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Coping with droughts and floods: A Case study of Kanyemba, Mbire District, Zimbabwe

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ABSTRACT

Most of Southern Africa is affected by extreme weather events, droughts and floods being the most common. The frequency of floods and droughts in Southern Africa in general, of which the Zambezi River Basin is part of, has been linked to climate change. Droughts and floods impact on the natural environment, and directly and indirectly impact on livelihoods. In the Middle Zambezi River Basin, which is located between Kariba and Cahora Bassa dams, extreme weather events are exacerbated by human activities, in particular the operation of both the Kariba and the Cahora Bassa reservoirs. To understand better, whether, and in what ways extreme weather events impact on livelihoods, this study used both quantitative and qualitative research methods to analyse rainfall variability and coping strategies used by households in the river basin. Data collection was done using semi-structured interviews, focus group discussions and structured questionnaires which were administered to 144 households. An analysis of rainfall variability and Cahora Bassa water level over 23 years was carried out. The study found that perceptions of households were that average rainfall has decreased over the years, and dry-spells have become more frequent. Furthermore, households perceived flood events to have increased over the last two decades. However, the analysis of rainfall variability revealed that the average rainfall received between 1988 and 2011 had not changed but the frequency of dry-spells and floods had increased. The occurrence of floods in the study area was found to be linked to heavy local rain and backflow from Cahora Bassa dam. The study found that households adopted a number of strategies to cope with droughts and floods, such as vegetable farming and crop production in the floodplain, taking on local jobs that brought in wages, planting late and livestock disposals. Some households also resorted to out-migration on a daily basis to Zambia or Mozambique. The study concluded that coping mechanisms were found to be inflexible and poorly suited to adapt to floods and droughts. The study recommends the implementation of adaptation measures such as the cultivation of drought-resistant crop varieties, irrigation and off-farm employment opportunities.

1. Introduction

As much as 90% of Southern Africa's population depends on agriculture for their livelihoods (POST, 2006; IPCC, 2007). Economies in the region are directly and indirectly dependent on agriculture. Agriculture accounts for about 70% of employment in the region and about 35% of the region's Gross National Product (GDP) (IPCC, 2007). This high dependence on agriculture makes the region susceptible to weather and climate-related elements, such as floods and droughts. Floods and droughts are associated with excess or insufficient rainfall, river overflow, climate change and human activities (Dilley, 2000). Human activities and climate change can alter the intensity and frequency of floods and droughts. In particular, droughts and floods have a devastating impact on livelihoods, mostly because they affect crop production (Dilley, 2000). It is important to note that the region is not only affected by full scale droughts which affect on seasonal rainfall totals. In some cases, dry spells occur at critical crop-growth stages and ruin a cropping season (Rockström, 2003a,b). In Zimbabwe the 2000–2001 flood and drought caused 800 deaths and affected almost 2 million people, of which about 1 million needed emergency food supplies. More than 300,000 people were displaced by the floods while agricultural land was covered with water. The economic impacts of the floods and droughts in Southern Africa included GDP reduction of

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about US$3 billion, increased unemployment, heightened burden on government expenditure and reduced industrial production due to curtailed power supply (ECA, 2007).

Although floods and drought have a devastating impact on national economies, it is at the household level where their impact is felt most acutely. Communities in Zimbabwe have experienced major climatic events which include the droughts of 1982, 1991–1992, 1994–1995, 1997–1998, 2002 and 2008. In addition, Zimbabwe was also affected by the El-Niño phenomenon which resulted in the floods of 1997–1998 (Dilley, 2000). According to IPCC (2007) floods and droughts are likely to get worse, as it is predicted that the magnitude and frequency of floods and droughts will increase during the 21st century due to changes associated with climate change and variability. This will increase the vulnerability of households that depend on rain-fed agriculture and livestock production for their livelihoods and create new burdens for those communities already poor (Smucker and Wisner, 2008). This paper makes an investigation into the perceptions and impact of drought and floods on rural households, and interrogates the mechanisms households employ to cope with droughts and floods. The paper uses the case of Kanyemba, which is located in the lower Manyame sub-catchment in the Middle Zambezi Valley.

2. Study area

Kanyemba lies in the Lower Manyame sub-catchment, which forms part of the Lower Middle Zambezi Valley (Fig. 1). It is located at the confluence of the Zambezi and the Mwanzamutanda rivers. When following Zimbabwe's political boundaries Kanyemba is in Ward 1, Mbire District. The district is in Mashonaland Central Province. Kanyemba is bordered by Mozambique to the east and Zambia to the north. The ward's population of about 4,500 people is spread across 24 villages. It is notable that the study area is inhabited by the Chikunda and the Vadema or Doma tribes. These tribes were previously nomadic hunter-gatherers who were forced to settle down as a result of colonialism (Marindo-Ranganai, 1995; Isaacman, 2000). The Chikunda and Doma tribes settled in the mountains near the Zambezi River. However, during the droughts of 1984 and 1986, they moved from the mountains to settle in Kanyemba in the Zambezi valley. They have been relatively isolated from mainstream Zimbabwean society (Marindo-Ranganai, 1995; Isaacman, 2000).

The core livelihood activities in the area are agriculture and livestock rearing. Crops such as maize, sorghum, millet, cowpeas, pumpkins, bananas and vegetables are grown, mainly along the Mwanzamutanda floodplain. Due to erratic rainfall, the ward is considered unsuitable for dry-land cropping, and as a result floodplain crop cultivation is practised. Goats are the major livestock kept in the area since the area is infested with tsetse flies which make livestock rearing difficult. Cattle are generally preferred by tsetse flies. When using an agro-meteorological classification, the area is be suitable for livestock production under extensive production systems and for wildlife production (FAO, 2006).

3. Methodology

This study used both qualitative and quantitative data collection methods. Focus group discussions, key informant interviews and document reviews were used to extract qualitative data while quantitative techniques were used to analyse rainfall data. Two focus group discussions were conducted, one with members of the local community and the other with ward officials such as the councillor, wildlife managers, traditional leaders and the head of the village. Issues covered in the focus group discussions included crop production, cropping patterns, flood hazards and rainfall patterns (past and present). Perceptions on floods, droughts and impacts on crop production were also explored in the focus group discussions. Semi-structured face-face interviews were also conducted. A sound recorder was used to record the interviews in order to minimize information loss. Quantitative data were collected using a structured questionnaire. A sample size of 144 households was selected using the 2008 intercensal data. Of the

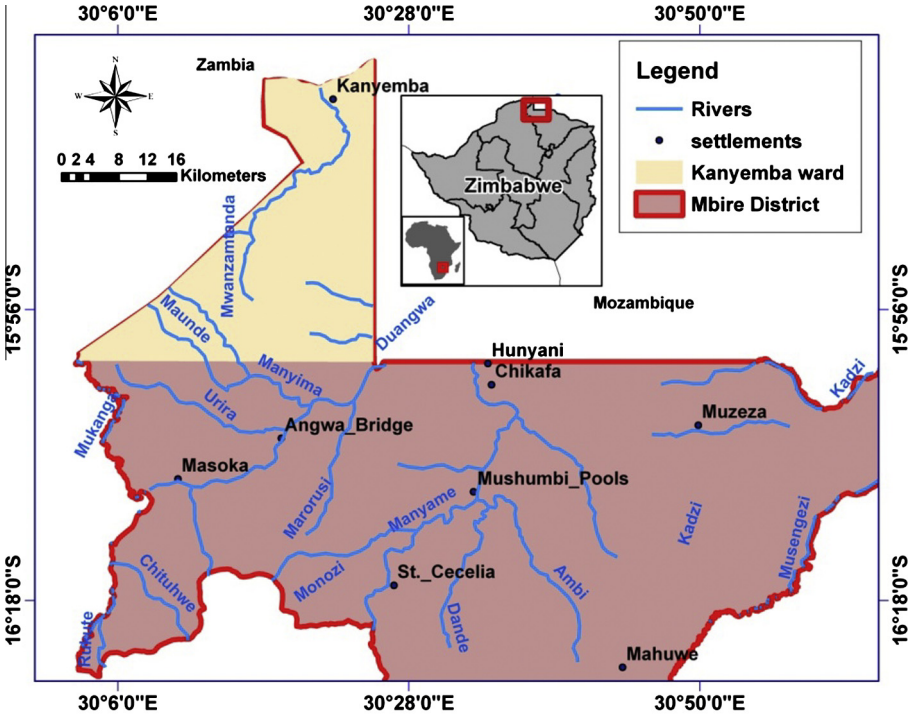

Fig. 1. Location of Ward 1, Kanyemba, in the Mbire District of Zimbabwe.

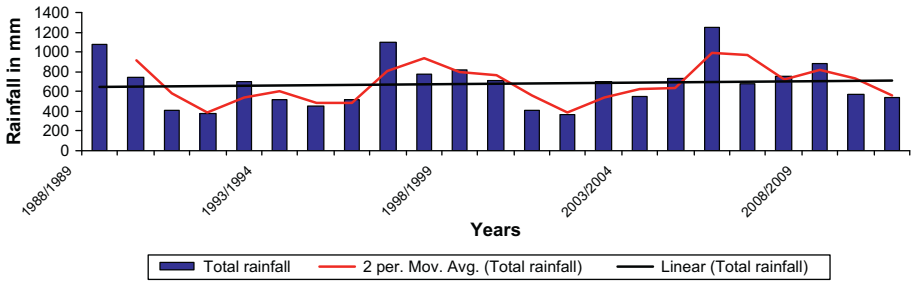

Fig. 2. Annual rainfall, Kanyemba Meteorological Station, 1988–2011.

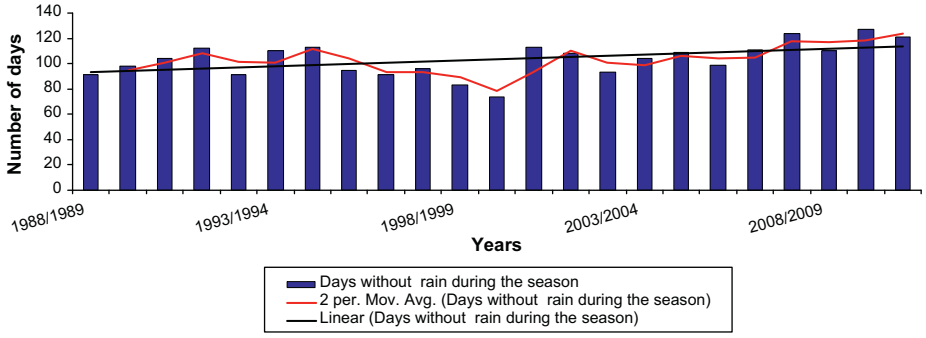

Fig. 3. Days without rainfall during the crop season, Kanyemba Meteorological Station, 1988–2011.

respondents, 90 were male while 54 were female. The Cochran formula[1] (Bartlett et al., 2001) was used to calculate sample size at a confidence level of 95%. To conduct the survey, a sampling interval[2] was performed (Wunsch, 1986). Interviews were conducted with a field assistant chosen from the community. Questionnaires were used to capture the communities' opinions about issues such as droughts and floods, rainfall pattern, and households profiles. This method was also used to collect information from households on how they cope with droughts and floods. To substantiate qualitative data related to perceptions and impact of weather events, secondary data, including on crop production, rainfall (23 years) and water levels, was collected from the Mbire Rural District Council, the Zimbabwe Meteorological Office and Mozambique Electricity Company, respectively. Data analysis was carried out using SPSS 13 and Excel software.

4. Results

4.1. Perceptions of droughts, floods and rainfall

Various attitudes and judgments were found in the communities related to floods, rainfall and droughts. The majority of the respondents (80%) stated that rainfall patterns in the area have changed over the last 20 years. It was reported that the area was receiving less and less rainfall and that the frequency of dry spells had increased.

4.1.1. Trends of rainfall in Kanyemba

An analysis was done to see whether or not rainfall data supported the perceptions of the respondents on rainfall trends. The analysis revealed a cyclic variability in both annual and seasonal rainfall (Fig. 2) although no upward or downward trend was detected from simple liner trend analysis.

As shown in Fig. 3, the dry-spells occur mostly early in the rainy season (October and November), and generally coincide with the germination or early development stages when crops are sensitive to water stress. For the period under analyses, about 70% of the planting seasons were affected by dry-spells of 20 days or more. The worst droughts and delays in rainfall which the majority of the respondents (81%) identified was that of 2001–2002 and most recently 2009/2010.

The frequency and impact of dry-spells on crop and uneven distribution of rain during the planting season explains why the local community feels that rainfall averages have decreased. In addition, the perception around rainfall was linked to perceptions of floods caused by heavy rain within a short period.

4.1.2. Floods occurrence in Kanyemba

About 90% of respondents indicated that the frequency of flooding had increased in the past two decades. Apart from the floods of 2010, the other flooding events which were cited included those that occurred in 1982, 1988, 1993, 1996, and 2007. The two main factors which were identified as contributing to flooding in Kanyemba were backflow from the Cahora Bassa dam and rainfall events. Heavy rains, which occur mostly around January and February, were said to cause flooding.

Analyses of rainfall data showed that between 1988 and 2011, floods due to local rain were linked to short periods of heavy rain that occurred at the peak of the rainfall season and mostly during the period December to February (Fig. 4).

The maximum rainfall between 1988 and 2011 averaged 267 mm per month, with a standard deviation of 107 mm.

The 1997/98 and 2005/06 floods occurred around March when the Cahora Bassa dam reached a height of about 300 m above sea level. Most respondents (60%) indicated that when the Cahora Bassa Dam rises, the backwater and resultant lake area stretches as far back as the Mwanzamutanda River confluence with the Zambezi River. The Mwanzamutanda River will thus not be able to

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

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

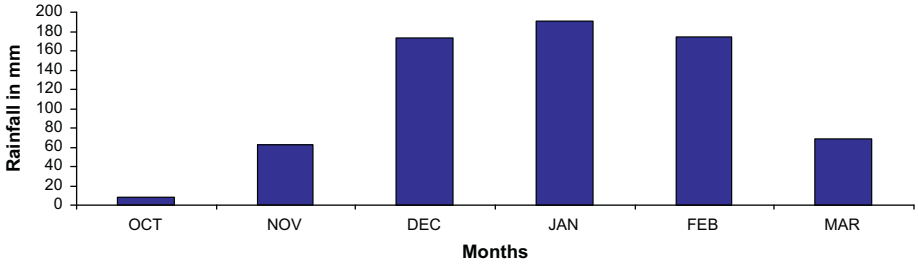

Fig. 4. Monthly average distribution of rainfall, Kanyemba meteorological station, 1988–2011.

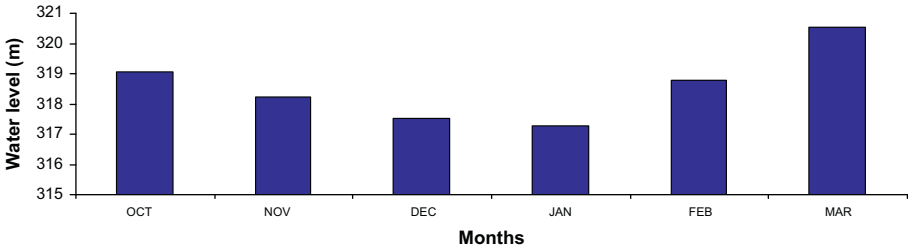

Fig. 5. Monthly average water level at Cahora Bassa Lake, Mozambique Electricity Company, 1988–2010.

discharge into the Zambezi River with the resultant further flooding of the Mwanzamutanda River due to backwater effect. This happens mostly around March (Fig. 5).

4.2. Livelihood activities

As there are different perceptions on floods and droughts, households in Kanyemba also reported different livelihood strategies. Households not only practiced rain-fed farming in the uplands but also engaged in flood recession agriculture. Households reported that they reared livestock, mainly goats, for subsistence. In addition, most households (60%) cultivate two or three fields totalling altogether about 4 ha. The fields are located on the floodplain where maize and groundnuts are cultivated. Households also reported that they had fields in the upland areas where they practised dryland crop cultivation, growing groundnuts and sorghum. Twenty percent (20%) of households have fields on both floodplain and upland areas where they grow maize, sorghum and groundnuts. However, crop failure rate was reported to be high in the upland areas where dryland crop cultivation is practised. As a result, the majority (80%) of the households opted to grow mainly maize on the floodplain.

Seventy-percent (70%) of the respondents reported that since the 1990s, due to recurrent droughts, crop fields in the uplands have been expanded. Almost 70% of households involved in dryland farming reported that they had increased their fields from about three to about five hectares, but had not changed the crops they cultivated. This strategy was seen as guaranteeing a harvest in times of drought. Respondents argued that because of this strategy the yields for maize, the staple crop, fluctuated annually but averaged between 300 and 400 kg/ha. Cotton used to be a key cash crop in the area. However, due to a number of reasons, such as inflation, a fall in the cotton producer price, the bad state of roads, lack of draught animal and the high costs of fertilizer and labour, almost all the households stopped growing cotton in 2008.

The study area is part of the Communal Areas Management for Indigenous Resources Programme (CAMPFIRE) which is meant to benefit areas situated in wildlife management areas (Mukamuri et al., 2008). The community benefits from part of the proceeds which the local authority earns from trophy hunting. Some of the community members are employed as tour guides and earn some income through this activity. Money earned from trophy hunting benefits the whole community as this is invested in community development projects such as the construction of schools and hospitals. It is also common practice that the meat from animals which professional hunters/tourists kill is distributed to households through the heads of the villages.

4.3. Impact of droughts and floods

About 90% of the population subsists on smallholder farming. The relatively recent major climatic events that hit the community were the 2010 drought and floods which destroyed crops. The 2010 drought damaged on average 1.55 ha of crops per household.

As far as the different types of crops are concerned, groundnuts were found to be more affected by the drought than maize and sorghum. This was because maize is mostly grown on the floodplain where there is a lot of moisture and it is therefore less affected by drought. Groundnuts are grown in the upland areas because of their tolerance to droughts for a certain period. However, the 2010 drought damaged all crops to varying degrees. Every household interviewed reported that their crops had been damaged by the drought which occurred in that year. About 20% of households stated that they experienced a 90% decrease in crop yields. In some cases the drought wilted all the seedlings and 40% of the households reported that they had to buy additional seed.

Since the cropping season in the floodplain starts in November, almost 90% of households did cultivate the land before the onset of the floods which occur in March. Households that had planted early lost their entire crop. About11% of respondents reported that their livestock, mainly goats, had been washed away by floods, which resulted in goat ownership on average falling from 5 to 4 per household. Over and above this, properties were also affected with almost 80 families being rescued by the civil protection unit. Affected families were taken to Chapoto Primary School and assisted with food, blankets and other emergency products by Non Governmental Organisation such as Christian Care.

4.4. Socio-economic impact

The impact of the floods and droughts on the communities has been categorized into two components: household food insecurity

and economic costs. The economic costs involve indirect costs (affecting crop-derived income). Crop production (maize, sorghum and groundnuts) averaged 1600 kg per household compared to 4500 kg for the year before flood (Table 1). A comparison between two seasons shows a difference of 2900 kg which represents almost 65% of loss due to floods and droughts. About half of the respondents reported that they suffered from hunger after droughts or floods and that they had been assisted by Non Governmental Organizations (NGOs). NGOs provided emergency relief food packs.

Droughts and floods reduced household food availability, and agricultural income derived from crop sales. According to respondents (60%), crops such as maize, groundnuts and sorghum are sold, respectively, for US$4 and US$2 per 20 kg each and the money earned is carefully appropriated for buying household goods such as sugar, soap, petrol and oil. They reported that during floods and droughts household income is severely affected since the quantity of crops sold in Zambia is little and the money earned is insufficient to meet all household needs. Furthermore, they reported that during a flood or drought period, the price of grain at the local market increases.

4.5. Coping mechanisms

The occurrence of droughts and floods means that communities have developed diverse means of coping with the impacts of these droughts and floods. Coping mechanisms for the way in which a household might respond to floods and droughts has been drawn up using Corbett's (1988) study.

4.5.1. Coping with droughts

Cropping responses: In terms of crop production, about 70% of households stated that they employed various cultivation strategies in response to the impacts of drought and floods. Respondents reported that since 1982, the floodplain has been cultivated twice a year. Around September, households clear land for cultivation and this is followed by the planting of maize, groundnuts, bananas, sugarcane and sorghum in mid October. The same period is also marked by some members of households moving into temporary huts constructed near the floodplain. This is done to protect crops from wild animals. Unfavourable conditions exist on the floodplain during this sowing period, and as floods come around January or February, flood water washes away crops. Households lose mainly maize, groundnuts and sorghum. Sugarcane and bananas are more resistant to floods. As soon as the flood water recedes, households move back to re-cultivate the floodplain. Households utilise residual moisture in the sandy soil of the floodplain to grow maize. These households dig holes of about 50 cm square approximately, with depths that vary according to the distance from the stream bank, making the holes deeper as they move further away from the river. Fig. 6 shows maize planted on the floodplain.

The depth to which the holes are dug depends on both moisture levels in the field and on distance from the river. The holes are spaced about 0.3 m apart within rows and 0.3 m between rows. Sowing is done by planting between 2 and 10 seeds per hole. The idea behind the number of seeds per hole is to minimize the number of holes to be dug and in so doing to reduce the workload in the field whilst at the same time maximizing water uptake by the plant. The result from these practices is that the crops grow faster, survive the drought better and give much larger and healthier yields. As a result the crops fetch good prices on the market. Households get a supplementary harvest of vegetables in the stream bank. During the dry season, when the rain season ends (around March–April) households make ridges on the stream bank to grow vegetables while there is still moisture before the river dries up. When the river does dry up, households dig wells in the riverbed to water vegetables. The production of diversified crops such as carrots, tomatoes, onions, sweet potatoes, cabbages and pumpkins is also used as a strategy to guard against crop failure. Vegetable farming brings cash returns for households and during these times they purchase basic household foodstuffs and other goods (farming equipment, seeds and utensils).

Fig. 6. Maize planted on the floodplain.

Late sowing: In a normal year the farmers usually start field preparation for maize in September and early October before the first rains. However, in a drought year their strategy is to delay planting so that they can benefit from delayed rains. Instead of leaving the land fallow they plant early maturing cultivars in November. Early maturing crops succeed and mature on time and give better yields than other varieties. Households often sow Kanongo maize (early maturing variety) to avoid the risk caused by long dry-spells that occur frequently after the first rains in October.

Wild fruits: while men engage in farming activities, women gather wild fruits. In Kanyemba, wild fruits such as masawa (*ziziphus mauritiana)* are used to supplement household food requirements.

Pottery: Almost 9% of households reported that they sold pottery. This is mainly done by female members of households. Clay pots are sold to supplement household income.

Table 1
Average crops harvested per household in Kanyemba.

Season	Event	Statistics	Crop production (kg/HH)			
			Maize	Sorghum	Groundnut	Cotton
2009/2010[a]	Flood and dry-spells	Mean	575	450	575	
		Standard dev.	1.98	3.85	2.51	–
2008/2009[b]	No flood and dry-spells	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 (LDGA), survey 2008.

Fishing: Almost all households reported that they engaged in fishing activities to supplement food and income. Both men and women reported that they engaged in fishing. Females stated that they used their earnings to buy goods such as soap, salt and cooking oil. Unlike the Zambian and Mozambican authorities, the Parks and Wildlife Management Authority in Zimbabwe permits fishing with lines and hooks.

4.5.2. Coping with floods

Mixed cropping: About 60% of households practiced mixed cropping. Maize, groundnut and sorghum were cultivated together with sugarcane and bananas on the same plot. Bananas were planted in lines along the field and sugarcane is planted in the middle of the field. During the sowing period, households plant maize, groundnuts and sorghum in the spaces between sugar cane and also between sugarcane and bananas.

The study found that apart from specific strategies used to cope with either droughts or floods, some strategies were employed to cope with a combination of the harsh socio-economic and ecological environment in the area. Such strategies were common and were unrelated to flooding or droughts.

Casual labour: Almost 45% of households are in the labour market. The main local industries where people work are companies involved in the tourism industry such as safaris. Camps that cater for tourists regularly employ people to cook for tourists or to guard camps. However, the tourism season lasts only 4–5 months and the money earned is insufficient to cover all the household expenses.

Remittances: There were remittances from household members within and outside the country. Other family members work in Zambia or Mozambique. Seventy percent of the households stated that they received remittances on an irregular basis. Households reported receiving remittances in both monetary and non-monetary forms. Households who receive monetary remittances stated that the major share of remittances was spent on basic needs such as soap, sugar and general food. Respondents stated that the money earned through remittances was not sufficient as many of their family members were employed in low-income activities.

Livestock sales: Households also sell livestock to livestock traders within the district or from Zambia. Livestock are sold at the onset of floods or drought. According to respondents (30%), money earned from livestock sales during flood or droughts is mostly used to buy food. At other times, money earned from livestock sales is used for expenses like school fees, taking family member to doctors in case of emergency, and clothes for family. Livestock is not only used to cover family expenses but it is also a source of protein (milk, meat, yoghurt, cheese, cooking oil) Animal dung is used as manure for vegetable farming. Households stated that the sale of livestock has the greatest impact on their security because livestock is their 'life's bank' and being forced to sell livestock as a result of the drought or flood constitutes a real loss of valuable money and productive resources.

Labour migration response: About 8% of households in Kanyemba migrate as a strategy of survival. The majority of labour migrants are wage employees in Zambia or Mozambique. Migrants are unskilled workers who end up working in low-paying jobs in factories, construction sites or as cleaners or truck off-loaders. In some cases migrants also work in agriculture as seasonal labourers (weeding, harvesting) or in mines, and quarries. The duration of time spent by migrants in their destination communities (Zambia or Mozambique) was between 2 and 3 months. The money earned by migrant labour is used, for instance, to purchase goats if there was a loss in the herd during drought or flood or/and to buy farming materials such as hoes and seeds. The money from migrant labour is insufficient to purchase agriculture materials or to spend on other long-term investments, such as starting up a business or investing in savings.

5. Discussion and conclusions

Although the common perception is that rainfall averages are decreasing, the analysis of rainfall did not show any changes in rainfall between 1988 and 2011. The perception that rainfall is decreasing may be due to the lack of optimum rainfall needed for agriculture during the growing stage of crop as was found to be the case in arid zones in Sub-Saharan Africa where less than 30% of rainfall is used as productive green-water for grain such as maize, sorghum and millet (Falkenmark and Rockström, 2006). Uneven rainfall distribution during the crop growing season impacts on the crops, leaving the impression that rainfall has 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. The impact of dry-spells on crops together with uneven rainfall distribution explains why local communities feel that the rain is decreasing. Heavy rains within a short period, backflow from Cahora Bassa Dam, coupled with local rain have led to two kind of flooding in Kanyemba. The first type of flooding is the seasonal flood related to heavy local rain which occurs mostly in January or February at the peak of the rainfall season. The second type of flooding is dam operation-induced flood (Madamombe, 2004). For instance, the 2010 flood occurred when Northern Zambia and Northern Mozambique had received above normal rains and the Kariba Dam, in Zimbabwe, was 73% full. This prompted the opening of flood gates on the 9th of March 2010. Backflow from Cahora Bassa coupled with local rain resulted in the accumulation of water at the Mwanzamutanda confluence and led to flooding in Kanyemba on the 13th of March (OCHA and SADC, 2010).

Prolonged dry-spells impacted negatively on rain-fed agriculture by reducing crop production that subsequently impacted on the communities' livelihood. Metcalfe (1993) confirms that Kanyemba is prone to dry-spells and periodic dry spells during the planting season and that this reduces crop production. This is consistent with the study by ECA (2007) which stated that the majority of the population in most African countries live in rural areas practicing rain-fed agriculture and that recurrent drought resulted in a poverty trap for local communities due to production losses.

Devereux (2007) notes that the major impact of climatic events on rural livelihoods is on crop production. Floods can reduce farm yields or even completely wipe out crops. This affects rural households which depend mostly on agriculture. Gwimbi (2009) has reported similar effects of floods in Zimbabwe's rural areas. In this way, weather hazards contribute to economic losses and undermine agricultural based development (Dorward and Kydd, 2002). In communities dependent on resources that are sensitive to climatic conditions, droughts and floods can plague social cohesion and erode communities' resilience. Devereux (2001) argues that social obligations exist to address the impacts of droughts or floods and that these obligations are 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 own well-being over and above all else. This implies that droughts or floods leave individual households without the means to help each other (Herren, 1991).

An examination of the existing coping mechanisms in Kanyemba showed that communities use different strategies to cope with droughts and floods. Mixed cropping, late sowing, vegetable farming and livestock sales were found to be the dominant

strategies used by households to cope with droughts and floods. Households diversified crops and planted carrots, tomatoes, onions, sweet potatoes, cabbages and pumpkins in the valley. This allows households to have a production that is flexible with respect to their responses to climatic events (Teklu et al., 1991). This strategy is in line with what has been found in other parts of the world. 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 but only if water availability can help them for more production. In the case of Kanyemba, vegetable farming and crop production are not sufficient because the period over which a community may be able to sustain its livelihood using these strategies is quite short. This is because vegetable farming takes about 4 months, by which time the water table in the riverbed has decreased.

Floods and droughts have led households in Kanyemba to diversify income through casual labour. This is also typical for most African countries. In Malawi for instance, most smallholders are no longer self-sufficient in crop production due to climatic events and rural Malawians depend heavily on casual employment for cash or food to fill their annual production deficit (Devereux, 2007). Income diversification through casual labour reduces the risk to household livelihoods caused by the impacts of water hazards. However, while income diversification may be positive, it is not sufficient as money earned from the labour is insufficient to cover a household's expenses given that casual labour is a low income activity (Naess et al., 2010).

The study concludes that coping mechanisms were found to be flexible enough to provide some form of livelihood security for households. However, the study recommends the implementation of additional measures such as the cultivation of drought-resistant crop varieties, irrigation and off-farm employment opportunities to make communities more resilient.

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