International Journal of Humanities Social Sciences and Education (IJHSSE)
Volume 4, 2017, PP 1-20
ISSN 2349-0373 (Print) & ISSN 2349-0381 (Online)
www.arcjournals.org

Exploring the Role of Indigenous Knowledge in Flood Disaster Risk Reduction in Zimbabwe

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Abstract: *This study sought to identify alternative strategies that can be used to improve flood risk reduction strategies for Muzarabani District. Using a case study approach, the study collected qualitative data through the use of focus group discussions with community members inhabiting the flood plain, and key Informant interviews with traditional leaders and staff from government technical departments. These were used alongside semi structured household questionnaires. Both young and old agreed on the important value and role of locally available flood risk reduction strategies that have been used by the communities to prepare and plan for their survival and rehabilitation in relation to flooding. There were still elders with a wealth of indigenous knowledge that needed to be tapped and used before it disappeared. Communities exhibited knowledge on early warning systems and this significantly enhanced preparedness for disaster response and mitigation. However, these have never been scientifically proved but they have been in use over a long period of time and the communities have come to regard them as effective. This paper recommends that there should be deliberate efforts to harness the varied forms of indigenous knowledge that have helped the communities to bounce back from the effects of flooding and incorporate them into the mainstream flood risk reduction strategies which are currently based on science.*

Keywords: *Flood risk, indigenous, preparedness, knowledge, community, mitigation.*

Abbreviations:

AGRITEX	Agricultural Research and Technical Extension Services
CBOs	Community Based Organisations
CIMMYT	Centro Internacional de Mejaromiento de Maiz y Trigo (Spanish) International Maize and Wheat Improvement Centre
DCP	Department of Civil Protection
EMA	Environmental Management Agency
FGDs	Focus Group Discussions
IK	Indigenous Knowledge
IKS	Indigenous Knowledge Systems
IOM	International Organisation for Migration
IPRs	Intellectual Property Rights
NFI	Non-Food Item
OCHA	Office for the Coordination of Humanitarian Affairs
SADC	Southern African Development Community
SIRDC	Scientific and Industrial Research Development Centre

1. INTRODUCTION AND BACKGROUND

Flooding is the most common environmental hazard worldwide (Paton, 2006a). This is due to the vast geographical distribution of river floodplains and low-lying coastal areas. It is difficult to define exactly a flood is. It is largely classified as an overflowing of water onto normally dry land. This encompasses the simple notion that a flood involves an excess of water compared with average water levels. Floods can be categorised as either river floods or coastal floods. River floods are often atmospherically driven, caused by excessive precipitation. They can also occur due to landslides falling into rivers, and by dam or levee failures. Coastal surges are often due to storm surges caused by tropical cyclones or tectonically produced tsunamis (Cadel *et. al.*, 2003).

Paton (2006b) notes that there are several types of floods and these include flash floods, storm floods and dam and levee failures. Flash floods normally occur with little or no warning at all and can be deadly due to the rapid rise in water levels and the high flow-velocities of the water. Several factors contribute to the occurrence of flash floods and these are rainfall intensity, duration, surface condition and topography. Urban areas are more susceptible to flash floods due to the lack of natural drainage systems and the high amounts of impervious surfaces such as concrete and tarmac (Brooks, 2003). These tend to increase the rate of run off into water systems. Storm floods normally inundate coastal margins due to severe onshore winds, often accompanied by low atmospheric pressure and sometimes high tides. This kind of flooding is not found in Zimbabwe as the country is land locked. Dam and levee failures occur when the flood is larger than the one predicted when the structure was built to contain. This causes a sudden burst of water which causes a flash flood downstream. Failed dams and levees can cause catastrophic floods due to the intensive energy involved in the sudden burst of water. The Muzarabani area suffers from flash floods because of the flood plain (Gwimbi, 2004)

UNDP (2012) asserts that flood risk reduction as a concept denotes the practice of reducing flood disaster risks through systematic efforts to analyse and manage the causal factors of flooding, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

Shumba (2000) notes that Zimbabwe is among several countries deemed to be vulnerable to flooding especially areas that lie in the Zambezi and Save Valleys. This is because of several reasons chief of which being that people settle on flood plains because of the benefits that accrue to them. Some of the benefits are that in semi-arid regions, the flood plains offer the much needed moisture needed to sustain subsistence crop production. The other reason Zimbabwe as a country is largely dependent on rain-fed subsistence agriculture and constantly experiences unfriendly weather patterns making it "highly vulnerable to vicissitudes of weather patterns" (NCPCC, 2013). These unfavourable weather patterns have resulted in disasters such as droughts and floods, that impact on people's livelihoods differently.

Gwimbi (2004) posits that over the past few years, Zimbabwe, as is true for the Southern African Development Community (SADC) region has experienced recurring flooding episodes. The development of disaster risk reduction strategies related to flooding encompasses four critical components: prediction, monitoring, impact assessment and response. Entailed in this are effective drought early warning and delivery systems, vulnerability assessments, and mitigation and response actions (UNISDR 2002).

2. CONTEXTUALISING THE STUDY

As Gasana et al. (2011) assets, agriculture is at the heart of the Zimbabwean economy, contributing approximately 17% of the country's Gross Domestic Product. Consequently, cyclones, floods, and droughts pose a serious threat to the food security of the country.

NCPCC (2013) assets that in the 2012-2013 rainy season, major flooding threatened areas such as Muzarabani in Mashonaland Central and Chikwalakwala in Matabeleland South which are traditionally flood prone areas. On 21 January, the Air Force of Zimbabwe was deployed to evacuate villagers from Chikwalakwala. NCPCC (2013) notes that the main provinces that were affected by floods in 2013 and where humanitarian consequences required response from the Government and humanitarian partners are in Matabeleland South, Matebeleland North, Manicaland, Mashonaland Central, Masvingo and Midlands. The Department of Civil Protection (DCP) supported by humanitarian partners such as OCHA, IOM, the Zimbabwe Red Cross Society, Plan International and

Christian Care conducted assessments in affected locations found out that an estimated 4,475 people affected across Zimbabwe.

NCPCC (2013) noted that in the same year, a humanitarian partner, IOM verified 2,820 people through assessments across the country and supported them with emergency shelter and other Non-Food Items (NFIs), providing assistance to an estimated 1,155 people with tarpaulins and NFIs (blankets, cooking utensils, clothes and hygiene kits). The scenario above points to communities that are vulnerable to flooding and its associated risks. The need for flood risk reduction and management is apparent.

Traditionally, response to flooding in Zimbabwe has been through a reactive, crisis management approach. This approach to flood management responds to the impacts of floods once they occur in an attempt to speed the recovery process. This crisis management approach has been noted to be costly, largely untimely, poorly coordinated, and often results in resources or assistance being misdirected. This study seeks to locate the position and role of indigenous knowledge systems in mitigating flooding in Zimbabwe.

As the globalisation concept holds sway across the whole world, indigenous knowledge systems, local beliefs and practices continue to be threatened, sometimes even to extinction. As a result of this erosion of local values systems and beliefs, indigenous knowledge received scant attention from the international community until the last three decades of the twentieth century. However, in 1999 in Budapest, Hungary, the global scientific community acknowledged the relevance of indigenous knowledge and endorsed it at the World Conference on Science by recommending that scientific and traditional knowledge should be integrated particularly in the field of environment and development. Currently, there is a growing realization that indigenous knowledge is part of the global heritage and a national resource to be utilized for the benefit of all humanity.

There exist profound enthusiasm and deliberate propositions to incorporate and integrate Indigenous Knowledge Systems particularly in the field of disaster management and development. Indigenous knowledge has been seen to be very useful in the fields of health, agriculture, disaster risk reduction, animal health, early warning systems and many other socio-economic facets of life.

Owing to the fact that Indigenous knowledge is an immensely valuable resource that provides humankind with insights on how communities have interacted with their changing environment, this study seeks to explore its possible application in disaster risk reduction especially risks associated with flooding.

3. METHODOLOGY

Overally, the project looked at flood risk management strategies with the aim of investigating the role of indigenous knowledge in those strategies. 12 out the 26 villages that make up Chadereka Ward were sampled. These are the villages that are mostly affected by flooding in the flood plain. The reference period for all questions asked covered the period from the year 2000 to 2013. In line with the objectives of this study, the focus was on appraising current flood risk management strategies in order to locate the role of indigenous knowledge. Specifically, it focused on early warning systems, through to farming methods and coping mechanisms in general. The study population in this case comprised of the total population of Chadereka Ward in Muzarabani District which stands at 7 084. Based on the district's disaster profile, Chadereka, Karuve, Janhi, Gomo, Kwariramhere, Marapuka, Rumero, Chikwasha, Kaguna, Changata, Dambudzo and Chidavaenzi villages were purposively selected for the study. 18 out of the ward's 26 villages were reported to be uniformly vulnerable to flooding in the same area and given this generalized vulnerability of the population to flooding, the research considered it appropriate to select a cluster of villages to participate in the study based on geographical location and vulnerability to the flooding.

4. THEORETICAL FRAMEWORK

This paper is premised on the social capital theory in its attempt to explain role of indigenous knowledge as a social capital in the Muzarabani flood plain in Zimbabwe. This theory arose due to the inadequacies of the classical development theories and it spurred a rethinking of development approaches. The World Bank has taken the lead in exploring the integration of local values in development. To begin with, IKS belongs to the social capital school (Bourdieu 1986). The social capital concept is discussed in light of the contemporary globalization mode that is being used for

mainstream development and drought mitigation. The concept of globalization is perhaps today the most recurrent term employed by scholars and world leaders alike to rationalize the development and underdevelopment of the various parts of the world. As a result of this, it has assumed the status of an essentially contested concept. This concept was used as a pedestal for the ensuing research project.

Bourdieu (1986:248) defines Social capital as "actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition, or in other words, to membership in a group". Social capital is then described as an investment (whether or not intended) in social relationships that makes available to individuals a stock of resources raising returns from individual and joint efforts (Lolo, unpublished). In this case we understand that social capital is a private good in the sense that it is accumulated by individuals.

Coleman (1988:98) uses the term social capital to refer to all human relationships. He defines social capital in functional terms, i.e. "the value of these aspects of social structure to actors as resources that they can use to achieve their interests." He regards organizational structures as resources which "can be combined with other resources to produce different system-level behaviour or, in other cases, different outcomes for individuals." Coleman's concept of social capital includes: obligations, expectations, and trustworthiness of structures; information channels; and norms and effective sanctions. All of these social structures or institutions involve cognition and mental images.

Current manifestations of globalization are characterized by a worldwide increase of human mobility, products, services, and especially information. It also implies an increased number of transnational companies which act as global oligopolies. In order to enable this world system, nation states create national regulations leading to a freedom of capital and loss of tradition and identity. Daes (1998) further indicates that agreements for bilateral aid have an effect of dispossessing communities of their knowledge and identity. As a result, globalization has become a primary cause of conflict between indigenous peoples and others.

According to Mazrui (2001) globalisation is also viewed as the opening up and interconnectedness of the world. As a result of this, it can be noted that globalisation has commoditised and privatized knowledge, resulting in the knowledge economy. Indigenous knowledge has not been exempt from this privatisation. Knowledge that was in the public domain, owned by communities and passed down from generation to generation, has been privatised by applying intellectual property rights (IPRs) that confer rights on individuals, thus effectively robbing whole communities.

From the social capital perspective, indigenous peoples find that the two things are at odds and could potentially lead to a conflictive situation. They believe that many issues are being overlooked, such as their spiritual connections to their lands and territories, their concerns for the impact on their cultural identity and economic livelihood, and their unfair exclusion from decision-making processes, including the process of free and informed prior consent and the lack of adequate compensation when the resources on the lands are exploited. For all these reasons, indigenous peoples tend to see globalization as a threat to their territories, their traditions and cultural expressions, their cultures and identities, compelling them to fight harder on a variety of fronts to ensure their cultural survival, as well as to find a new way to assert their rights and autonomy.

Brohman (1996:323) observes that due to the growing realization of the importance of IK, there are compelling facts that have seen policy makers shifting from exclusionary 'Eurocentric frameworks' that excluded rural population and indigenous people from participating in the process of development to more participatory and sustainable development.

Viewing IK as a social capital that has a role to play in the development of the people of Chadereka ward in Muzarabani fits well against the backdrop of the social capital theory. It emphasizes the prominence of those asserts that communities regard as their capital and seeks to build on these for sustainable development.

5. Rise of IK in Development Discourse

Different scholars have offered various definitions, some of which are too narrow due to their ethno-centric nature. Indigenous knowledge has been defined as a pool of beliefs, values, and, institutional and technological practices developed by individuals and/or communities for solving their problems, and making sense of the world through rituals, rules and a kind of ready reckoner of do's and don'ts in the wake of uncertainties (Gupta, 2004). It is essentially tacit knowledge that is not easily codifiable.

Warren (1991) offers a slightly different definition by presenting it as knowledge that is unique to a given culture or society. IK contrasts with the international knowledge system generated by universities, research institutions and private firms. Warren goes ahead to present various dimensions of IK. It is the basis for local-level decision making in agriculture, health care, food preparation, education, natural-resource management, and a host of other activities in rural communities.

Morris (2005) considers IK to be cultural knowledge in its broadest sense, including all of the social, political, economic and spiritual aspects of a local way of life. IK is embedded in a dynamic system in which spirituality, kinship, local politics and other factors are tied together and influence one another. Spiritual beliefs about nature may influence how resources are managed and how willing people are to adopt new resource management strategies. Most of this knowledge and these skills have been passed from earlier generations but individual men and women in each new generation adapt and add to this body of knowledge in a constant adjustment to changing circumstances and environmental conditions. They in turn pass on the body of knowledge.

UNICED (2003) complements and broadens Warren's definition by acknowledging the growing realization that indigenous knowledge as part of the global heritage and a national resource to be utilized for the benefit of all humanity. Indigenous knowledge has utility in the areas pertaining to food security, human and animal health, education, natural resource management and other vital economic and social activities. UNICED further emphasizes the integrative nature of IK. UNICED, posit that it is a key element of the social capital of the poor and constitutes their main asset in their efforts to gain control of their own lives. Therefore, indigenous knowledge cannot be ignored in a world where it plays such an important role in disaster management, environmental conservation and the social and economic well-being of local communities.

Another classic dimension of Indigenous knowledge is proffered by Catholic Relief Services, (2000) who go on to offer advantages of IKS. Indigenous knowledge has two powerful advantages over outside knowledge- it has little or no cost and is readily available. Indigenous knowledge systems and technologies are found to be socially desirable, economically affordable, and sustainable and involve minimum risk to rural farmers and producers, and above all, they are widely believed to conserve resources. One of the characteristics of this definition is the dynamism of indigenous knowledge through the integrative nature of IK through embracing components of science and technology.

Coming back closer to home, Chavanduka (1995) presents an interesting definition of IK as that body of accumulated wisdom that has evolved from years of experience and trial-and-error problem solving by groups of people working to meet the challenges they face in their local environments, drawing upon the resources they have at hand'. Van Damme (1997) argues that indigenous knowledge systems are labelled as local and traditional because they are constructed in a local context for resolving local challenges in the environment. However, it is contested whether Indigenous Knowledge has such a limited function and competence that it cannot be utilised in a broader, national and global manner and whether such knowledge is not a universal resource.

Indigenous knowledge can be summed up as the wisdom of a people for survival in their own environment. It is a broad concept that covers all forms of knowledge of a particular community living in a particular area. It is dynamic and continually evolving. Traditional communities rely on traditional knowledge and it is necessary to integrate their knowledge systems with scientific knowledge and emerging technologies.

Chambers and Howes (1979) point out that the root of the problem lies the fact that officials: agricultural extension staff, planners, research workers, 'experts' and others – depend on scientific knowledge to legitimise their superior status. They, thus, have a vested interest in devaluing IK and in imposing a sense of dependence on the part of their rural clients.

Modernisation is about Africa and other less developed continents following the developmental footsteps of Europe. Policy and practice shifts are encouraged in this model. For instance, the agriculture modernisation process involves encouraging farmers to try new crops, new production methods and new marketing skills (Ellis and Biggs, 2001). In general, modernization led to the introduction of hybrids, the green house technology, genetically modified food, use of artificial fertilizers, insecticides, tractors and the application of other scientific knowledge to replace traditional agricultural practices. In modernization thinking, there is no room for IK as this body of knowledge is part of the "old way of thinking" that has to give way to new ways of thinking which is a prerequisite for development to take place.

The dependency theory of development arose as a result of discontentment with the modernization theory. The theory came as a critical reaction to the conventional approaches to economic development that emerged in the aftermath of the Second World War. Andre Gunder Frank (1967), in his analysis of the post-colonial state, argued that classical development theories such as modernisation are misleading in that they fail to articulate the true relationship between the developed world and the poor regions of the world. The dependency theory also did not focus on IK but rather centred on the relationships between the developed and developing world and the implications thereof for the developing world. Barr and Cochran (1992) posit that empowerment requires a shift away from the deficit model: from focusing on weaknesses to recognizing strengths; from believing people are basically bad to believing that individuals are basically good; expecting little from program participants to having high expectations of participants. It also involves changing the belief that the disadvantaged have different aspirations than the more advantaged to recognition that aspirations are similar while access to resources differs. In light of IK, development agents require a paradigm shift where they need to focus on strengths of local initiatives and build upon them in a participatory manner for sustainable development.

Development is about socio-cultural transformation in which IK represents a driving force for change. Learning about the local community is vital for promoting development and sustaining growth. Local knowledge strengthens the process of development because of their close relations to the traditional values held by the society.

6. IKS AND SCIENTIFIC KNOWLEDGE DICHOTOMY

There are marked differences between indigenous and Western knowledge with respect to their history and distinctive characteristics. Thrupp (1989) argues that the presumption that indigenous knowledge is concerned with the immediate and concrete necessities of people's daily livelihoods, while Western knowledge attempts to construct general explanations and is one step removed from the daily lives of people, does not hold water. At the same time, many writers on indigenous knowledge agree that it also encompasses 'non-technical insights, wisdom, ideas, perceptions and innovative capabilities.

Some indigenous knowledge theorists have argued that science is open, systematic, objective and analytical. It advances by building rigorously on prior achievements. Indigenous knowledge, however, is closed, non-systematic, holistic rather than analytical, without an overall conceptual framework, and advances on the basis of new experiences, not on the basis of a deductive logic (Banuri and Apffel-Marglin, 1993).

Indigenous knowledge is often seen to exist in a local context, anchored to a particular social group in a particular setting at a particular time. Western knowledge, on the other hand, has been divorced from an epistemic framework in the search for universal validity (Banuri and Apffel-Marglin, 1993).

The distinction between indigenous and Western/scientific knowledge can present problems for those who believe in the significance of indigenous knowledge for development. Levi-Strauss (1962) for example, anticipated many of the arguments advanced today to create a demarcation line between indigenous and Western knowledge'. Levi-Strauss suggested that 'primitive' cultures are more embedded in their environments than modern cultures; 'primitive' peoples are less prone than scientific investigators to analytic reasoning, that might question the foundations of their knowledge; and 'primitive' thought systems are more closed than scientific modes of thought. Unfortunately, neither Levi-Strauss's arguments nor current attempts to separate indigenous knowledge from Western knowledge can be sustained.

7. INDIGENOUS KNOWLEDGE AND DISASTER RISK REDUCTION

According to SAARC (2008) indigenous knowledge-disaster risk reduction interface can broadly be classified in four categories: technological, economic, social and cultural.

7.1. Technological

Indigenous technology is generally more visible and has attracted attention of environmentalists, engineers and development specialists and therefore is better documented than other aspects of knowledge on disaster risk reduction. As an example, communities have intimate knowledge about the quality and classification of soil and the plants and seeds that are resistant to drought or flood and

have developed appropriate practices for early and late cropping, inter-cropping and kitchen gardens which reduces the risk of poor harvests by widening the range of crops grown. Pesticides and fertilizers made from locally available plants and other resources which enhance production in distress conditions are also well documented.

7.2. Economic

Communities have developed their indigenous economic strategies to deal with the disasters. Economic diversification had been the principle element of this strategy. Having more than one source of income or food is invaluable during times of stress and therefore, members of the rural household engaged in agriculture develop alternate skills in other works like making and selling handicrafts, carpentry, building or blacksmithing. With urbanization and globalization, a growing number of rural communities are coming to depend on cash remittances from family members who migrate to work in towns and cities, or even in other countries.

7.3. Social

The social coping mechanism including kinship networks, mutual aid and self-help groups. People who are suffering from shortage of food for instance, often call upon kin, neighbours, or patrons for help. Labour and food sharing during crises is standard in many societies. Community labour in rebuilding and reconstruction is another example of social and organizational coping strategies during disasters.

7.4. Cultural

This includes the worldviews and religious beliefs which helps the community in the perceiving the warning system about the disaster and provide a medium to pass on the knowledge and experience of the generations besides being the source of finding a solution to unexplainable phenomena. Above all, cultural factors act as a source of recreation for the community and help in coping with the mental trauma caused by the disaster.

Under the Indigenous knowledge system, disaster risk reduction develops through the processes of anticipation, coping, adaptation and recovery of the community.

8. Indigenous Knowledge on Flood Risk Reduction in Zimbabwe

Mwaura (2008) notes that in Africa, local communities had well-developed traditional indigenous knowledge systems for environmental management and coping strategies, making them more resilient to environmental change. This knowledge had, and still has, a high degree of acceptability amongst the majority of populations in which it has been preserved. These communities can easily identify with this knowledge and it facilitates their understanding of certain modern scientific concepts for environmental management including disaster prevention, preparedness, response and mitigation. Mapara (2009) also argues that the same can be said about Zimbabwe and the people of the Muzarabani flood plain as scientific methods to flood risk management are not accessible to the majority of the affected populations.

Mapara (2009) further argues that in Zimbabwe, indigenous knowledge is a precious national resource that can facilitate the process of disaster prevention, preparedness and response in cost-effective, participatory and sustainable ways. Hence a blend of approaches and methods from science and technology and from traditional knowledge opens avenues towards better disaster prevention, preparedness, response and mitigation. Scientific and Industrial Research and Development Centre (SIRDC) (2012) notes that globally, there is increasing acknowledgement of the relevance of indigenous knowledge as an invaluable and underused knowledge reservoir, which presents developing countries, particularly Africa, with a powerful asset in environmental conservation and natural disaster management. Specifically, from time immemorial, natural disaster management in Africa has been deeply rooted in local communities which apply and use indigenous knowledge to master and monitor climate and other natural systems and establish early warning indicators for their own benefit and future generations.

Kaseke (1993) argues that in the traditional Zimbabwean worldview, environmental resources (land, water, animals and plants) are not just production factors with economic significance but also have

their place within the sanctity of nature. Certain places have a special spiritual significance and are used as locations for rituals and sacrifices, for example, sacred grooves, shrines, mountains and rivers. These locations are quite often patches of high biodiversity which are well conserved and protected by the community. For the traditional people of Muzarabani, gods, spirits, shrines, ritual crops and animals, food items and cash crops are all inter-related (Kaseke 1993).

United Nations (2009) asserts that indigenous knowledge is therefore an essential element in the development process and the livelihoods of many local communities. A major challenge that African countries continue to face is how to reconcile indigenous knowledge and modern science without substituting each other, respecting the two sets of values, and building on their respective strengths. UN (2009) notes that recent studies in Kenya on the application and use of traditional knowledge in environmental conservation and natural disaster management cited examples of areas where such knowledge is still prevalent and harnessed.

Mapara (2009) notes that in the Muzarabani flood plain, application and use of indigenous knowledge for disaster management is also prevalent. Floods can be predicted from the height of birds' nests near rivers while moth numbers can predict drought. It is generally regarded that when hippos are seen moving away from the Zambezi moving upstream on its feeder rivers, then there is impending flooding. The same has also been said about elephants. It is often quoted in Muzarabani folklore that at least two weeks before flooding; elephants are usual seen moving from the low lying areas of the Zambezi basin to the Mavhuradonha mountain range. The position of the sun and the cry of a specific bird on trees near rivers may predict onset of the rainy season for farming. These examples underscore the importance of harnessing indigenous knowledge not only as a precious national resource but also as a vital element in environmental conservation and natural disaster prevention, preparedness and response.

9. Minimal Tillage as a Response to Flooding in Muzarabani

Minimum tillage is a crop management system based on three principles a) minimum soil movement (no soil inversion by tillage), b) soil surface cover with crop residues and / or living plants and c) crop rotation to avoid pest and diseases. CIMMYT (2011) has registered the following benefits across Zimbabwe in areas where this has been tried. According to the same CIMMYT research operation, even in areas that are prone to flooding like the Muzarabani flood plain, farmers have been able to reduce the rate of soil erosion due to the protection of soil surface structure by residues and the maintenance of continuous pores with the absence of tillage. CIMMYT (2011) notes that where conservation farming was practiced in areas that are prone to flooding, there was a marked reduction of water run-off and soil erosion due to increased water infiltration and the ponding effect of residues. This research project also seeks to bring to the fore farming practices that obtain in the Muzarabani flood plain as farmers respond to yearly threats to flooding.

10. Traditional Early Warning Systems

Mwaura (2008) indicates that in most parts of Africa, upon slaughter, goat guts would be examined by a specialized elder, and if they were found to be having watery cysts on them during the month of August this would be taken to foretell that the imminent season would have a lot of rains but if the small intestine was found to be empty, drought, famine, hostility and war were to be expected in the chiefdom. The baobab or the monkey bread (*Muuyu*) is one of the most important plants used as indigenous early warning indicators of rainfall and drought. The tree sheds all leaves at the end of the long rains (March-May) and remains leafless during the long dry season (June-September). Near the onset of the short rains (October-November), tender new leaves start appearing on the tree. The community also uses the fruiting pattern of the tree to divine the likely performance of the season, especially rainfall failure and drought. Prolific fruiting of the same tree is indicative of a likely poor season ahead.

The table below details some of the cues that communities glean from animals and the environment and use them as early warning indicators:

Table1. *Summarised Early Warning signs, Presentation and Discussion of findings, Characteristics of Respondents, Gender*

Predictor/Signal	Description	Implications
Nesting Position of Ploceus spp birds	When floods are likely to happen, the Ploceus spp birds nest very high on the trees next to rivers between November and February. When floods are not likely to occur, they nest low on the trees.	Planting of crop along flood plains is avoided.
Cry of *Cuculus solitarius* bird	The cry of *Cuculus solitarius* bird between August and November is a sign of the beginning of the wet season.	Farmers prepare farming inputs upon the cry of the bird and start to mobilize their flood communication systems.
Chirping of *Centropus burchellii* bird	The chirping *Centropus burchellii* bird during October to April is a sign that thunderstorm is approaching	Herd boys will bring livestock home for safety of their livestock and their safety. Flood communication systems are put in place and communities are prepared to move to higher ground should need arise.
The visit of *Scopus umbretta* bird in a homestead	The visit of certain bird species in a homestead is associated with imminent strike by lightning in that homestead.	Some means of protecting the homesteads against the lightning is done. Rains with lightning are associated with flash floods and communities lock up in higher pens their small livestock such as chickens.
Cry of frogs	The cry of frogs during the summer season (September to March) is taken as a sign of approaching rainfall.	Farmers prepare their farming inputs in readiness to plough and plant. Farmers also put in place mechanisms for their own safety during a flood.
The position of the moon	When the moon is slightly tilted to the west and the crescent is facing down during the periods of August to December, it is taken as imminent sign of rainfall within a week.	Farmers prepare their farming inputs in readiness to plough and plant. Traditional leaders activate flood management mechanisms such as communication protocols and the messenger function.
Dark clouds on the west of the country	The appearance of towering scary darkened clouds on the west, of immediate fierce hailstorm accompanied by thunder and lightning.	Herd boys bring livestock at home and every member of homestead leave fields and rush home for safety.

Source: UNEP (2008:68)

Table2. *Distribution of respondents by gender*

Gender	Frequency	Percent
Male	16	32
Female	34	68
Total	50	100

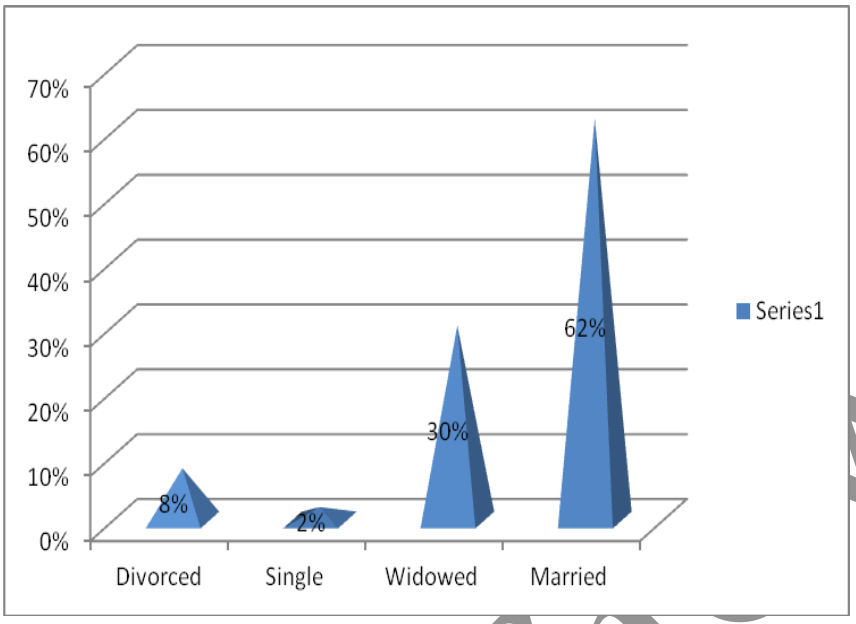
Source: Primary Data

Of the respondents consulted, 32% were male while 68% were female. This could be attributed to a number of factors chief of which is the socio-cultural set up where the majority of communal farmers are female. It could also be explained by the fact that due to the collapse of the cotton industry in Muzarabani due to low pricing, men have left their traditional homes to try and find employment in the tobacco farms in the Muzarabani escarpment.

10.1. Marital Status

Of the respondents engaged, 62% respondents were married with children and this implies a higher level of responsibility over assets and children in an event of a flood. It was important

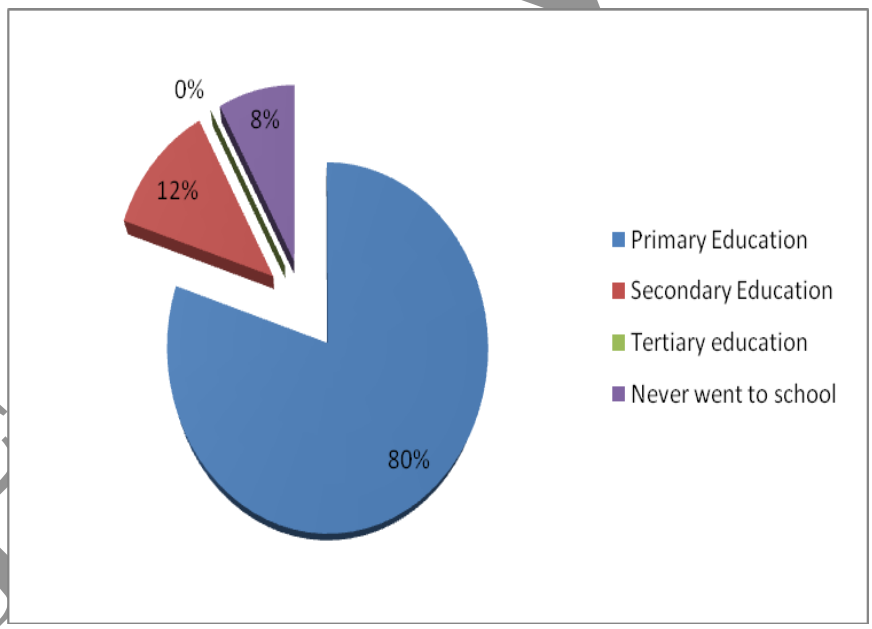
to know the marital status of respondents as this has a bearing on assets investments and the level of responsibility in the event of a flood. Flood risk and loss is higher on families that own assets as well as livestock.



Source: Primary Data

Figure1. *Distribution of respondents by marital status*

10.2. Level of Education



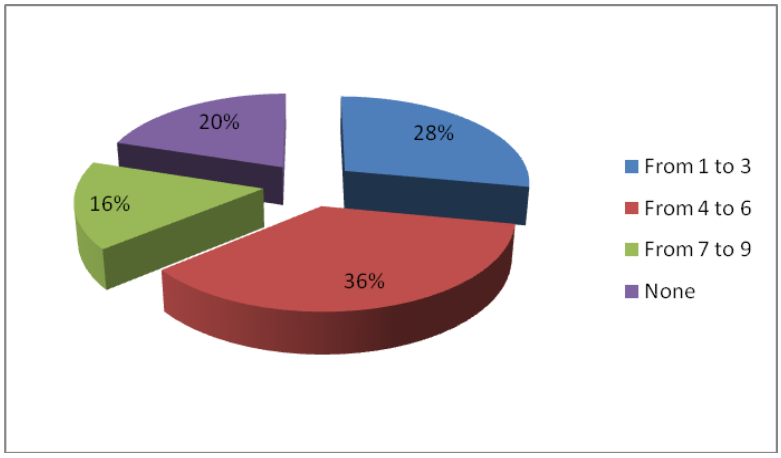
Source: Primary Data

Figure2. *Distribution of respondents by Level of education*

The study revealed that 80% of all the respondents were educated up to primary level while only 12% reached secondary education. 8% of the respondents indicated that they never went to school while none reached tertiary education. This may indicate that education is not highly valued by the flood plain communities. The low level of education was also cited by the Agricultural Research and Technical Extension Services (AGRITEX) and veterinary officers during KIIs as a contributory factor to low appreciation of flood issues and some of the decisions taken by communal farmers in the event of a flood. The Veterinary officer noted that several farmers had lost their small livestock due to their lack of appreciation for

the need to build goat pens in relatively higher places. However, it was also revealed that there is no correlation between education and the level of indigenous knowledge in the area concerning flooding. Even those that had never gone to school could fairly interpret signs and indicators leading to flooding. The study felt it necessary to establish education levels in order to check whether education level has any connection to understanding of flood issues. It was also revealed through focus group discussions that even the respondents with a low level of education possessed a good appreciation of indigenous knowledge related to flooding.

10.3. Cattle Ownership



Source: Primary Data

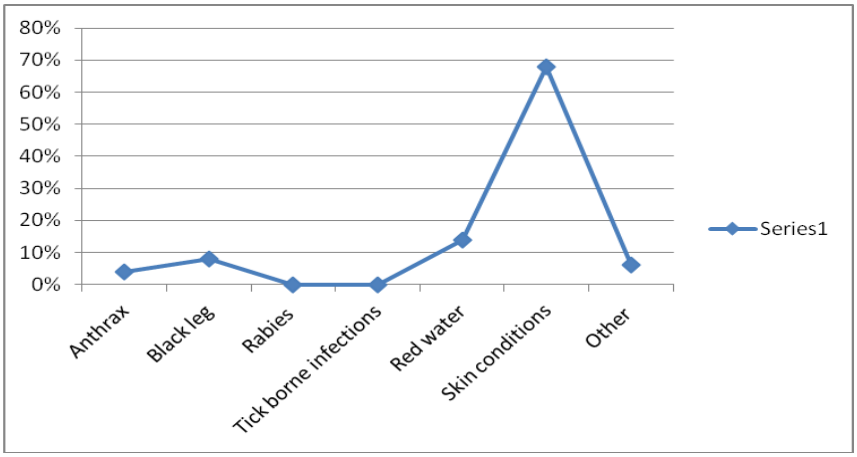
Figure3. *Distribution of respondents by CattleOwnership*

It was established that 20% of the respondents do not own any cattle at all while 36% own between 4-6 cattle. In a rural situation such as the flood plain of Muzarabani district, cattle are used for traction for both ploughing and carting. Cattle are also seen as a status symbol as well as social security as families sell their cattle and buy food in times when crops have either failed due to flooding or drought. It was also established, through the focus group discussions and key informant interview that both small and big livestock form the greatest safety net for the people of the Muzarabani flood plain during emergency situations as they act as a means of transport and can also be translated into cash or food. It was also established that a family with an average size of five is able to sustain itself from the proceeds arising from the sale of one beast for a whole year. Therefore, cattle are a major determinant of how a family fares after a flooding emergency.

10.4. Impact of Livestock Loss

The study sought to assess the impact of loss of livestock due to flooding. 92% of the respondents indicated that they had lost small livestock such as chickens and goats in the last severe flooding of 2008 while only 8% indicated that they had lost cattle due to flooding. 78% of the respondents revealed that they had lost their means of livelihood while 22% indicated that they had lost their draught power. The focus group discussions confirmed that those that indicated that they had lost their source of livelihood were the ones that had lost small livestock as these are sold off to cater for family needs in times of social and economic stress and shocks. Those that indicated loss of draught power were identified as having lost cattle and it was confirmed that this was surely a big blow to the families economically as cattle are used as traction for both plough and cart. It was also revealed that those that indicated they had lost a form of livelihood were amongst those respondents who owned more than 4 beasts while those who indicated loss of draught power represented those that have few cattle and had their herds wiped out by the flooding of the 2007-8 agricultural season.

10.5. Diseases which Affect Livestock as a Result of Flooding



Source: Primary Data

Figure 1. *Showing Diseases which Affect Cattle Most*

The research revealed that households own an average of between 3-8 goats and chickens. These play a critical role in mitigating hardships caused by flooding. If a household comes across food deficits as a result of either flooding or drought, small livestock can easily be translated into cash or cereals through batter trade.

Skin conditions were cited as the most prominent condition that affects livestock during and in the aftermath of a flood. These stood at 66% of all the responses solicited. Skin conditions were noted as affecting small livestock such as goats more that the big livestock such as cattle. Tick borne diseases were not cited as a challenge at all and it was explained in the focus group discussions that since the area would be flooded all ticks are either flooded or are washed away by the flood water. Key informant interviews also revealed that the area is prone to cattle diseases such as black leg and red water and incidence of these diseases seem to escalate when there is a flood.

Of interest were other conditions noted by farmers. Prominent amongst other diseases was what was termed *"dzungu rezvipfuwo"* which detailed a condition where "goats feel dizzy, start to go down in circles, fall down and froth from the mouth and die in about two hours' time". The veterinary officer in the area confirmed this condition and noted that it a phenomena that they observed during the last flood. However, the carcases of the dead goats were not tested clinically tested for diseases hence the condition could not be ascertained. The above statistics show that flooding is responsible for certain health conditions of livestock.

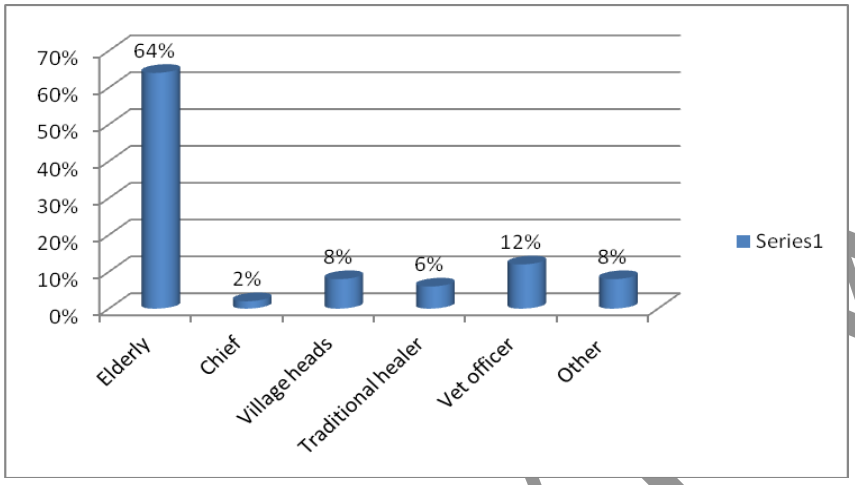
10.6. Local Remedies for Treating Livestock Diseases

84% of the respondents interviewed revealed that there are local remedies used to treat these flood related livestock diseases. Even those that appeared young were also knowledgeable of the same remedies used to try and cure the said illness. 16% of the respondents engaged professed ignorance of any locally available remedies for their livestock and indicated that they normally make use of the veterinary services officer resident in their ward. They however, cited a challenge with availability of medicines for these flood induced illnesses.

The focus group discussions and key informant interviews also confirmed that community members use some locally available remedies to cure livestock diseases. Black soot *(chin'ai)* taken from the inside of kitchen roof tops is boiled in water with salt and animals are made to drink the syrup. Certain herbs such as aloe-vera *(gavakava)* and wild flowers such as *"mukudo"* tree were also cited as remedies for skin conditions. It was noted that aloe vera and *"mukudo"* tree are applied on livestock skins when the livestock have skin conditions.

Community members were convinced that their remedies were effective while the veterinary services officer could not ascertain the effectiveness citing the fact that the local remedies had not been clinically tested. The confidence that communities have in their local remedies do point to the central place that local indigenous knowledge has in flood risk reduction and management in the flood plain in Muzarabani.

When respondents were asked to specify their source of knowledge for the local remedies to the flood induced illnesses for livestock, the table shows their responses:



Source: Primary Data

Figure 6. *Distribution of Respondents by Source of Knowledge for Remedies*

The above figure shows that 64% of the respondents felt that the elderly were the custodians of knowledge related to local remedies while 12% indicated that the veterinary officer was a central figure in the use of locally available remedies for flood induced illnesses. During the key informant interviews with both the veterinary services officer and the AGRITEX officer it was also revealed that since there is generally a lack of medicines for treating livestock conditions in the area due to its remoteness, they end up urging farmers to use the locally available remedies for livestock diseases even though these have not been clinically proven to be effective. Village heads and traditional healers were also cited as being custodians of the said knowledge on how to treat livestock illness. Of interest were 8% of the respondents who specified that there are other custodians of this knowledge. Faith healers were cited as having knowledge to heal livestock diseases through "the inspiration of the spirit".

The focus group discussion confirmed that faith healers do prescribe remedies and it was agreed that in cases where prescriptions are given the work and the livestock recover. It was observed that the communities believe in this as the apostolic faith constitutes almost 60% of the respondents in this study. One group member noted that "munhu waMwari kana ari pamweya anogona kupiwa tsanangudzo dzinoita kuti chipfuwo changu chirarame" (if the man of God is in the spirit, he can diagnose and prescribe medicine for my livestock). It was also observed that great confidence is placed in the man of God and community members are keen to consult with him even on issues of livestock health. It was therefore concluded that in this case religion has become relevant to the people of Chadereka as it is being used for solutions to local problems.

10.7. Indigenous Knowledge and Flood Early Warning

Table 3. *Distribution of respondents by early warning indicators*

Presence of early warning indicators to flooding	Frequency	Percent
Yes	48	96
No	2	4
Total	50	100

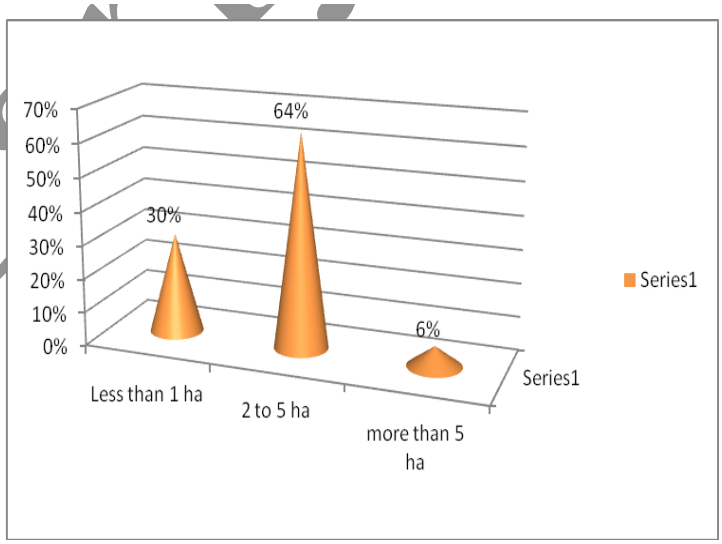
Source: Primary Data

Asked on whether there are any traditional early warning indicators used to predict flooding, 96% of the respondents engaged in the household survey revealed that there are locally available indicators that can be used to predict a flood. The focus group discussions confirmed that these are not at all scientifically proven but they have been adopted and used by the community and have been validated by experience. A number of prominent examples of these early warning indicators were cited. The respondents noted that normally they see the patterns of rainfall in the season. It was generally agreed in the Focus Group Discussions (FGDs) that if it rains for three consecutive days and storm clouds continue to show on the horizon on the Mozambican border then the likelihood is that it will flood. It was also revealed that river animals are also seen inland just before flooding occurs. These river animals are hippos and crocodiles that come out of the Hoya and Zambezi rivers.

It was also confirmed that wild animals such as elephants, that feed along the banks of the Zambezi and Hoya Rivers, flee to the mountains just about "a week before flooding" and communities are able to know that flooding is eminent. The participants in the FGDs argued that elephants normally migrate in May to July to the Muzarabani escarpment and when they do it during the rainy season it surely implies flooding is eminent. It was also observed that beside elephants, there are also other wild animals such as wild deer and rabbits that are seen looking for and grazing in higher ground that is normally reserved for human habitation. Respondents revealed that just before a flood these small wild animals "cast away fear of humans and stay close to humans as if asking to be saved". These indicators were confirmed in key informant interviews with the village heads who confirmed that taking heed of some of these seemingly unimportant indicators leads to effective flood risk management as people gather their cattle and small livestock and keep them on secure higher ground in an area called *"magarakata"*.

Both key informants and FGDs believed generally believed that these animals have a fairly good understanding of flooding and taking heed of their cues saves both lives and properties. The communities believed that early warning was central to flood risk management and shared that the earlier they could predict a flood the less loss they incurred after the flooding.

11. Productive Land Holding



Source: Primary Data

Figure 2. *Distribution of respondents by productive land holding*

30% of the engaged respondents indicated that they "own" less than a hectare of productive land while 64% "own" between 2 to 5 hectares of productive land. 6% "own" more than 5 hectares of land. The focus group discussions revealed that the land is state land and farmers

only have user's rights to the land. It was also revealed that each household in the flood plain had land in specifically two categories. The larger piece of land is in areas which villagers call *"kumaminda"* while the smaller piece of land allocated to each household has direct access to a river. The key informants revealed that these pieces of land in wetlands are called *"kumatimba"* and families use the larger piece of land for rain fed agriculture while the pieces of land in the wetlands are used after the rainy season and continue to retain moisture. It was revealed through the FGDs that these pieces of land in wetlands vary in sizes between a quarter of an acre and one acre. These plots are used to produce crops such as maize, fruits such as bananas and cash crops such as okra.

It was also revealed by the key informants that these small pieces of land in wetlands and river banks are prone to flooding and farmers have learnt from experience not to produce anything in the plots until after the rainy season. In FGDs, farmers displayed knowledge of the dangers of producing crops along river banks and the consequences of the practice thereof. This use of these plots at appropriate times revealed that the communities have known how to relate to their environment and be able to turn their negatives into positives.

Key informant interviews also revealed that the farmers are always in conflict with the Environmental Management Agency (EMA) as the department has campaigned against stream bank cultivation. However, in following up with the farmers they indicated that their food security is tied up to the small plots as they are able to ensure their crops reach fruition even after the rainy season.

12. Food Crops Grown

Table 5. *Distribution of respondents according to food crops grown*

Food Crop	Frequency	Percent
Maize	**34**	**68**
Millet	**0**	**0**
Sorghum	**16**	**32**
Total	**50**	**100**

Source: Primary Data

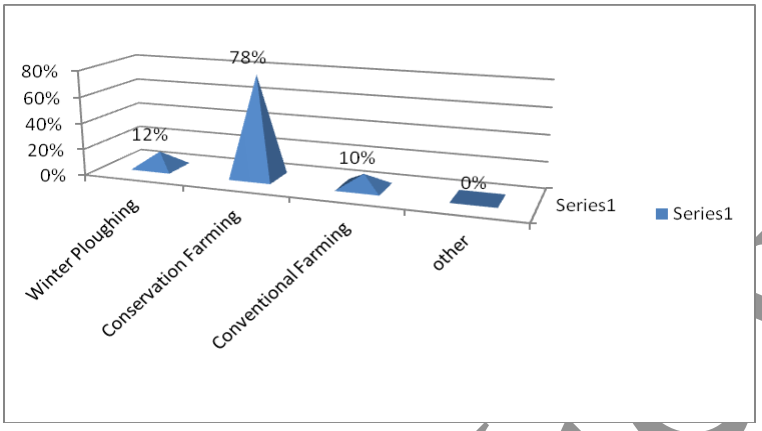
68% of the respondents indicated that they grow maize as their first choice crop while 32% noted that they grow sorghum as the crop of choice. Both the key informant and the FGDs confirmed that maize was most the most preferred crop owing to its taste. As a result of this choice, the farmers normally plant their maize crop towards the end of the rainy season in their plots that interface with the rivers. It was also observed that communities grow sorghum only because its chances of reaching fruition are higher than maize in their dry fields. The study also revealed that in the villages studied, no farmers produce millet.

68% of the respondents revealed that they grow indigenous crops and the main crop they referred to is sorghum. Sorghum was cited as the indigenous crop of choice by farmers as it fits in well with the climatic conditions in the Zambezi valley. Farmers indicated that there were no seed multiplication initiatives in Chadereka Ward. However, farmers also noted that they intercrop and mix crops such maize and cow peas in the same field. It was confirmed by the FGDs and key informants that farmers are well aware of the complimentary role that cow peas make to the growth of maize and therefor had adopted intercropping as a way of fixing nitrogen into the soil. Besides being a rich source of nitrogen for other plants, the cow peas plans help intensify crops as well as to increase and diversify harvest. It is also an effective method of reducing topsoil loss since it breaks the rate of surface water run-off.

The FGDs revealed that although sorghum is the crop of first choice for 32% of the respondents, it is only produced because of its moisture stress resistant properties. The Zambezi Valley has a rainy season which is characterised by a long mid-season break and

due to high temperatures, most cereal crops wilt but sorghum has been seen to show resilience and communities realize some harvests. Through the FGDs, it was shown that farmers in Chadereka community dislike farming sorghum because its production is labour intensive and is easily destroyed by birds and pests such as the armoured crickets. As such, significant portions of the harvest are lost to birds and the pests therefore farmers get discouraged from growing them.

12.1. Farming Methods that Assist Minimize Flooding

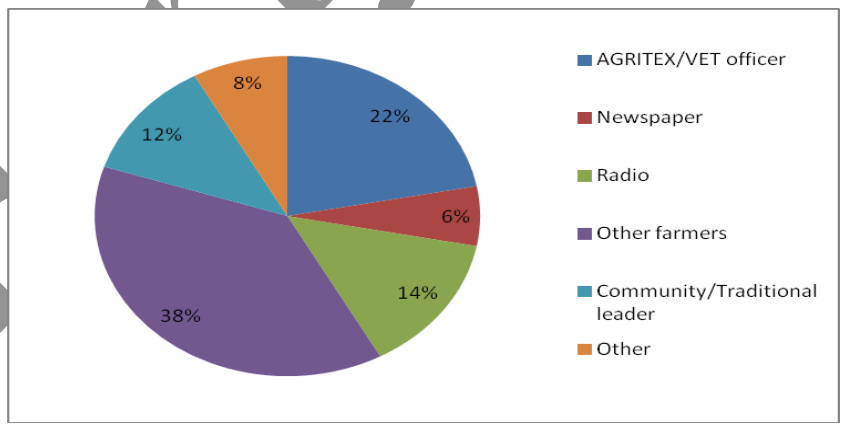


Source: Primary Data

Figure 8. *Distribution of respondents according to farming methods that minimize flooding*

78% of respondents indicated that conservation farming is the most prominent farming method that could assist minimize flooding. The FGDs and key informants also revealed that this method should be done in conjunction with reduced stream bank cultivation. It was reported that because farmers undertake stream bank cultivation, they disturb the natural river course and the natural water barriers and it therefore becomes easy for excess water to flow inland when the rivers are full. 10% felt that winter ploughing has potential to minimize flooding. They indicated that in winter there is no run off water and therefore the disturbed oil surface does not fill in the rivers with silt.

12.2. Sources of Flooding Information



Source: Primary Data

Figure 9. *Distribution of respondents according to sources of flooding information*

38% of all the respondents revealed that they get information related to flooding from their fellow community members while 12% cited community and traditional leaders as a vital source of information on flooding. 14% of the respondents indicated that the radio is their source of information. The newspaper was cited by only 6% owing to the low literacy levels in the area as well as the fact that the area is far away from urban centres where newspapers are the main means by which people receive news and updates. The FGDs confirmed that

peers informed each other on flooding and this therefore raises the need for community flood risk reduction education so that peers are able to transmit correct messages.

Related to sources of information, 74% of the respondents indicated that the elderly in the community are reservoirs of indigenous flood related knowledge. It was also confirmed by the FGDs that those who are advanced in age and have lived in the flood plain longer normally have long institutional memory on early warning indicators for flooding.

12.3. Rain Prediction Methods

Table 7. *Distribution of respondents by rain prediction methods*

Rain prediction method	Frequency	Percent
Behaviour of wild animals, birds, reptiles and insects	34	68
Behaviour of domestic animals	14	28
Trees and vegetation	2	4
Other	0	0
Total	50	100

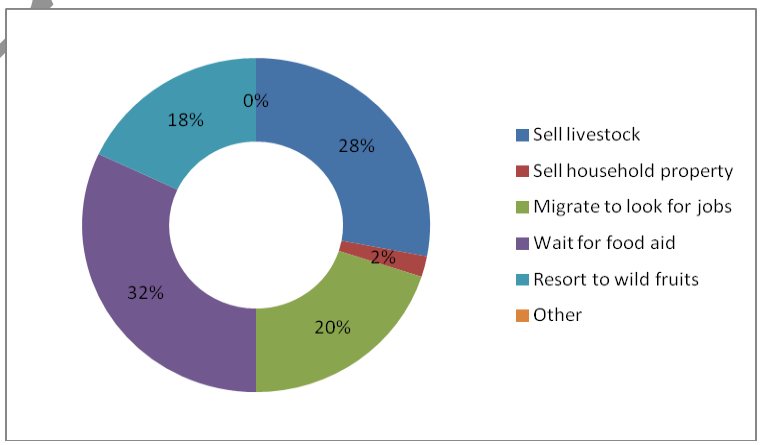
Source: Primary Data

68% of the respondents indicated that they do predict rains and flooding from the behavior of wild animals, birds, insects and reptiles. FGDs also confirmed that river animals such as the hippos and crocodiles often seek shelter on higher ground well before a flood. It was also revealed that there is a type of bird, locally known as *"ngozha"* which normally nest and breed in the reeds during the rainy season. However, when a flood is coming, the farmers indicated that the birds nest high in trees that are far away from the rivers. It was also revealed by the village heads that wild animals such as elephants have a keen sense of knowing that flooding is imminent and leave the Zambezi valley well in advance before the flooding. Traditionally, elephants have their time to migrate into the Mavhuradonha Mountains and when this happens in the rainy season farmers are "assured" that flooding will take place.

28% of the respondents indicated that they get cues from their domestic animals such as cattle and donkeys before flooding occurs. Village heads noted that donkeys do not like water and before a flood they look "agitated and concerned" and this is interpreted as a sign that a distressing situation is coming.

Related to early warning cues, FGDs revealed that these cues the villagers get from the wild animals and their domestic animals are a great determinant of the type of crops the farmers will grow in that particular season. The communities indicated that when the cues are showing likelihood for flooding, they refrain from growing cotton as the crop is averse to flooding and lots of rains.

12.4. Mechanisms for Survival After Crop Failures



Source: Primary Data

Figure 10. *Distribution of respondents by survival mechanisms*

28%, representing 14 respondents indicated that they sell their livestock in order to cope with crop failures related to either flooding or drought. 18% resort to wild fruits while 20% resort to migration into neighbouring Mozambique to look for jobs along the lake front. Of interest is that 32% of the respondents noted that they would wait for food aid. World Vision is currently undertaking a food aid programme in Muzarabani District and the figure seems to show that the communities have become dependent on food aid.

The FGDs confirmed this dependence to food aid as every year people now "expect" World Vision to feed them. The FGDs also confirmed that in times of crop failure, communities resort to drinking porridge called *"gununzvi"*, made from "*masawu"*, which is a wild fruit in abundance in Muzarabani district. Farmers harvest the fruit and dry them for use later on when there are crop failures.

12.5. Role of Government in Flood Mitigation

90% of the respondents revealed that the government assist in mobilizing external agencies and coordinating food aid assistance when there is a flood. 10% felt that the government also provides direct food assistance. This was confirmed by the FGDs which revealed that this comes in the form of the grain loan scheme.

12.6. Role of Ngos in Flood Mitigation

94% of the respondents noted that NGOs provide direct food and other non-food assistance during flooding. FGDs confirmed that non-food assistance can be in the form of tents, clothing, blankets and water purification chemicals. 6% (3) of the respondents indicated that after a flood NGOs assist in food security initiatives.

13. Conclusion

Despite massive investments in education, awareness raising on flooding and its effects on humans and their assets, loss of lives to humans and their livestock have persisted as well as loss of crops and investments in agriculture. Indigenous knowledge seems to be on the verge of disappearing judging by the hesitation in the acceptance of its value and capacity to solve existing problems. In light of this, success in development is more likely to be achieved when local people are involved in the planning and implementation of development projects; and project officials who are familiar with indigenous knowledge are better equipped to facilitate participation by the local populations. It has been proved that if indigenous knowledge is developed by the local communities, it may provide leads for developing modern technological solutions to the local as well as global problems. As opined by UNEP (2008:29), indigenous knowledge systems in Africa have not been systematically recorded and are therefore not readily accessible to policy makers, researchers and development agents although several writers have provided detailed overviews of indigenous knowledge systems in agricultural development, pastoral management, and agro-forestry. This "uncertain status" of the indigenous knowledge is of great concern. The study revealed that communities in the flood plain of Muzarabani do appreciate and use indigenous knowledge in flood risk reduction and management if the flood plain. It showed that farmers take cues from animal behaviour and this largely influences how farmers grow their crops in different seasons. The study also revealed that the communities inhabiting the Chadereka flood plain use conservation farming techniques as a way to conserve soil in their fields in the wetlands. This showed that farmers are aware of the relationship between them and their environment. It was also revealed that conservation farming as a concept is not being fully embraced by adoption of certain components such as minimum tillage is being encouraged. The need to combine modern knowledge and indigenous knowledge in disaster preparedness and mitigation with the goal of building community capacity in a participatory, sustainable and cost-effective manner can therefore not be over emphasized. The study recommends that local government and its development partners such as NGOs and Community Based Organisations (CBOs)

deliberately recognize and adopt flood related indigenous knowledge and use it to the benefit of the Chadereka communities. In this regard there is need to quickly expedite a process of collecting and compiling the diverse range of indigenous knowledge before it disappears since it is largely embedded in institutional memory of elderly people.

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