FLOOD DISASTER PREPAREDNESS AND ECONOMIC IMPACTS ON RURAL HOUSEHOLDS: A COMPARATIVE STUDY OF MWANDI DISTRICT OF ZAMBIA AND EASTERN ZAMBEZI REGION OF NAMIBIA

MP Mabuku

Submitted in partial fulfilment of the requirements
for the degree of PhD

School of Bioresources Engineering
University of KwaZulu-Natal
Pietermaritzburg
March 2014

Supervisor: Dr. A Senzanje
Co-supervisors: Prof. J Graham, Dr. M Mudhara and Prof. W Mulwafu

PREFACE

I, Monde Patrina Mabuku declare that

(i) The literature review and proposal reported in this thesis, except where otherwise indicated, is my original work.

(ii) This literature review and proposal has not been submitted for any degree or examination at any other university.

(iii) This literature review and proposal does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from other persons.

(iv) This literature review and proposal does not contain other persons' writing, unless specifically acknowledged as being sourced from other researchers. Where other written sources have been quoted, then:

  (a) their words have been re-written but the general information attributed to them has been referenced;

  (b) where their exact words have been used, their writing has been placed inside quotation marks, and referenced.

(v) Where I have reproduced a publication of which I am an author, co-author or editor, I have indicated in detail which part of the publication was actually written by myself alone and have fully referenced such publications.

(vi) This literature review and proposal does not contain text, graphics or tables copied and pasted from the Internet, unless specifically acknowledged, and the source being detailed in the thesis and in the References sections.

Signed:

Supervisor:

Co-supervisor:

ABSTRACT

The Zambezi basin is considered vulnerable to climate variability as evidenced by recurrent floods. The increased occurrence and severity of floods in recent years has inundated areas previously not flooded in the Eastern Zambezi region of Namibia and in Mwandi district of Zambia. The magnitudes and frequency of these floods, coupled with poor disaster preparedness and lack of effective adaptation strategies, have negative impacts on rural households. A review of literature was done to collate information pertaining to the floods and economic impacts, flood disaster preparedness and adaptation strategies adopted by rural households. Factors that lead to the choice of different adaptation strategies and preparedness level are also reviewed. Furthermore, the different approaches to assessing impacts, disaster preparedness level and adaptation strategies are identified. The review indicates that floods have shown to be increasing in frequency and magnitude around the globe, and have different impacts. These impacts are either direct or indirect and can be negative or positive. In most of the literature on disaster preparedness levels; individual, households, communities, and national government ranges from low to medium preparedness. It was found that the difference in preparedness levels is due to factors such as socio-cognitive factors, which include; risk perception, sense of community, responsibility efficacy etc. Different adaptation strategies are undertaken by households to minimise flood impacts on income, crop and livestock production. These adaptation strategies include crop diversification, relocation permanently to higher grounds and changing planting dates. The choice of different adaptation strategies by households depends on socio-economic factors. Socio-economic factors includes; age, marital status and gender etc. Different econometric models are used to assess economic impacts. For example models such as Switching regression, Heckman two stage and propensity score matching are used. In assessing the adaptation strategies adopted by household Decision Support Systems (DSS) exists. Example of these are CBA and MCA. Few empirical studies has examined flood economic impacts, preparedness and adaptation strategies by rural households. More research is required to comprehend how rural households respond and adapt to flood disasters. Therefore, a case study project will be conducted in order to evaluate economic impacts of floods on rural households, determine the level of flood disaster preparedness and evaluate different adaptation measures undertaken by the rural households in Mwandi and East Zambezi regions of Zambia and Namibia, respectively.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

Floods are basin-wide phenomena that do not respect any sort of boundaries (Bakker, 2009). The Zambezi basin is reported to be more susceptible to the impacts of floods and droughts. Changes in hydrological systems have become one of the contentious issues in the global climatic negotiations because it is the result of climate change. These changes negatively impact on rural livelihoods, particularly those who depend on natural capitals for survival. Globally, in the last three decades flood increased in frequency, intensity and magnitude (MTENR, 2007; Doocy *et al*., 2013). According to the World Bank (2005), in Africa, floods and drought are the major natural hazards threating people's livelihoods. On the other hand, in Southern Africa, climate variability have become an already existing major challenge for many people who especially rely on rain-fed agriculture (Gwimbi, 2009). For example, the floods of 2000, hit countries like Botswana, Malawi, Mozambique, Namibia (Vaz, 2000). In Eastern Zambezi region of Namibia, there has been an increase in the area inundated by floods, even in the areas that were perceived as higher ground (Mudabeti, 2010; Mabuku, 2013).

Floods have socio-economic impacts on rural livelihoods and communities have to cope or adapt to these impacts. For example, the 2008 and 2009 major floods affected Namibia (Van Langenhove, 2009). During this period 100 people drowned, 30% and more were affected and these floods accounted for over US$200 million worth of losses (Groeve, 2010).

In the Zambezi basin, the adaptive capacity of rural people varies from household to household and depends on the assets at their disposal to pursue a particular livelihood strategy. However, the more the adaptive capacity and the higher the preparedness level of the households the better the likelihood that rural households will respond when a disasters occur while maintaining their livelihoods or rebuilding and recovering from such disasters afterwards.

The aim and objectives of this document are:

i. Firstly, to review the literature on (a) flood occurrence at global, regional, national and local scales (b) economic impacts of floods at different scales and assessment of different models to assess impacts (c) the general disaster preparedness components and factors influencing disaster preparedness of different communities, and (d) the

adaptation strategies in place in order to adapt to floods. Chapters 1-6 contains this review.

ii. Secondly, to propose a PhD research project (Chapter 7), with the emphasis on the aim, objectives, methodology, case-study area, resource planning and timescale. The paper further highlights the originality of the research. The proposed study involves the assessment of flood impacts and preparedness against flood disaster on two rural communities in Mwandi district of Zambia and Eastern Zambezi region of Namibia. It's a cross country comparative case study.

2. FLOODS OCCURRENCE AND ECONOMIC IMPACTS

A flood is a natural phenomenon which affects people around the world; it leads to financial, environmental and human loss (Keoduangsine and Goodwin, 2012). According to UNDP (2009), a flood is defined as a sudden period where water overspills the natural or non-natural banks onto usually dry area. Similarly, UNDP/DEWA, (2009) define a flood as the temporal accumulation of water in usually dry areas resulting from the spilling over of the natural or non-natural boundaries of a river or other body of water. Floods have worldwide occurrence at different magnitude and frequency and are of different types. These types are river, flash and coastal floods (UKELA, 2014).

2.1 Types of Floods

River floods results in a slow rise of water level as well as gradual inundation of large areas through water spilling over river banks and are caused by excessive rainfall (Keoduangsine and Goodwin, 2012). A river flood is generally the result of water from high precipitation levels, not necessarily in the flooded area but upstream of the river (Jonkman, 2005). Flash flood is defined as a ‘‘fast and extreme movement in high level of water into a usually dry area’’. It can also be defined as a fast rise in a river above a set flood level, starting within 6 hours of an extreme rainfall or dam failure (The National Weather Service, 2006). These occur after high intensity local rainfall leading to a quick raise of water levels affecting the lives of inhabitants (Jonkman, 2005). Coastal floods on the other hand are occurring when the level of the sea rise above normal, forcing water inland (Jonkman, 2005). River floods are the most common floods type occurring in the Eastern Zambezi region of Namibia and Mwandi district of Zambia.

2.2 Flood Occurrence at Global, Regional and Local Scale

According to Thompson and Sultana (1996), floods are the most common natural disasters that leads to deaths worldwide. The statistics on flood events indicate a significant increased over the last three decades (Nektarios, 2011). Over the same period, McMichael and Schneider (2011) reports that 57 nations have been affected by catastrophic floods. 29 of these nations are reported to be in Africa, 19 (Asia) and 9 (Latin America). According to statistics of the UNDP (2009), it was reported that more than 3,300 floods and droughts occurred across the globe,

between 1991 and 2005. More flood events are recorded between 2004 and 2010 as shown in Figure 2.1 below. The affected population by these disasters is estimated at 3.4 billion. This indicate 98% of the global total population affected by natural disasters during the same period (Lei, 2009). Due to their geographic and climate conditions, some regions are more vulnerable to severe floods and droughts than others (World Bank, 2005; Teodoro *et al*., 2001). Asia, for example, leads all other continents in terms of the number of floods and droughts which all amount to nearly 40% of the world total (World Bank, 2005). However, regions and countries differ in their ability to successfully prepare, respond as well as adapt to their impacts of floods. Because of this variation, the statistics of people negatively impacted by flood differ by region or country.

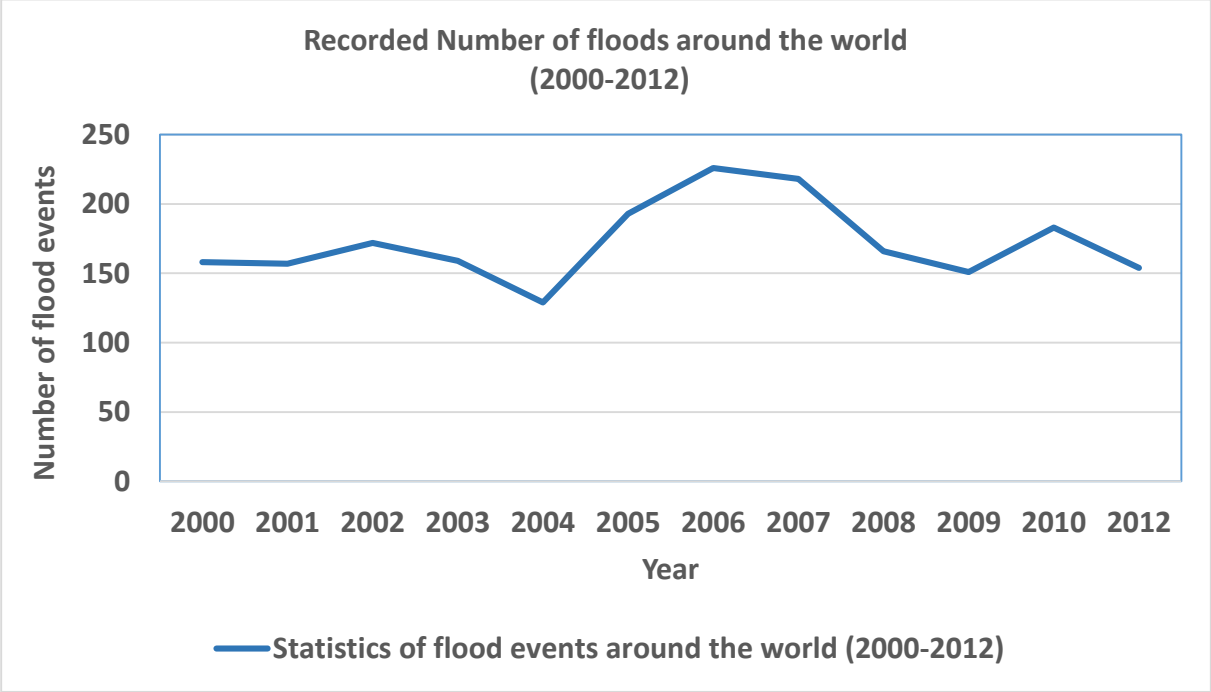

Figure 2. 1 Statistics of flood events documented between 2000 and 2012 globally (After UNISDR, 2012).

In Africa, it is reported that floods and drought are the main natural disasters causing threats to people's livelihoods (Kenna, 2008). According to Kenna (2008) flood associated mortalities in Africa, as well as related financial damages, have risen over the past quasi century. Floods and drought disasters in Africa affect millions of individuals and increase the hunger to these individuals (World Bank, 2005). A study by Kenna (2008) reported that concentrated and

nintended human settling in flood-risk areas contributes highly to the increase in risk of flooding.

United Nations (2009) further reports that, in September 2009, flooding affected six hundred thousand people in sixteen West African countries. The most affected nations were Burkina Faso, Ghana, Niger and Senegal. In 2007, millions of people in Burkina Faso, Ethiopia, Mali, Niger, Sudan, Togo and Uganda were displaced by flooding (UNDP, 2009). These floods killed over 500 people (UNDP, 2009).

In Southern Africa, floods are a common feature and their occurrence poses a threat, which cannot be eradicated but has to be managed (Muhonda, 2011). Despite significant achievements in science and technology, rural communities endure the negative consequences of severe flooding in the region (Musah and Akai, 2014). In a study by Lwando (2013), floods in Sesheke and Mwandi districts of Zambia negatively affected 70% of the rural households. Similarly in Namibia, Eastern Zambezi region of Namibia, almost 80% of the rural households are negatively affected by these floods (Mabuku, 2012). Reports by SADC Disaster Reduction Risk Unit (2014) shows that in February 2014, 100 homes were affected by floods in Botswana, 100 people were left homeless in Madagascar, affecting more than 20,000 hectares of crops and are affected more than 15,000 rural households in Mozambique. It was also reported that around 1,700 houses had been destroyed, and almost 6,000 damaged Mozambique. In Tanzania 10,000 people were affected and houses, crops, roads, bridges, destroyed or damaged (SADC DRRU, 2014).

2.3 Socio-economic Impacts of Floods

Xiao (2012) reported that research carried out have reported several losses in assets in nations affected by a disasters. Baade *et al.,* (2007) reports short-run negative effects in sales whilst Belasen and Polachek, (2008) reports a significant reduction in occupation. On a positive side Skidmore and Toya, (2002) found that sometimes disasters may foster acceptance of innovative technology, rise productivity, and enhance financial development. Reduction in unemployment rate and increases in earnings in nations affected by disasters have been reported (Ewing *et al*., 2005; Belasen and Polachek, 2008).

The impact of flooding on agriculture differs significantly according to tolerance of a specific crop, frequency, duration and seasonality of the disaster (Morris *et al*, 2010). In Bangaldesh, Kahn *et al*. (2012), found that most farmers cultivate in the low land. Rice as the main crop grown was damaged by flash floods due to unavailability of controlling measures. In another study in Bangladesh, Lopamudra (2010) found that large areas are cultivated and that agricultural productivity (crop yield) is greater in the flood-prone districts. The results of another study further reviews that when floods are extreme crop yield amount decrease, however crop productivity rises during normal floods and in the few months after floods (Lopamudra, 2010). In Nigeria, it was found that floods in 2012 had the following negative impacts on the cultivated areas (Muhammad, 2012).

However, in certain instances floods have positive impacts. Some of the positive impacts include source of abundance water required for crop productivity, groundwater recharge and support fish production (Lopamudra (2010). Soil fertility augmentation through the growth of Nitrogen-fixing algae is also reported (Hofer & Messerli, 2006). The combination of the above factors result in improved agricultural production and reduce the cost of irrigation and fertilization.

In examining the effects that climate variability and change have on maize production in Limpopo, Akpalu *et al.* (2008) found that rainfall improved maize production by Forty-two percent and temperature by Thirty-eight percent. The impacts of floods and drought in Malawi are linked to losses in Gross Domestic Product by 1.7% (Pauw *et al*, 2009).

2.4 Systems Approach to Disaster Management

A new consensus has emerged that the best way to address both the causes and consequences of disasters is through a more systems-based approach, one that treats Disaster Risk Management (DRM) as a transversal issue, cutting through public policies from a variety of sectors, and integrated under a comprehensive strategy (Pelling and Holloway, 2005). In particular, it incorporates research on the threat of disaster, vulnerability assessment, and strengthening of governance systems, while more closely linking DRM with development processes overall (O'Donnell, 2010). The theoretical proposal for this more systems-based approach emerged in the 1990s. It was in the 2000s when the theory began to be applied. In many regions, the shift from the more response-based approach to a more systems-based

approach has been quite gradual (Watanabe M, 2013). The systems approach places an emphasis on processes and instruments that facilitate interdisciplinary cooperation between distinct actors in order to embed DRM within existing development spheres. It entails strategies that address each of the phases within the cycle of disasters: prevention, preparedness, response and recovery (O'Donnell, 2010).

2.5 Impact Assessment Approaches

There are numerous studies undertaken to study financial effects of natural disasters that lead to human and economic loss (Xiao, 2011). According to Xiao (2011), natural disaster impact research follow a common route: a simulation modelling method and an experimental assessment method. On one hand, the simulation modelling method depends on models that capture main socio-economic interactions. Disaster events are regarded as shocks and impacts are evaluated from the simulated results. This line of research includes impact valuation based on an input–output (IO) framework. For example, models based on computable general equilibrium (CGE) by Rose and Liao (2005), and Rose *et al*, (2007) and regional econometric models by Chang and Falit-Baiamonte (2002).

On the other hand, the experimental assessment method, evaluates disaster impacts through direct observations, using descriptive or econometric analysis such as the use of Propensity Score Matching (PSM), switching regression, Difference-in Difference or Double Difference and Heckman two stage models. Research demonstrates that at national level, economically there is resilience in absorbing shocks caused by natural disasters (Worthington and Valadkhani, 2004). Contrary, research conclusions at local level are reported to be inconsistence (Xiao, 2011).

2.5.1 Impact evaluation challenges

Estimation of the impact of floods on households grounded on non- experimental approach is the main methodological challenge because of the selection bias problem, and the problem of missing data for the counterfactual (Bundel and Costa, 2000; Wooldridge, 2003). Selection bias is related to the problem of identifying the appropriate counterfactual benchmark or baseline against which to compare the impact of flooded households and non-flooded households

(Mmbando *et al*, 2015). Each individual is either under the intervention being assessed or not and therefore the individual cannot be in both. Outcomes are only observed in one state (affected or non-affected); the counterfactual is unobservable. Households who are affected may have different characteristics from the ones who are not-affected (Smale *et al*., 2012). The implication of this is that the use of standard regression techniques (ordinary least square (OLS) to estimate the parameters of the equation would result in biased and inconsistent estimates (Mmbando, 2015). Therefore, PSM can be used in evaluating the impacts of floods on rural households.

2.5.2 Propensity Score Matching

The Propensity Score Matching (PSM) method is a systematic procedure of estimating counterfactuals for the unobserved values to estimate impact estimates with no (or negligible) bias (Mulengeta, 2012). The validity of the outputs of the PSM method depends on the satisfaction of two basic assumptions namely: the Conditional Independence Assumption (CIA) and the Common Support Condition (CSC) (Becker and Ichino, 2002). According to Mulengeta (2012), CIA (also known as Unconfoundedness Assumption) states that the potential outcomes are independent of the treatment status. The CIA ensures that, although treated and untreated groups differ, these differences may be accounted for in order to reduce the selection bias. This allows the untreated units to be used to construct a counterfactual for the treatment group. The common support condition involves the existence of sufficient overlap in the characteristics of the treated and untreated units to find adequate matches (or a common support). According to Shahidur *et al.* (2010), the following are the advantages of using a PSM;

- If selection bias from unobserved characteristics is likely to be negligible, then PSM may provide a good comparison with randomized estimate,
- the use of PSM does not necessarily require a baseline or panel survey, and
- PSM is also a semi parametric method, imposing fewer constraints on the functional form of the treatment model, as well as fewer assumptions about the distribution of the error term.

3. AN OVERVIEW OF FLOOD DISASTER PREPAREDNESS

‘‘Preparedness is defined as the knowledge, capabilities and actions of governments, organizations, community groups, and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions’’ (UNISDR, 2009). Furthermore Edwards, (1993) defines disaster preparedness as making sure the society is ready for any disaster likely to occur, through taking preventive measures and reacting to a disaster. However, preparedness is not fixed in nature, it changes. It requires regular amendments and transformation as social circumstances changes (Perry & Lindell, 2003). In line with this, Paton (2003) developed a model describing the developmental process of preparation that starts with factors that encourages individuals to prepare, advances to the creation of intention and ends in taking decision to prepare for disasters. One general method of examining preparedness at household level is to survey the quantity of emergency supplies on hand (Levac *et al.*, 2012).

The perception of preparedness denotes a sequence of self-protective behaviours to alleviate the negative impacts that emanate from a disaster (Faupel *et al*., 1992). There are different measures that can be undertaken to prepare for flood disasters. For example, Mulilis & Lippa, (1989) has indicated the following as some of the measures; having a flashlight and a radio, first-aid kit, food and water, information seeking on how to act during and after a flood, attending gatherings in order to prepare for floods, reading materials and listening to messages meant for flood preparedness. In previous research, disaster preparedness is examined as either a one general concept or with some sub-categories. According to Malkina-Pykh (2013), disaster preparedness is classified into three categories or components:

(a) Material Preparedness: includes strong alterations of the home and possession of numerous tools valuable throughout a disaster such as, food and water supplies, fire extinguisher or first aid kit,

(b) Planning Activities: locating a safe place for temporal relocating or finding a gathering place externally, and

(c) Knowledge and Skills: Refers to what people know about the disaster and how to prepare for such disasters e.g attending a first aid course or reading material based on disaster preparedness. Table 3.1 shows the different categories on which researchers have been able to assess level of preparedness.

Table 3.1 Summary of components studied by different authors to measure level of preparedness

Source		USIDR (2005)	Rustam Khairi *et al.* (2013)	Ainuddin *et al*. (2012)	Mishra *et al*. (2010)	Luna (2001)	Rachmalia *et al*, (2010)	Miceli (2008)	Doocy (2013)
Country of study			Malaysia	Pakistan	India	Phillipines	Indonesia	Italy	Uganda
Disaster type			Tsunami	Earthquake	Flood	All disasters	Tsunami	Flood	Floods and Landslides
Methodology			3-point Likert scale based survey	Key informants and group discussions	5-point Likert scale based survey	In-depth interview	5-point Likert scale based survey	Stratifies cluster survey	Survey
Components of disaster preparedness	Vulnerability assessment			✓		✓		✓	
	Planning		✓						
	Institutional framework					✓			
	Information system	✓		✓	✓	✓	✓	✓	
	Resource base		✓	✓	✓		✓	✓	
	warning systems	✓	✓	✓		✓			
	response mechanisms		✓			✓	✓	✓	
	Education and training	✓	✓		✓		✓	✓	
	Rehearsals	✓		✓					
Preparedness level			High	Low	Moderate		Moderate	Fairly	Low

Disaster preparedness is significant because it has a possibility of reducing losses of life and property. It is known that disasters can be unpreventable and commonly unpredictable (Levac, 2012). According to Morissey and Reser (2003) disaster preparedness reduces psychological pain associated with the likelihood of the occurrence of these disasters. Therefore if a person gets prepared for a possible future disaster, the physical and psychological impact will be reduced. Finally disaster preparedness reduces the traumatic stress associated with flood occurrences.

3.1 Socio-cognitive Factors Influencing the Level of Households' Preparedness

There are several factors that hinder preparedness. According to Paton (2003) the first are factors able to motivate individuals to take preparedness measures. These factors are called precursor factors or variables. Second are factors that are known to link the precursor variables with the intention formation. Lastly are the factors that describe the connection between intentions formation and real preparedness. These factors are described in a form of a model as indicated in Figure 3.1 and described below.

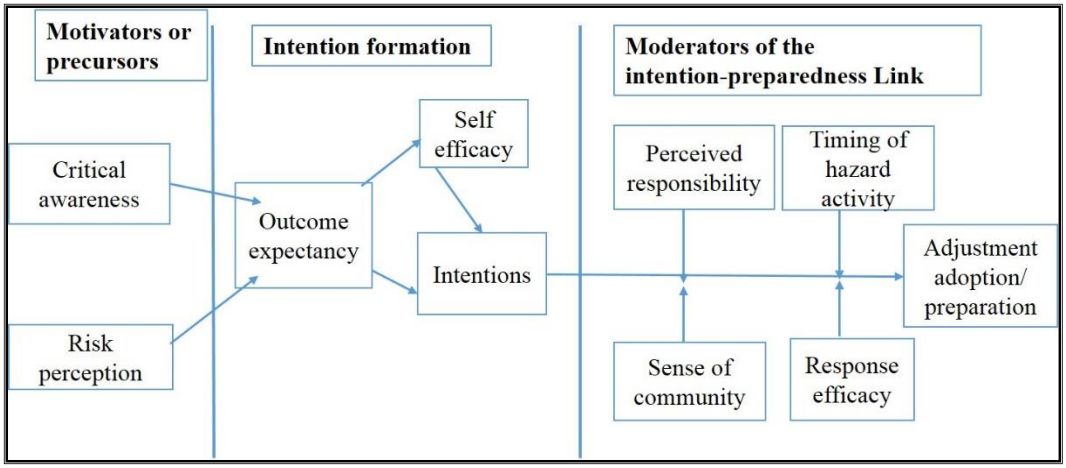

Figure 3.1 The social-cognitive preparedness model (Paton, 2003)

3.1.1 Risk perception

Kinateder *et al* (2015) define risk perception as the belief an individual have of a forthcoming threat to own life and health. Literature in health protective behaviour and contemporary approaches to public hazard education shows that risk perception represents a valid precursor variable (Lindell and Perry, 1992; Sjöberg, 2000). However, despite the acceptance that a given

disaster can pose a threat to own life, this perception may be moderated by other factors (Paton *et al*., 2000; Paton *et al*.,2003).The risk perception of an individual rise after the occurrence of the event (Jackson, 1981).

3.1.2 Critical awareness

Critical awareness is the degree to which individuals think and talk about a specific source of danger or threat in their environment (Paton, 2003). Effectiveness in preparedness may be hindered by individual low risk awareness (Scolobig, 2012). It is assumed that households with low risk awareness have low disaster preparedness (Scolobig, 2012). This as a result create insufficient adaptation to disasters. These findings are consistence with Grothmann and Reusswig (2006), Miceli *et al*. (2008) and Terpstra *et al*., (2009). These researchers have also shown that disaster preparedness is positively related to the feeling of worry concerning the risk. Therefore, the higher the household level of risk awareness the higher the possibility of households taking protective measures (Floyd *et al*., 2000; Neuwirth *et al*. 2000). Preparedness is therefore becoming a key issue to be considered for effective adaption to disasters.

3.1.3 Outcome expectancy

Paton (2003) define Outcome expectancy as the perceptions of whether personal actions will effectively mitigate or reduce a problem. In a study undertaken by Paton (2005) on bushfire preparedness, it was found that positive outcome expectancy had a direct influence on both intention and preparing whilst negative outcome expectance was the driver of non-preparation.

3.1.4 Self-efficacy

Self-efficacy is the belief regarding personal capacity to act effectively (Encyclopaedia of Adolescence, 2011). Self-efficacy is regarded as a precursor of adjustment adoption and resilience in natural hazard contexts (Bishop *et al*, 2000; Lindell and Whitney, 2000). According to Paton (2003), self-efficacy is strongly linked to the number and quality of preparedness action undertaken, the amount of persistence and effort invested in risk reduction (Levac, 2011). The more confident people are about their capability to successfully respond to an emergency, the more likely they are to engage in preparedness behaviours (Bandura, 1998).

If peers and families have means to create self-efficacy; people are more likely to prepare if those around them believe in preparedness (Levac, 2011).

3.1.5 Sense of community

Sense of community is defined as the feelings of attachment for people and places (Paton, 2006). It is known to influence adjustment decisions. People with high sense of community have higher possibility of converting intentions into actual preparedness (Paton, 2006).

3.1.6 Perceived responsibility

Perceived responsibility is the belief that someone has responsibility for self and others. This will determine whether an individual will be prepared for disaster or not. Ballantyne *et al.* (2000), states that if people have a perception that others are responsible for their safety there is less possibility of converting intentions into actions. If people believe they have responsibility to safeguard their life and others, there is the likelihood that they will convert intentions to actions (Paton, 2006).

The literature on factors that hinder household emergency preparedness is inconclusive. In a study by the Institute for Catastrophic Loss Reduction for the Red Cross, 78% of respondents indicated that there were no barriers preventing them from taking part in emergency preparedness activities (Falkiner, 2008). The remaining 22% suggested that their efforts were deterred by time pressures (33%), lack of information (29%), and lack of financial resources (26%). In another study by Diekman *et al.* (2007) two main barriers identified were used, expired, or misplaced supplies and lack of communication. Other reasons for lack of household preparedness included ignorance for emergency preparedness, no enough time to prepare a kit, lack of knowledge and skills to prepare for disasters, believing that a disaster will not affect household's members, lack of efficacy expectations, lack of critical of awareness.

4. ADAPTATION STRATEGIES IN VIEW OF CLIMATE CHANGE

It is reported that Africa is not a major driver of climate change, but is a victim (Conway, 2005). Despite that, the weather is becoming progressively unpredictable (Cross, 2001). According to El-Raey (2004) analysis of long-term rainfall records in Africa shows more variability in climate from year to year. Floods events will increase due to the variability in climate which in return will increase the level of population exposure to more flooding (Roger, 2003). This exposure have impacts on agricultural production of households. According to Roger (2003) the exposure of population requires intensive research and interventions intended to strengthen local capacity to adapt to flooding, especially for the poor in developing countries. IPCC (2007) defines adaptation as the ‘‘adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities’’.

Hinkel *et al*. (2013) reports that a number of categories exists for adaptation to disasters. Bruin (2011) also acknowledged different groups of adaptation strategies to climate change. They can be grouped into autonomous or private and planned or public sector adaptation strategies (Bruin, 2011). On one hand, private adaptation strategies include action taken by non-state agencies such as farmers, communities or organisations and or firms in response to climate change. Agricultural adaptation strategies may involve switching crops, shifting crop calendar, engaging new management practices for a specific climate regime, changing irrigation system and selecting different cropping technologies (Bruin, 2011). On another hand, public adaptation involves actions taken by local, regional and or national government to provide infrastructure and institutions to reduce the negative impact of climate change. For example public agricultural adaptation strategies include development of new irrigation infrastructure, transport or storage infrastructure, land use arrangements and property rights, water shed management institutions (World Bank, 2010).

According to Sathaye and Christensen (1998) and Bruin (2011) adaptation strategies can be either proactive or anticipatory. Proactive adaptation strategies are engaged in anticipation of climate change while reactive adaptation strategies addresses effects of climate change after they have been experienced. In crop production, reactive adaptation strategies include control of soil erosion, construction of irrigation dams, improving soil fertility, development of new

varieties, shifting planting and harvesting time among other. Anticipatory adaptation strategies, on the other hand, involve the development of tolerant cultivars, research development, policy measures on taxation and incentives. Gbetibouo (2009) suggested that smallholder farmers can adapt to climate change by changing planting dates and diversifying crops, practicing soil and water conservation measures and planting trees (Yesuf *et al*, 2008). In southern Malawi, studies conducted by Nangoma (2007) and EAD (2006) on household adaptation strategies to climate and weather variability, identified improved varieties, irrigation farming, shifting cropping dates and crop diversification as some of the household adaptation strategies to climatic and weather variability.

Burton *et al*. (1993) differentiates between categories of adaptation strategies as behaviours that prevent loss, tolerate loss, and spread loss socially, temporally or spatially, change use and activity and change location. Carter *et al*. (1994) distinguish between intervention types such as infrastructural, institutional, administrative, organizational, regulatory, financial, research and development, market mechanisms and technological change. Other authors discuss the ordering of adaptation, it may be for example, that short-term reactive technological adaptations are followed sequentially by long-term, strategic administrative reforms (e.g., Smit *et al*., 1996), so that quick fixes and slow reform are not mutually exclusive.

4.1 Factors Influencing Adaptation Strategies to Floods

In a study that was done by Bird *et al*, (2013), many factors were found to hamper or promote the adoption of flood adaptation strategies. These factors include:

- Flood experience – people with previous flood disaster experience have reported to experience pain, inconvenience and stress. These people had a desire to reduce the impacts through adaptation.
- Positive outcome expectancy – the need to protect family members, belongings and assets and, a desire to have peace of mind, were positive drivers in changing household's behaviour to reduce flood risk.
- Proper communication and information sharing – proper channel of communication and sharing information understood by the victims prior to and during the flood, promote the implementation of adaptation strategies. For example, inadequate information and

misinterpretation of message may reduce households' adaptive capacity (Yesuf *et al*., 2008).

- Insurance – slowness of obtaining insurance pay-outs have been seen to act as a barrier to recovery. Settling in disaster prone areas results in paying more insurance, reduces the exposure to disaster prone areas.

Other factors include, formal and informal institutions, accessibility to credit and information, land tenure, gender and size of the farm significantly influence household choice when adapting to climate change. (Nhemachena and Hassan, 2007; Deressa *et al*., 2008; Gbetibouo, 2009; Yesuf *et al.* 2008 In Phindile *et al*, 2014)

Several research have been carried out in Sub Sahara Africa on climatic and weather variability, adaptation strategies and agricultural production. However, most studies have concentrated on the impacts of climatic variability on crop production and less on the factors that influence household choice of adaptation strategies (Akpalu *et al*., 2008; Hassan and Nhemachena, 2008; Aggarwal *et al*., 2010).

Maddison (2006) revealed that education, gender, extension services or information and experience significantly influenced households in adapting towards climatic change. It was found that education and gender increased the probability of adoption of adaptation strategies by 0.03% and 6%, respectively. Study findings recommended that education and extension services should be emphasised to appropriately adapt towards changes in climate. Furthermore, lack of appropriate seed, credit accessibility, security of tenure and market accessibility were some of the barriers to household adaptation. In a similar study, Deressa (2006) employed a Heckman model to assess the determinants of household adaptation to climate change in Ethiopia. The study found that household size and gender, availability of credit and temperature had positive influence on household adaptation to climate change. For instance, credit accessibility and climatic information increased household likelihood of adopting adaptation strategies by 48% and 37%, respectively.

Douglas & Alam (2006) assessed farmers' adaptation towards climatic change and variability in the southern part of Malawi. It was found that most households in Malawi do not have sufficient capacity to cope with challenges posed by climatic change and variability.

Deressa *et al.* (2009) used the multinomial logit (MNL) model to investigate the factors influencing household choices of climate change adaptation methods. The results from the study indicated that household characteristics such as education, farm and nonfarm incomes which could be enhanced through policy intervention have significant impact on adaptation to climate change. The study further revealed that households adopted soil conservation measures, use of different crop varieties, tree-planting, and changing planting dates. Irrigation was applied to farms to reduce the negative impacts of disasters. Those who did not adapt mentioned lack of information on adaptation methods and financial constraints to using any of the adaptation methods. Table 4.1 below is the summary of some of the factors studied by different researchers as discussed above.

4.2 Assessment of Adaptation Strategies

Adaptation assessment is defined as the identification of strategies meant help in adapting to climate change (Hague, 2012). It also includes the evaluation of the identified adaptation strategies against selected evaluation criteria such as cost, feasibility and availability of resources. Several methods exist on assessing the effectiveness of the adaptation strategies. The most commonly used techniques are: Cost Effective Analysis (CEA), Cost Benefit Analysis (CBA) and Multi-Criteria Analysis (MCA). Various terminologies are used to refer to MCA, These are Multiple Objective Decision Support (MODS), Multi-Attribute Decision Making (MADM) and Multi-Criteria Decision Analysis (MCDA) (Hajkowicz & Collins, 2007). Different techniques of evaluation are relevant in different cases. For example, CBA is specified to handle optimization. Its main aim is economic efficiency therefore it is expressed in financial form (Hague, 2012). On the contrary, Multi-Criteria Analysis describes any structured approach used to determine overall preferences among alternative options, where the options accomplish several objectives (Brooks *et al*., 2009). This method is appropriate for a participatory process since it employs stakeholders' participation in weighing the criteria (Brooks *et al*., 2009). MCA is a widely applied approach in relation to environmental issues, including climate change. The advantage of MCA firstly is that it helps to categorize measures according to priority, for example, short term, small scale, and highest priority and secondly, its ability to make a weighting or scoring, which can incorporate monetary or non-monetary data, qualitative data and diverse measurement and rating scales. And thirdly, it can support an in-depth performance

evaluation of each strategy, as well as in the design of more robust and better options. There are various techniques for weighting the criteria (Grafakos *et al.*, 2010a).

There are examples of successful applications of the MCA method for the assessment of adaptation measures and options in different countries; urban flood risk assessment in Germany (Kubal *et al.*, 2009), ranking of adaptation options for climate change in the Netherlands (Bruin *et al*., 2009), and decision making process for policy planning in Canada (Qin *et al*., 2008). It has also been used to locate flood vulnerable areas by incorporating GIS into the MCA aiming to assess flood risk (Kourgialas & Karatzas, 2011). This method has been applied in other sectors as well for adaptation measures assessment. For example, it has been applied in the agricultural sector for the identification of vulnerability and the assessment of alternative crop options (Julius *et al*., 2009). MCA techniques have been applied to optimize policy selection in the remediation of contaminated sites (Gallego *et al*., 2004), the reduction of contaminants entering aquatic ecosystems, the optimization of water and coastal resources, and the management of other resources (Herath, 2004). Application of MCA methods provides a significant improvement in the decision process and public acceptance of the suggested strategy (Linkov *et al*., 2006).

Although it seems to be clear on paper it is not in practice, since there is no common set of criteria or parameters to assess adaptation options in different locations and situations (Hague, 2012). Situations vary from case to case. According to Hague (2012), the guidelines for impacts and adaptation assessment provided by IPCC consist of seven steps as described below:

a) Step 1: Selection of all potential adaptation options for the study area.
b) Step 2: Stakeholder criteria selection is done in order to assess the adaptation measures and identify evaluation criteria in a participatory manner. The criteria are to fulfil some qualitative attributes such as value relevance, operationalise and reliability etc.
c) Step 3: based on their expertise, experts scores or assesses each of the strategies against the criteria meant for evaluation.
d) Step 4: Stakeholder focus group discussions on weighting of criteria allows all scores obtained from Step 3 to be standardized to a common scale based on the min–max standardization technique.

e) Step 5: Giving priority to the most efficient and effective adaptation strategies for the study area based on the criteria.

f) Step 6: Sensitivity analysis. The sensitivity analysis is carried out to investigate how sensitive the result of the final ranking is to the input variable of criteria weights, and to incorporate the uncertainty and range of stakeholder preferences

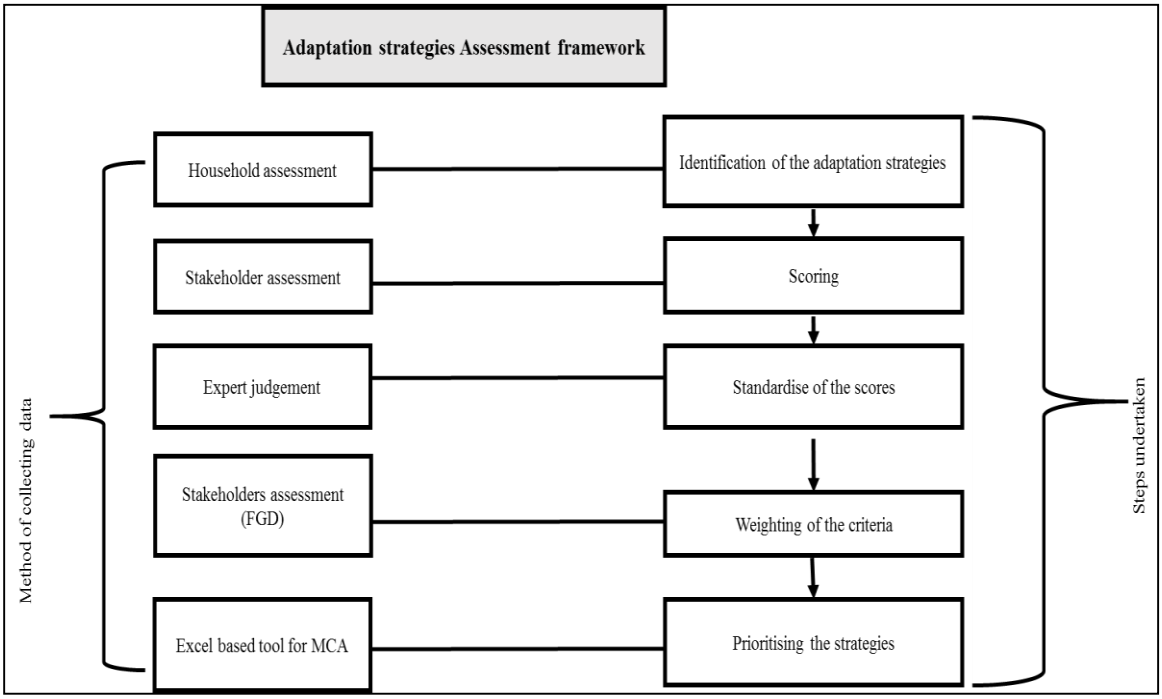

Figure 4.1 A summary of the steps carried in MCA evaluation (after Hague, 2012)

The steps described above will help in identifying and assessing the adaptation strategies to flood disaster and their effectiveness based on some criterion determined by the rural community.

5. SUSTAINABLE LIVELIHOOD FRAMEWORK

The Sustainable Livelihood Framework (SLF/SLA) shows stakeholders as operating in a context of vulnerability (e.g shocks, trends, seasonality etc.), within which they have access to certain assets (natural, social, financial, physical and human). These assets increase in weight and importance through the prevailing social, institutional and organizational environment (policies, institutions and processes) (Ellis, 2000). This context decisively shapes the livelihood strategies that are open to people in pursuit of their self-defined beneficial livelihood outcomes (Kollmair *et al*., 2002).

There are other frameworks that exists, for example Socio-ecological Framework explains how human develop and adapt in the context of human-environment interactions (Motsholapheko *et al.*, 2011). On the other hand, the conceptual framework of the Double Structure indicates that vulnerability cannot sufficiently be reflected without taking into account coping and response capacity (Birkmann, 2006). Furthermore, the Pressure and Release (PAR) model functions at different spatial (place, region, world), functional and temporal scales and takes into account the interaction of the multiple perturbations and stressor/stresses (Birkmann, 2006). The PAR model is based equation which defines risk as a function of the hazard and vulnerability. It emphasizes the underlying driving forces of vulnerability and the conditions existent in a system that contribute to disaster situations when a hazard occurs. In another approach a holistic approach to risk and vulnerability is identified. In this approach vulnerability is conditioned by three categories of factors (Carreño, 2007). The model takes into account the consequences of exposure and susceptibility as well as socioeconomic fragility and lack of resilience of potential hazardous event. Since this study focuses on impact assessment, preparedness and adaptation, the use of SLA will be appropriate. This is because it takes into account the assets that are likely to be impacted by disaster as well as the short term and long adaptation to these disaster. When a disaster strikes, its impact is on different assets that rural households have access to. These assets are clearly defined in the SLA. Within the same SLA the short and long-term adaptive capacity influences the livelihood outcome of households, which in a way can be translated to how prepared the households are.

6. DISCUSSION AND CONCLUSIONS

Literature review has cited different types of floods in Africa and beyond. These can either be river, coastal or flash floods. Floods disasters are increasing in magnitude and frequencies. The increase in the magnitude and frequency is due to inappropriate land-use, population growth, deforestation and rainfall. This is in line with Merz *et al.* (2012) who identified climate change, river channel modification and landuse landcover change as possible drivers of changes in flooding frequencies and magnitudes. There is a greater likelihood that climate variability will negatively impact on nearly every aspect of the wellbeing of the communities because of high variability of rainfall in time and space, scarce water resources and vulnerability due to regional low adaptive and mitigation capacities (Kusangaya *et al.*, 2013). Despite the negative impacts cited, these floods have some positive impacts on income and agricultural production. Positive impacts of floods includes reducing cost of fertiliser as most floods deposit nutrients which helps in the growth of crops, therefore enhancing yield. Negative impacts on the other hand include; reduction of income sources which results in reduction of rural household's income and destruction of homes, increasing the cost of reconstruction or relocation.

However, quantifying or assessing these impacts has proved to be challenging for researchers. This is because in most areas, the lack of baseline studies has proved to be missing. In areas where baseline is available, the variables or parameters that are required to be measured may not exist. Moreover literature has shown that there are different econometric models of assessing impacts. These econometric models may be used in absence of baseline information. One of the common used methods is Propensity Score Matching (PSM).

Although, floods are increasing in magnitude and frequently and have negative impacts all over the world, many people still fail to prepare. There are many factors why people fail to prepare for flood disaster thus a need to examining these factors applicable to the study area. Studies related to disaster preparedness and factors will then provide information to disaster managers. Since socio-cognitive factors are factors related to the behaviour or perception of people, it is a starting point in implementing flood disaster preparedness measures. For example, risk perception and response capability depend on an individual's understanding of the hazard (Miceli *et al.*, 2010). For people to take action, they must believe the hazard is a threat, believe they have the ability to avoid it, and believe that there are positive outcome in taking

preventative actions (Damon, 2010).By so doing the possibility of them taking up preventative measures is very high. Evaluation of one's resources is also an important factor of risk perception (Mullis *et al.*, 2000). When people perceive that their available resources are enough to avoid a threat, risk perception is reduced. The perceived likelihood of a threat turning into an actual event is another important factor in emergency preparedness (Pennings, 2008). Certain attributes such as the predictability, duration and pattern of an event, the number of casualties or the degree of damage, and the availability of prevention or treatment, act as risk or protective factors which determine psycho-social effects and perception of risk (Lemyre *et al*., 2005). People will only adopt preventative action if they believe the hazard to be important to them (Paton, 2003), or if they have caregiving responsibilities for children or older adults (Olympia *et al*., 2010). Results from Mulilis *et al*. (2000) suggest that property owners are generally more prepared than renters, who in turn are more prepared than student renters.

Access to media as a primary source of emergence information and warning is another motivating factor of disaster preparedness (Reddick, 2011). However, clear, constant and reliable message that is well understood and interpreted by people with lower literacy levels, is vital during entire phases of disaster preparedness (Paton and Johnston, 2001). For example, Cretikos *et al*. (2008) found that radio was the most commonly accessed source for information during natural disasters. Balluz *et al*. (2000) on the other hand, identified that television bulletins and warning sirens were the most successful means of issuing tornado warnings.

Different adaptation to climate change and variability exists. Adoption of adaptation strategies by rural households should be encouraged, therefore a need for assessment of the adaptation strategies and their effectiveness evaluated. According to Kapucu (2008) awareness interventions are the first step to encourage the public to adopt proper disaster preparedness activities as well as adapt to floods. In eastern Zambezi of Namibia and Mwandi district of Zambia, little is known about the economic impacts of floods, level of flood preparedness and adaptation strategies adopted in view of floods, therefore this research is aimed at filling this knowledge gap.

7. PROJECT PROPOSAL

7.1 Rationale

Since prehistoric times people have lived in flood-prone areas due to some reasons. Firstly, flood plains have desirable geographic environments which enable economic growth, such as navigation and agricultural productivity (Douben, 2006). Worldwide, floodplains are likely to rise in river flooding risk with subsequently overwhelming impacts on human society and the environment (Ceola *et al.*, 2014). According to Douben (2006) floods are the major damaging of all natural disasters. For example, floods that occurred in 2011 and 2012 worldwide affected about two hundred million inhabitants and caused a total damage of approximately Nighty-five US dollars (Ceola *et al*., 2014).

In the rural communities of Namibia and Zambia, specifically in the Zambezi region and Mwandi districts, households depend on natural resources or capitals which are negatively affected by the occurrence of floods. The magnitude and severity of these floods are reported to have severe ecological, financial and social impacts on livelihoods of households. Since rural household's livelihood is more dependent on agriculture production, people have to cope and adapt to the change and variability in climate, the impacts will be intensified without proper adaptation. Frequent droughts and floods are regarded as a main reason why people are poor. As a result these people are forced to pursuing non-farm alternatives to maintain their livelihoods (Shewmake, 2008; Akpalu, *et al*., 2008). According to Kalaba *et al*. (2010), livelihoods of rural people depend on the use of natural resources for survival, thus the increase in this dependence is reported to increase the amount of pressure exhibited on the environment, resulting in overexploitation, deforestation and finally desertification, which will in return increase the severity and magnitude of floods. With this in mind, a need for a deeper understanding of flood impacts, flood preparedness and adaptation strategies of households together with the socio-economic factors influencing their choices is important. It is important that the livelihoods of these households are sustainable despite the continuous negative impacts of floods on the livelihoods. This can be attained through preparedness and sustainable adaptation strategies.

At present, there is a dearth of information on the quantification of the rural household economic impacts of flooding in Eastern Zambezi region of Namibia and Sesheke/Mwandi Districts of Zambia. In Namibia there have been few research that embarked on analysis of different factors influencing household's decision to pursue diverse livelihood strategies. For example, an assessment that was carried out by Ashley and LaFranchi (1997) looked at livelihood strategies of rural households in the Zambezi region and the implication for conservancies and natural resource management. However, factors which may drive the households' choice of the adaptation strategies were not studied. Furthermore, Lwando (2013) carried out a study on climate variability and gender in Sesheke district. In the study, assessment of the flood impacts were analysed qualitatively. The study did not critically look at the level of preparedness, adaptation strategies and factors influencing the choice of these adaptation strategies. This is necessary for the design of an effective implementation of sustainable adaptation livelihood strategies through policy formulation, extension support, and mitigation measures. This in return will assist households to adapt and prepare for future flooding events or disasters. Furthermore, assessing the economic impacts of floods in rural community is an essential step in determining the vulnerability of the community to floods. This, as a result, will assist in dealing with the impacts related to flooding and address such impacts through well informed decisions making.

Therefore, the research proposal is aimed at addressing five key research questions: (i) What are the economic impacts of floods on rural households? (ii)What is the level of flood preparedness at household level? (iii) What are the socio-cognitive factors influencing the level of preparedness? (iv)What are the adaptation strategies adopted by households in face of floods and how effective are they? (v)What are the socio-economic factors influencing the choice of these adaptation strategies? (vi)What framework would best serve rural households through enhanced flood disaster preparedness in the study area?

7.1 Scope of the study

This study focuses on analysis of economic impacts of floods, flood disaster preparedness and adaptation strategies. Analysis of metrological and hydrological data, causes of floods and landuse landcover change within the study area is out of scope of this study.

7.2 Aim

This research is aimed at evaluating the economic impacts of floods at household level and flood disaster preparedness in order to formulate appropriate interventions to improve rural household's flood preparedness and adaptive capacity for sustainable livelihood. In addition, the different socio-economic and socio-cognitive factors that influence adaptation and flood preparedness will be assessed.

7.3 Objectives

The following are the specific objectives of this research:

- assess the economic impacts of floods on rural households,
- evaluate the households' level of flood preparedness,
- evaluate the effectiveness of the adaptations strategies adopted by rural households in the face of floods,
- determine the socio-economic factors influencing the choice of adaptation strategies, and
- Develop a framework for improving household's livelihoods through enhanced preparedness.

7.4 Originality of the study

The study will contribute to new knowledge in the field of disaster risk reduction in Zambia and Namibia in a number of ways. Firstly, it will be the first to develop a framework envisaged to serve rural households through enhanced flood disaster preparedness. Secondly, the study will also assess the economic impacts using propensity score matching, this approach allows for assessing impacts without a need of baseline information. Thirdly, the effectiveness of the adaptation strategy in two countries will be studied using Multi Criteria Analysis. Fourthly, the study will also identify problems, such as inconsistencies or gaps in literature. Finally, The study takes into account the importance of bringing together areas of work that have not been brought together and the lack of studies that considers trans-boundary aspects, hence the inclusive of Namibia and Zambia cases.

7.5 Methodology

7.5.1 Study area

Zambezi region is one of the 14 regions of Namibia. The region has been known as Caprivi region until in August 2013 when the name changed to Zambezi (NSA, 2014). It was named after the Zambezi River that runs along its border. The region is divided into eight constituencies. The Zambezi region covers an area of about 14,500 square kilometres. The region borders with Zambia in the North; Angola in the Northwest; Botswana in the East and South and Zimbabwe in the East. Average rainfall in Zambezi region ranges between 600-700 mm per year, and increase gradually from south to north. The rainfall occurs from October to March. The frequency of rainfall is more than 60 days as annual average, with a rainfall variability of less than 20-25%. Evaporation rate is between 2400-2600 mm per annum and the average temperature is between 7^0 C and 35^0 C.

For the scope of this study, in Namibia, Eastern Zambezi is covered. This study area consists of 3 constituencies namely Kabbe North, Kabbe South and Katima Mulilo rural. It covers a total area of 4106.9 km^2. The study area is selected, firstly because it is falls within the Zambezi basin, which is the focus of WaterNet PhD programme. Secondly, the study area is the most affected by floods in Namibia. The population for the study area is 30 917 people and 5265 households. The population density is 3.1 persons per square kilometre. The people in Eastern Zambezi region derive their source of income from; business activity (not farming), wages and salaries, farming, old age pension, cash remittances, retirement fund, and orphan grant (NSA, 2014)

The abundance of water is a distinctive feature that differentiates the Eastern Zambezi region from the other part of the Zambezi region. Of only four permanently flowing rivers in Zambezi region, three are in the Eastern Zambezi region: the Chobe, Linyanti and Zambezi. The Zambezi River in the northeast (Zambezi Region) occasionally overflows into the flood plain to the Chobe River west of the Kasane border with Botswana, causing a reverse flow in the Chobe in the southwest direction toward Lake Liambezi. The sources of water in the northern river systems are the rains in southern Angola that reaches up to 1000 mm per annum (Mendelsohn, 2009).

In Western province of Zambia, Mwandi district is selected as the second study area. Mwandi district was one of the constituency of Western province and was part of Sesheke District until the 15th November 2013, when it was declared a district on its own (Provincial and District Order, 2013). It is located in the South of Western Province. It is located between 23° and 26° longitudes East and 15° and 18° latitudes South and shares borders with Kazungula and Kalomo districts of Southern Province (Lwando, 2013). Within the Province the district borders with Sesheke, Kaoma, Shangombo and Senanga district. The district consists of 6,248 households and 27,922 inhabitants (Central Statistical Office, 2012). It falls under Kazungula-Mwandi plain (zone 7A) food economy zone. According to the Zambia Vulnerability Assessment Committee (2004), this livelihood zone has a generally semi-arid climate, with periodic drought and flooding. The main economic activities are crops and livestock production, formal employment, trading, curios (related to tourism), fishing and sale of wild fruits (Central Statistical Office, 2012). The above are the main reason why the study area was selected. Table 7.1 shows the study area location

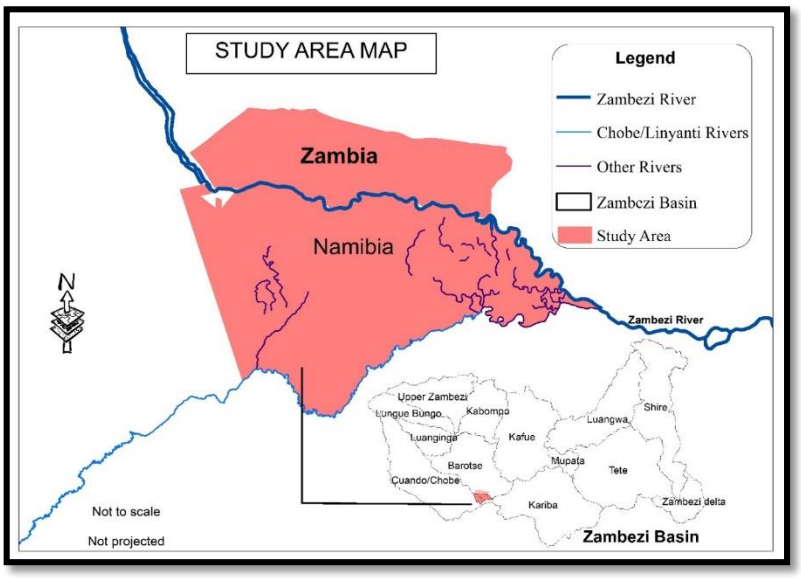

Figure 7.1 The location of the study area

7.5.2 Conceptual framework - Sustainable Livelihood Approach (SLA)

The Sustainable Livelihood Approach (SLA) will be applied in this study to assess the impacts of flooding on the livelihood assets of rural communities (Figure 7. 2). The SLA point out that the analysis of livelihoods based on natural resources consists of five assets - human assets,

natural assets, financial assets, social assets and physical assets (DFID, 2000 In Kamwi *et al*, 2015). The framework states that within a specified vulnerability context, people deploy these livelihood assets in various combinations, within situations influenced by institutional structures and processes in order to pursue diverse livelihood strategies, with more or less measurable livelihood outcomes (DFID, 2000 In Kamwi *et al*, 2015). The livelihood assets, short and long-term adaptive strategies (see Boxes 1, 3, 3.1 and 3.2 in Figure 7.2 below) is the area of interest within the framework. In this case, the choice of a specific livelihood strategy is centred on households' environmental resource endowment and entitlement in terms of the assets. The availability of the endowments and entitlements for livelihoods and the way they are conditioned may be affected by the occurrence of floods (vulnerability context).

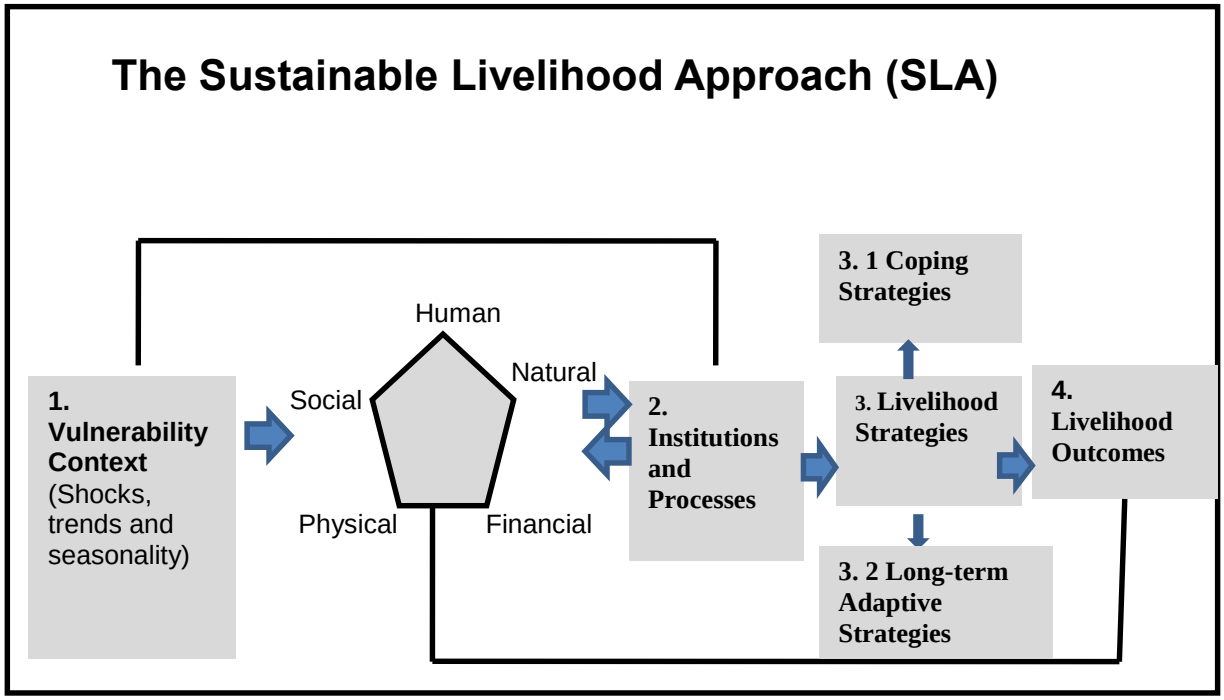

Figure 7.2 The sustainable livelihood approach (SLA) (After DFID, 2000)

7.5.3 Research Design

In order to assess the economic impacts of floods on rural households as well as the level of preparedness and adaptation strategies adopted by these households, detailed empirical research will be conducted. A comparative case study approach will be used. The study will encompass collection of quantitative and qualitative data. The study will use data collection instruments

such as household surveys through structured questionnaires, focus group discussions, structured interviews, and direct observations.

7.5.4 Sampling and Unit of Analysis

The unit of analysis will be a household. All households within the study area will have an equal chance to be sampled. In behavioral research, a sample of not fewer than five percent of the total population or not less than thirty units are regarded as adequate for any statistical analysis (Moser and Kalton, 1971; Balnaves and Caputi, 2001; Stutely, 2003). A sample size of 5% or more is regarded as sufficient in research (Hetherington, 1975; Turyahabwe, 2006). According to Saunders *et al, (*2012), researchers always work to a 95% level of certainty to represent characteristic of the population. Saunder *et al.* (2012) provided different smallest number of samples needed from different population size at 0.05 significance level for different margin of error. Using Saunder (2012) recommendations at 95% confidence level with 5% margin of error, 400 households will be the sample size in this study.

7.5.5 Data collection

Data collection will consist of household survey with structured questionnaire, key informants interviews, focus group discussions and observations. A structured questionnaire will be administered to each of the sampled households, with the head of the household as the unit of measure. In the absence of the head of the household, any elder who has knowledge concerning the general livelihood of the household will be questioned.

The household survey will be supplemented by key informants interviews and focus group discussions, which will be conducted with relevant stakeholders. Secondary information will be obtained from relevant institutions and literature. A household survey will be divided into the following sections; (i) human assets in terms of demographic and socio-economic (ii) financial aspects (iii) economic impacts of flood disaster on households (iv) household adaptation strategies (v) preparedness and socio-cognitive factors.

7.5.6 Data analysis

7.5.6.1 Assessing the economic impacts of floods on rural households

In the analysis of the data for Objective 1. Propensity Score Matching will be applied. The first step in PSM will be to estimate to some degree the propensity scores using some logistic models. This will be done for each individual in the sample to estimate the probability that they would be chosen to be treated (flooded) given a list of covariance such as age, gender, marital status, access to assets and other demographic and social factors. Secondly, PSM then matches across respondents both flooded and non-flooded in the survey sample who have the same characteristics or same propensity score levels. The reason is to find respondents in the non-flooded group having the same propensity score levels to the treated group. The respondents not corresponding or not matching are excluded from the analysis in the next step. Thirdly, the corresponding individuals are grouped or stratified according to their marching propensity levels. The means of the outcome variable are compared in each group. Finally, the difference in the means are compared (flooded and non-flooded strata) by weighted averages in order to estimate the average causal effects across the entire sample. The variables to be measured are indicated in Table 7.1 below.

Table 7.1 Research questions and variables to be measured under Objective 1

Research question	**Dependent variable**	**Independent variables**	**Independent variables**
What are the impacts of floods on income and income generating activities?	Income	-Age -Sex -Marital status -Designation -Education level -Family size -Location Flood duration	Remittances Farm income from crop sale Income from livestock sale -Number of years -stayed in the area - Flood occurrence

7.5.6.2 Determining the level of disaster preparedness

In order to determine level of preparedness the variables used in preparedness scale will be given scores. The variables with the highest weight will be considered the most significant while the ones with lower score will be less significant. The mean scores of each parameter will be categorised into three levels (low, moderate, high) of flood disaster preparedness. In examining the difference between flood preparedness in Zambia and Namibia, t-test will be used for normal distributed variables and for variables not normally distributed Mann-Whitney U test will be applied. Correlation coefficients between level of preparedness and socio-cognitive factors will be applied to see which of the factors are significant to flood preparedness. Some of the parameters to be measured under Objective 2 are indicated in Table 7.2 below.

Table 7.2 Variables to be measured under Objective 2

Research question	**Dependent variable**	**Independent variables**
What is the level of households' flood preparedness?	Preparedness	Member of households taught on what to do in case of flood emergency
		Member of household who attended first aid course
		Asked someone information about what to do in case of flood emergency
		Stored emergency food, medicine, clean water to use during flood emergency
		Keep a battery operated radio, flashlight or candle for flood emergency
		Have any knowledge on existing early warning system, sources of information on early warning

Table 7.3 Socio-cognitive variables to be measured under Objective 3

Research questions	**Dependent variable**	**independent Variables**
What are the social-cognitive factors that affect the level of households' preparedness?	Preparedness	-Risk Perception -Critical awareness -Responsibility efficacy -Outcome expectancy -Self-efficacy -Sense of community

7.5.6.3 Evaluating the effectiveness of the Adaptation strategies

In evaluating the effectiveness of the adaptation strategies, Multi-Criteria Analysis approach will be used. Firstly, criteria and the adaptation strategies (alternative) will be selected based on literature review as indicated in Table 7.4. However, rural households and experts will verify which criteria applies to them through focus group discussion and key informants survey. This will be done by using the Weighted Average Method (WAM). The value of 1 will indicate the worst performance and a value of 5 will indicate the best performance. The relative importance of each criterion will be determined using relative importance factors assigned by the stakeholders through focus group discussions and key informants. Relative importance factors are then normalized to produce a set of normalized criterion weights. Each designated alternative rating is then multiplied by the normalized weight as indicated in the formula below.

$$\mathbf{Sj} = \sum_{\mathbf{i=1}} \mathbf{Wi} * \mathbf{Ri, j} \qquad 7.1$$

Where, Sj = overall score for alternative j, W = Weight of criteria i, R = relative importance of criterion i

Table 7.4 Criteria to be used to measure adaptation strategies' effectiveness

Category of Criteria	Criteria	Unit	Objective
Efficiency	Vulnerability reduction	Percentage (0-100)	Maximise
Environmental	Environmental sustainability by enhancing ecological condition	Scale (1-5)	Maximise
Economic	Economic viability	Scale (1-5)	Minimise
Social	Public acceptance	Scale (1-5)	Maximise
Macro economical	Employment creation	Scale (1-5)	Maximise
Institution and technical	Institutional and Technical	Scale (1-5)	Minimise

Table 7.5 Definitions of the Criteria

Criteria	Definition of the Criteria	Comments
Vulnerability reduction	Effectiveness of the strategy in reducing vulnerability.	The higher the score, the higher the vulnerability
Environmental sustainability by enhancing ecological condition	Adaptation measure will enhance the ecological condition	The higher the score, the higher enhancement
Public acceptance	Acceptance of implementing the strategy by the rural households	The higher the score the higher the acceptance
Employment creation	Employment created through the adaptation of the strategy	The higher the score the higher the level of employment
Institutional and technical capacity	Institutional and technical capacity required to implement the adaptation strategy	The higher the score the lower the capacity required

Table 7.6 An example of a Matrix for the scoring of adaptation measure to flooding by experts and rural households.

Evaluation Criteria / **Alternatives**	Vulnerability reduction	Environmental sustainability	Economic viability	Public acceptance	Employment creation	Institutional and technical capacity
Flood water harvesting						
Adoption of flood resistance crops, e.g., rice						
Reducing livestock number						
Early warning system						

7.5.6.4 Determine the socio-economic factors influencing the choice of adaptation strategies

In determining the socio-economic factors influencing the choice of adaptation strategies, the correlation coefficients will be applied. The socio-economic factors shown in Table 7.7 will be examined and multinomial probit or logit models will be employed. These models are appropriate because they are used when the number of choices existing are more than two. For this reason they have been employed in climate change and agriculture studies (Kurukulasuriya *et al*., 2006; Deressa *et al*. 2007; Nhemachena and Hassan, 2009). The advantages of Multivariate choice models over binomial logit and probit models are two. First, they allow exploring both factors conditioning specific choices or combination of choices. Second, they take care of self-selection and interactions between alternatives.

Table 7. 7 Socio-economic variables to be measured under Objective 4

Research question	Dependent variables	Independent variables	Independent variables
What are the socio-economic factors that drive the choice of households' adaptation strategies to flooding?	Adaptation strategy	Age	Family size
		Marital status	Wealth status
		Gender	Income
		Education level	Migration

7.6 Resource Planning

All resources, including finances needed to conduct this research will be provided by WaterNet, the sponsor of the research. The research is part of WaterNet PhD programme. The approved budget amounts to 40 000 EURO and spread over a 3 year period (January 2014 – December 2016). The budget caters for the following resource required: software purchases, transport, fieldwork, book allowances, and travel and subsistence allowance for project team, printing and stationery for focus group discussions.

7.7 Time Scale

Table 7.8 A summary of activities and their timeframe

Tasks	Months												
	J	F	M	A	M	J	J	A	S	O	N	D	Year
Registration							■						
Literature review and proposal write-up								■	■	■	■	■	
Presentation at the WaterNet symposium										■			
Submission of proposal and literature review												■	2014
Development of research instruments											■	■	
Literature review and proposal defence	■	■											
Write up of a review paper on flood preparedness (paper1)						■	■	■	■				
Literature review continued	■	■	■	■	■	■	■	■	■	■	■	■	
Pilot study (Pretesting of instruments)	■												
Fieldwork (data collection (Household survey)			■	■	■								
Data entry and analysis						■	■	■					
Draft chapter(s) and feedback							■	■	■				
Publication of Objective 1 (paper 2)								■	■				
Fieldwork for Phase 2 (Focus Group)								■	■	■			
Data entry and analysis										■	■	■	2015
Presentation at the WaterNet symposium										■			
Thesis write-up of the thesis	■	■	■	■	■								
Publication of Objective 2 and 3 (Paper 3 and 4)					■	■	■	■					
Draft 1 submission of dissertation & feedback							■	■	■				
Draft 2 submission of dissertation & feedback									■	■			
Publication of objective 4 (Paper 5)										■			
Presentation at the WaterNet symposium										■			2016
Final submission of thesis										■	■	■	

8. REFERENCES

Ainuddin, S and Routray, JK. 2012. Institutional framework, key stakeholders and community preparedness for earthquake induced disaster management in Balochistan. *Disaster Prevention and Management: An International Journal* 21(1): 22 – 36.

Akpalu, W, Hassan, RM and Ringler, C. 2008. Climate Variability and Maize Yield in South Africa: Results from GME and MELE Methods, IFPRI Discussion Paper No. 843, South Africa.

Ashley, C and Lafranchi, C. 1997. Livelihood strategies of rural households in Caprivi: implications for conservancies and natural resource management. Directorate of Environmental Affairs, Ministry of Environment and Tourism, Windhoek, Namibia.

Baade, RA, Rovert, B, and Victor, M. 2007. Estimating the Economic Impact of Natural and Social Disasters, with an Application to Hurricane Katrina. *Urban Studies* 44: 2061–2076.

Balluz, L, Schieve, L, Holmes, T, Kiezak, S and Malilay, J. 2000. Predictors for people's response to a tornado warning: Arkansas, 1 March 1997. *Disaster*s, 24(1): 71–77.

Balnaves, M and Caputi, P. (2001). Introduction to Quantitative Methods, SAGE Publications.

Bandura, A. 1998. Health promotion from the perspective of social cognitive theory. *Psychology and Health* 13: 623–649.

Belasen, AR, and Polachek, S. 2008. How Hurricanes Affect Wages and Employment in Local Labor Markets. *American Economic Review* 98: 49–53.

Bird, D, King, D, Haynes, K, Box, P, Okada, T and Nairn, K. 2013. *Impact of the 2010–11 floods and the factors that inhibit and enable household adaptation strategies*. Report No 153. National Climate Change Adaptation Research Facility, Gold Coast, QLD, Australia.

Birkmann, J. 2006. Measuring vulnerability to natural hazards: Towards disaster resilient societies. Tokyo: United Nations University. 55 -77.

Brooks, M, Gagnon-Lebrun, F, Harvey, H and Sauvé, C. 2009. *Prioritizing climate change risks and actions on adaptation: A Review of selected institutions, tools, and approaches*. Final Report, Discussion Paper, Government of Canada, Canada

Carreño, M-L, Cardona, O and Barbat, A. 2007. Urban seismic risk evaluation: A Holistic approach. *Natural Hazards* 40(1): 137-172.

Central Statistical Office. 2012. Zambia 2010 Census of Population and Housing Descriptive Tables, volume 11 National descriptive Tables. Lusaka, Zambia.

Ceola, S, Laio, F and Montanari, A. 2014. Satellite night-time lights reveal increasing human exposure to floods worldwide. *Geophysical Research Letters* 41**:** 7184-7190.

Chang, SE and Falit-Baiamonte, A. 2002. Disaster vulnerability of businesses in the 2001 Nisqually earthquake. *Global Environmental Change Part B: Environmental Hazards* 4 (2): 59–71.

Chang, SE. 1984. Do disaster areas benefit from disasters? *Growth and Change* 15(4): 24–31.

Conway, D. 2005. From headwater tributaries to international river: observing and adapting to climate variability and change in the Nile basin. *Global Environmental Change* 15(2): 99–114.

Cretikos, M, Eastwood, K, Dalton, C, Merritt, T, Tuyl, F., Winn, L and Durrheim, D. 2008. Household disaster preparedness and information sources: Rapid cluster survey after a storm in New South Wales, Australia. *BMC Public Health* 8:195.

Cross, JA. 2001. Megacities and small towns: different perspectives on hazard vulnerability. *Environmental Hazards* 3(2): 63–80.

Damon, SA, Naylor, R, and Therriault, S. 2010. Public communication in unplanned biomass burning events. *Inhalation Toxicology* 22(2):113–116.

Deressa, TT, Hassan RM., Ringler C, Alemu T and Yusuf M. 2009. Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global Environmental Change* 19(2):248-255.

DFID. 2000. Sustainable Livelihoods Guidance Sheets. Department for International Development. Available from: http://www.livelihoods.org/info/info_guidancesheets.html. (Accessed: 14 March, 2015)

Diekman, ST, Kearney, SP, O'Neil, ME and Mack, KA. 2007. Qualitative study on homeowners' emergency preparedness: Experiences, perceptions and practices. *Prehospital and Disaster Medicine* 22(6): 494–501

Doocy S, Daniels A, Murray S, Kirsch TD. 2013. The Human Impact of Floods: A Historical Review of Events 1980-2009 and Systematic Literature Review. *PLOS Currents Disasters* 2013 April 16(1). Available from: http://currents.plos.org/disasters/article/the-human-impact-of-floods-a-his. [Accessed 15 March, 2015]

Doocy, SR, Evan, G and Yuri KT. 2013. Disaster preparedness and humanitarian response in flood and landslide-affected communities in Eastern Uganda. *Disaster Prevention & Management* 22(4): 326-339.

Douben, K.J. 2006. Characteristics of river floods and flooding: a global overview, 1985–2003. *Irrigation and Drainage* 55: S9-S21.

Douglas, I and Alam, K. 2006. Climate change, urban flooding and the rights of the urban poor in Africa: Key findings from six African cities. *Action Aid*, London 6.

Ellis, F. 2000. The determinants of rural livelihood diversification in developing countries. *Journal of Agricultural Economics* 51(2)**:** 289-302.

El-Raey, M, Dewidar KR and El-Hattab, M. 2004. Adaptation to the impacts of sea-level rise in Egypt. *Mitigation and Adaptation Strategies for Global Change* 4: 343–361.

Ewing, B, Jamie B. K, and Thompson MA. 2005. Empirical examination of the Corpus Christi unemployment and Hurricane Bret. *Natural Hazards Review* 6(4): 191–196.

Falkiner, L. 2003. Impact analysis of the Canadian Red Cross Expect the Unexpected Program. Institute for Catastrophic Loss Reduction. Available from: http://www.redcross.ca/crc/documents/3-1-3-1-Independent-Impact-Analysis.pdf. [Accessed: 19 March, 2015].

Floyd, D, Prentice-Dunn, S and Rogers, RW. 2000. A meta-analysis of research on protection motivation theory. *Journal of Applied Social Psycholo*gy 30(2):407–429.

Gallego, E, Jiménez, A, Mateos, A, Sazykina, T, Ríos-Insua, S. 2004. Application of Multi-attribute Analysis (MAA) to search for optimum remedial strategies for contaminated lakes with the MOIRA system. Paper presented at the 11th annual meeting of the International Radiation Protection Association; Madrid, Spain, May 23–28.

Gbetibouo, GA. 2009. Understating Farmers' Perceptions and Adaptation to Climate Change and Variability: The Case of the Limpopo Basin. IFPRI. Discussion Paper. Washington, D.C.

Gharagozlou, A, Nazari, H. and Seddighi, M. 2011. Spatial analysis for flood control by using environmental modeling. *Journal of Geographic Information System* 3(4)**:** 367-372.

Grothmann, T, Reusswig, F. 2006. People at risk of flooding. Why some residents take precautionary action while others do not. *Natural Hazards* 38(1-2):101–120.

Gwimbi, P. 2009. Linking rural community livelihoods to resilience building in flood risk reduction in Zimbabwe. *JÀMBÁ: Journal of Disaster Risk Studies* 2(1): 71-79.

Hajkowicz, S and Collins, K. 2007. Water Resource Management. A Review of Multiple Criteria Analysis for water resource planning and management. *Water Resource Management* 21(9):1553–1566.

Haque, AN, Grafakos, S and Huijsman, M. 2012. Participatory integrated assessment of flood protection measures for climate adaptation in Dhaka. *Environment and Urbanization* 24(1):197-213.

Herath, G. 2004. Incorporating community objectives in improved wetland management: the use of the analytic hierarchy process. *Journal of Environmental Management* 70(3): 263–73.

Hetherington, J. C. 1975. Samples? What Shape? How large? *Scottish Forestry* 29: 260-267.

Hinkel, J, Van Vuuren, DP, Nicholls, RJ and Klein, RJ. 2013. The effects of adaptation and mitigation on coastal flood impacts during the 21st century. An application of the DIVA and IMAGE models. *Climatic Change* 117(4):783-794.

Hofer, T. and Messerli, B. 2006. Floods in Bangladesh: History, Dynamics and Rethinking the Role of the Himalayas, Tokyo, United Nations University Press.

Intergovernmental Panel on Climate Change (IPCC) TAR. 2001. Climate Change 2001: Working Group II: Impacts, Adaptation and Vulnerability. Third Assessment Report, Annex B: Glossary of Terms, 1032.

Islam, I. 2008. Wetlands of Dhaka Metro Area: A Study from Social, Economic and Institutional Perspectives. PhD thesis, Japan Society of Promotion of Science (JSPS), College of Policy Science, Ritsumeikan University, Japan.

Jonkman, SN. 2005. Global perspectives on loss of human life. *Natural Hazards* 34: 151–175.

Julius, SH and Scheraga, JD. 2009. The team model for evaluating alternative adaptation strategies, Global Change Research Program, USEPA.

Kamwi, JM, Chirwa PWC, Manda SOM., Graz PF and Kätsch C. 2015. Livelihoods, land use and land cover change in the Zambezi Region, Namibia. *Population and Environment* 37(2) ,207-230.

Kalaba, FK, Chirwa, PW, Syampungani, S and Ajayi, OC. 2010. Contribution of agroforestry to biodiversity and livelihoods improvement in rural communities of Southern African regions. In *Tropical Rainforests and Agroforests under Global Change*, Springer, 461-476.

Kapucu, N. 2008. Culture of preparedness: Household disaster preparedness. Disaster *Prevention and Management* 17(4): 526–535.

Kenna, S. 2008. Do social housing providers across Yorkshire and the East Midlands have effective flood risk management in place when maintaining and repairing their housing stock? *Journal of Building Appraisal* 4(2): 71-85.

Keoduangsine, S and Goodwin, R. 2012. An appropriate flood warning system in the context of developing countries. *International Journal of Innovation, Management and Technology* 3: 213.

Kollmair, M and Gamper, ST. 2002. The Sustainable Livelihood Approach. Input Paper for the Integrated Training Course of NCCR North-South. Development Study Group. University of Zurich.

Kourgialas, NN and Karatzas, GP. 2011. Flood management and a GIS modelling method to assess flood-hazard areas a case study. *Hydrological Sciences Journal* 56(2): 212-225.

Kubal, C, Haase, D, Meyer, V and Scheuer, S. 2009. Integrated urban flood risk assessment – adapting a multicriteria approach to a city. *Natural Hazards and Earth System Sciences* 9(6): 1881-1895.

Kurukulasuriya, P, Mendelsohn, R, Hassan, R, Benhin, J, Deressa, T, Diop, M, Eid, HM, Fosu, KY, Gbetibouo, G and Jain, S. 2006. Will African agriculture survive climate change? *The World Bank Economic Review* 20**:** 367-388.

Kusangaya, S, Warburton, ML, Van Garderen, EA and Jewitt, GPW. 2014. Impacts of climate change on water resources in southern Africa: A review. *Physics and Chemistry of the Earth, Parts A/B/C* 67: 47–54.

Lemyre, L, Clement, M, Corneil, W, Craig, L, Boutette, P, Tyshenko, M. 2005. A psychosocial risk assessment and management framework to enhance response to CBRN terrorism threats and attacks. *Biosecurity and Bioterrorism* 3(4): 316–330.

Levac, J, Toal-Sullivan, D and O'Sullivan TL. 2012. Household emergency preparedness: A literature review. *Journal of Community Health* 37(3):725–733

Lindell, MK and Whitney, DJ. 2000. Correlates of household seismic hazard adjustment adoption. *Risk Analysis* 20(1): 13-26.

Linkov, I, Satterstrom, FK, Kiker, G, Batchelor, C, Bridges,T, Fergusond, E. 2006. From comparative risk assessment to multi-criteria decision analysis and adaptive management: Recent developments and applications. *Environment International*, 32 (8): 1072–1093.

Lopamudra, B. 2010. Effects of flood on agricultural productivity in Bangladesh, *Oxford Development Studies* 38(3): 339-356.

Luna, ME. 2001. Disaster mitigation and preparedness: The case of NGOs in the Philippines, *Disasters* 25(3): 216–226.

Lwando M. 2013. Climate Variability and Gender: Emerging Experiences from Western Zambia. *Environment and Natural Resources Research* 3 (4).

Mabuku, PM. 2013. Floods and their impacts on rural households' food security in Eastern Caprivi, Namibia. Unpublished MSc Thesis. College of Engineering and Technology, University of Dar es salaam, Tanzania.

Maddison, D. 2006. The perception and adaptation to climate change in Africa. CEEPA Discussion Paper No 10, CEEPA, University of Pretoria, South Africa.

Malkina-Pykh, IG. 2013. An integrated model of psychological preparedness for the threat impacts of climate change. Disaster proceedings of the International Conference on Disaster Management and Human Health: Reducing Risk, Improving Outcomes: 121-133.

McIvor, D. and Paton, D. (2007). Preparing for natural hazards: normative and attitudinal influences. *Disaster Prevention and Management: An International Journal* 16(1): 79-88.

Merz, B. S. Vorogushyn, S. Uhlemann, J. Delgado and Y. Hundecha. 2012. HESS Opinions; More efforts and scientific rigour are needed to attribute trends in flood time series. *Hydrology and Earth System Sciences* 16(5): 1379-1387.

Miceli, R, Sotgiu, I and Settanni, M. 2008. Disaster preparedness and perception of flood risk: A study in an alpine valley in Italy. *Journal of Environmental Psychology* 28 (2): 164–173.

Mishra, S, Mazumdar, S and Suar, D. 2010. Place attachment and flood preparedness, *Journal of Environmental Psychology* 30(2): 187–197.

Moser, CA and Kalton, G. 1971. Survey methods in social investigation. Survey methods in social investigation. 2nd Edition.

Motsholapheko, MR, Kgathi, DL and Vanderpost, C. 2011. Rural livelihoods and household adaptation to extreme flooding in the Okavango Delta, Botswana. *Physics and Chemistry of the Earth, Parts A/B/C* 36: 984-995.

Mulilis, J. P, Duval, T. S and Bovalino, K. 2000. Tornado preparedness of students, nonstudent renters, and nonstudent owners: Issues of PrE theory. *Journal of Applied Social Psychology*, 30(6): 1310–1329.

Mulengeta, T. 2012. Impacts of Adoption of Improved Wheat Technologies on Households' Food Consumption in South-eastern Ethiopia. Poster presentation at the International association of Agricultural economists Triennial Conference. Foz do Iguaçu, Brazil.

Musah, B and Akai, CY. 2014. Effects of flood disasters on livelihood coping mechanism in Tolon/Kumbumgu district of northern region of Ghana. *Int. J. Agric. Pol. Res.* 2(1):033-040.

Nektarios, NK and George, PK. 2011. Flood management and a GIS modelling method to assess flood-hazard areas. *Hydrological Sciences Journal* 56 (2): 212-225.

Neuwirth, K, Dunwoody, S, Griffin, R. 2000. Protection motivation and risk communication. *Risk Analysis* 20(5):721–734.

Nhemachena, C. 2009. Agriculture and future climate dynamics in Africa: impacts and adaptation options. University of Pretoria. South Africa.

Nick, V. 2012. Food security and African agriculture. *South African Journal of International Affairs* 19(2): 157-177.

O'Donnell, I. 2010. Addressing the Grand Challenges of Disaster Risk: A Systems Approach to Disaster Risk Management. UNISDR, Geneva.

OECD. 2006. Water and Agriculture: Sustainability, Markets and Policies. Organisation for Economic Co-operation and Development (OECD). Italy.

Olympia, RP, Rivera, R, Heverley, S, Anyanwu, U and Gregorits, M. 2010. Natural disasters and mass-casualty events affecting children and families: A description of emergency preparedness and the role of the primary care physician. *Clinical Pediatrics*, 49(7): 686–698.

Paton, D, and Johnston, D. 2001. Disasters and communities: Vulnerability, resilience and preparedness. *Disaster Prevention and Management,* 10(4): 270–277.

Paton, D. 2003. Disaster preparedness: A social-cognitive perspective. *Disaster Prevention and Management* 12(3): 210–216.

Pelling, M, Holloway, A. 2005. Legislation for Mainstreaming Disaster Risk Reduction .Tearfund. Teddington

Pennings, JME, and Grossman, DB. 2008. responding to crises and disasters: the role of risk attitudes and risk perceptions. *Disasters,* 32(3): 434–448.

Qin, XS, Huang, GH, Chakma, Nie, XH and Lin, QG. 2008. A MCDM-based expert system for climate-change impact assessment and adaptation planning – A case study for the Georgia Basin. *Expert Systems with Applications* 34(3): 2164-2179.

Rachmalia, MNS, Urai Hatthakit, RN, Aranya Chaowalit, APN. 2011. Tsunami preparedness of people living in affected and non-affected areas: A comparative study in coastal area in Aceh, Indonesia. *Australasian Emergency Nursing Journal* 14(1): 17-25.

Reddick, C. 2011. Information technology and emergency management: Preparedness and planning in US states. *Disasters*, 35(1): 45–61.

Roger, F. 2003. Flooding, vulnerability and coping strategies: local responses to a global threat South Bank University, London, UK. *Progress in Development Studies* 3(1):43–58.

Rose, A and Liao YS. 2005. Modelling regional economic resilience to disasters: A Computable General Equilibrium Analysis of water service disruptions, *Journal of Regional Science* 45(1): 75–112.

Rose, A, Gbadebo, AO and Liao, SY. 2007. Regional Economic Impacts of a Terrorist Attack on the Water System of Los Angeles: A Computable General Disequilibrium Analysis, in H. Richardson, P. Gordon and J. Moore II (eds.), Economic Costs and Consequences of a Terrorist Attack. Cheltenham, UK: Edward Elgar, 291–316.

Rustam, KZ, Raja, NRA, Zainora, A and Aisyah NI. 2013. Impacts of the 2004 Tsunami: Preparedness of the Malaysian Coastal Communities. *Procedia - Social and Behavioral Sciences* 105: 569 – 576.

SADC DRRU. 2014. Disaster Risk Reduction Unit update 3.

Saunders, M, Lewis, P and Thornhill, A. 2012. Research methods for Business Students. Sixth edition. Pearson Education Limited, Harlow, England.

Scolobig, A, De Marchi, B and Borga, M. 2012. The missing link between flood risk awareness and preparedness: findings from case studies in an Alpine Region. *Natural Hazards* 63:499–520.

Shahidur, RK, Gayatri BK, Hussain, AS. 2010. Handbook on Impact Evaluation. Quantitative Methods and Practices. World Bank, Washington.

Shewmake, S. 2008. Vulnerability and the Impact of Climate Change in South Africa's Limpopo River Basin. International Food Policy Research Institute. Discussion Paper No 00804.

Skidmore, M and Toya, H. 2002. Do natural disasters promote long-run growth? *Economic Inquiry* 40 (4): 664–687.

Stutely, M. 2003. Numbers Guide: the essential of business numeracy. London: Bloomberg Press.

Terpstra, T, Lindel, M and Gutteling, J. 2009. Does communicating (flood) risk affect (flood) risk perceptions? Results of a quasi-experimental study. *Risk Anal* 29(8):1141–1155.

Thompson, PM and Sultana, P. 1996. Distributional and social impacts of flood control in Bangladesh. *The Geographical Journal* 1:162.

Turyahabwe, N. 2006. Local capacity to manage a decentralized system of governance: The case of Uganda. PhD thesis, Stellenbosch University, South Africa.

United Kingdom Environmental Law Association (UKELA). 2014. Type of flood. Available from: http://www.environmentlaw.org.uk/rte.asp?id=100. [Accessed: 01 December, 2014].

Vaz, CAI. 2000. Coping with floods: the experience of Mozambique. Paper presented at the 1st WARFSA/WaterNet Symposium: Sustainable Use of Water Resources, Maputo, 1-2 November 2000.

Watanabe M. 2013. Institutionalising Disaster Risk Management: Latin America's Systems Approach. Evidence and Lesson Learned from Latin America (ELLA). Latin America

Worthington, A and Valadkhani, A. 2004. Measuring the impact of natural disasters on capital markets: An empirical application using Intervention Analysis. *Applied Economics* 36: 2177–2186.

Xiao, Y. 2011. Local economic impacts of natural disasters, *Journal of Regional Science* 51(4):804–820.

Yesuf, M, Falco, DS, Deressa, T, Ringler, C and Kohlin, G. 2008. The Impact of Climate Change and Adaptation on Food Production in Low-Income Countries. Ethiopia Development Research Institute. International Food Policy Research Institute. Discussion Paper 828, Washington D.C.

Zambia Vulnerability Assessment Committee. 2004. Zambia livelihood map rezoning and baseline profiling. Final Report, October 2004, Lusaka, Zambia.