assistance. The box 4.2 presents a case which illustrates how social relations were negatively affected by floods and droughts.

Box 4. 2: Flood event and social ties

Shamashi 45 years old was living in Angwa with his wife and their daughter, where they were living well and were food was sufficient. In 2008 during the crisis, following the land reform policy, they came to Kanyemba due to relative proximity of the area to Zambia where Shamashi had access to Zambia market selling his maize in good price. When the 2010 flood comes it destroy 2 ha of his upland field (1.5 ha of maize and 0.5 ha of groundnut) and life became difficult following the event. They had to sell most of their animals to buy food and basic needs for house. To survive during this period (almost a year) they sacrificed 3 goats and many chickens. Additional expenditures for the daughter's medical assistance in Zambia also drained all their household assets (Television and agriculture tools). As flood left Shamashi's house with no stock of maize and was not listed in the emergency assistances from Non Governmental Organisation (Christian care), the option of surviving was no-existent. Combined with a lack of alternative source of income, begging becomes the only option left for Shamashi to respond to food needs for his house. From May to June 2010 Shamashi and his wife begged food in the village, sometime they visit tourists in the Safari camp. After two months of begging without having good support, their attitude toward the communities became strain. His wife, under the influence of her family, left two months later. He now lives with his mother and his 14 year old daughter, who had to stop school to help the family. The girl is working in the floodplain garden and she sometimes does paid farm labour (weeding, harvesting or collecting vegetables). To rebuild his life, Shamashi requested a piece of land in the fertile soil of the Mwanzamutanda flood plain where he can cultivate even without draught animals compare to upland field, his request was denied simply because of his origin (is not from Kanyemba where the access to flood plain is by inheritance or close relatives). With the assistance of Christian Care who gave him maize seeds, hoes and poultry to rear, Mr. Shamashi restarted planting is 2 ha upland field which produces per season 300 kg to 500 kg, depending on the rainfall pattern during the season. In 2011 during our field work, when upland harvest was insufficient, he sold all chickens to purchase food instead of relying on the assistance of bad experience. In addition to his farm activities, Mr Shamashi is now carrying out paid work (weeding in the village or neighbouring village). He is paid in kind (10 kg of maize or groundnut). Sometimes villagers lend him money without interest and he is able to pay the loan back with labour. During our field work he borrowed 20$ to pay for a hospital bill when he was sick. He reimbursed it all with labour. Life is not so bad as long as he can work, however, he would like to rebuild his family, buy a few animals and have enough money and call back his wife and daughter.

> During floods or drought, farmers care the most of his household, some social activity such as Pungwa dance[9] is not their interest because they are avoiding people to ask them for assistance (Victor, 65 years, Mariga village)

Given water-related extremes events in the communities, droughts and flood can become a way of life based on coping mechanisms which help community to survive, Kanyemba communities responded to droughts and floods as a way of minimizing its impacts or overcoming them.

4.2.3 Coping mechanisms

The study found that the community experiences droughts and floods several times. This certainty of droughts and floods occurrence implies that community have developed diverse means of coping to the impacts of droughts and floods. Distinct sequence in what household respond to floods and droughts has been found using Corbett study (1988).

Coping with droughts and floods

Insurance mechanisms

Cropping responses: In terms of production, about 70% of households employed various production strategies in response to the impacts of drought and flood. As stated earlier, the flood plain used to be cultivated once a year around March – April, after the flood water had receded. However, since 1980s increased dry-spells led households to cultivate twice a year, middle October constitutes the first planting and April for the second planting. Most families shift to the flood plain and live in make shift huts during the crop season. Therefore, preparation of land will start in early September mostly in the edge of the flood plain, followed by planting seed of maize, groundnuts and sorghum in middle of October. Until harvesting, they have to look after the crop very carefully. They engage in weeding and other control measures. Protecting the crop from the wild animals is another very important task households have to do by constructing a crop protection look out (Figure 4.10); this is the main reason for living in the field. Unfavourable conditions exist in the flood plain during this sowing period, when floods come around January or February, flood water washed away crops. Household then lose mainly maize, groundnut and sorghum while sugar canes and bananas resist to flood. As soon as the flood water receded, households move back to re-cultivate the more fertile soils of the flood plain. Households utilise residual moisture in sandy soil of the flood plain to grow maize. Households dig holes of about 50 cm square

[9] Pungwa dance: Night dance

approximately, with depths that vary according to the distance from the stream bank, making holes deeper further away from the river. The depth depend on the moisture availability in the field it why the holes away from the river is deeper (Figure 4.11).

Figure 4. 10: Crop protection lookout

Figure 4. 11: Dowe in sandy soil

The holes are spaced about 0.3 m apart within rows and 0.3 m between rows. Sowing is done by planting a number of seeds in one hole, between 2 to 10 per hole. The idea behind number of seed is to minimize the number of holes to be dug and reduce by the way workload in the field, and also maximize the water uptake by the plant. One participant at a focus group discussion said that:

> "The systems that makes people to keep on living during droughts or a flood is dowe[10]" (Group discussion, April, 2011).

The result from these practices is that the crop mostly maize grows faster due to moisture in the soil and fertile alluvial soil deposit by flood water, survives the drought better, yields much larger and healthier, thereby fetching good prices in the market. Households get in the streambank a supplementary harvest of vegetables (Figure 4.12). During the dry season, when the rain stop completely (around March-April) households make ridges in the stream bank to grow vegetables while there is still moisture before the river dries up. When the river dries up, communities digs wells in the river bed for watering vegetables (Figure 4.13). In the field, communities produce divert crops such as, carrots, tomatoes, onions, sweet potatoes, cabbages and pumpkins. Vegetable farming brings returns for households, during these times they purchase household and other goods (farming equipment, seeds and utensils).

[10] Dowe : A hole of 50 cm square approximately with 40 cm deep on average in the sandy soil of the flood plain, where people are seeking residual moisture to grow maize because

Figure 4. 12: Streambank farming

Figure 4. 13: Riverbed well

Late sowing: In a normal year the farmers usually start seedbed preparation for maize in September and early October before the first bout of rain. However, in a drought year they opt for delayed plantation. The reasons behind this strategy as stated by the respondents were to take benefit from delayed rains. Further, through experiences farmers have become aware of the variable nature of rains. In Kanyemba, the long dry spell mainly during October causes havoc. Therefore instead of keeping the land fallow they plant the land with early mature cultivars during November. Early mature crops succeed and mature on time and give better yield than timely sown cultivars if water stress appears. Farmers often sow Kanongo maize (early maturing variety) to avoid the risk of long dry spell that occurs frequently after the first bout of rain in October. However, the degree of success of late sowing strategy depends on the continuity of rainfall. If the second bout of rain is also very low and followed by another dry spell then the crop is bound to fail.

Wildproduct response: while men are farming, mostly women depended on supplies of wild foods. In Kanyemba, wild fruits such as masawa fruit (Figure 4.14) is used as stock-feed were dried and ground into powder for making porridge or Mahewu.

Figure 4. 14: Dry masawu fruit

Earthen pot response: Almost 9% of households are engaged in making earthen pot for sell. Most households are no longer self-sufficient in crop production due to climatic events; men fetch clay soil to make earthen pot for sell to fill their production deficit.

Fishing response: This is done when other strategies such as crop production are not yet in place. Fishing with lines[11] (4% of household) is mostly carried out by boys, men and women in some cases. Fishing for both man and woman is for trading. Women who engage in this activity are mostly widows or those in female household heads. Female fishers use their earnings for food consumption and good such as soap, salt and oil. However, unlike the Zambian and Mozambican authorities, the Parks and Wildlife Management Authority in Zimbabwe sanctions fish with lines and hooks with the exception of one cooperative, which practises commercial fishing using gill nets. Fishing in Zambezi and Mwanzamutanda is against the law and this undermines the coping mechanism of the local communities. As confirmed by respondents:

> "We use to fish in Mwanza mutanda and Zambezi river, but is only the laws that limit us" (Nyakutepa, 35 years, Chiramba village).

Causal labour response: Informal employments have become increasingly important in Kanyemba as households seek to withstand the impact of floods and droughts, given the increasing constraints on crop production due to floods and droughts; households have become increasingly reliant on the market to cover their livelihood and food needs. Market reliance results in the need to generate cash income, which can only be done through additional activities which are not so vulnerable to climatic uncertainty. Labour sale became important income-generating activities since 2001/2002 drought; almost 45% of household is engaged in the labour market. The main local Industries that engage people for labour are Safaris (an organized journey to look at, or sometime to hunt wild animal) and truck offloading. Around May tourists or hunters hire in the local communities 2 to 4 people to cook or keep the camp for them during the hunting period. Money (about $30 per day) earned from the Safari as stated by respondents, gives a good return to workers. But safari is lasting only 4 to 5 months and the money earned can not covers all the household expenses. Money is mostly used to purchase household good such as electronic goods. There are often lean periods, as the household are dependent on sector sensitive to floods and droughts. As Kanyemba is along the way to Zambia so goods are transported through the area. About 2 to

[11] They do this illegally, in fact they do not want to divulge to anybody

3 times a week trucks from Harare stop at the police station in Kanyemba where people are engaged to offload trucks and being payed (Figure 4.15). From offloading trucks, money is mainly used for food.

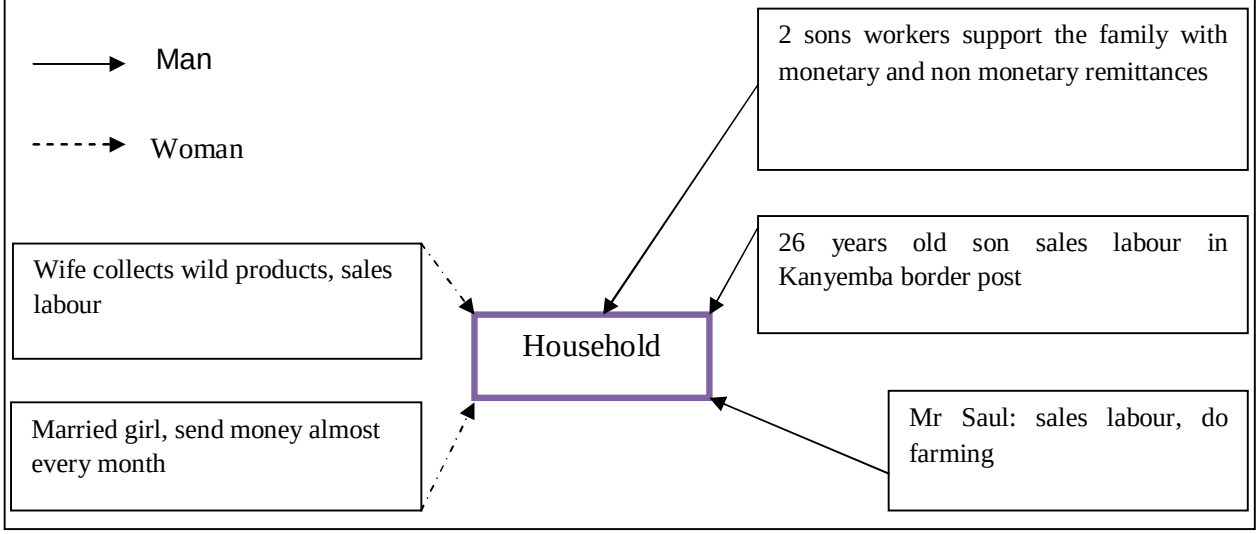
Figure 4. 15: Causal labour in Kanyemba border post

Remittance responses: It was reported that remittance were from households members within the country and outside of the country, 3% of respondent reported that, family member use to move within the District or in main towns (Harare, Bulawayo, Bindura) and employed as waiters, cleaners, and shop assistants. Other family members work at Zambia or Mozambique. Seventy percent of the recipient households stated that they receive remittances on an irregular basis. Remittances were not an important source of income of recipient households. Insufficient savings due to low income and living expenses in town was cited as the main reason for irregular remittance transfers. Households reported receiving remittances in both monetary and non-monetary forms, including clothes, cell phones, footwear, cosmetics, and food. Households who receive remittances stated that the major share of remittances was spent on basic needs such soap and sugar, particularly food. Respondents stated that money earned was not sufficient as many of their family members were employed in low- income activities. The box 4.3 presents a case which illustrates some coping mechanisms used to reduce the impact of floods and droughts.

Box 4. 3: Remittances and piecework as coping mechanisms

Mr. Saul, 48, and Mrs. Kakou, 45, are both from Kanyemba and they are farming in the flood plain on Mr. Saul's father's land. They have 5 children and one little son two of whom, aged 24 and 20, became workers in Mozambique about 5 years ago and have received most of their education from the secondary school in Kanyemba. One boy, 25, attended also secondary school but is still living with them. One daughter, 22, is married and went to live with her husband 6 years ago in Zambia. She uses to send them money (50$) almost every month. The youngest girl, aged 18, just attended primary school and when she was 15, to South Africa via Harare to find work. They haven't heard from her since she left 3 years ago and they don't know which kind of work she is doing. Maize is the main source of income of Mr. and Mrs. Saul. They own 3 hectares of maize, which produce 400 to 500 kg per season. If the floods doesn't come Mr. Saul doesn't worry, but his field is vulnerable to floods. Most years, they are 2 month short of maize. They then do paid labour (second source of income), gather food from the forest (third source of income) or if they are desperate, will get assistance from their 2 sons (workers). They also own 8 goats and 19 poultry. Since the 1982 flood where they were affected, Mr decides to rear goat to prevent future risk. Two years later they bought goat in 1984 for 700 Zimbabwe dollars with the money they saved from labour. Goats are for sale in the emergency case and their droppings are as manure for vegetable farming. Poultry are used for ceremonies, to sell in time of need or ultimately for consumption during the time they have no food. Mr. Saul and his wife are both literate and their only wish is for their children to succeed in life. They are particularly proud of their sons (workers) who helped build the house and bought them a TV and cell phones. Mr. Saul wishes that the Chinese Uranium company could open earlier so they could come and live close to them, however, beyond that he has little hope for his own future due to increased floods and droughts now is day.

Household support



Assets disposal

Livestock sales response: Households also sell livestock to livestock traders from within Zimbabwe or from Zambia. At the onset of floods and droughts more livestock have been sold in the village in lower prices, thereby leading to weaker terms of trade and decreased household incomes. According to respondents (29%), money earned from livestock sale during floods or droughts is mostly used only for food. While during normal time, money earning from livestocks sale is used for the expense like school fees, taking family member to doctors in case of emergency (they go to Zambia for medical assistance), and clothes for family. Livestock plays an essential role in people's livelihood. Livestocks are not only for the family expense but also source of meat and their droppings are used for vegetable farming as manures in the flood plain. Sixty percent of households stated that the sale of livestock is the first most important impact because livestock is their life's bank and their disposal through selling as a result of the drought or flood is a loss of valuable money and productive resources.

Migration

Labour migration response: With regard to migration responses, about 8% households in Kanyemba are engaged in migration strategies in a daily basis as a way of withstanding the impact of droughts.

> "Kanyemba community has for long have ties, social and economic with the neighbouring communities across in Zambia and Mozambique with the result that people have been assisted by these countries in case of emergency (Kamango, 68 years, Nyaroparo village).

The majority of labour migrants are wage employees in the destination (mostly in Zambia). Migrants are unskilled workers who ended up in low-paying as factory or construction labours or cleaners or trucks offloaders. In some case migrants also were in agriculture (weeding, Harvesting), mines, and quarries. Time spent by migrant in the destination communities (Zambia or Mozambique) was about 7 to 14 days. Money earned is used to purchase goat if there were loss in the herd during droughts or floods and to buy farming material such as hoes and seeds. Migrants' money is restricted on buying agriculture material because money earned is not enough to spend on other long-term investments, such as business.

Coping with floods

Insurance mechanisms

Intercrop farming: 60% of household do farming by mixing maize, groundnut and sorghum with sugar cane and bananas in the same plot. Sugar canes and bananas are permanent crop in the field through the year. Bananas are planted in line along the field and sugar canes in the middle of the field. During the sowing period, household plant maize, groundnuts and sorghum in the spaces within sugar canes and between sugar canes and bananas (Figure 4.16). In the onset of flood, maize, groundnut and sorghum can be washed away while bananas and sugar canes stand. Standing crops (Sugar canes and bananas) constitute a bumper harvest that help household to withstand the effect of flood until the coming sowing period when the flood water receded.

Figure 4. 16: Intercrop farming

Move to high areas: Since the 1982 flood when a 60 years woman was killed by flood, communities in Kanyemba have shifted from the lowland to upland to secure their properties and house. How ever, Chiramba community did not move far from the flood area, as a result the community is several time affected by flood. In response to flooding, households moved their properties and animals to high ground but as the floods rose they had to move them to the hills. Some household in Chiramba village have built platforms of about 2m high for their chickens or goats according to the high of flood that they witnesses (Figure 4.17).

Figure 4. 17: Plat form, protecting livestock against floods and wild animal

Elevating hut: The last decades, Kanyemba communities have witness floods mostly in their fields. About September when households shift to the flood plain, they build two huts of about 2 meter high and 20 m distant between the two huts. One hut is used for protecting harvested crops against floods. The second hut is used for living with size depending on the number of people. The living hut is dividing into two levels; the ground level is for keeping agriculture materials such as hoes, baskets, bags, mortar and cooking-pots. The second level is provided with mosquito-net were people use for sleeping during the crop season (Figure 4.18). Floods do not occur suddenly, men would watch the level of water in the river rise while they would make their preparations accordingly, packing together a few clothes and utensils, storing non-perishable food and put them in the hut where they will stay until the flood water receded.

Figure 4. 18: Elevating hut, coping with floods

4.3 Discussion

Perceptions of rainfall, droughts and floods

Related to this study on coping with droughts and floods, local perceptions for increased dry-spells have been confirmed from the rainfall analysis. However, annual rainfall data does not shows any changes in rainfall amount despite that the perceptions of the respondents was that there was not enough rainfall. These perceptions may be due to the lack of optimum rainfall needed for agriculture during the crop season as the case of arid zone. Falkenmark and Rockström (2006) found in Sub-Saharan Africa where less than 30% of rainfall is used as productive green-water for grain such as maize, sorghum and millet. Uneven rainfall distribution during the crop season as shown in figure 4.3 impact on crop also making respondents feeling that the rainfall amount have decreased. Barron *et al.,* (2003) found that uneven seasonal distribution of rainfall may expose the crop to a range of mild to severe intra-seasonal dry spells, which may subsequently affect the yield adversely. Additionally, dry-spells occur mostly early in the season (October and November), and coincide with the germination stage when crops are sensitive to drought. The impact of dry-spells on crop and uneven rainfall distribution explains why local community feel that the rain is less today. Heavy rain within a short period, backflow from Cahora Bassa coupled with local rain has led to two kind of flooding in Kanyemba. The first and most frequent type of floods is the seasonal floods which occur mostly in January or February at the peak of the rainfall season and the second is dam operation-induced flood (Madamombe, 2004). For instance, the 2010 flood occurred when Northern Zambia and northern Mozambique had particularly received above normal rains. In turn, the Kariba dam, in Zimbabwe, was 73% full. These prompted the opening of flood gates on the 9th of March 2010. Backflow from Cahora Bassa coupled with local rain have accumulated water at Mwanzamutanda confluence and led to flood in Kanyemba on 13th of March where crop fields and family were affected (OCHA and SADC, 2010). Views on floods and droughts are one of the drivers for important decisions for adopting livelihood activities based on extensive agriculture or flood plain agriculture. Mati (2005) found that in the rural communities were rainfall is erratic and agriculture input (fertilizer and machinery) are limited, local communities rely on extensive agriculture to increase their productivity. Mainly in Sub-Saharan Africa where extensive Agriculture is common due to inadequate access to agriculture input and climatic condition (Ravindranath *et al.*, 2008). In case of Zimbabwe particularly in the middle Zambezi, Fritz *et al.,* (2003) observe that the increase in cultivated land was a way of the settled people to cope with the

harsh environment in the Zambezi valley. Extensive agriculture and less production in case of Kanyemba has been found to be close to Kidane (1999) study which shows that increased cultivated land reduces the capacity of soils, thereby making them less productive. As a result, crops can suffer from moisture stress and drought even during normal rainfall seasons. As far as environmental goods and services is concerned, increased cultivated land affect the capacity of the environment to sustain human activities (Gerwing, 2002). Young and Solbrig (1993) argues that savannas ecosystems in Africa are an important biological and economic resource for rural communities, thus, the management of natural resources is important for local communities to improve their livelihood. As Ghimire and Pimbert (1997) stated, natural resources management has always been important in facilitating communities to improve present and future livelihood. Sustainability of human activities pass through management of natural resources as the case of Zimbabwean laws restricting extensive agriculture in the conserved areas. Protected and agricultural areas represent two categories of land use in Kanyemba. Understanding how and where the two can form synergies is necessary both for future conservation efforts and for preventing the destruction of land that characterize actual land practices in the rural communities.

Rural communities rely on the flood plain because of residual moisture, natural fertilization low cost of labour and have a very high net return to energy expenditures. Horowitz (1999) observe that the region of low rainfall; flood plain is the most important source of food and have sustained dense human and animal population at least a millennium. Floodplains as traditional areas of special importance for rural communities, offer favourable conditions for human settlement, economic development and assets for sustainable livelihood support (Rolfe, 2006). Senegal flood plain for instance has sustained thousand of people, Along the Senegal River and throughout the Sahel, allowing the communities to survive during the dry season (Hamerlynck *et al.,* 2000). However, flood plain farming depends upon the intensity and extent of the year's flood extension (Saarnak, 2003). Flood extension can be exacerbating in dammed rivers which increase annual difference between the sizes of the inundation, in some case resulting in the destruction of farm land or reduction of farm land (Degeorges and Reilly, 2006). In case of Kanyemba, flooding is mostly resulting in destruction of farm land than reduction of farm land. This may relate to the occurrence of heavy rain within short period coupled with backflow from Cahora Bassa. Saarnak (2003) explain that communities located between two dams are likely prone to large flood due to local rain combined with dam flows. Though, dams have affected river's natural flooding thereby the flood plain farming is also effected. Dam management and the varying precipitation in the river basin

cause large yearly variations in river valley inundations and thus affects the yield in flood plain farming (Saarnak, 2003).

Impact of droughts and floods

Prolonged dry-spells impacted negatively on rain-fed agriculture by reducing crop production thereby impact on communities' livelihood. Metcalfe (1993) confirm that Kanyemba is prone to dry-spells and periodic seasonal droughts during the crop season that reduce crop production and leave local communities with hunger. This is consistent with the study by ECA (2007) who stated that the majority of the populations in most African countries live in rural areas practicing rain-fed agriculture and recurrent drought put local communities in a poverty trap due to production losses. A characteristic of drought-induced production losses is that such losses take time to rebuild. If drought is recurrent or if households experience other constraints, households may enter a poverty trap from which it is difficult to escape (COMESA, 2009). Without any irrigation facilities or efficient water harvesting strategy, Kanyemba is more likely to be vulnerable as the drought is exacerbating by climate change. According to O'Brien *et al.,* (2004) in arid zone, communities without higher irrigation rates are expected to have a lower capacity to adapt to climate challenges and other economic shocks.

Floods in Kanyemba render farms unproductive for the time it washed away crops and even deposit sandy soils on farms that will make cultivation expensive and difficult for some time. Floods therefore have a large potential of reducing food production. Such reduction in food production can lower nutrition standards and the loss of agricultural labour. IHP (2004) confirms that, floods are the most taxing type of water-related natural disasters to humans and resources. It is the rural people that suffer the highest economic and human toll from the occurrence of floods (Manish and Vijav, 2008). Devereux (2007) notes that, the impact of climatic event on rural livelihoods is on crop production. Floods undermine farm yields, reducing household food availability according to the extent that the family depends on agriculture for its food. Given that the livelihood of Kanyemba is dependent on agriculture, derived income from agriculture is also affected and the starvation is likely to follows periods of floods. In southern Africa for instance, floods is a major problem for many rural communities where agriculture production have been affected and limited access to food (Gwimbi, 2009). It has been found that in Zimbabwe, floods have threatened food security and household economy in rural areas where the agriculture on which they rely has been flooded (Gwimbi, 2009). A community that livelihood depend on agriculture is likely expose to floods and droughts as the case of Kanyemba .The Households and economies that are

more diversified are less vulnerable to these direct impacts of floods, provided that their alternative income sources are neither correlated with rainfall nor directly or indirectly dependent on agriculture (Devereux, 2006). In these ways, weather risks contribute less to economic losses and rural community enhance it development based on livelihood diversification (Dorward and Kydd, 2002). In the communities dependent on the resources sensitive to climatic conditions, droughts and floods can plague social cohesion and erode communities' resilience. Devereux (2002) argues that social obligations exists to address the impacts of droughts or floods and is triggered by hardship situations. However, during periods of droughts or floods the system of social obligation may not function properly since people need to cater for their well-being above all else. Poor rainfall has impacted on the propensity of households to be organized themselves as a cooperative for production (Bratton, 1987). This implies that droughts or floods leave no individual household the chance to help any other (Herren, 1991).

Coping mechanisms

The examination of the existing coping mechanisms showed that communities were using different strategies to cope with droughts and floods. Crop production, vegetable farming and livestock sales have been dominant. As long as communities do not have an alternative of coping than using the resource that they have, these three mechanisms are more likely to continue to play significant role on coping with floods and droughts once strengthened. Additionally, sowing in the flood plain changed from 1 to 2 times a year due to the perceptions of increased dry-spells which affects rainfed farming. The first sowing in the flood plain is a risk reduction strategy, the idea is that if the flood come before harvest they will lose if not, they can harvest and recover the loss that occurs in the upland. Diversified crops such as, carrots, tomatoes, onions, sweet potatoes, cabbages and pumpkins in the valley; allows the households to have a production that is flexible with respect to their responses to climatic events (Teklu *et al.*, 1991). According to Mati (2005) valley bottoms are very important for providing food security in semi-arid areas prone to regular droughts. The valley can sustain communities only if water availability can help them for more production. In case of Kanyemba, vegetable farming and crop production are not providing food security because the period over which community may be able to sustain its livelihood using these strategies is quite short since vegetable farming takes about 4 months (about two harvests), by which time the water table in the well decrease. In this cases water availability is an obstacle, it has became an important resources that contributes by means of reducing the coping capacity of the community (Beltrán-Morales *et al.*, 2007). Floods and droughts have

led Kanyemba communities to diversify income adopting causal labour as the case for most African countries. In Malawi for instance, most households are no longer self-sufficient in crop production due to climatic events, rural Malawians depend heavily on casual employment for cash or food to fill their annual production deficit (Devereux, 2007). Income diversification from causal labour reduces the risk to household livelihoods from the impacts of water hazards. However, while income diversification may be a positive development, it is not sufficient as money earn from the labour can't cover household's expenses given that causal labour is a low income activity (Naess *et al.,* 2010).

Of particular interest in fishing and wild production is that institutions have limited communities on their way of coping with droughts and floods. In Kanyemba flexibility to multiple income sources is limited due to limited employment opportunity. Thus, communities rely on natural resources such as fishing and wildproduction for coping. It's why Flintan and Telda (2010) found that some Zimbabweans have reacted by getting cross-border relatives or friends to allow them access to fisheries or look for wild product on the Zambian and Mozambican sides of the Zambezi River. Institution and regulation can affect the adaptive capacity of local community as found in Mali and Ethiopia where institutions influence access to resources which affect adaptive capacity of local communities (Naess *et al.,* 2010). Literature indicates that remittances act as a safety net for recipient households in the aftermath of natural disasters (Clarke and Wallsten, 2004; Mohapatra *et al.,* 2009). According to Banerjee *et al.,*(2011). Remittances are of two types: financial and social. Financial remittances can be monetary or non-monetary. Non financial remittances contribute to disaster preparedness. For example, they are used to procure households' wellbeing and quick responses in case of emergency. Financial remittances have an immediate and direct impact on a household's response to water hazards. In Kanyemba households affected by rapid onset water hazards, spending of remittances on basic needs was considerably high. Banerjee *et al.,* (2011) confirm that remittances can impacts in the communities by contributing to basic nutrition needs; improving livings conditions, and ensure immediate relief for the household during periods of livelihood shocks. Social remittances include the skills, ideas, practices, and knowledge that migrants bring back to their origin communities. Recipient households stated receive only monetary remittances than social remittances, this is probably linked to low income activities and unskilled labour on which family member is involve.

Livestock sale is common practice in Kanyemba. The onset of droughts or floods leads to the reduction in farm production and derived incomes; off farm mechanism such livestock sales

allows communities to withstand the impact of floods or droughts. Studies by O'Meagher (2003) confirm that the sale of livestock has been observed as the most important asset to withstand floods and droughts impact. However, sale of livestock from Kanyemba perspective is the most serious losses for the community since the replacement is difficult and reduce household's asset base from which to draw in the event of future shock and lessen the potential to exploit opportunities to sell livestock products such as meet. Comparative study within Mbire District showed that, the sales of animals across the District exceeded by far the numbers purchased, signifying the desperation for food that people went through and reflecting a process of disinvestment and distress (AWF, 2010).

The decision of Kanyemba communities to work in Zambia or Mozambique in daily basis is generally, a proactive household strategy to diversify sources of income and reduce the risks posed by water hazards to existing livelihoods. The temporary migration is influenced by the expectation of diversify income source at the destination than within the country (Banerjee *et al.,* 2011). Sen (1981) introduced the concept of derived migration to explain how floods and droughts reduce the demand for goods and services by lack of agriculture labour, threatening the livelihoods of those whose incomes depend indirectly on agriculture. In case of Kanyemba causal labour and out migration has impacted on crop production since people are no more interested in agriculture. Therefore, people living with remittance, informal or formal employment have been affected due to the scarcity of crop product in the market.

Since 1982 high and prolonged flood, communities in Kanyemba developed preventive mechanisms to protect their assets mostly in the field where they construct hut during the crop season. Intercropping, moved to high areas and elevating house play an important role during floods. Communities can cope before the event. Mitigation strategies are adopted, which aim to reduce the adverse effect of a hazard on a community or to avoid disaster from happening (by avoiding hazardous locations, evading seasonal disease vectors, choosing a safe location for a house) (Davies, 1993).

Moving toward relief response

Regarding to the framework, we suggest that communities was somewhere in the stable domain in 1960s as stated by some respondents (45%). This time everyone in the communities could harvest and sell the product of his farm. There were good rain and Mwanzamutanda River was flowing almost through the year, people had access to natural resources and flood plain was cultivated to supplement rainfed agriculture. Due to dry-spells during the crop season in 1980s as stated by respondents (60%), communities started use

flood plain twice a year as an alternative to crop failure in rainfed agriculture and communities started living in the disturbed zone where droughts are severe than floods. At this point rainfed production due to droughts is too low but coping mechanisms such causal labour, livestock sales and wild production combined with flood plain production sustained communities' livelihood. In the 2000s, increasing dry-spells and floods due to heavy rainfall coupled with the backflow from Cahora Bassa Dam have led to high rate of crop failure in both; flood plain and rainfed agriculture and livelihood system based on crop production decline drastically. Then communities moved upwards along the y-axis above flood threshold and beyond drought threshold to the vulnerable state where floods and droughts are recurrent. At vulnerable state, both flood plain production and upland production are no longer sustaining community' livelihood and the pace of droughts and floods reduce the capacity of the community to recover from the previous impact. Thus, droughts and floods frequency undermines communities' coping mechanisms and make them vulnerable.

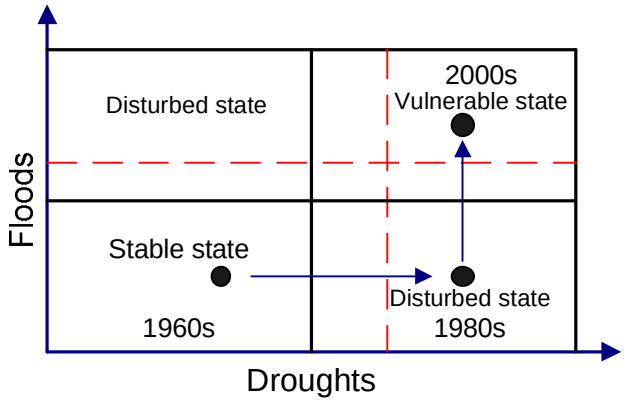


Figure 4.19: Communities' state in face of droughts and floods

Summary

Perceptions for rainfall changes, recurrent droughts and floods have lead Kanyemba communities to pursue different livelihood strategies to adapt with water hazards depending on the resource available, their skills and knowledges. However, internal and external factors constrain local communities on their way of coping with floods and droughts. Frequency and floods and droughts have reduced the capacity of local communities in such a way that current practices and resources are not able to cope with floods and droughts. Institutions, infrastructures and poor access to market undermine also local communities' efforts to counter water hazards.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The common perceptions of communities in Kanyemba are that climate has changed for the worse with less rainfall amounts and increased frequency of droughts and floods events in the last two decades. These perceptions corroborated well with rainfall analyses that evidenced floods occurrences, frequent dry-spells and rainfall distribution changes in the periods stated by the respondents. Although rainfall amount did not show any significant changes, high frequency of dry-spells mostly during the crop season was misleading communities on their perceptions for the changes of rainfall amount.

Communities' perceptions of changes influenced the adoption of particular livelihood activities. Expansion of land cultivation, flood plain farming and livestock rearing illustrated the level of understanding of the changes, and consequently their ability to cope with them. However, recurring droughts and floods affected communities' livelihood. Communities has witnesses high rate of crop production failure, destruction of standing crop and asset disposal such as livestock due to droughts and floods. Thus, droughts and floods have made communities' livelihood vulnerable, either directly through crop production failure or indirectly through asset disposal and household derived income from agriculture.

To minimize the impacts of droughts and floods, a pattern of responses was seen, building up from adjustments, such as vegetable farming, late sowing and crop production; or reliance on off-farm income sources (piecework, remittance, wild production and fishing), to the disposal of assets, notably livestock sales to a shift such as migration. Households have adopted numbers of mechanisms to address droughts and floods vulnerability. However, these coping mechanisms were found not flexible to cope with droughts and floods. Further, Current policies on environment have also reduced local communities' capacity to cope with floods and droughts.

5.2 Recommendations

1. Consideration of communities' perceptions on the environmental change analysis since local perceptions shape communities behaviour and corroborate findings and further study on the economic impact of droughts and floods is needed
2. Intervention is needed to mitigate water hazards and shift in focus from food aid to longterm mitigation measures by supporting later sowing, vegetable farming and intercropping that help households to cope with floods and droughts
3. Diversify livelihoods activities to enable communities to withstand the impact of droughts and floods

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Appendix 1. Focus group discussion guide

- What cause the variation in yield over the period?
- Which of floods and droughts is associated with crops failure?
- What are the causes of changing pattern?
- How are the pattern of droughts and floods?

GROUP DISCUSSION REPORT

Cluster	
Village	
Group (e.g. old men)	
Number of participants	
Sex (Number of M and W)	
Number of household in the village	

M = Man

W = Woman

Appendix 2. Semi-structured interview guide

Interviewer: Bola Bosongo

This interview collects information about floods and droughts that have happened in your area, how you perceive changes in the occurrence floods and droughts, the impacts of floods and droughts in your community, how you cope with floods and droughts.

Perception on floods and droughts

I) Frequency and magnitude of floods/droughts
II) Observed changes in the timing, frequency and intensity of floods/droughts
III) Most recent and significant floods/droughts
IV) What leads to the occurrence of floods or droughts

Floods and droughts impacts

I) Most affected by droughts/floods
II) How vulnerable are the livelihoods to floods and droughts
III) Impact of floods and drought on:
- Main livelihoods (what and how)
- Socially vulnerable groups: women and child headed families, old people, People living with HIV/AIDS
- Food security
- Social life: migration, school attendance, family life
- Economy: business opportunities, employment
- Any other areas

Coping mechanisms

I) Practices in the community to deal with impact of floods and droughts
II) preparation: how do you prepare for floods/droughts (what and how)
III) Mitigation: what is done to mitigate the impacts of droughts/floods
IV) How have you adapted to living with recurrent droughts and floods in the area in terms of livelihood and agricultural systems (how)
V) Challenges faced in coping with floods and droughts
VI) During last flood/drought what assistance did you get –was it timely and did it make any difference.

Appendix 3. Survey questionnaires

Location …….....

Date……..

Questionnaire number ……..

QUESTIONNAIRE ON COPING WITH DROUGHTS AND FLOODS

This questionnaire collects information about floods and droughts that have happened in your area, how you perceive change in rainfall, frequency of floods and droughts, the impact of floods and droughts in your community, how you cope with floods and droughts.

Your answer to the questions will be treated confidentially.

Section A: Personal details

1. Sex: M [1] [2]

2. Which one of the following age categories do you currently fall in?

under 23	24-30	31-37	38-44	48-54	55 - 61	62 +
1	2	3	4	5	6	7

3. How long have you been living in this area?

Less than a year ☐ 1 – 7 years ☐ 8-14 years ☐ 15-22 years ☐

23-30years ☐ Since born ☐

4. How many persons (including you) live in your household?

Less than 5 ☐ 6 - 12 ☐ 13 - 20 ☐

5. What is your main source of household income?

livestock sales ☐ Cash from crops that I sell ☐ Cash from family business ☐

Remittance ☐ Formal employment ☐ Informal employment ☐

Other (specify):

……

……

Section B: Floods, droughts and rainfall

6. What is the current rainfall pattern in your area?

……
……
……
……
……

7. What can you say has been the common rainfall pattern in the past?

……
……
……
……
……

8. In this area, using the number of months in which rainfall occurs in the past, indicate by circling number in the table below whether rainfall was: (1) less than normal rainfall season (less than four months of rain), (2) normal rainfall season (four months of rain), (3) more than normal rainfall season (more than four months of rain).

Rainfall / Score	Less than four months	Normal	More than normal
Score	1	2	3

9. During the crop season, how has been the extend of day without rain in the past years: (1) minor (5 – 12 days), (2) medium (13 – 20 days), (3) high (21 - 28), (4) too high (29 -36)

Flood / Score	Minor	Medium	High	Too high
Score	1	2	3	4

10. In the past, how many times has this area experienced floods? : (1) Rarely (once in four years), (2) sometime (once in three years), (3) frequent (every year).

Flood / Score	Rarely	Sometime	Often
Score	1	2	3

11. In the past, how many times has this area experienced droughts? : (1) Rarely (once in four years), (2) sometime (once in three years), (3) frequent (every year).

Flood / Score	Rarely	Sometime	Often
Score	1	2	3

Section C: Impact of flood and drought in your household

12. Have the flood or drought which you describe above affected you?

Yes ☐ No ☐

If yes, describe how……
……

……
……
……

13. Do you have a field? Yes ☐ No ☐ If yes how many hectares? ……..

14. What kind of crop do you grow? ……...

15. In your field, what was extend of damages caused by flood last year? Circle appropriate number, whether flood impact was (1) minor (no damage at all), (2) medium (damage little crop, livestock and asset), (3) high (damage all crop, livestock and asset).

Impact / score	Minor	Medium	High
Score	1	2	3

16. In your field, what was extend of damages caused by drought in your field last year? Circle appropriate number, whether drought impact was (1) minor (no damage at all), (2) medium (damage little crop), (3) high (damage all crop).

Impact / Score	Minor	Medium	High
Score	1	2	3

17. Last year crop season, how many hectares of the following crops have been washed away by flood?

Crops / Year	Maize				Sorghum				Millet				Groundnut				Cotton			
	0.5-2 hectares	3-4 hectares	5- 6 hectares	7-8hectares	0.5-2 hectares	3-4 hectares	5- 6hectares	7-8 hectares	0.5-2 hectares	3-4 hectares	5- 6hectares	7-8 hectares	0.5-2 hectares	3-4 hectares	5- 6 hectares	7-8 hectares	0.5-2 hectares	3-4 hectares	5- 6 hectares	7-8 hectares
2010	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

18. Last year crop season, how many hectares of the following crops have been affected by drought?

Crops / Year	Maize				Sorghum				Millet				Groundnut				Cotton			
	0.5-2 hectares	3-4 hectares	5- 6 hectares	7-8hectares	0.5-2 hectares	3-4 hectares	5- 6hectares	7-8 hectares	0.5-2 hectares	3-4 hectares	5- 6hectares	7-8 hectares	0.5-2 hectares	3-4 hectares	5- 6 hectares	7-8 hectares	0.5-2 hectares	3-4 hectares	5- 6 hectares	7-8 hectares
2010	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

19. Last year crop season, how many hectares of the following crops have been affected wild animal?

Crops / Year	Maize				Sorghum				Millet				Groundnut				Cotton			
	0.5-2 hectares	3-4 hectares	5- 6 hectares	7-8hectares	0.5-2 hectares	3-4 hectares	5- 6hectares	7-8 hectares	0.5-2 hectares	3-4 hectares	5- 6hectares	7-8 hectares	0.5-2 hectares	3-4 hectares	5- 6 hectares	7-8 hectares	0.5-2 hectares	3-4 hectares	5- 6 hectares	7-8 hectares
2010	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

20. Last crop season, how much of the following crops have you harvested? Circle appropriate number, whether production was: (1) no harvest (1- 7 bags of 50 kg), (2) low (8 - 15 bags of 50 kg), (3) average (16 - 23 bags of 50 kg), (4) high (24 - 31 bags of 50 kg) for crops and (1) no harvest (1 bale), (2) low (2- 9 bales), (3) average (10 – 17 bales), (4) high (18 – 25 bales) for cotton.

Crops / Year	Maize				Sorghum				Millet				Groundnut				Cotton			
	No harvest	low	Average	High	No harvest	low	Average	High	No harvest	low	Average	High	No harvest	low	Average	High	No harvest	Low	average	High
2010	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

21. If your harvest is low, medium or high, what would you say is the cause of such harvests?

……
……

……
……

22. Are there any crops which you used to grow but have stopped growing?

……
……
……

Can you explain why you have stopped growing the crops?

……
……
……

Are there any new crops which you have started growing recently?

……
……
……

Why have you taken up these crops?

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……
……
……

23. Please think about state of your herd last 2 year and circle appropriate number, whether livestock in your herd was (1) null (do not have), (2) low (1 – 7), (3) medium (8 – 15), (4) high (16 – 23).

Livestock	Cattle				Goat				Donkey				Poultry				sheep			
Years	null	low	mid	high	null	low	mid	high	null	low	mid	high	null	low	mid	high	null	Low	mid	high
2010	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
2011	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

24. Compare with what you have actually, number of livestock is increased or decreased?

……..

What is the reason? ……

Section D: Coping mechanisms used in your household to cope with floods and droughts.

25. Can you tell us more about what you do to make sure that droughts or floods affect you as little as possible? What type of measures do you take?

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……

26. Can you tell us how do you recover damages caused by drought or flood event?

……
……
……
……

27. When floods occur, what do you do to secure your livelihood?

Livestock sales	☐	Hand tillage	☐	Fishing	☐
Petty trade	☐	Wild production	☐		
Remittance	☐	Piecework	☐		

Other (specify):
……
……

28. When droughts occur, what do you do to secure your livelihood?

Livestock sales	☐	Crop production	☐	Hand tillage	☐
Petty trade	☐	Wild production	☐	Fishing	☐
Remittance	☐	Piecework	☐	Vegetable farming	☐

Other (specify):
……
……
……

29. When there is drought how do you obtain water for your consumption, livestock and crop?

……
……
……
……

End of questionnaire

Thank you very much!!!

Appendix 4. Cropping calendar, occurrence of floods and droughts during the crops season