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Socioeconomic impacts of floods and droughts in the middle Zambezi river basin

Case of Kanyemba

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Abstract

Purpose – The purpose of the paper is to analyse how floods and droughts affect communities' livelihood in the middle Zambezi river basin and coping mechanisms which households apply to counter the impact of floods and droughts.

Design/methodology/approach – The method adopted was semi-structured interviews, focus group discussions and semi-structured questionnaires.

Findings – Thematic analysis shows that the major issues affecting communities' livelihood in the middle Zambezi river basin are related to frequent floods and droughts. Floods are due to heavy seasonal rainfall which occurs at the peak of the rainfall season. As for droughts, the frequency of dry-spells of 20 days on average has been observed during the crop season. The impacts of floods and droughts in the district, notably in some wards such as Kanyemba, are the reduction of crop production, food shortages, reduction of agriculture derived income and erosion of social network. Households have responded to these impacts through a number of coping mechanisms including disposal of assets, labour migration, stream bank and floodplain cultivation, piecework, remittance, wild production and fishing. However, such coping mechanisms are short term and some of them are in conflict with the country's environmental laws.

Originality/value – This paper reports a study on the first such finding related to socioeconomic impact of floods and droughts on households located in the middle Zambezi valley which is 500 km from Harare with a specific focus on traditional coping strategies in the face of disasters.

Keywords Impact, Floods, Socioeconomic, Coping mechanisms, Droughts, Kanyemba

Paper type Research paper

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1. Introduction

Africa is the world's second-largest and second most-populous continent after Asia. With about 922 million people (as of 2005), it accounted for over 20 per cent of all the weather and climate-related disasters that occurred globally (IPCC, 2001a). Africa has the highest mortality-related vulnerability indicators for weather events. In the last 30 years, seven out of the ten climate-related disasters in the world have taken place in sub-Saharan Africa. The famines that hit parts of Africa due to drought from the mid to late 1980s account for the larger part of the burden regarding the number of casualties (Benson, 2003). The number of people exposed to floods in the region grew from 500,000 per year in 1970 to almost 2 million people per year in 2010 (IPCC, 2001b). Climate-related risk is still increasing consistently in sub-Saharan Africa, despite a downward global trend. If climate change models are accurate, it most likely that the risk due to weather events is expected to grow as the region is extremely vulnerable to extreme climate events.

While key sectors such as transportation, infrastructure, water, and tourism are sensitive to extreme events in Africa, it is the agriculture sector that is particularly exposed and vulnerable (Meason and Jury, 1997). The economies of many African countries rely heavily on rain-fed agriculture, dominated by small-scale and subsistence farming. It contributes approximately 50 per cent to Africa's total export value and approximately 21 per cent of its total GDP (Dilley, 2000). With the least efficient agriculture industry in the world, sub-Saharan Africa is extremely vulnerable to extreme climate events. 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 (Mulenga *et al.*, 2003). Recent examples include the devastating floods over southern Mozambique and northeastern South Africa in early 2000 and the intense drought over much of Zambia, Malawi, Zimbabwe and northern South Africa in 2001-2004 (IPCC, 2001b). However, it is unfortunate that in Zimbabwe households are susceptible not only to droughts but also to floods. Thus, within a single year, households in some area can experience the twin tragedies which have a devastating impact. Climate change raised major problem as the country's economy is agriculture based (Devereux, 2002). Major climatic events which the country has experienced in the past have included the droughts of 1991-1992, 1994-1995, 1997-1998 and 2002, the El-Niño rains that resulted in the floods of 1997-1998 and the more recent droughts of 2002 (Benson, 2003). During the 1991-1992 droughts in Zimbabwe, the income of the poor rural households dropped by 50 per cent in some areas, the agricultural growth and total output slowed (Benson and Clay, 2000). A study by Gwimbi (2009) on climatic events impact in the middle Zambezi basin showed significant correlation between weather impact and variables such as crop damages (80 per cent), dropping out of school by children (76 per cent), flooding of homes (55 per cent) and flood related illnesses and death (73 per cent). Disease outbreaks were associated with the disruption of the clean water supply (83 per cent) and persistence of water in the low-lying areas, which created breeding places for mosquitoes (96 per cent).

The negative impacts of droughts and floods that include declining harvests, deaths, displacements, damage to infrastructure, spread of disease and loss of livelihood have led households to develop diverse means of coping to withstand the effect of an extreme load that may cause harm.

While much is known about the causes of droughts or floods in the middle Zambezi river basin, little is known about impact and households' coping strategies. This paper therefore seeks to make an investigation on the impacts of floods and droughts, and how community within the basin cope with droughts and floods.

2. Study area

Kanyemba is located in ward 1 of Mbire district's 17 wards. It is within the hydrological boundary of lower Manyame sub-catchment under 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° south and 30.3° east. On average, the annual rainfall for the region is between 450 and 650 mm and it reaches its peak in January or February (Fritz *et al.*, 2003). Kanyemba is bordered by two countries, respectively, Mozambique in the east and Zambia in the north. The ward's population of about 4,500 people is spread across 24 villages. The population density is about 15 people per km^2 and the growth population rate is about 2 per cent (AWF, 2010). The main livelihood activities in the area are agriculture and livestock rearing. Crops such as maize, sorghum, millet, cowpeas, pumpkins, bananas and vegetables are grown in the ward. However, yields in both rainfed and recession agriculture are low due to erratic rainfall, flooding and wildlife. Tsetse flies are also another problem as they restrict farmers to rear cow and work their fields with draught power (AWF, 2010). Natural forest has been set aside under Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) for wildlife management to generate substantial income for the community through hunting tourism, and the communities are benefiting trough the construction of school and hospital (Metcalfe, 1993) (Figure 1).

3. Methodology

The study employed both quantitative and qualitative approaches. In quantitative approach the design determines our choice and action, while in the qualitative approach, the choices and actions determine our design or strategy (Huysamen, 1993). The study was conducted in Kanyemba in Mbire district in Zimbabwe's Mashonaland central province. Kanyemba community was selected due to frequent floods and droughts experienced in the last ten years. Even if it were theoretically possible to identify contact and study the entire relevant population, time and cost considerations usually make this a prohibitive undertaking. The use of samples may therefore result in more accurate information than might have been obtained if one had studied the entire population, this is so because, with a sample, time, money and effort had been concentrated to produce better quality research, better instruments and more in-depth information (Strydom *et al.*, 2005). Based on Cochran formula[1] (Bartlett *et al.*, 2001) at a confidence level of 95 per cent, 144 households out of 903 were sampled and structured questionnaires were administrated to sampled household by using sampling interval[2] (Wunsch, 1986). A total of three and two key informant interviews were conducted at community and district levels, respectively, using voice recorder. The composition of key informants comprised of all critical players that have a role to play in the management of floods and droughts in the district. At community level, the interviewees were representatives of the community. It was envisaged that the representatives would give typical perceptions and perspectives on the subject matter. The interviews were conducted at a venue organized within the community. Two focus group discussions were conducted,

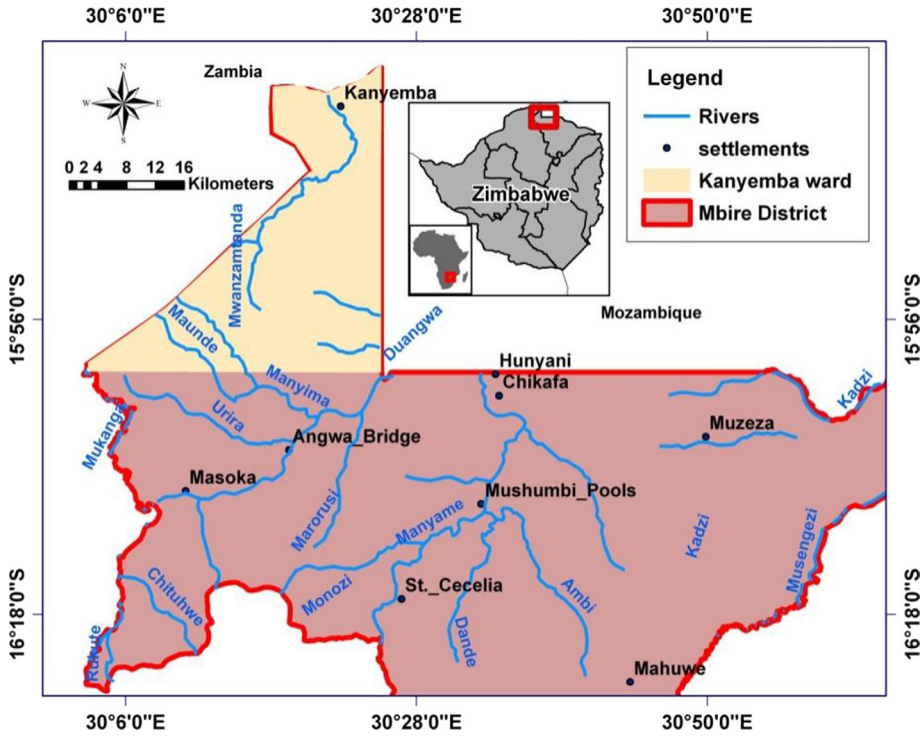


Figure 1.
Kanyemba ward
in Mbire district

one with communities and other with ward officials (councillor, traditional leader and the head of the village). Each focus group discussion was comprised of three women aged between 45 and 65 years old and seven men averaged 60 years old. The total number of respondents surveyed was 90 male and 54 female. The target population, therefore, for the study that is, households, institutions and community leaders and practitioners was purposively selected at household, district and community levels, respectively. The sample was composed of elements that contain the most characteristics, representative or typical attributes of the population (Strydom *et al.*, 2005). To corroborate qualitative data, secondary data including crop production and precipitation (23 years) were collected from Mbire district authority, Zimbabwe Meteorological Office, respectively. Data analysis was carried out using SPSS and Excel software.

With regards to climate vulnerability assessment, we adapted the assessment tool from climate change vulnerability index. The approach includes three major components: environmental threats, coping mechanisms, livelihood strategies. Each component is comprised of several sub-components. Because each of the sub-components is weighted on a different value, it was first necessary to standardize each as an index and apply equal weights to all major components. The equation used for the approach was adapted from that used in the climate vulnerability index (CVI) (Sullivan, 2009):

$$\mathrm{CVI} = \frac{\sum_{i=1}^{N} riXi}{\sum_{i=1}^{N} ri}$$

where, Xi refers to component i of the CVI structure, for the specific factor being considered, while r acts as a weighting, and represents the value with each particular sub-components.

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. 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.

4. Results

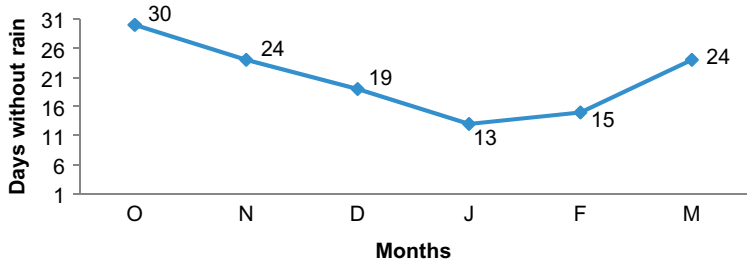
This section presents the findings of the study that correspond to the objectives. It highlights the livelihood strategies of the communities and performs the rainfall analyses focusing on the trends of precipitation linked to dry-spells and floods occurrence. Furthermore, it provides a discussion on the impacts of floods and droughts on the livelihood system, the coping strategies, underlying the causes of socioeconomic impact.

4.1 Livelihood strategies

The research revealed that the first most important livelihood sources for the assessed communities in Kanyemba were crop production (95 per cent) followed by livestock rearing (2.7 per cent) and piecework (1.3 per cent). The main sources of food were found to be own production, followed by casual labour and fishing. The majority of the respondents (70 per cent) reported that since 1990s due to recurrent droughts, crop crops fields have expanded by clearing the forest. Respondents argue that the intensification of agriculture through more land cultivated is to increase the chance of harvesting if droughts do not affect the entire field. A consequence of ever increasing human demand for land, and the widespread forest clearance have a major effect on the resilience of community which rely on forest product.

4.2 Dry-spells occurrence in Kanyemba

The analyses of rainfall revealed a high variability in both annual and seasonal rainfall (Figure 2). Despite the rainfall variability (with coefficient of variation of 95 per cent), the total amount of rainfall did not change from 1988 to 2011 (mean annual of 680 mm).



Source: Meteorological Office, Zimbabwe (2011)

Figure 2.
Monthly average distribution of days without rainfall during the crop season, Kanyemba meteorological station, 1988-2011

However, from 1988 to 2011, frequencies of dry-spells have increased during the crop season, having a coefficient of variation of 162 per cent (Figure 2). As shown in the Figure 2, the dry-spells occur mostly early in the season (October and November), and coincide with the germination stage when crops are sensitive to water stress. About 70 per cent 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 per cent) identified was that of 2001-2002 and most recently of 2009/2010.

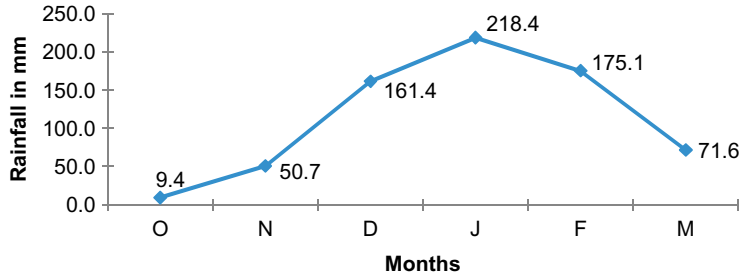
4.3 Floods occurrence in Kanyemba

The rainfall analysis showed that floods were probably linked with short period of heavy rain that occurs in January or February at the peak of the rainfall season (Figure 3). Three fourth of respondents said they have previously been affected by incidents of flooding (1982, 1988, 1993, 1996, 2007 and 2010). About three quarters of the respondents stated that the main factors which contribute to flooding in Kanyemba are the local heavy rains which occur mostly around January and February coupled with the back flow from the dam. When the Kariba Dam rises, water is released from the dam while the backflow from Cahora Bassa increase substantially (About 320 m on average). 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.

4.4 Impact of droughts and floods

The impact of the floods and droughts on the communities has been categorized into two components that include crop production loss and reduction of agriculture derived income. The economic costs involve indirect costs (affecting crop derived income). Crop production (maize, sorghum and groundnuts) averaged 1,600 kg per farmer compare to 4,500 kg for the year before flood (Table I). About 90 per cent of the population is engaged in farming; the area planted per farmer averaged 5 ha including 1.5 ha for sorghum, 2 ha for maize and 2 ha for groundnuts. The relative recent major climatic events that hit the community are 2010 drought and flood were combined effect destroys communities' crops. The study shows that the 2010 drought damaged on average 1, 2 ha of crops per households (Figure 4).

Drought damaged crops to varying degrees, 20 per cent of households affected by as much as a 90 per cent decrease in expected output. In some cases the drought killed all the seedlings and 40 per cent of households had to buy additional seeds to plant. In addition to affecting the seedlings, the drought then reduced the overall crop yield.



Source: Meteorological Office, Zimbabwe (2011)

Figure 3.
Monthly average distribution of rainfall during the crop season, Kanyemba meteorological station, 1988-2011

In the flood plain along Mwanzamutanda River, farmers has witnessed floods destroying standing crops (Figure 4). For instance the 2010 flood destroyed almost 1 ha of crops per farmer as stated by 70 per cent of respondents. Crops production analysis shows 65 per cent of loss due to floods and droughts.

4.5 Impact on social network

While disasters build social environment, the study found that the erosion of social cohesion was linked to adverse climatic conditions. More than half of the respondents (60 per cent) stated that floods and droughts have impacted on social networks. In the onset of drought or flood households are no longer in a position to help each other. The fact is that 20 kg of drought tolerant seed cost 30$ and most of the households are not able to afford it. As result, some households (about 90 per cent) plant local varieties of maize, and groundnut because they cannot afford drought resistant seed in the shop while 2 per cent plant using drought resistant varieties of maize, sorghum, and groundnut. Almost 12 per cent of households do not have seed reserves or be in a position to purchase replacement seeds, failed planting. In this situation households which harvested deny assistance for three raisons: family care, seed for the next season and prevent future event. As a result, the relationships among village families have been deteriorated mostly when affected families visited their relatives and were not given assistance.

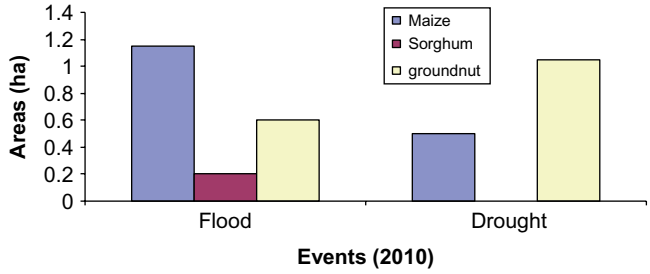
4.6 Coping with droughts and floods

Droughts and floods occurrence implies that households have developed diverse means of coping. For those communities, coping mechanisms are integral elements of livelihood systems. Distinct sequence in what household respond to floods and droughts has been found as follow.

			Crop production (kg/HH)			
Season	Event	Statistics	Maize	Sorghum	Groundnut	Cotton
2009/2010[a]	Flood and dry-spells	Mean	575	450	575	
		SD	1.98	3.85	2.51	–
2008/2009[b]	No flood and dry-spells	Mean	1,750	750	2,000	667
		SD	2.5	5.89	3.01	10.05

Notes: [a]Data from survey, Mach 2011; [b]data from Lower Guruve Development Association (LDGA), survey 2008; HH – house hold

Table I.
Average crops harvested per household in Kanyemba



Source: Survey, March 2011

Figure 4.
Standing crops affected by drought and flood

Cropping responses. To overcome climatic stress, about 70 per cent of households employed various production strategies in response to the impacts of drought and flood. 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 the flood plain twice a year. Before flooding, households plant their fields with the idea that flood will not come or will come with less intensity and they can harvest. Most of the time when floods come around January or February, flood water washed away standing crops. Household then lose mainly maize, groundnut and sorghum. As soon as the flood water receded, households move back (March – April) to re-cultivate the more fertile soils of the flood plain. They dig holes of about 50 cm^2 approximately, with depths that vary according to the distance from the stream bank (some hole can reach 1 m deep), making holes deeper further away from the river due to less moisture availability in the field. Furthermore, only a small percentage of the sampled households do not depend on crop production as a coping strategy.

Late sowing. Farmers usually start seedbed preparation for crops 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 (65 per cent) were to take benefit from delayed 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.

Fishing response. This strategy encompasses crop production in case of low production. Fishing with lines (4 per cent of household) is mostly carried out by boys, men and women. 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. It was observed the marital status of household head played an important role in fishing strategy. Married households had a diversity of fishing method (lines, hooks, gill) as opposed to the single, divorced, separated and widowed household heads.

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 activities which are not so vulnerable to climatic uncertainty. Labour sale became important income-generating activities since 2001/2002 drought; almost 65 per cent 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) or truck offloading. Money earned from the Safari as stated by respondents, gives a good return to workers. But safari is lasting only 4-5 months and the money earned cannot 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 2-3 times a week, people are engaged to offload trucks and being payed. From offloading trucks, money is mainly used for food.

Labour migration response. With regard to migration responses, about 8 per cent of households in Kanyemba are engaged in migration strategies in a daily. The majority of labour migrants are wage employees in Zambia. Migrants are unskilled workers who ended up in low-paying as factory, construction labours or cleaners. In some case migrants also were in agriculture (weeding, harvesting), mines, and quarries. Time spent by migrant in the destination was about 7-14 days. Money earned is used to purchase goat if there were loss in the herd during the 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.

Intercrop farming. 60 per cent of household do farming in the flood plain 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. 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.

Livestock sales response. Households sell livestock to traders from Harare or Zambia. At the onset of floods or droughts more livestock have been sold in the village. According to respondents (79 per cent), money earned from livestock sale during floods or droughts used for food. In normal time, money earning from livestocks sale was used for the expense like school fees, taking family member to doctors and buy clothes for family. Livestock plays an important role in community'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. 60 percent of households stated that the sale of livestock is the first most important impact because livestock is their bank and their disposal through selling in a normal time. Selling livestock as a result of the droughts or floods is a loss of valuable money and productive resources.

Remittance responses. It was reported that remittance were from households members within the country and outside of the country, 3 per cent of respondent reported that, family member use to move within the district or in main towns (Harare, Bulawayo, Bindura) and be employed as waiters, cleaners, and shop assistants. Other family members work at Zambia or Mozambique. 70 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 money, 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.

5. Climate vulnerability assessment

The livelihood index showed that local communities are not diversifying their income beyond livestock rearing and crop production. It was shown that the marital status played an important role in determining the livelihood strategy. Those who were married had a diversity of livelihoods (crop production, livestock rearing and fishing) as opposed to the single, divorced, separated and widowed household heads. Furthermore, only a small percentage of the sampled households do not depend on crop production as a livelihood source. The implication is that since crop production is the main source of livelihood and food, increased exposure to floods and droughts will exacerbate their vulnerabilities by compromising household's food and income security. There is clear evidence that the communities in Kanyemba had very limited livelihood options as most of them indicated to have little or no significant secondary livelihood sources. The communities will have reduced resilience to floods and droughts due to lack of a wide range of livelihood options. They will lead to exposure of community through three major impacts on their livelihoods: destruction of environment, reduction in livelihoods opportunities, and stresses on existing social institutions (Figure 5).

It was observed that floods and droughts are the main natural threat in the community. The historical profile of the community revealed that frequent droughts and floods impact on communities on a regular basis and some time are often combined. Respondents (65 per cent) stated that floods occur every year and destroy half of their crop yield. Flooding are sometimes perceived by community as being more important than the damage that hazards could cause. Somehow, taking risks is part of people's coping strategy. Kanyemba is flood prone areas which have remained in the same location for over 100 years and therefore have faced many flood disasters. However, moving the fields from floodplain to safer ground has never been considered. The proximity of rivers is a major asset which provides a source of food as well as income, transportation and water for consumption and irrigation. Furthermore, flooding of vulnerable field can bring benefits of enriched soil. For many people, the benefits are worth more than the risk of flooding (Figure 6).

Droughts strongly impact agriculture, disrupting the annual harvest cycle, affecting prices for agricultural commodities in real time through market speculation,

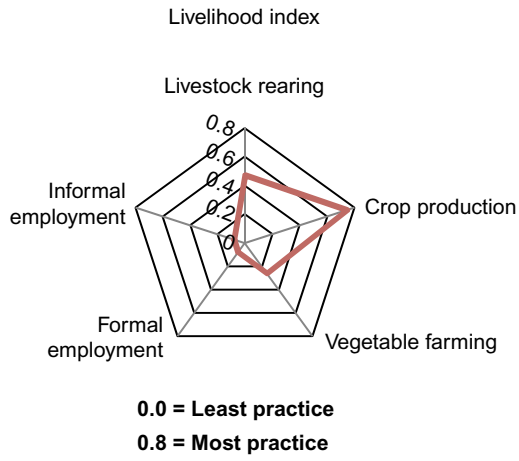


Figure 5.
Spider diagram of the contributing factors of the livelihood strategy

and, through lingering scarcities for many months after the drought has ended. Within communities, consecutive droughts often create maize shortage which results in a continuously inadequate diet. Affected people most of the time integrate other foods such as millet and taro into their diet. To some extent, chronic food insecurity and malnutrition have become a way of life. The study revealed that in the village, the main point of human and animal conflict was the cropping field. 47 per cent of the interviewed farmers reported that elephants prefer the staple food which is maize compared to other crops grown in their community. However, annual average acreage damaged by elephants in the village has been decreasing since 2000 (Figure 7).

In coping dimension, despite crop production, others system showed poorer scores and may threaten the enhancement of resilience in communities. This suggests that, a large number of people dependent on occupations that are adversely affected by floods and droughts. It is possible that these strategies will not be able to compensate a narrow band of possible climate vulnerability. Resilience to climate variability is not new, but less coping strategies is expected to present heightened risk and potentially grave consequences. This is particularly true in Kanyemba context where direct dependence on the natural

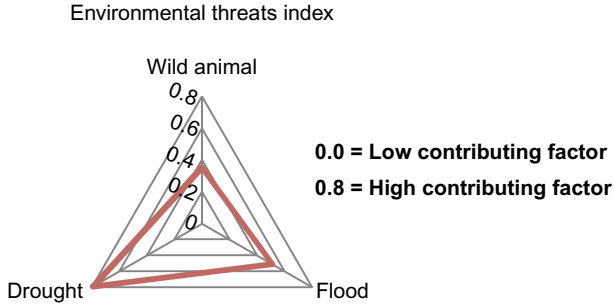


Figure 6.
Triangle diagram of the environmental factors that threaten community's livelihood

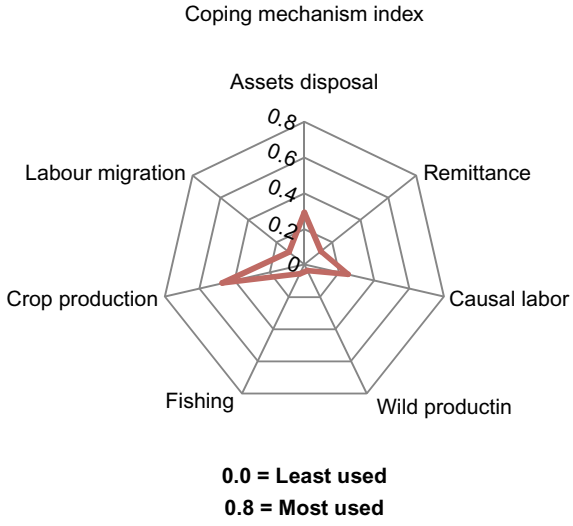


Figure 7.
Spider diagram of the coping mechanism

environment for livelihood support combines with a lack of infrastructure and high levels of poverty create vulnerability in the face of all types of environmental change.

Overall climate assessment mapping (Figure 8) shows higher values for environmental threats, low value for livelihood strategies and coping mechanisms. Climate variability is leading to floods or droughts in the basin and communities within the basin are likely to suffer. In this respect, environment threats is an added risk to these communities which have already been undergoing a process of less livelihood and coping strategies, caused both by overexploitation and inappropriate land-use. Floods and droughts have a significant impact on the indigenous coping mechanisms employed by the communities in the basin as increasingly fragile livelihood systems struggle to withstand environmental shocks. These overall index reflect a limited capacities and resources at their disposal to respond to increased stresses; their ability to meet basic needs and improve their lives is constrained by climate impacts such as floods and droughts, therefore, low adaptation measure, one-dimensional livelihood and environmental threats exacerbate existing vulnerabilities and further jeopardize the development within the community in the basin.

Conclusion

The study concluded that floods and droughts have adverse impact on the socio-economic status of people in the middle Zambezi river basin. It was clear that households cope differently when affected by floods. The current coping strategies such as disposal of assets, labour migration, stream bank and floodplain cultivation, piecework, remittance, wild production, inter-cropping and fishing being employed by households are not effective. The study established that the coping strategies were not sustainable because the situation seems not to improve in the community.

To a large extent, the study has established that livelihood patterns play an important role in the resilience of community. Limited resources constrain the capacity of community to counter floods and droughts impacts so they could maintain a minimum subsistence level for long term.

It is also evident that there are varying underlying causes of people's vulnerability, Environment, livelihood system and inadequate coping measures were identified as being the main underlying causes of vulnerability for community in Kanyemba.

Clearly, there is need to develop better and appropriate measures to prepare and adapt with the effects of the floods and droughts. The focus must be on diversifying livelihood strategies of the people and involvement of all stakeholders in the basin to enhance communities' resilience to floods and droughts. The local coping capacities should not be underestimated but rather built upon.

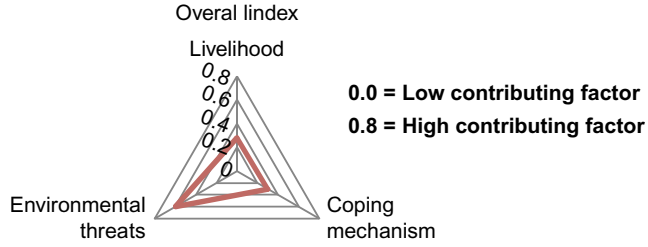


Figure 8.
Triangle diagram of the vulnerability assessment

Notes

1. $n = (t^2)(s^2)/(d^2)$, d – acceptable margin error at 95 per cent confidence, t – value for selected alpha and s – variation in the population.
2. $I = N/n$, N – population size and n – sample size.

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