DETERMINANTS OF IN-SITU FLOOD DAMAGE MITIGATION IN BWAISE 3, KAMPALA UGANDA

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March, 2016

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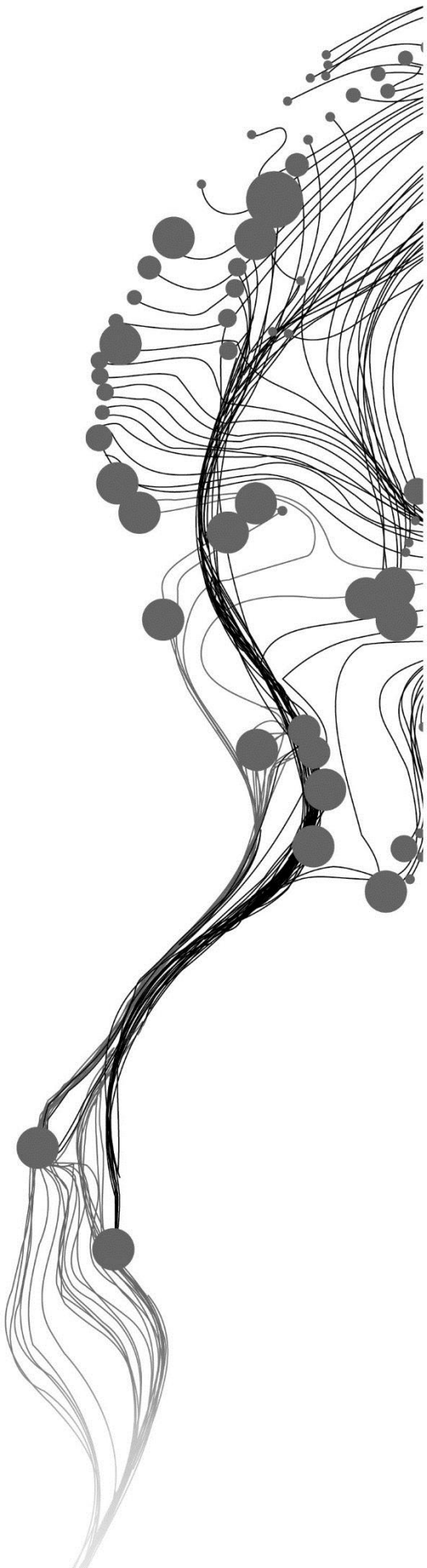

DETERMINANTS OF IN-SITU FLOOD DAMAGE MITIGATION IN BWAISE 3, KAMPALA, UGANDA

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Thesis submitted to the Faculty of Geo-Information Science and Earth Observation of the University of Twente in partial fulfilment of the requirements for the degree of Master of Science in Geo-information Science and Earth Observation.
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ABSTRACT

Owing to its relief and climate, Kampala faces recurrent floods which destroys lives and property. The situation is worse among the poor in slum settlements. Due to lack of public funds to effectively deal with the problem, understanding the ability of at risk communities to mitigate is integral. Particularly understanding why some households mitigate and others do not. Available literature in the subject does not touch much on public mitigation and is still scanty in the African context. The aim of this study is to establish the determinants of both private and public flood damage mitigation in Bwaise parish 3 – an informal settlement in Kampala, Uganda with the view of recommending in-situ mitigation principles. A questionnaire, in-depth interviews, transact walks and documentary sources were used to gather data on income, tenure security, time in the settlement, flood experience, risk attitude, social networks, governance context, threat appraisal, coping appraisal and flood damage mitigation. Within the Protection Motivation Framework, correlation and multiple linear regression analysis were used to establish the relationship between a set of key co-variables and flood damage mitigation. A spatial perspective was added by loading the household data into maps in ArcMap 10.3. The study established no significant correlation between flood probability; flood damage probability; flood benefits on one hand and damage mitigation on the other. This implies that flood exposure is not a determinant of flood damage mitigation in Bwaise 3. Consequently it poses some questions on the applicability of the Protection Motivation Theory in this informal settlement. Residents of this area are sceptical about the efficacy of capturing rain water and grassing the yard on the grounds of costs and small plot sizes respectively. Distance from the drainage channel is weakly negatively correlated to mitigation level. Flooding in this area is not only intense closer to the drainage channel but there are other factors like ground water level, which speed up inundation, for example on the western part of the settlement. It was also established that although some damage mitigation measures like small dykes are effective in barring run off from the yards, if not designed properly they speed up the accumulation of rain water both onsite and offsite. While social networks have an influence on level of mitigation, income, a proxy for socio-economic status does not. Risk attitudes, measured by assessing willingness of households to spend on mitigation, is not significantly correlated to flood experience. In turn flood experience is not significantly correlated to mitigation level. Governance context directly influenced flood damage mitigation at community level. When Kampala City Council (KCC) was transformed into Kampala Capital City Authority (KCCA), a separation of power between the political and the technical wing of the municipality reduced corrupt activities. This resulted in more effective development control and more revenue streams. Flood damage mitigation activities like expansion of the primary drainage channel, desilting of the drainage channels, paving of the road sides and yards of people living closer to the channels became widespread. In redesigning the settlement the raising of yards and houses must be prioritised compared to small dykes. Effective tertiary channels are integral in reducing inundation in the area since it has a very low gradient. House designs must promote and be compatible for capturing rainwater. Densification techniques can be used to relieve some ground of developments and create room for grass.

Key words: Bwaise 3, flood experience, threat appraisal, coping appraisal, governance, flood damage mitigation

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The contribution of contact persons in respondent organisations and departments is invaluable. Thank you Ellen, Fiona and Mohamed from Act Together, Hariet, Jude, Flavia, Joel from Kampala Capital City Authority. The ward administrator of Bwaise 3 was also helpful in this study. I am also indebted to Pade from the Uganda ministry of Housing, Lands and Resettlement for availing time to discuss the ministry's involvement in flood mitigation. Thank you Catherine from the Disaster Management Unit in the Uganda Prime Minister's Office for your information of the office's role in disaster mitigation efforts in Kampala. All the households that responded to my questionnaires and interviews made this work a success.

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ACCRONYMS

AMREF	:	African Medical Research and Education Foundation
GIS	:	Geographic Information System
IFMK	:	Integrated Flood Management Kampala project
KCC	:	Kampala City Council
KCCA	:	Kampala Capital City Authority
NGO	:	Non-Governmental Organisation
SDSN	:	Sustainable Development Solutions Network
UN Habitat	:	United Nations Human Settlements programme
USA	:	United States of America

1. INTRODUCTION AND JUSTIFICATION

1.1. Background and justification for study

Kampala's climate and relief make it a flood prone city. This predicament has been exacerbated by rampant urban growth and encroachment on flood prone areas in recent years. Consequently flood events increased from 5 in 1993 to 8 in 2007 (Lwasa, 2010). The same author notes that flood impacts include loss of life, loss of property, loss of labour time and increase in water borne diseases such as malaria, dysentery and typhoid. The situation is worse among low income households in slums because relatively more of them settle in flood prone areas.

Efforts to improve adaptation in these areas were strongly related to Millennium development goal number 7 – Ensuring Environmental Sustainability, specifically target 7D – By 2020, "to have achieved a significant improvement of the lives of at least 100 million slum dwellers" (World Bank, 2008). They also relate to the Sustainable Development Goal number 11 – "to make cities and human settlements inclusive, safe, resilient and sustainable." (Sustainable Development Solutions Network (SDSN), 2014) Because of this, the problem has attracted a lot of research interest among scholars and development agencies who provided a number of mitigation recommendations. A case in point is UN Habitat, which sponsored the 'Integrated flood management in Kampala' project (IFMK) around 2012/13 within the ambit of the 'Cities and Climate Change Initiative'. This project and many others have mainly concentrated on risk assessment; flood simulation and household resilience; vulnerability mapping; sustainable urban drainage system; and waste management (Membele, 2014; Nadraiqere, 2014; Odeyemi, 2013; Sliuzas, Jetten, et al., 2013)

IFMK's aim was to carry out a risk assessment exercise culminating in an action plan for flood mitigation (Sliuzas, Jetten, et al., 2013). Using Cellular Automata, Perez-Molina, (2014) modelled urban growth and flood interactions as a spin off from the IFMK project. The project's recommendations include: relocation of selected settlements; protection of wetlands; widening of storm drains; construction of water harvesting tanks; construction of dams; and planting of grass on bare surfaces, among others. Save for relocation, which is not the object of this research, the other recommendations are highly related to in-situ upgrading.

While these are crucial steps towards flood mitigation, their implementation and sustainability requires a buy-in and contribution from the communities at risk. Studies, for example, Chatterjee, (2010); Glavovic, Saunders, & Becker, (2010); Islam, Malak, & Islam, (2013); Lwasa, (2010); Motsholapheko, Kgathi, & Vanderpost, (2015); Samaddar, Choi, Misra, Bijay, & Tatano, (2015), have shown that top-down approaches to flood mitigation do not always offer lasting solutions to the problem and as a result risk unaware practices continue to rise in these communities. These scholars identified failure to capture community knowledge and priorities, inability to foster community ownership, wrong policy prescriptions, as well as misunderstanding of the 'anatomy' and dynamics of at risk communities, as common issues. In the case of Kampala, a few scholars (Kamugisha, 2013; Membele, 2014; Odeyemi, 2013) have attempted to analyse the social aspect of risk. However these studies did not manage to derive mitigation design principles from community knowledge and risk perceptions. By establishing the determinants of in-situ flood damage mitigation, this study provides crucial data on factors that affect willingness and ability to mitigate. It also sets a platform to establish the community thinking about proposed mitigation measures in the IFMK project. Furthermore, it leads to an understanding of the governance framework and socio-economic setting within which certain abilities and constraints, willingness and unwillingness to mitigate are shaped. Such

information is critical in shaping sustainable mitigation policy since it enables its grounding in community knowledge, abilities and priorities.

Knowledge, abilities and the priorities of communities determine their perception of risk. Often technical risk assessments by experts differ from community perceptions (Raaijmakers, Krywkow, & van der Veen, 2008). Four key debates can be followed up in existing literature. The first relates to the cost-benefit analysis of risk (Raaijmakers et al., 2008); the second relates to risk manageability (Peters-Guarin, McCall, & Van Westen, 2012). The third relates to coping strategies (Wamsler & Brink, 2014). The fourth one discusses motivation of households and communities to mitigate risk. The last debate is still at its infancy and both academics and practitioners are seeking to build a theory that explain it. In the first decade of the 21st century, the Protection Motivation Theory was adapted from the health sciences. Since its adoption, many studies, but mainly in Europe and the USA, have used it as an analytical framework for establishing determinants of flood risk mitigation. Therefore its applicability is still under scrutiny in other countries and regions. By applying it in Kampala, this study provides a case for testing its applicability in the African context. It also augments the effort of other scholars to improve it. The discussion of results also touches on some of the concepts employed in the first three debates mentioned earlier. For example the arguments raised by Wamsler & Brink, (2014) regarding individual, communitarian, hierarchical, fatalistic, ad-hoc, planned and intentional and unintentional coping strategies are key in discussing micro-strategies employed in the study area.

The nature of data generated is crucial for the drawing of principles that can be used by practitioners for grassroots based re-design and/or on-site upgrading. This is crucial for the success of the prescribed mitigation interventions. It is also in line with the thinking of stakeholders working in the area, for example Lift Cities and Act Together. These non-governmental organisations are part of other NGOs working in the area, but have distinguished themselves with their focus on flood resilience building.

Apart from generating support for urban planning practitioners in Uganda, this knowledge adds to the literature on socio-technical considerations for flood damage mitigation. Since less studies in the area have concentrated on qualitative issues, data relating to community knowledge, perceptions and mitigation priorities contributes to ongoing debates about community participation and programme success.

1.2. Statement of the problem

Community participation is influenced by how people perceive risk and mitigation options. In turn risk perception is influenced by heuristics of information processing, cognitive-affective factors, social and political institutions and cultural backgrounds (Wachinger & Renn, 2010). Risk perception studies have therefore gained currency in the last decade. Examples include Birkholz, Muro, Jeffrey, & Smith, (2014); Elrick-barr, Preston, Thomsen, & Smith, (2014); Grothmann & Reusswig, (2006); Nascimento, Guimaraes, Mingoti, Moura, & Faleiro, (2008); Poussin, Botzen, & Aerts, (2014); Reynaud, Aubert, & Nguyen, (2013); Wachinger & Renn, (2010). The main goal of such studies has been to build an understanding of the determinants of mitigation behaviour in flood prone areas. The theoretical framework guiding such studies is still under construction. The majority of these studies borrow ideas from the Protection Motivation Theory (Rogers, 1975) which originated in health sciences. It postulates that adaptive and maladaptive health related behaviours are a result of how people perceive the risk associated with a behaviour and the costs associated with it. Therefore threat and coping appraisal form the main drivers of behavioural change. This theory as it applies to flood management has been tested mainly in Europe and the USA. Besides, the concepts and variables that are used to explain flood adaptation behaviour still need more refinement. Furthermore the relationship between community governance and flood damage mitigation is still not clear. In Kampala little has been done to establish the factors that influence flood damage mitigation. This makes

Kampala an appropriate case for testing the application of the theory in the developing world context and in the process testing the relevance of other concepts and variables that can potentially improve the theory. Such concepts include governance context, risk benefits and distance from drainage features. Furthermore it is an opportunity to demonstrate how perception and mitigation data can be visualised in a way which augments statistical analysis which to this end has dominated literature in the subject. Results of this study will therefore provide a more informed basis for negotiation with the communities at risk, in the implementation of flood mitigation measures.

1.3. General objective

The main objective is to explain factors that determine adoption of flood damage mitigation measures in Bwaise area of Kampala, Uganda, with the intention of proposing re-design principles for adoption of mitigation measures.

1.3.1. Research design matrix

In line with Choguill, (2005)'s argument that many research reports are inadequate because of poorly organised ideas and instruments, the research design matrix is used in this thesis as the schema to operationalise the general objective. Consequently specific objectives, hypotheses, summary of methods and outputs are presented here. This was done to avoid lack of attention on some objectives, research questions, and hypotheses. Although some may view it as unconventional, in this thesis, it provided an elaborate template for checking fulfilment of objectives stepwise.

Table 1.1: Research design matrix

Objectives and questions	Hypotheses	Methods	Expected outputs
a. To establish the relationship between community perceptions and flood risk mitigation • How do household perceptions about flood risk benefits relate to mitigation levels? • How do household perceptions about flood risk probability relate to mitigation levels? • How do household perceptions about flood risk consequences relate to mitigation levels? • How do household perceptions about response efficacy relate to mitigation levels? • How do household perceptions about self-efficacy relate to mitigation levels? • How do household perceptions about coping costs relate to mitigation levels? • What does the community think about proposed mitigation measures in the IFMK project?	• High perceived risk benefits reduce flood mitigation • High perceived flood probability increase mitigation behaviour • High perceived risk consequences increase flood mitigation • High perceived response efficacy increases mitigation • High perceived self-efficacy leads to high level of mitigation • High perceived response costs leads to low mitigation level	***Data gathering*** • Questionnaire with household representatives • Interviews with some household representatives, municipal officers, civil society and NGO representatives ***Data analysis*** • Cross tabulation • Regression analysis	• Statistical tables and graphs • Narratives
b. To establish the relationship between distance to drainage channel and implementation of mitigation measures • What is the relationship between distance from drainage channels and mitigation levels in Bwaise?	• The greater the distance from drainage channels the less the adaptation level	***Data gathering*** • Questionnaire with household representatives • Mapping ***Data analysis*** • Regression analysis	• Statistical tables and graphs • Maps

c. To establish the relationship between social and socio-economic factors and flood risk mitigation. • How does involvement in social networks relate to mitigation levels? • How does socio-economic status relate to mitigation levels? • How does risk framing affect community mitigation priorities?	• The more the social networks a household has, the higher the mitigation level • The higher the socio-economic status of a household, the higher the mitigation level	***Data gathering*** • In-depth interviews with some household representatives • Questionnaire with household representatives ***Data analysis*** • Regression analysis • Thematic content analysis	• Statistical tables and graphs • Narratives
d. To establish the relationship between flood experience, risk attitude and levels of adaptation • How does flood experience affect mitigation levels • How does flood experience affect risk attitudes • How do risk attitudes affect mitigation levels	• The higher the experience with floods the higher the level of mitigation • The more the flood experience the more the level of risk aversion • The more the level of risk aversion, the less the mitigation level	***Data gathering*** • Questionnaire with household representatives ***Data analysis*** • Regression analysis	• Statistical tables and graphs
e. To establish the relationship between community governance and flood adaptation. • How does the community governance framework relate to mitigation levels? • Are there other institutions and processes of governance that can be used in flood adaptation?	• The higher the governance index (in terms of extent, coherence, flexibility, and intensity), the higher the level of mitigation in an area • The more the household receives protection information and incentives, the more the level of mitigation	***Data gathering*** • In-depth interviews With household representatives, municipal officials, civil society representatives Data analysis • Thematic content analysis	Narratives
f. To draw a set of principles which can guide the design of community adaptation measures in Bwaise. • How can data on mitigation determinants be used to provide community design principles		***Data gathering*** • In-depth interviews residents, planning officials, civil society organisations ***Data analysis*** • Thematic content analysis	Maps Narratives

	• Digitising points and overlaying

Source: adapted from Choguill, (2005)

1.4. Thesis outline

The thesis is organised into 7 chapters as follows:

1.4.1. Chapter 1

Introduces the background to research problem and the justification for study. It also sets the aim for study, objectives research questions and hypotheses that operationalised the aim.

1.4.2. Chapter 2

Reviews literature on flood damage mitigation using the Protection Motivation Theoretical framework. It discusses the evolution of understanding about flood risk, perception of flood probability, perception of flood damage probability, flood benefit, response efficacy, self-efficacy, cost perception, flood experience, risk attitude, flood management policy, social networks, and social status as determinants of flood damage mitigation. Methods that have been used so far to measure these concepts are also discussed. The research gap identified in chapter one is also elaborated in this chapter.

1.4.3. Chapter 3

Chapter 3 describes the study area and the population frame after which it explains the sampling strategy, research design, research approach, and research instruments.

1.4.4. Chapter 4

In the fourth chapter the first set of findings are presented and discussed. The chapter assesses the influence of socio-economic status and flood experience on flood mitigation and draws conclusions regarding the applicability of the Protection Motivation Theory in the light of the results.

1.4.5. Chapter 5

This chapter discusses the contribution of flood risk and perception of it to flood damage mitigation again within the auspices of the Protection Motivation Theory.

1.4.6. Chapter 6

Discusses the influence of governance style on flood damage mitigation. This is done by comparing the governance context under Kampala City Council (KCC) and in the post 2010 era when it was transformed to Kampala Capital City Authority (KCCA). The Water Governance Assessment Framework was used to perform the assessment.

1.4.7. Chapter 7

Tests the combined flood mitigation prediction power of the independent variables in the Protection Motivation Theory using a hierarchical linear regression model.

2. LITERATURE REVIEW

2.1. Introduction

This section contextualises risk perception within ongoing risk management debates. The researcher adopts Schanze's (2006) definitions of risk perception and risk management. The former is defined as the overall view of individuals and groups about risks that depends on their personal and shared backgrounds. The later can be defined as the strategies and actions employed to analyse, assess and attempt to reduce risk. The fact that it involves strategies and actions brings in an element of governance. It therefore, follows that apart from physical attributes of risk and community perceptions about the same, understanding of community governance processes are key in enhancing adaptive capacity in flood prone areas (Berman, Quinn, & Paavola, 2013). Firstly the researcher introduces new concepts and explains the organisation of the chapter. Secondly, a framework to explain the determinants of flood damage mitigation is presented. Thirdly the components of the framework are explained with a discussion of how they have been shown to influence flood damage mitigation in previous studies. Fourthly the researcher summarises flood damage mitigation research in Kampala and lastly concludes the chapter.

2.2. Determinants of flood damage mitigation

The concepts mentioned in the previous section help to analyse the influencing factors of flood damage mitigation. Such factors in turn necessitated flood mitigation programming since they act as 'moderation buttons' of the community mitigation system. To explain the system, a big chunk of contemporary research employs the Protection motivation framework shown in Appendix 11. In this study the modified PMT framework by Poussin, Botzen, & Aerts, (2014) adapted to include perceived benefits and governance context as shown in figure 2.1 below.

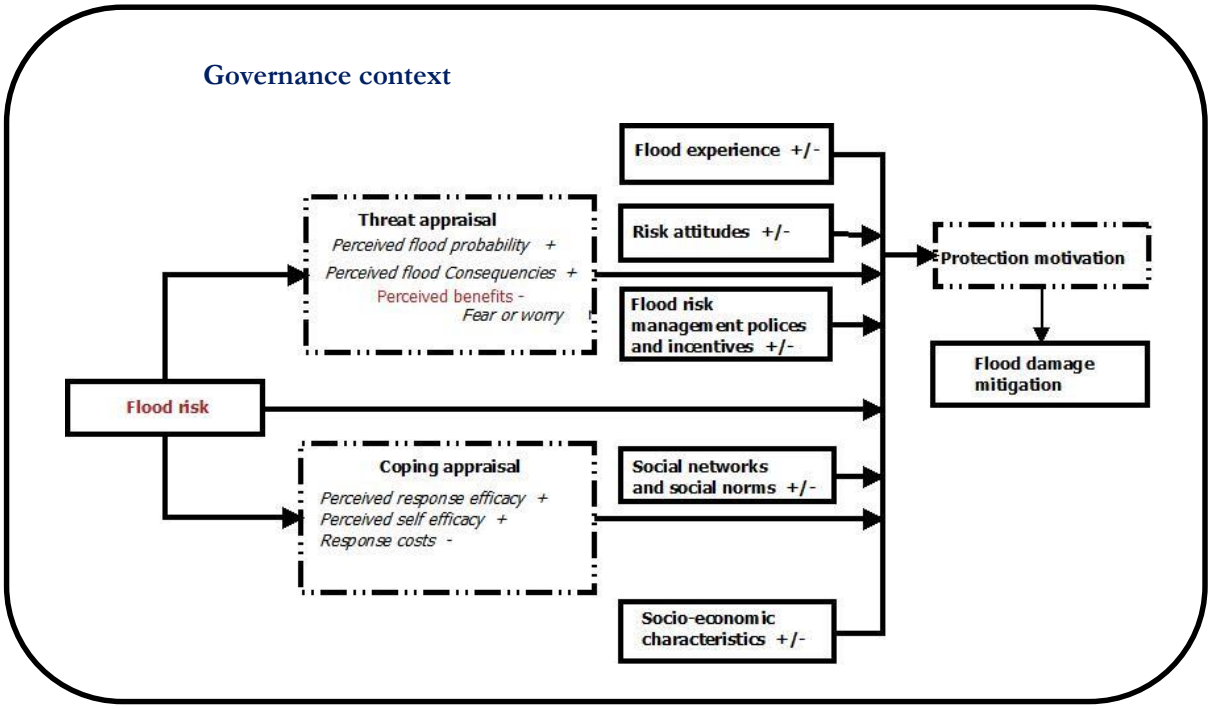


Figure 2.1: Modified framework of the Protection Motivation Theory
Source: Adapted from Poussin, Botzen, & Aerts (2014)

Figure 2 above shows the determinants of flood damage mitigation behaviour. The breaking line boxes show elements of the original PMT framework. Those in solid lines represent added elements by Poussin et al., (2014) and the red and purple fonts are additions of this thesis. From the left the diagram shows flood risk. Secondly one can observe threat appraisal by individuals, households and communities. The diagram shows that flood risk does not directly influence flood damage mitigation behaviour. Rather, individuals interpret risk in relation to threat and their coping capacity. Threat is mainly determined by the perceived probability, perceived benefits and perceived consequences associated with the risk. Coping appraisal is done in relation to perceived effectiveness of flood damage mitigation measures (response efficacy). These two processes together with protection motivation form part of the original formulation of the theory. Poussin et al., (2014) added the five elements in the middle, namely flood experience, risk attitudes, flood risk management policies and socio-economic. This study views a spatial presentation of the findings as crucial in development intervention. Hence the addition of flood risk on the first end. Secondly, importance is given to perceived benefits in the process of threat appraisal. This follows Osberghaus, (2014) remark that some individuals and households may not mitigate for them to continue receiving aid (charity hazard). Lastly governance context is added to the five elements added by Poussin et al., (2014) to the theoretical framework. In subsequent paragraphs the main concepts are explained within the context of ongoing debates in literature.

2.2.1. Flood risk: Evolving perspectives

Risk can be defined as the probability of a hazard occurring in a way that exposes valuable elements (Schanze, 2006). Physical approaches to risk analysis form the foundation for other angles from which to analyse it (Shreve et al., 2014). These approaches have been adopted to quantify risk in physical terms culminating in an objective understanding of the phenomenon. In flood management, physical approaches may employ geo-information technology to produce risk maps using flood probability data, runoff velocity, water depth, sedimentation, among others (Schanze, 2006). Within the tenets of this approach, flood risk perception is understood to be influenced by levels of knowledge about the objective flood risk in the physical environment (Wachinger & Renn, 2010). An assumption is that citizens have access to and can correctly comprehend risk maps.

2.2.2. Flood risk perception

Since flood risk interacts with human beings, researchers built on the physical understanding of risk to establish why people settle in risky areas despite the damage associated with such areas (Shreve et al., 2014). This gave birth to the psychometric paradigm. The paradigm mainly guided the process of characterising risk judgement by individuals and how it differs from that of experts by mapping heuristics (Shreve et al., 2014). The authors further explain that from this viewpoint, risk perception is shaped by likelihood, magnitude, probability, consequence and aggregation of risk. However, this view has been criticised for focusing on the individual ignoring environmental, social, cultural and economic factors. This gap was reduced by sociological research which is both constructivist and positivist. Consequently it helped to understand how people develop risk perceptions in the social context, for example by linking cognition, social aspects and actions. (Shreve et al., 2014). Frameworks have been developed therefore, that capture risk as both socially constructed, and objective. One example is the Social Amplification of risk framework (Kasperson et al., 1988). This is however outside the scope of this study but worth mentioning for a detailed understanding of the evolution of thinking in the subject of study.

2.2.3. Threat and coping appraisal

People shield themselves from a hazard if they think that the risk is high (Poussin et al., 2014). Threat appraisal includes perceived probability, perceived consequences (Reynaud, Aubert, & Nguyen, 2013), and perceived benefits of action (Osberghaus, 2014; Raaijmakers et al., 2008). Additionally they consider the

coping alternatives available in terms of effectiveness (high response efficacy), simple (high self-efficacy), and cheaper (low response costs) (Poussin et al., 2014). Previous studies, for example Grothmann & Patt, 2005; Messner & Meyer, 2006; Poussin et al., 2014; Reynaud et al., (2013), agree that threat and coping appraisal have a positive correlation with adoption of mitigation measures. However, the levels of significance vary from case to case. This calls for more studies on the subject to build a more general image of how these concepts relate to adoption of mitigation measures.

2.2.4. Flood experience

This is the past involvement of an individual or household in the hazard event. It is believed to stimulate them to adopt non-structural mitigation measures but not intentions to implement measures (Grothmann & Patt, 2005; Kreibich, Thieken, Grunenberg, Ullrich, & Sommer, 2009; Poussin et al., 2014; Thieken, Cammerer, Dobler, Lammel, & Schöberl, 2014). However, intentions to implement measures was found to have a positive correlation with flood experience in one part of the study area – the Ardennes where the frequency of flooding is very high. In the same line of argument Kellens, Zaalberg, Neutens, Vanneuville, & De Maeyer, (2011) differentiate direct personal experience to flooding (which usually leads to adoption of mitigation measures) and vicarious experience which normally do not result in adoption of measures. The former refers to the currency and damage frequency while the later refers to hearing about hazard events from others. However these scholars and the others they refer to, based their conclusions on European cases. Therefore, it is interesting to establish whether the same holds for a case from an African country. In this thesis flood experience is divided into one with damage and that without damage. Flood damage refers to any form of harm to humans, their assets and their health which stimulates adoption of mitigation measures (Messner & Meyer, 2006).

2.2.5. Risk attitudes

Risk attitudes are the inner judgements of an individual regarding uncertainties, investment costs and potential benefits from the investment http://study.com/academy/lesson/risk-aversion-definition-principle-example.html. Though with a small relationship, risk aversion in individuals positively result in implementation of mitigation measures or at least intention to mitigate (Poussin et al., 2014)

2.2.6. Flood risk management policies and incentives

Flood risk management policies and incentives negatively influence the adoption of flood mitigation measures in developing countries (Poussin et al., 2014; Terpstra, 2011). To observe this, the influence of having received and/or looked for information about flood risk; and having received an incentive on adoption of or intention to adopt mitigation measures was tested. This has been seen to increase a feeling of being protected and thereby reducing initiative to mitigate at household level. However it is argued in this thesis that such a feeling can easily develop where people have a general trust in government authorities. An attribute which does not obtain in Kampala.

2.2.7. Social networks

Social networks are associational lines in a society and social norms are rules for interaction in the society. They play a crucial role in the adoption of mitigation measures through lines of credit and other forms of support (Reynaud et al., 2013)

2.2.8. Socio-economic status

The influence of socio-economic characteristics on mitigation behaviour is mixed (Kellens et al., 2013). Income, age, home ownership, education level, household size are the main variables under this concept, which have been observed to have an effect on levels of adaptation. According to Poussin et al., (2014), home ownership (tenants are usually restricted to implement structural measures without the landlord's approval), education level and household size are positively correlated to adoption of mitigation measures (Bubeck, Botzen, Kreibich, & H. Aerts, 2012; Kreibich et al., 2009). The same goes for income and age -

albeit with a significant dependence on the time of continuous residence on current property. Elsewhere, other scholars established that the older the respondents, the less willing to adopt more measures. In this matrix of findings an addition of the trend in Kampala is interesting.

2.2.9. Governance context

Mitigation decisions are also influenced by the context of actors the household and community finds itself in. For example implementation of measures may be in response to what other actors are doing (Elrick-barr, Preston, Thomsen, & Smith, 2014). The willingness can also be affected by the governance approach to risk management. In the Netherlands (Terpstra, 2011) observed that the governance approach to flood risk causes citizens to build much trust in the public authorities ending up doing little in terms of proactive mitigation. Theoretical constructs surrounding contemporary public governance relate to the New Public Management. This is based on the public choice theory and popularises the need for grassroots participation and local representation (Gruening, 2001). Decentralisation guided by principles transparency, accountability, popular participation has therefore characterised reform efforts inspired by this school of thought (Eakin, Eriksen, Eikeland, & Øyen, 2011). Although the idea is catchy, recent studies have established poor performance in authorities that embrace it especially in developing countries. For example Eakin et al., (2011) established that the philosophy in Upper Lerma Valley has not yielded popular participation. Rather politically mobilised groups are the once that can push the authorities to respond to their flooding situation leading to fragmented interventions. This has let some public authorities to control actors in the decentralised framework. A case in point is Kampala city where the decentralised Kampala City Council was not performing partly because of politicking and corruption (Stelman, 2012). This led to the transformation of the authority to Kampala Capital City Authority (KCCA) through an act of parliament in 2010 (Karyeija & Kyohairwe, 2010; Madinah, Boerhannoeddin, Noriza Binti Raja Ariffin, & Michael, 2015). According to (Madinah et al., 2015), there is notable change towards efficiency in project implementation but reduction in bottom-up accountability. This study sought to establish how the culture of governance changed when the city authority was changed from Kampala City Council (KCC) to Kampala Capital City Authority (KCCA) in 2010 and the implications it had in community flood mitigation in Bwaise 3. The Water Governance Assessment Tool which assesses the governance quality by establishing its extent, coherence, flexibility and intensity, was used in this process. These qualities were examined across 5 elements of governance which are: levels and scales; actors and networks; problem perspectives and goal ambitions, strategies and instruments; and responsibilities and resources for implementation. Please refer to appendix 10 for more detail. This was then related to the flood mitigation efforts in the area.

2.3. Flood damage mitigation

This concept contains the dependent variables like structural measures, avoidance measures, emergency preparedness measures and intentions to mitigate (Poussin et al., 2014). In other words levels of flood damage mitigation are believed to be influenced by the above-mentioned variables. In literature, flood damage mitigation has been given different dimensions. A distinction has been made between structural mitigation measures and non-structural mitigation measures, voluntary mitigation and involuntary mitigation, private mitigation and public mitigation.

2.4. Flood research in Kampala

Not much flood research has been carried out in Kampala. Although the few studies that have been carried out cut across the constructivist/positivist divide, more still needs to be done from the perspective of the former. Largely positivist studies were mainly aimed at assessing flood risk using urban growth scenarios and hydrological modelling culminating in the production of risk maps for the city or parts of the city. Examples include (Githinji, 2014; Perez-Molina, 2014; Sliuzas, Jetten, et al., 2013). These studies helped to

identify flood prone areas together with levels of severity. Their findings have become the basis for a number of recommendations for adopting flood mitigation measures by the Kampala municipality.

However these recommendations were not based on a wider consultation of the residents in these flood prone areas. A few studies, for example Kamugisha, (2013) and Odeyemi, (2013) looked at the social aspects of risk. Although the former undertook to establish the experiences, perceptions and coping mechanisms of residents about flood risk in Bwaise, its main focus was on business operators. Moreover, the framework of analysis was more biased towards physical attributes of risk – water depth, water duration, elevation and distance from a drainage channel. This appears to be largely following the physical approach to the study of perception which does not result in rich data. Coping strategies identified include doing nothing, cleaning of drainage channels, raising foundation and entrance of shops, removing of flood water from work places, borrowing money, use of sand bags to stop water from entering the shops, covering the flow with saw dust, moving items to a higher level. This having been established, it will still be interesting to know whether the same holds for households. Additionally characterising the coping mechanisms in relation to perception is integral in determining interventions that stimulate certain directions of adaptation. Questions therefore still remain about the socio-psychological factors contributing to different risk perceptions. Let alone the extent to which the perceptions determine adaptation action. Although coping mechanisms were discussed, they were not linked to knowledge and perception levels. Such information is readily usable by practitioners in designing mitigation measures and still needs to be provided. Odeyemi, (2013) studying in Kawempe area in Kampala attempted a social assessment of risk but it was limited to social vulnerability and perceptions about household mitigation measures. It follows therefore that the afore-mentioned gap still exists.

2.5. Review of research methods

The choice of methods used in flood risk perception studies depends on the goal of measuring the same. Three groups of studies can be identified. The first group identifies determinants of risk perception (Botzen, Aerts, & Bergh, 2009; Kellens, Vanneuville, Neutens, & De Maeyer, 2011). The second group relates flood risk perception to damage mitigation (Bubeck, Botzen, Kreibich, & Aerts, 2013; Kreibich et al., 2009; Botzen, Aerts, & van den Bergh, 2013; Peters-Guarin, Mccall, & van Westen, 2012; Nascimento, Guimaraes, Mingoti, Moura, & Faleiro, 2008; Osberghaus, 2014; Poussin et al., 2014). The third group uses flood risk perception to rank hazard types and events (Raaijmakers et al., 2008). The second group is of interest in this study since it links flood risk perception to flood damage mitigation.

As already noted in section 2.2 the majority of studies use modifications of the protection motivation theory which stipulate that threat appraisal and coping appraisal determine motivation levels to mitigate. The modifications have resulted in the addition of more determinants to risk perception (Botzen et al., 2013; Grothmann & Reusswig, 2006; Poussin et al., 2014), namely: socio-economic status; policy; attitudes; flood experience; and social networks and norms.

The majority of studies, for example: Botzen et al., (2013); Bubeck et al., (2013); Grothmann & Reusswig, (2006); Kreibich et al., (2009); Nascimento et al., (2008); Osberghaus, (2014); Poussin et al., (2014) use questionnaire surveys (telephone, face to face or internet) to establish the relationship of the above-mentioned determinants and flood damage mitigation. These studies use correlation and regression analysis with slight differences in the type of regression models used and methods of testing multi-collinearity among variables. The types of regression chosen are determined by the way the concepts are measured, for example; where the mitigation variable is binary, Bubeck et al., (2013); Grothmann & Reusswig, (2006); Osberghaus, (2014) (i.e. either a household mitigates or not), logistic regression or probit model is used. Studies with a taxonomy of mitigation, for example, Poussin et al., (2014) use multiple linear regression.

Although the use of binary dependent variables enables a detailed analysis of individual measures, it fails to present the broader picture which taxonomic linear regressions can do.

Another group of studies used participatory geo-information techniques to map community perceptions of risk (Peters-Guarin, Mccall, et al., 2012) The advantage of such studies is that they blend physical risk with how people perceive it and represent it in space. They therefore offer more understanding to practitioners especially in enabling targeting. This study does the same but not using participatory GIS. Rather it uses a questionnaire survey whose results are inputted on a point map, with the points representing interviewed households. This approach is not wide spread, yet if done properly, using Tobler's law, Miller, (2004) it helps to represent socio-psychological data which is crucial in mapping sensitisation and mitigation interventions.

2.6. Conclusion

The protection motivation theory is a promising framework for research about flood damage mitigation evidenced by its adoption by several researchers mentioned above. Its strength is in the acknowledgement that damage mitigation is not only a reaction to physical risk, but also to how at risk communities perceive that risk in relation to their ability. Threat and coping appraisal viewed together with flood experience, socio-economic status, social networks, flood probability, risk attitudes and flood policy, has shown a general agreement that flood probability and flood damage probability do not have a big impact on damage mitigation. The other variables however show a positive correlation with damage mitigation levels although in some cases the relationship is weak. Research in this subject has however been concentrated on Europe (mainly German, Netherlands and Belgium) and the United States of America. It has also assessed drivers of private mitigation and no study has addressed drivers of public damage mitigation. Furthermore, contemporary studies do not use visualisation techniques, yet they are crucial for targeting by practitioners. This thesis closes this gap by assessing the same in an informal settlement of Kampala – Bwaise parish 3.

3. METHODOLOGY

3.1. Introduction

This chapter explains the procedure which was followed in the execution of the study. It is organised in 3 main sections. This section introduces the reader to the chapter. The second one explains the research design. Its components include study approach, description of the study area, population delimitation, sampling strategy, data gathering methods, fieldwork process, data preparation and data analysis methods. The third section concludes the chapter.

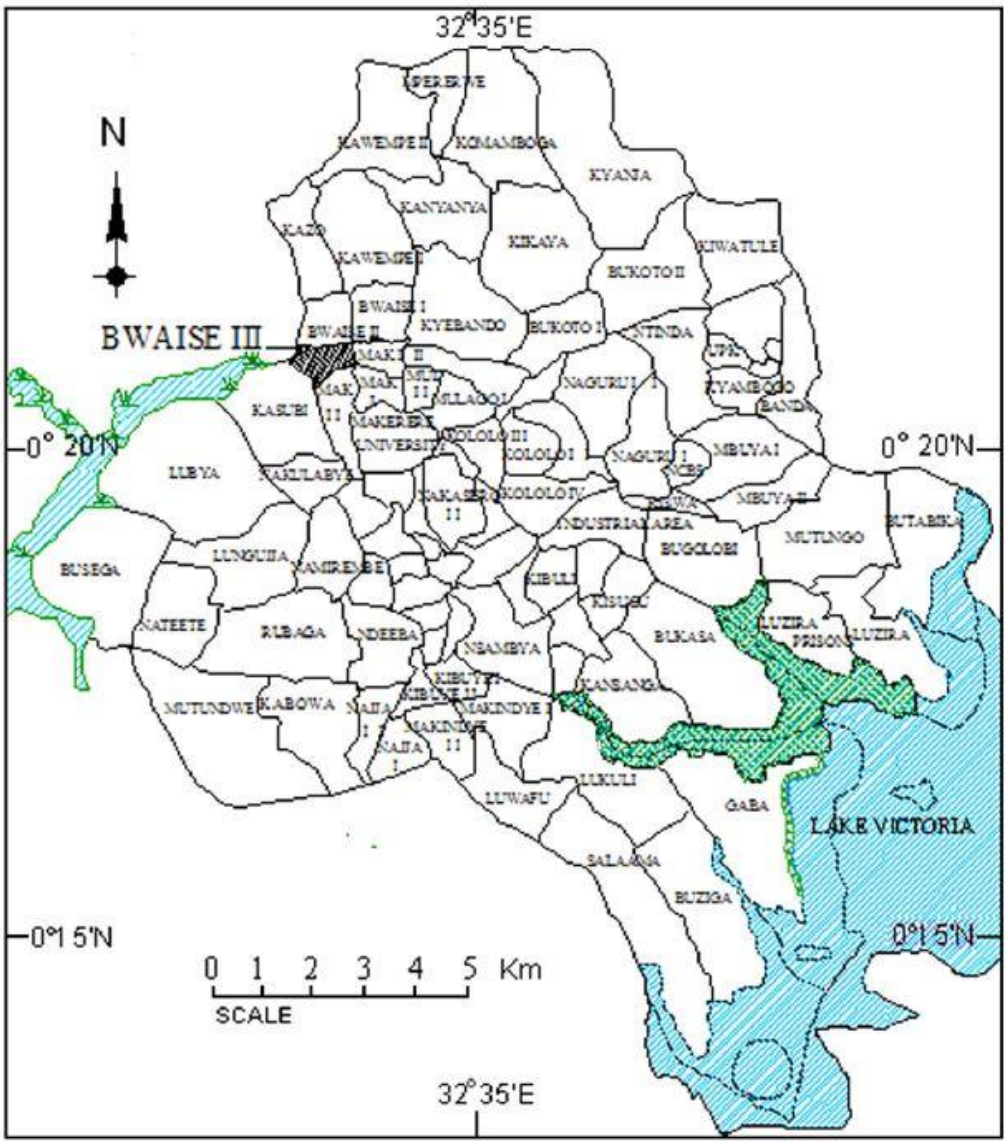
3.2. Research design

The study follows a case study design. A case study is a comprehensive investigation of a single example (Flyvbjerg, 2006). Following Kuhn, (1970) and Morgan, (2007) a mixed methods approach was adopted within the post-positivist paradigm. This stance acknowledges the relevance of both physical and meta-physical factors that determine human behaviour. The rationale behind the choice of this design is that it assisted to capture data on perception; governance; and adaptation which are related to physical and psycho-social attributes. Such data are both qualitative and quantitative. Qualitative data has come under scrutiny from radical positivists over the years due to the immersion of the researcher in the research process. This, according to them compromises objectivity. While this study contents with this fact, it also argues that objectivity from a radical positivist angle compromises the richness of data and even fails to capture some valuable data on behaviour. Therefore in the qualitative component of this study self-introspection was used to reduce researcher bias in line with axiological principles (Morrow, 2005). The case was selected based on its history of flooding and flood research.

3.2.1. Study area

Bwaise 3 is among the 24 parishes that constitute the Kawempe division of Kampala. The parish is home to about 7000 households adding up to a total population of around 50 000 people (Act Together, n.d.; Isunju et al., 2013). Five people constitute an average household. The land is owned by the Buganda kingdom (Kabaka) and customarily used by settlers. Bwaise 3 is a low lying area with acute squalid conditions – around 1600 housing units in 57 hectares. The majority of the population is involved in informal activities which can be characterised as small to medium enterprises. Figure 3 below shows the location of Bwaise in Kampala. The area is chosen because of pronounced flooding experiences in an informal development setting. Previous research in the area and the current focus on it as a pilot case for a lot of development planning initiatives also make it an interesting case. Because of its unique population characteristics, it offers a platform to test the applicability of the Protection Motivation Theory. .

Figure 3.1: Location of Bwaise 3 in Kampala



Source: (Kulabako, Nalubega, & Thunvik, 2007)

3.2.2. Population delimitation

The population frame consists of all households in Bwaise 3 parish. Since official lists in slums are often unreliable, a satellite image for 2010 was used as the population frame of buildings to be selected. Apart from unreliability of lists, the analysis of perceptions, social status and implementation of mitigation measures would be related to distance from the drainage channels. Therefore the use of an image as a sampling frame would fulfil such objectives. The image showed more concentration of buildings as one moves through the northings and fewer buildings along the eastings. This can be explained by the orientation of roads and secondary drains.

3.2.3. Sampling strategy

A fishnet grid in ArcMap 10.3 was used to fulfil both the objective of random selection and that of spatial spread of respondents from the drainage channels. Randomness was a bit compromised by making the grid rectangular (25m*50m. This came after an observation that the image had more amount of space covered by roads, open spaces and drains as one moves through the eastings. Therefore the length of the grid cell stretched in that direction to reduce the number of gaps. Centroids of the rectangular grids were created

and housing units upon which they fell were selected for interviewing. Households that inhabit those selected housing units were then interviewed. In cases where more than one households stay in a housing unit, the household from which the interviewer got a representative first was interviewed. Figure 4 below shows the map of Bwaise 3 parish with the fishnet grid and centroids.

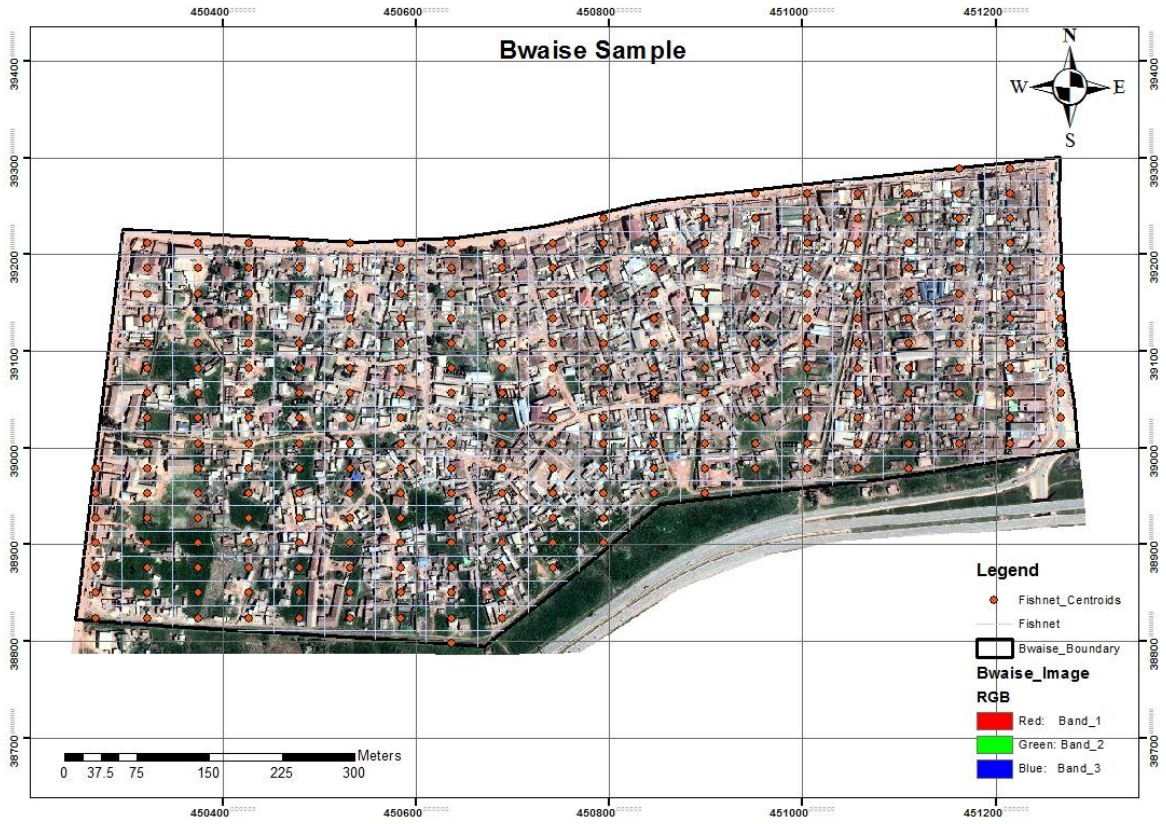


Figure 3.2: Sample selection in Bwaise 3

3.2.4. Data gathering methods

a. Two hundred and sixty eight semi - structured questionnaires were administered to residents. Questions were designed to establish the relationship between perceptions, experience, policies, social networks, socio-economic status, with household flood damage mitigation level. The structured part of the questionnaire helped to easily gather large amounts of data analysable in the Statistical Package for Social Scientists software. The unstructured part of the questionnaire helped to capture qualitative data for clarity on some sections of the questionnaire. For example clarity on types of incentives that residents received and also on mitigation measures that they implemented. Some socio-economic data like source of income were also generated using unstructured questions. The loss of richness of data associated with structured questions was countered by 10 in-depth interviews which were conducted with selected respondents. The12 in-depth interviews with officials in government and the NGO sector also served the same purpose.

b. In-depth interviews were administered to professionals, community leaders and selected residents who had answered the questionnaires. The professionals include the Director of Gender and Community services in the Kampala Capital City Authority (KCCA), the head of the preventive section of the public health department in KCCA, urban development commissioner in the Ministry of Lands, Housing and Urban development, the physical planner at KCCA headquarters, the physical planner at KCCA Kawempe division, the ward administrator of Bwaise Parish 3, the

commissioner in the disaster preparedness and management in the Prime Minister's office, 3 representatives from ACT Together and community representatives. The community leaders included the chairman, secretary of the Bwaise 3 Slum dwellers association and heads of 9 selected households. The purpose of the in depth interviews was to gain more quintessence with governance frameworks, community mitigation priorities and risk framing. The rationale behind such a choice is that, since the data required to observe these concepts are more qualitative, the instrument optimised data generation resulting in rich data which was used to validate some findings in the questionnaires.

c. Observation
   The researcher walked two times through several parts of the research area observing various mitigation efforts employed. The first one was during a normal day while the second one was just after heavy rain. The purpose of this exercise was to get familiar with the mitigation measures and their effectiveness as a way of validating the responses in the questionnaire.
d. Documentary sources of data were used for literature review and also as a source of technical assessment results to be compared to community views. This was advantageous in generation of concepts and variables and the understanding of knowledge in the subject under study.

3.2.5. Ethical considerations

In the execution of study, respondents were assured that their real names were not going to be part of the research results and that the data they gave would be used solely for academic purposes. No explicit images of individuals were used in this thesis.

3.2.6. The fieldwork process

The fieldwork was executed with the help of 6 research assistants. Their main purpose was to administer the questionnaire and community interviews while the researcher concentrated on key informal interviews with professionals. Three of the research assistants were final year undergraduate students at Makerere University. The other three assistants were solicited from the Bwaise 3 community. The student research assistants were trained first with some help from Professor Shuaib Lwasa of Makerere University. Since the questionnaire was in English and the community was less literate, the professor assisted by quizzing the research assistants about how they would translate some difficult words and phrases into the Luganda language. This triggered an interesting discussion until a common understanding was reached. The researcher explained to the assistants the research problem, the conceptual framework and went question by question making clear what type of data was sought. In the field time was created to monitor their progress for data quality control.

3.2.7. Data preparation

Data from the questionnaires was entered into the Statistical Package for Social Sciences and examined for gaps and consistency. Some unstructured data, for example mitigation measures and flood experience, were coded after the researcher noted some pattern in them. This necessitated their inclusion in statistical analysis. The fishnet centroids which represented sampling points were coded with the number for the respective questionnaires which were administered at each of them. Interview data was transcribed and edited and analysed in Atlas TI. The following table lists the concepts related to the variables in the data:

Table 3.1: Concepts and variables in the data

Concept	Variables in the data
Threat appraisal	1. Perception about the likelihood of being flooded measured along a no, low, medium and high continuum. 2. Perception about the likelihood of flood damage measured as above
Coping appraisal	1. Perception about the ability of any household member to implement flood mitigation measures. This was answered either as yes or no. 2. Perception about the effectiveness of flood mitigation measures assessed as ineffective, somewhat effective, effective, and very effective 3. Perception about time requirements for implementing flood mitigation measures assessed either as less or more. 4. Perception about costs of implementing flood mitigation measures assessed either as low or high NB. The responses to the above questions were put into three categories per household, that is: responses for structural flood mitigation measures, for non-structural flood mitigation measures, and public flood mitigation measures.
Flood experience	1. Whether a household or household member has experienced flooding before. Answers sought were either yes or no. 2. Extent of flooding – an unstructured question the answers of which were later coded as low risk flooding, damage to property, life threatening, and loss of life.
Risk management polices	1. Whether a household sought flood risk information generating a yes or no answer 2. Whether a household received flood risk information generating yes or no answers.
Risk attitudes	Whether the household is willing to spend resources to protect its property. The question was structured with the following answering options: not willing, somewhat willing, willing, and highly willing
Socio-economic status	1. Income - seven income brackets provided as choice answers normalised into per capita income. 2. Family size – answers were provided as scale values 3. Status of house - either owned, rented or borrowed. 4. Number of people employed in the formal or informal sector –data provided as scale variables. 5. Highest educational level reached by any member in the household – answer options structured into primary school, High school, or none
Benefits from flooding	1. Whether or not a household accrues benefits from flooding. Answers were either yes or no.
Distance from channel	1. Buffer distance from the drainage channel – distances derived from a ring buffer with 50m distances. 8 rings were created.
Governance	A qualitative analysis of the governance structures and principles from a comparison of Kampala City Council (the then city authority until 2010) and Kampala Capital City Authority
Damage mitigation(dependent variable)	Respondents were asked to list the flood damage mitigation measures that they have implemented in an open question. The answers were coded into structural, non-structural and communitarian mitigation. This is in line with current scholarship in flood damage mitigation. Counts of measures per class per respondent household were used as dependent variables in correlation and regression analysis.

3.2.8. Data analysis methods

a. Thematic Content analysis was used to analyse responses from open ended questions in the questionnaire and in-depth interviews. The themes were derived from literature, for example, flood levels, mitigation levels among others.
b. The research analysed questionnaire responses using pie charts, cross tabulation, Spearman's correlation and linear regression analysis in Statistical Package for Social Science. The first was used to show the age

of respondents, time of residence in Bwaise, and occupation. The rationale behind adopting such tools is their ability to represent categorical data which does not necessarily require correlation analysis. The second was used to establish how risk attitudes and mitigation level relate to food experience. The researcher used Spearman's correlation to establish how distance from the channel, perception of flood probability, perception of damage probability, response efficacy, self-efficacy, coping costs and flood benefits relate to flood damage mitigation level. One merit of using this approach is its ability to show correlation between non-normally distributed data. The linear regression was done in a hierarchical way since it is the best way for theory testing. Such attribute may be lost if one uses the step wise regression method (Field, 2013). The R^2 values were used to observe the extent to which the independent variables can predict the outcome in the dependent variables. To avoid multi-collinearity in the predictor variables, the researcher ensured that the Variance Inflation Factor (VIF) for each of them was below 10 (Field, 2013). In the linear regression model, the Durblin-Watson statistic is close to 2 – an indication that the errors in the model are independent. The spread of values in the residuals plots were used to assess heteroscedasticity and linearity. Please refer to appendix 13.

c. Maps were produced using ArcMap version 10.3 to relate community perceptions and levels of flood damage mitigation to spatial distribution of risk. Using the Gertis-Ordi G_i^* statistical analysis in ArcMap 10.3, Hot spots of perception, flood experience and mitigation levels were identified. A 150m zone of influence was used to enable the autocorrelation of at least 18 household points since the fishnet rectangle was 50m x 25m.

3.3. Conclusion

The use of a mixed methods approach to measure the determinants of flood damage mitigation in Bwaise offered an opportunity to understand the significance of individual factors on mitigation at the same time visualising perception across sample households. Moreover interview data necessitated in-depth understanding of the stories that shape their perceptions. Such an approach resulted in rich understanding of flood risk and how it is perceived differently even by people in the same vicinity from the drainage channel.

4. SOCIO-ECONOMIC STATUS AND FLOOD EXPERIENCE AS FACTORS OF FLOOD DAMAGE MITIGATION IN BWAISE 3

4.1. Introduction

The purpose of this chapter is to document the relationship between socio-economic status and flood experience on one hand and flood damage mitigation on the other. Age of respondents, income and occupation are the variables associated with socio-economic status. Flood damage mitigation as a variable comprises counts of damage mitigation measures adopted. The measures are classified into structural (e.g. small dykes, raising the floor and rebuilding the house), non-structural (e.g. putting furniture on a high place and moving away to a safer place) and communitarian (cleaning the darainage) Descriptive statistics about these and other variables to be explored latter are presented in table 4.1 below.

Table 4.1: Descriptive statistics for variables used

Descriptive Statistics

	Statistic	Range	Min.	Max.	Mean	Mode	Std. Error	SD	Variance
Household size	268	11	1	12	4.81		.152	2.484	6.172
Age	267	64	16	80	35.39		.769	12.566	157.908
People in informal sector	267	7	0	7	1.31		.060	.976	.952
Per capita Income	268	87500	0	87500	14638		854	13978	195401822
Status of house	267	2	1	3	n.a.	2	n.a.	n.a.	n.a.
Likelihood of flood damage	266	3	0	3	n.a.	3	n.a.	n.a.	n.a.
Benefit from flooding	264	3	0	3	.11		.026	.423	.179
Self-efficacy (structural)	261	4	0	4	n.a.	2	n.a.	n.a.	n.a.
Self-efficacy (non-structural)	268	4	0	4	n.a.	1	n.a.	n.a.	n.a.
Response efficacy (structural)	268	12	0	12	n.a.	7	n.a.	n.a.	n.a..
Response efficacy (non-structural)	268	11	0	11	n.a.	1	n.a.	n.a.	n.a.
Time requirement (structural)	257	6	0	6	n.a.	5	n.a..	n.a.	n.a.
Time requirement (non-structural)	268	8	0	8	n.a.	5	n.a.	n.a.	n.a.
Implementation cost (structural)	268	8	0	8	n.a.	7	n.a.	n.a.	n.a.
Implementation cost (non-structural)	268	8	0	8	n.a.	4	n.a.	n.a.	n.a.
Willingness spend resources to protect	262	3	0	3	n.a.	0	n.a.	n.a.	n.a.
Received information about flood protection	262	1	0	1	n.a.	0	n.a.	n.a.	n.a.
Feeling about flood protection from Government	263	3	0	3	n.a.	0	n.a.	n.a.	n.a.
Flood Experience	213	7	1	8	n.a.	1	n.a.	n.a.	n.a.

Mitigation measures caused by social networks	255	1	0	1	.58	.031	.494	.244	.58
Received incentive to implement mitigation measures	262	1	0	1	n.a.	0	n.a.	n.a.	n.a.
Occupation	253	3	1	4	n.a.	1	n.a.	n.a.	n.a.
Time in Bwaise	264	68	1	69	13.53		.727	11.810	139.470
Valid N (list wise)	160								

For many variables table 4.1 above shows very small average distances to the mean and consequently its squared value. This implies that in this settlement, households are almost at the same level in terms of socio-economic status, attitude, experience and mitigation. On the other hand, age, income and time of stay in Bwaise show bigger values of standard deviation and variance.

4.2. Characteristics of respondents

Females constitute 73 and males constitute 26. The majority of the respondents are young to lower middle aged (between 16 years and 37 years). A quarter of the population is in the upper middle age. The least two groups are 50 years – 60 years, and 60 years + which both constitute 13%. This can be seen visually in figure 4.1 below:

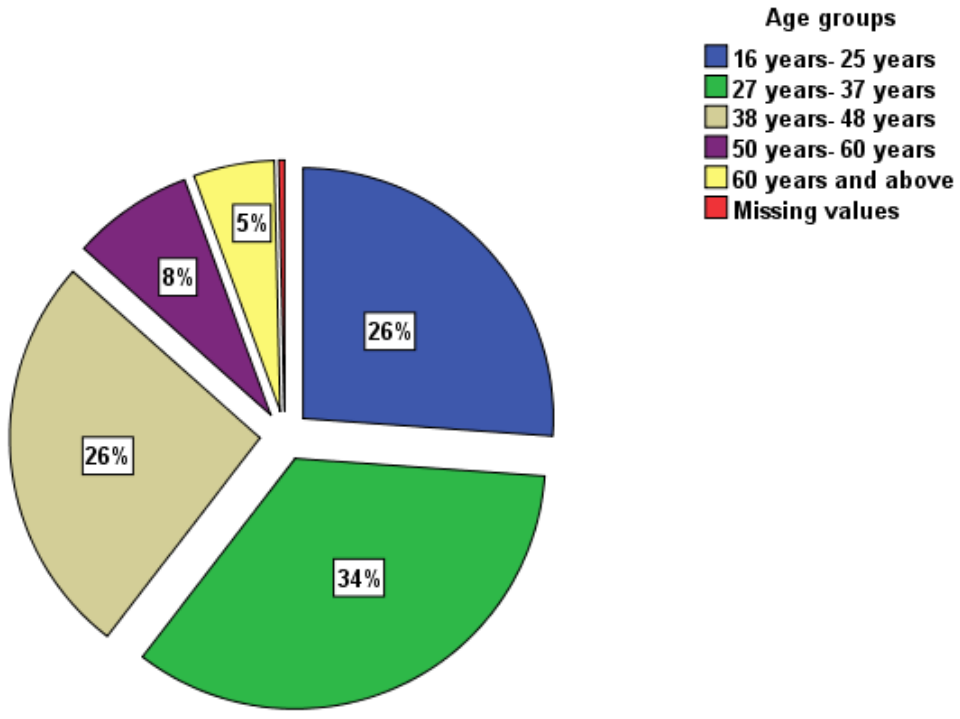


Figure 4.1: Age of respondents

The bigger fraction (33%) of households are fairly new in the settlement; their time of stay is between 0 and 5 years. Those who have between 6 years and 10 years are the second largest group constituting 20%, followed by those who have been there for 16 years to 20 years constituting 15%. The fourth is the 11 years to 15 years category amounting to 10%, followed by the 21 years to 25 years category constituting 8%. The

least populated groups are 26 years – 30 years, and 30+ which constitute 6% and 8% respectively. A correlation test between age and flood damage mitigation established no significant relationship.

As shown in the bar chart below, 73% of respondents are involved in small to medium enterprises. The second largest group (19.76%) is involved in low income jobs. The least two groups are involved in medium income jobs and not working, constituting 4.74% and 2.77% respectively. Respondents small to medium enterprises operate small informal businesses such as selling charcoal, selling vegetables, carpentry, transporting people with motor bikes or bicycles, among others. These occupations were categorised to produce the groups shown in figure 4.2 below.

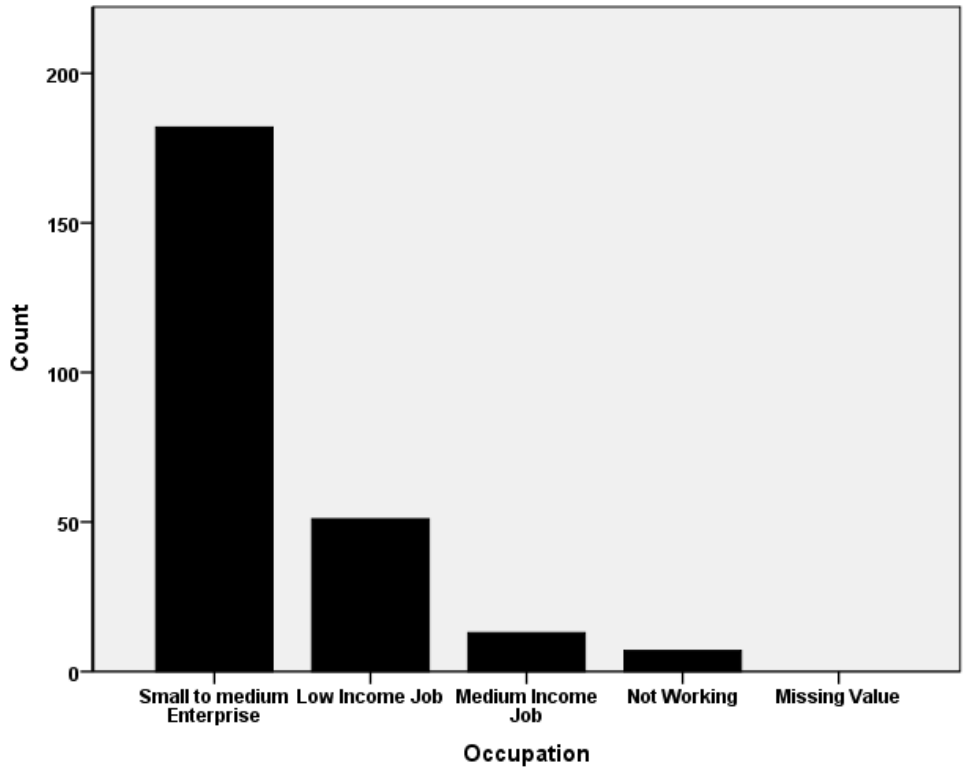


Figure 4:2: Occupation of respondents

The figure shows very little variability in income. The majority of the households are consequently very poor with some of them living on slightly over UGSH 4000 (US$ 1.50) per capita per month. To some, this figure may seem to be exaggerated but in the interview responses from an Act Together official and the physical planner for KCCA, it also emerged that Bwaise is a transitional neighbourhood where poor job seekers start staying as an entry point to the City. As a result some people are not working and just starting to enter the informal trading businesses as they seek jobs. It is also interesting that over 90% of the total population live on less than US$ 1 per capita per day (Interview with KCCA physical planner, Kawempe Division.

4.3. Influence of income on flood damage mitigation

The questionnaire generated data on mitigation measures adopted per household. These measures included raising of the floor of the house, rebuilding the house, building small dykes, building a veranda, moving to friends and relatives, participating in public cleaning exercises and moving household property to higher places. The responses were structured into structural and non-structural mitigation and the counts in these

two classes were used as dependent variables in correlation analysis and the linear regression model. The frequencies of the two types of mitigation are shown in figure 4.3 below:

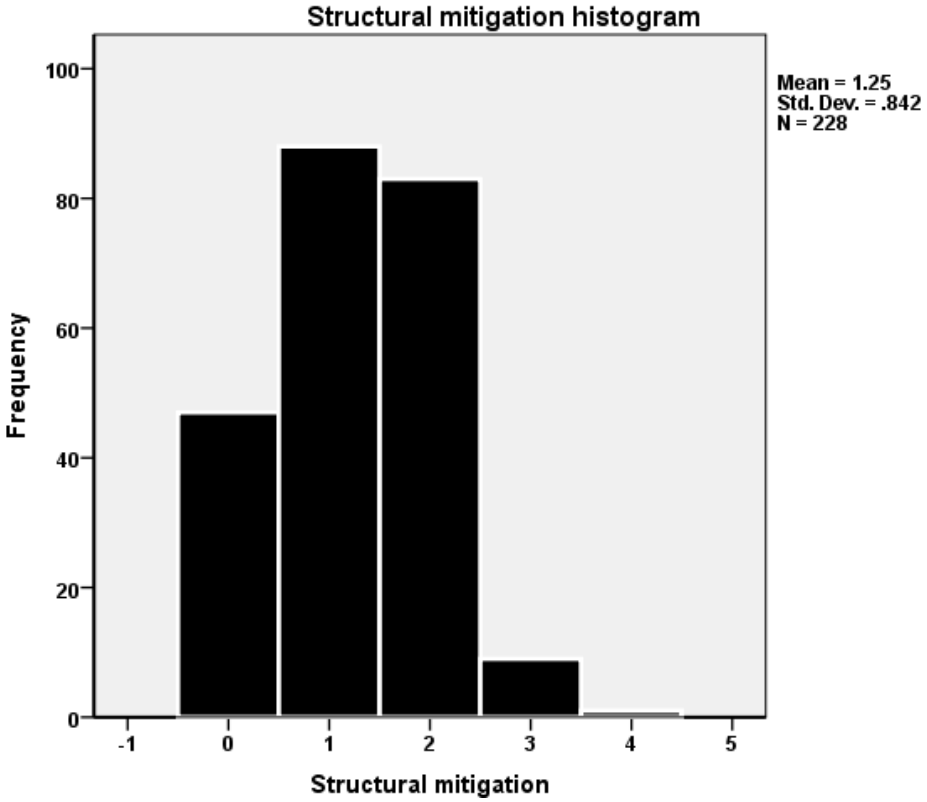


Figure 4.3a: Frequency distribution of structural mitigation measures

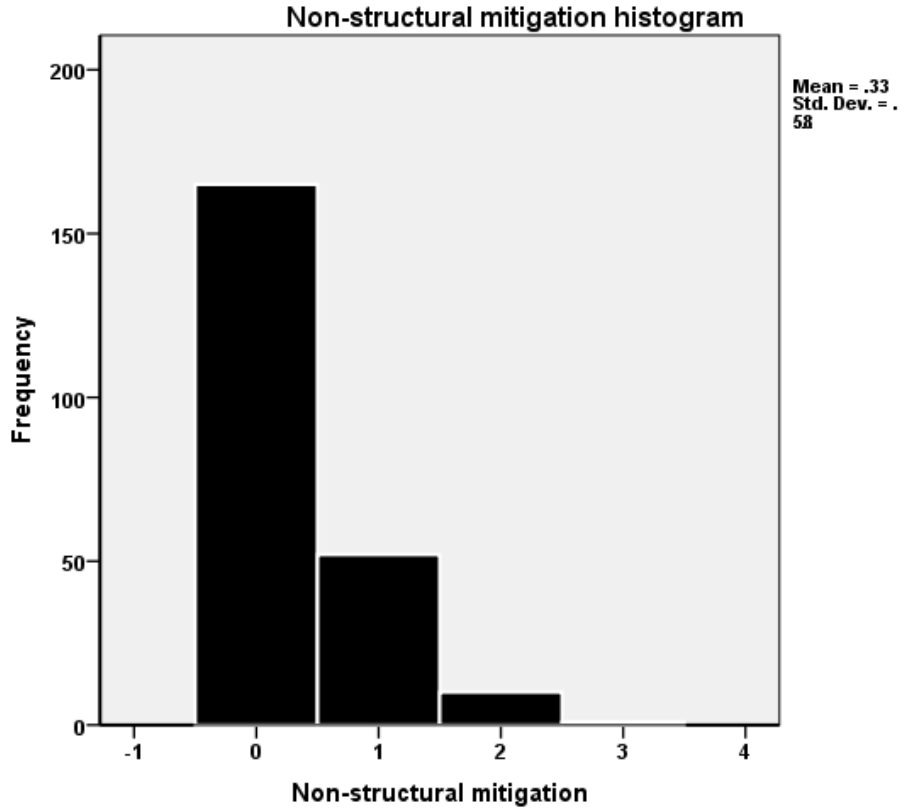


Figure 4.3b: Frequency distribution of non-structural mitigation

Figure 4.3a above shows that 87 households (32%) implemented one structural mitigation measure. About 80 (30%) of them implemented 2 structural mitigation measures and 47 (18%) did not implement any structural mitigation measure. Only 3% have 3 structural mitigation measures in place. The standard deviation – 0.842 shows a fairly small variation since the range is 4. About 65 % have not implemented any non-structural mitigation measure and about 20% of the households have implemented only one non-structural mitigation measure. Only 3.3% implemented 2 non-structural mitigation measures. There is very little variability in the scores which may also impact on the results of the correlation and regression analysis. However it suffices for identification of relationships. The following section establishes its relationship to per capita income.

As shown in table 4.2a below there is no significant correlation between per capita income and both structural and non-structural flood damage mitigation level. This can be explained by the fact that almost all the interviewed households live on less than a US$ 1/per capita per day. In the same way, occupation does not have a significant relationship with both structural and non-structural mitigation.

Table 4.2a: Correlation between per capita income and flood damage mitigation

			Non-structural mitigation	***Structural mitigation***
Spearman's rho	***Per capita income***	Correlation Coefficient	-.028	-.033
		Sig. (2-tailed)	.675	.616

a. List wise N = 228

Table 4.2b: Correlation between occupation and flood damage mitigation

			Non-structural mitigation	***Structural mitigation***
Spearman's rho	***Occupation***	Correlation Coefficient	-.046	-.023
		Sig. (2-tailed)	.675	.616

a. List wise N = 215

Besides establishing the relationship between mitigation level and other predictor variables like income and occupation, it was also a sub objective of this study to provide maps to necessitate spatially related settlement re-design principles. Such maps are provided in figure 4.4 below.

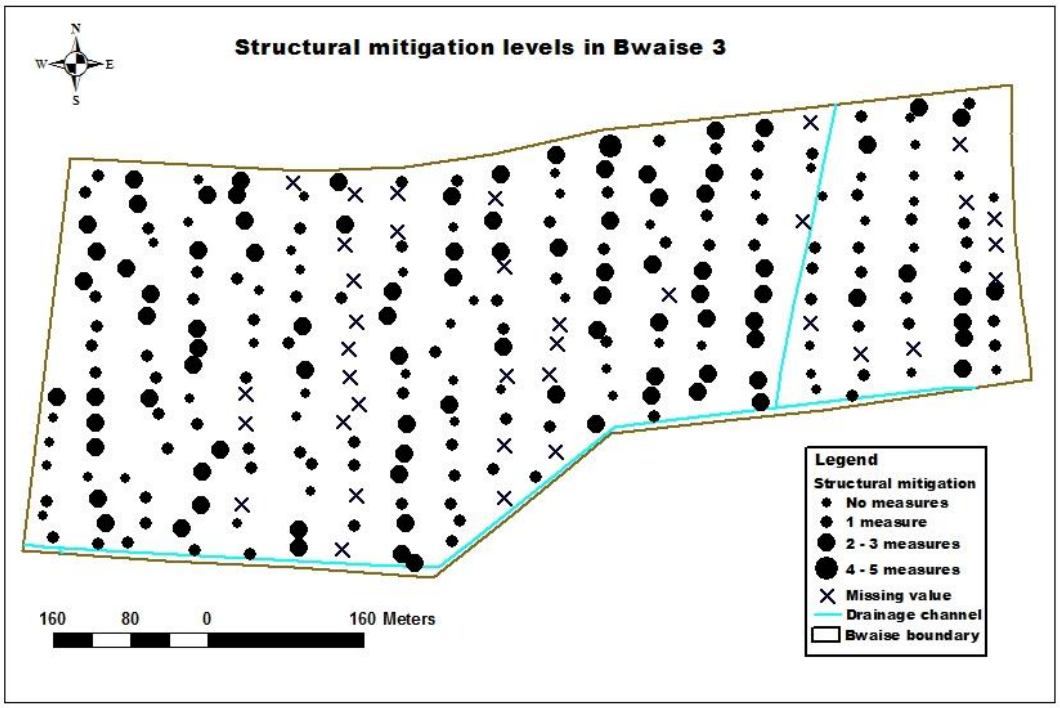


Figure 4.4a: Structural mitigation level in Bwaise 3

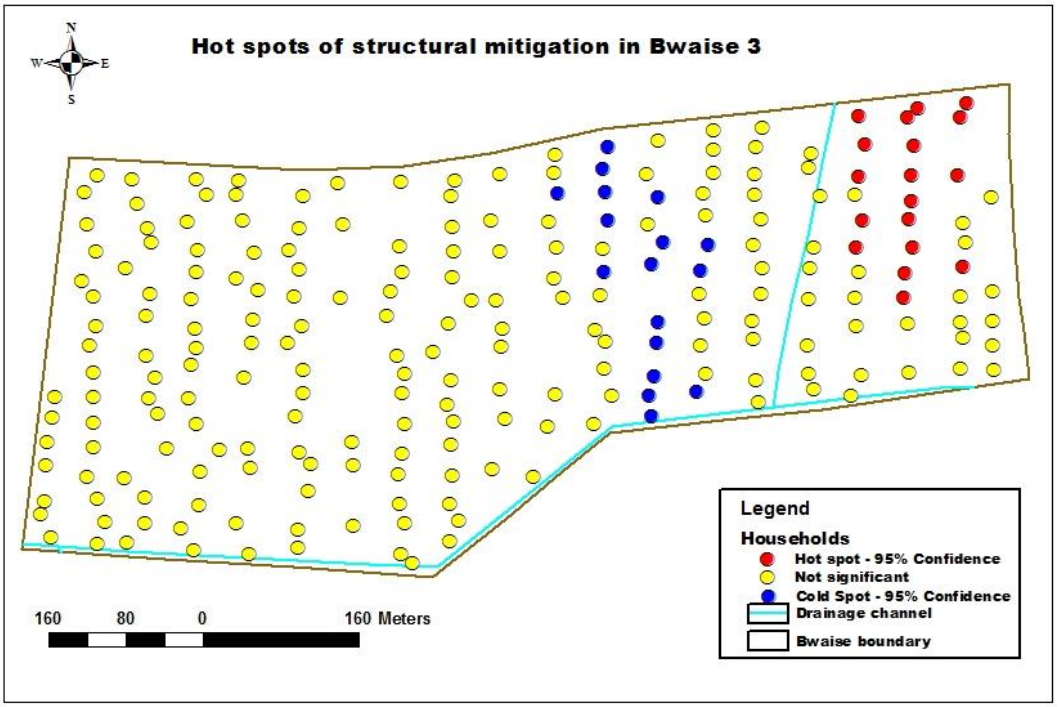


Figure 4.4b: Hot spots of structural mitigation levels

One can observe from the two maps that there is a pattern in the distribution of higher values on the two maps. There is a cluster of high structural mitigation to the immediate west of the secondary drainage (the one that runs through the eastern part of the settlement to the primary channel in the southern part).

4.4. Influence of social networks on flood damage mitigation

As shown in the diagram below, 58.4 % of the respondents adopted at least one flood damage mitigation measure because of influence from their social network and the remainder did not. One can conclude from this distribution that social networks significantly influence adoption of mitigation measures. This can be confirmed from table 4.3 on the next page. However, with non-structural mitigation the relationship is negative. It can be concluded therefore that social networks assist residents of Bwaise to put up structural mitigation measures. The strong negative correlation between social networks and non-structural mitigation can be a result of the positive relationship with structural mitigation. In other words the more the residents put up structural mitigation measures the more they feel secure and consequently reduce non-structural mitigation measures.

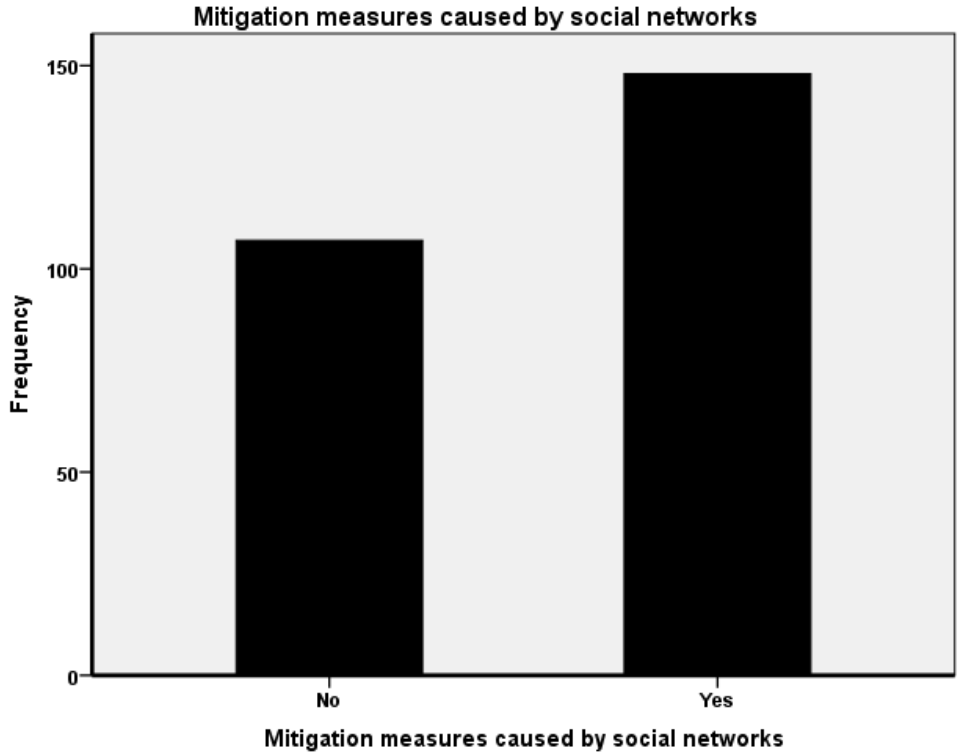


Figure 4.5: Mitigation because of social networks

An Act Together official revealed that the more the residents become part of the Slum Dwellers International, the more they are encouraged to save and consequently they put up more structural measures.

Table 4.3: Mitigation because of social networks

Table 4.3: Mitigation because of social networks

		Communitarian	*Non-structural mitigation*	*Structural Mitigation*
Mitigation because of social networks	Correlation Coefficient	0.075	-.204*	-.234**
	Sig. (2-tailed)	.265	.019	..054

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

a. List wise N = 221

The researcher also tested whether there is significant clustering tendency among those who mitigate because of social networks. Figure 4.6 below shows very little clustering. The red spots indicate areas of high adoption of measures because of social networks while the blue ones represent areas where there is low or no adoption of measures caused social networks.

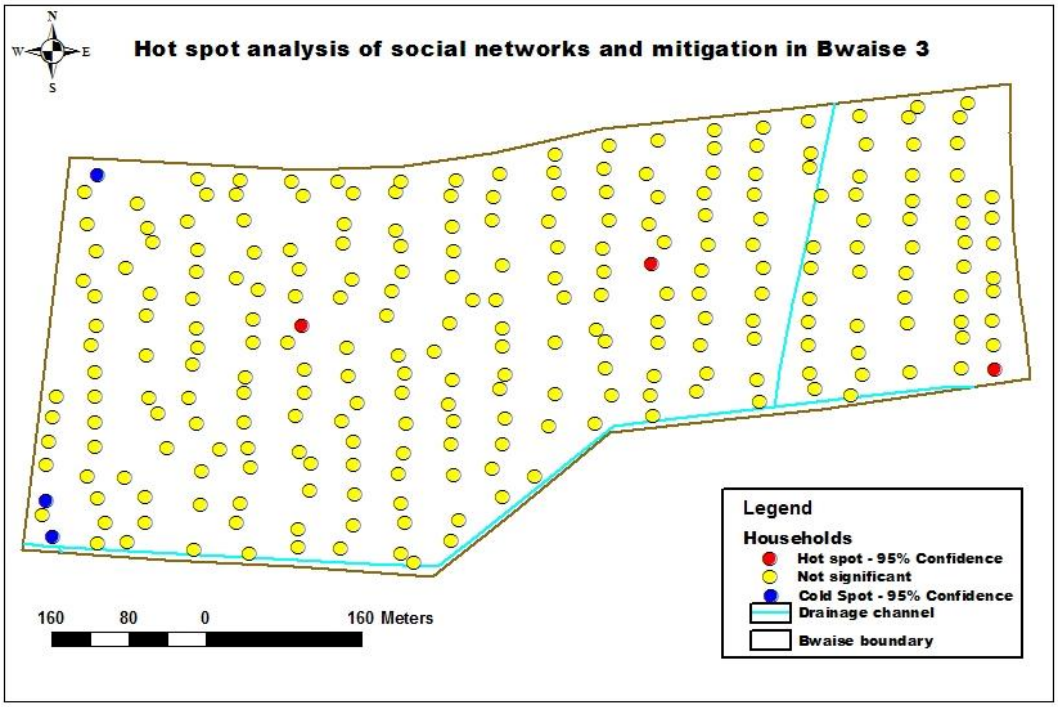


Figure 4.6: Hot spot analysis for mitigation because of social networks

Although social networks influence non-structural and structural mitigation it other variables are also likely to have an influence. The following section relates flood experience to risk attitude.

4.5. Relationship between flood experience and risk attitude

A total of 259 people responded to the questions on flood experience and risk attitude. Out of 47 respondents who did not experience flooding or inundation, 31 (66%) are not willing to spend resources on damage mitigation measures. Those who are somewhat willing are 5, constituting 11% while the willing and highly willing constitute 21% and 2% respectively.

Table 4.4: Cross tabulation of Willingness to spend on mitigation and flood experience

		Not willing	*Somewhat willing*	*Willing*	*Highly willing*	Total
Experienced flooding or	No	31	5	10	1	47
Inundation	Yes	97	59	34	22	212
Total		**128**	**64**	**44**	**23**	**259**

Two hundred and twelve respondents experienced flooding before. Among them 46% are not willing to spend on flood damage mitigation (according to household interview responses, many people feel that it is government responsibility), 28% are somewhat willing, 16% are willing and 10% are highly willing. It can be interesting to also establish the extent to which the degree of experienced flooding affect willingness to spend on flood damage mitigation. The table below shows that 50% of those who experienced floods that caused loss of life or threat to life are not willing to spend on mitigation. In the same way almost 50% of those that experience damage/ potential damage flooding are not willing to spend more on flood damage mitigation.

Table 4.5: Relationship between flood experience and willingness to spend on mitigation

		Willingness to spend on mitigation				
		Not willing	Somewhat willing	Willing	Highly willing	Total
Flood experience	Low flood exposure	63	42	18	13	136
	Damage/Potential damage	20	10	12	5	47
	Life threatening or loss of life	15	6	6	3	30
Total		**98**	**58**	**36**	**21**	**212**

Therefore, combining this with the observation from table 4.5, the hypothesis that flood experience motivates people to spend on mitigation against flood damage is not supported. One cannot conclude that the more deadly the flood experience is, the more households are willing to spend since the table does not have bigger scores on the bottom right corner. This being the case, an interesting question that one may remain with is how poor are the unwilling since willingness can be affected by poverty level. The table below shows an insignificant correlation between the two variables. This can be a result of very low income across the respondents as noted earlier.

Table 4.6: Relationship between per capita income and willingness to mitigate

			Willingness to spend on mitigation
Spearman's rho	***Per capita income***	Correlation Coefficient	-.094
		Sig. (2-tailed)	.126

a. List wise N = 266

Besides assessing influences of willingness to mitigate, it is also crucial to assess the influences of mitigation since it is the main dependent variable. The following section assesses its relationship to flood experience.

4.6. Flood experience and flood damage mitigation

The findings in the table below do not support the hypothesis that flood experience is positively correlated to structural mitigation level since it does not have bigger scores on the top right corner. Table 4.7b also confirms this. Instead, it is positively correlated to non-structural mitigation. In the same table flood experience does not show a significant relationship with communitarian mitigation. Therefore life threatening flood experience does not compel Bwaise residents to participate in community cleaning activities. This means that sensitisation is still desired in this area if high participation is to be attained.

Table 4.7a: Cross tabulation of flood experience and structural mitigation

		Structural Mitigation					
	Number of measures	0	1	2	3	4	**Total**
Flood experience	Low flood exposure	20	49	53	7	1	130
	Damage/Potential damage	12	17	16	1	0	46
	Life threatening or loss of life	7	12	9	1	0	29
Total		39	78	78	9	1	205

Table 4.7b: Correlation between flood experience and flood damage mitigation level

		Communitarian	*Non-structural mitigation*	*Structural Mitigation*
Flood experience	Correlation Coefficient	-.047	.163*	-.135.
	Sig. (2-tailed)	.504	.019	..054

Although there is no significant relationship between flood experience level and flood damage mitigation, it is interesting to establish whether there is significance clustering of extreme flood experience levels for planning intervention. Figures 4.7a and 4,7b below shows spatial distribution of flood experience.

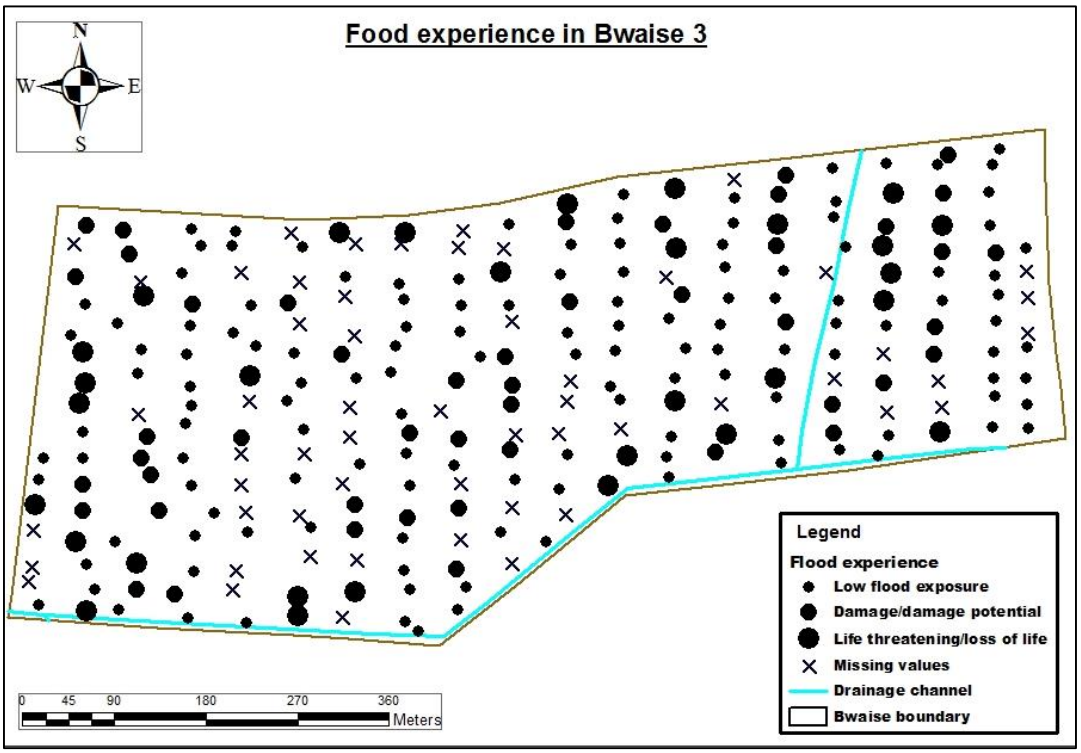


Figure 4.7a: Flood experience

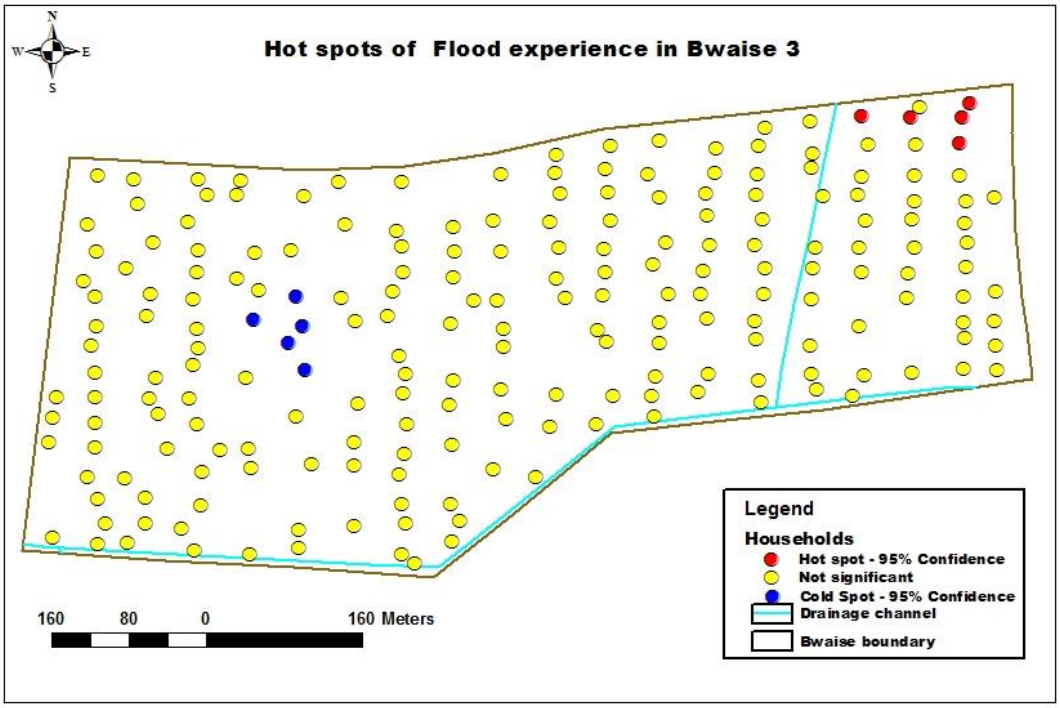


Figure 4.7b: Hot spots of flood experience in Bwaise 3

Figures 4.7a and b above indicate concentration of flood experience to the north eastern and south western parts of Bwaise 3. The former is a bit flat and faces Bwaise 2 which has a higher altitude. Consequently flood water easily collects from high areas in Bwaise 2 and floods in that portion of Bwaise 3 on its way to

the primary drainage channel. The other part to the west is swampy and easily floods. One respondent in this area had this to say, "I raised the floor of my house but it did not help since flooding continues because of underground water." Therefore in this place response efficacy is very low even for some high cost structural measures like raising the floor. As a result some houses in this area are abandoned as shown below.

Figure 4.8: Abandoned house in the western part of Bwaise 3

Photo credit: Researcher, October 2015)

4.7. Discussion and conclusion

While social networks have an influence on level of structural mitigation, income and occupation do not. This is in line with Poussin et al., (2014), Bubeck et al., (2012) and Kellens et al., (2013)'s conclusion that results of socio-economic influence on flood damage mitigation are mixed. However they contradict Botzen et al., (2013) in the Netherlands and Osberghaus, (2014)'s findings in Germany. These differences in the European studies can be explained by differences in proxies that are used to measure socio-economic status. For example, while Poussin et al., (2014) uses age, gender, income, educational level, household size and location, Osberghaus, (2014) uses home ownership only. In the context of Bwaise 3 the failure of income to explain variations in mitigation level can be a result of dire flood risk levels that used to affect the community before the construction of the primary channel. It can also be argued that in the case of Bwaise, the very low levels of per capita income mean little variability in it as a variable and consequently reduces its influence on mitigation level. Instead social networks play a significant role in structural mitigation in contradiction to Poussin et al., (2014) who found no significant between damage mitigation and social networks. Interestingly in Bwaise 3 it is negatively correlated to non-structural mitigation. One can conclude therefore that in very poor communities, social networks can be a crucial variable to observe since such communities are trained to save and receive aid that assist in their mitigation efforts more than income only. Risk attitudes, measured by assessing willingness of households to spend on mitigation, is not significantly correlated to flood experience. In turn flood experience is not significantly correlated to mitigation level. This contradicts Osberghaus, (2014) and Poussin et al., (2014)'s findings which exhibit a positive relationship between flood experience and mitigation level. This difference between European cases and Bwaise 3 can be explained by the small level of fatality that exist among residents of Bwaise (Interview with key informant) and partly because of little variability in mitigation level.

5. FLOOD RISK, FLOOD RISK PERCEPTION AND FLOOD DAMAGE MITIGATION IN BWAISE 3

5.1. Introduction

This chapter discusses the influence of flood threat and coping appraisal on flood damage mitigation level. In doing so an assessment of the applicability of the Protection Motivation Theory is carried out. It does this by establishing the correlation between household distance from the primary and secondary drainage channel, perception of flood probability, perception of damage likelihood, response efficacy of mitigation measures, self-efficacy, coping costs, flood benefit on one hand and mitigation level on the other.

5.2. Levels of flood damage mitigation relative to distance from the drainage channels

Distance from the primary and secondary drainage channels was derived from a multiple ring (50 m) buffer resulting in 9 classes. As already mentioned in the previous chapter, mitigation levels were derived from counts of structural and non-structural mitigation measures respectively. In the case of communitarian mitigation a binary variable was used since respondents were asked whether they participate in the cleaning of drainage channels or not. Table 5.1 below shows no significant relationship between distance from the primary and secondary drainage.

Table 5.1: Correlation between distance from drainage channel and mitigation level

		Communitarian mitigation	*Non-structural mitigation*	*Structural mitigation*
Distance from drainage channel	Correlation Coefficient	-.026	.028	.014
	Sig. (2-tailed)	.701	.673	.828

a. List wise N = 228

This finding can be explained by the observation made by the researcher during a transact walk after heavy rainfall towards the end of the fieldwork. Flooding in Bwaise 3 does not occur only from the primary and secondary channel overflows. Instead direct rainfall easily accumulates on some yards partly due to poor site planning and partly due to the small dykes that are built to keep offsite flowing water from entering the yard as shown in figure 5.1b below. It is also a fact that some poorly designed tertiary channels in the western part exacerbate the problem. Figure 5.1a shows part of such a channel with stagnant water before the rain.

Figure 5.1a: Tertiary drainage with stagnant water before the rain
Source: Researcher, October 2015

Figure 5.1b: Water accumulation on yard because of poor site planning

Source: Interviewee (October 2015)

Having said this about distance from drainage channels, it would be interesting to know whether perception about flood probability is related to mitigation level. The following section addresses this question.

5.3. Flood probability perception and levels of mitigation

As shown in table 5.2 below, both structural and communitarian mitigation do not have a significant relationship with flood probability. However non-structural mitigation does. Inference can be made therefore, that households with a high perception of flood probability have implemented non-structural damage mitigation measures before and are likely to do so in the future.

Table 5.2: Correlation between flood probability and mitigation level

			Communitarian mitigation	*Non-structural mitigation*	*Structural mitigation*
Spearman's rho	***Likelihood of being flooded***	Correlation Coefficient	.074	.155*	-.030
		Sig. (2-tailed)	.267	.019	.651

*. Correlation is significant at the 0.05 level (2-tailed).
a. List wise N = 228

A test for clustering was performed and no significant clustering was established.

5.4. Relationship between perception of damage likelihood and damage mitigation

The table below shows a strong negative relationship between likelihood of flood damage and non-structural mitigation but no relationship with communitarian and structural mitigation. One can conclude therefore that the higher the perception of flood damage likelihood the lower the level of non-structural mitigation. This can be explained in two ways. Firstly it may mean that those with a higher perception of damage likelihood but with high self-efficacy are putting more resources to structural measures. Secondly it may mean that those who perceive flood damage likelihood but have low self-efficacy have developed fatalism, i.e. the 'living with floods' mentality.

Table 5.3: Correlation between perception of damage likelihood and mitigation level

			Communitarian mitigation	*Non-structural mitigation*	*Structural mitigation*
Spearman's rho	***Likelihood of flood damage***	Correlation Coefficient	.033	-.198**	-.010
		Sig. (2-tailed)	.624	.003	.877

**. Correlation is significant at the 0.01 level (2-tailed).
a. List wise N = 228

Because of its significance in influencing non-structural mitigation, it is interesting to test for clustering. The following map shows a small clustering tendency in perception of damage likelihood in the north eastern part of the settlement. If one compares this with figures 4.4b and 4.7b in the previous chapter, an observation can be made that the area also has high flood experience. As can also be observed in figure 5.3, the area also has a low perception of response efficacy. The implication is that the level of flooding or inundation is dire to the extent that they feel all the measures included in the survey are not effective for them. The next section assesses this in detail.

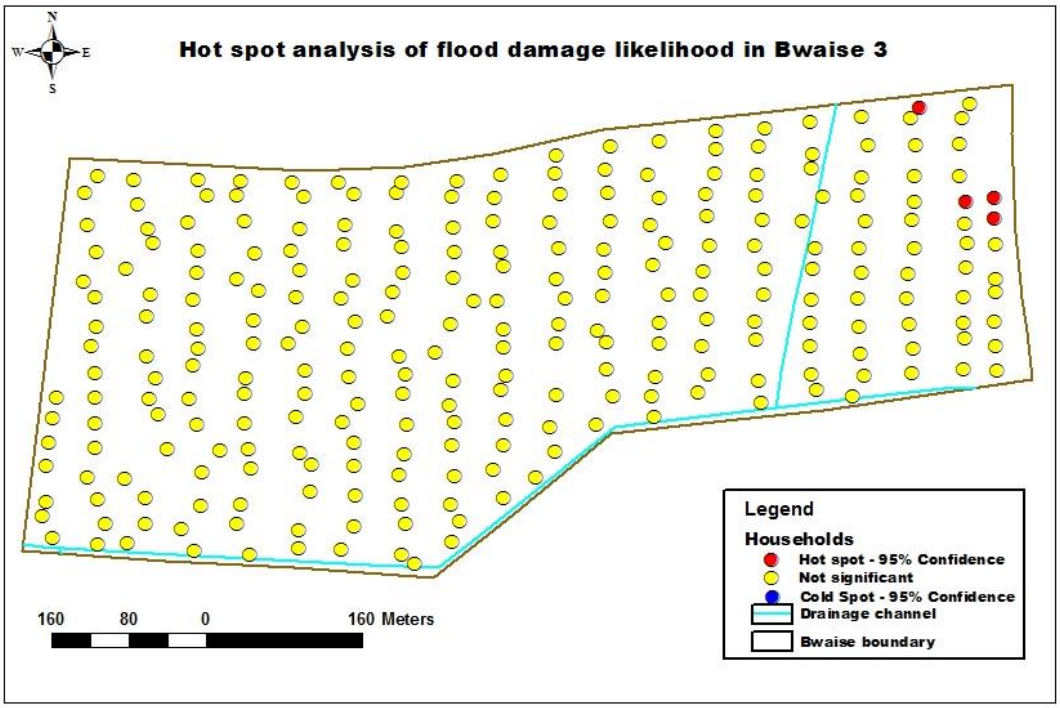


Figure 5:2: Hot spot analysis for damage likelihood

5.5. Perception about response efficacy and its relationship to damage mitigation

Perception of response efficacy is the cognitive judgement that at risk individuals develop regarding the effectiveness of a mitigation measure. In this thesis it was measured through a likert scale per every measure. Following Poussin et al., (2014) the row scores were then aggregated per group (e.g. structural damage mitigation measure) to get an index that was then used as a predictor variable. Table 5.4 below shows no significant relationship between it and mitigation. Therefore the researcher rejects the hypothesis that high perception of response efficacy leads to high flood damage mitigation level in Bwaise 3. Response efficacy for individual mitigation measures can be observed in appendices 3 and 7.

Table 5.4: Relationship between response efficacy and mitigation level

			Communitarian mitigation	*Non-structural mitigation*	*Structural mitigation*
Spearman's rho	***Response efficacy***	Correlation Coefficient	-.062	-.089	.021
		Sig. (2-tailed)	.370	.181	.750

a. List wise N = 228

Figure 5.3 below shows that there is very little significant clustering of response efficacy. Clustering of low perception of response efficacy is found in the north eastern part. As explained in the previous section, this area also has low structural mitigation level and high flood experience. It might imply that there is need to resettle residents of this area using the land sharing technique with densification. This is discussed more in the recommendations.

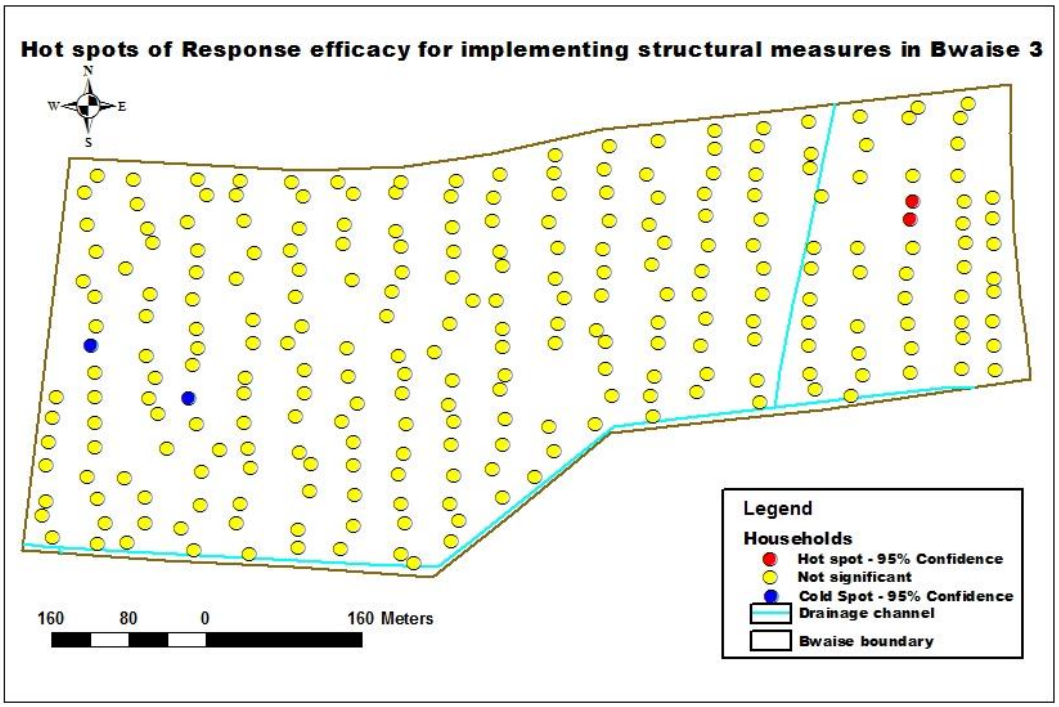


Figure 5.3: Hot spot analysis of response efficacy in Bwaise 3

5.6. Perception of self-efficacy as an influence of damage mitigation

Perception of self-efficacy is the feeling that individuals develop relating to their (or a household member's) ability to implement a damage mitigation measure (Grothmann & Reusswig, 2006). It was measured in the same way as response efficacy. Table 5.5 below shows a very strong positive correlation between perception of self-efficacy and both the level of structural flood damage mitigation (co-efficient of 0.378**) and communitarian mitigation (0.236**). In other words, the more able the households feel, the more they put up structural mitigation measures as well as participate in community cleaning exercises. A policy maker may be interested in further understanding how able they are and how the ability is spatially distributed. Such visualisation is provided in appendices 2 and 6. While structural and communitarian mitigation show a strong positive correlation with perception of self-efficacy, this is not the case with non-structural mitigation.

Table 5.5: Relationship between perceived self-efficacy and flood damage mitigation

			Communitarian mitigation	*Non-structural mitigation*	*Structural mitigation*
Spearman's rho	***Perception about self-efficacy***	Correlation Coefficient	.236**	-.084	.378**
		Sig. (2-tailed)	.000	.213	.005

**. Correlation is significant at the 0.01 level (2-tailed).

b. List wise N = 224 for structural mitigation and 223 for non-structural mitigation

Figure 5.4 shows some clustering tendency forming a cold spot with points marked in blue – an area of clustered high self-efficacy.

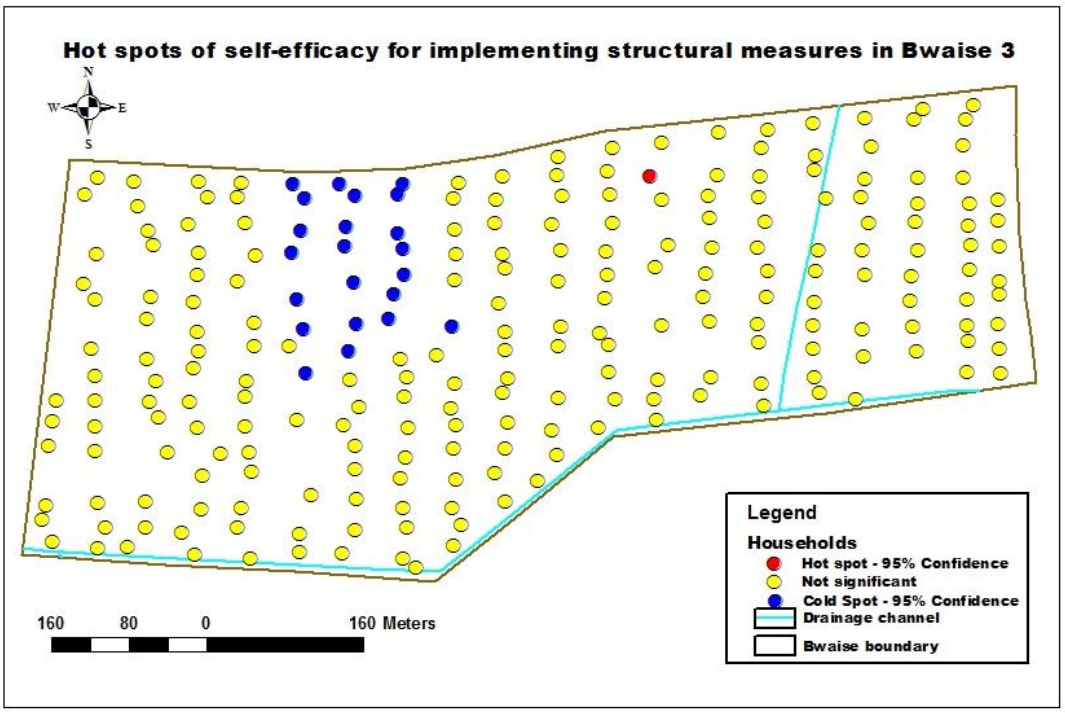


Figure 5.4: Hot spots of self-efficacy for structural measures

Since self-efficacy is positively related to mitigation level, the cold spot means that people in that area generally possess the ability to implement structural and communitarian measures. In terms of intervention, residents of such an area can be used to influence others or if resources are not enough they can be considered last.

5.7. Relationship between perceptions of coping costs and mitigation level

Coping cost include both monetary and time obligations relating to flood damage mitigation. The two tables below (5a and 5b) show a significant negative relationship between it (both in terms of money and time) and non-structural mitigation. On the other hand communitarian and structural mitigation do not have a significant relationship with coping cost. It is however surprising that perception of coping costs affect non-structural mitigation which seems to be cheaper compared to structural mitigation. Interestingly it holds because finding from an interview with one respondent showed that in many cases the abruptness of flooding in the area leaves little time for the residents to adjust. The respondent had this to say; "Water bumps into the house with very high speed and takes goods out." Consequently service providers such as the *boda boda* (motor bike) operators charge more when residents want for example to move their goods to higher places. In the case of structural mitigation, it is a different story since the measures are midterm to long term and also proactive. In the light of the foregoing, the hypothesis that perception of coping cost is related to flood damage mitigation is accepted with regard to non-structural mitigation and rejected with regards to structural and communitarian mitigation.

Table 5.6a: Relationship between perception of implementation cost and flood damage mitigation

			Communitarian mitigation	*Non-structural mitigation*	*Structural mitigation*
Spearman's rho	***Perception about implementation cost***	Correlation Coefficient	0.088	-.146*	-.032
		Sig. (2-tailed)	.0211	.027	.634

*. Correlation is significant at the 0.05 level (2-tailed).
a. List wise N = 218

Table 5.6b: Correlation between perception of time cost and damage mitigation

			Communitarian mitigation	*Non-structural mitigation*	*Structural mitigation*
Spearman's rho	***Perception about time cost***	Correlation Coefficient	-.069	-.141*	-.018
		Sig. (2-tailed)	.0310	.034	.789

*. Correlation is significant at the 0.05 level (2-tailed).
a. List wise N = 211

When visualised on a map in figure 5.5a perception of implementation cost also show concentration of high values on the central part of the settlement. It is dense in the area to the left of the secondary channel and in the south eastern corner. Surprisingly in such areas residents have high mitigation levels as shown in figure 4.4. Faced with these conflicting observations, the researcher sought an explanation by mapping house use conditions. The assumption was that the houses are rented and therefore the owners implemented structural measures but the lodgers' perception is still bound to differ because of their socio-economic status. Indeed the assumption proved to be true. For data on individual mitigation measures the reader is referred to appendices 5 and 9.

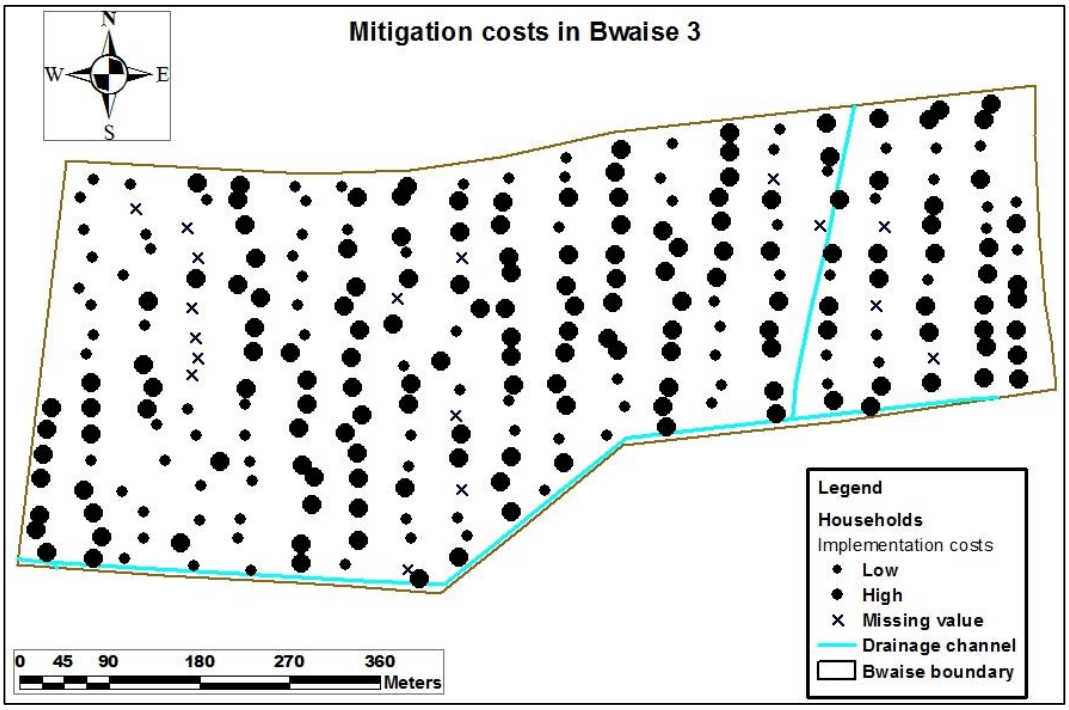


Figure 5.5a: Perception of implementation cost for structural mitigation

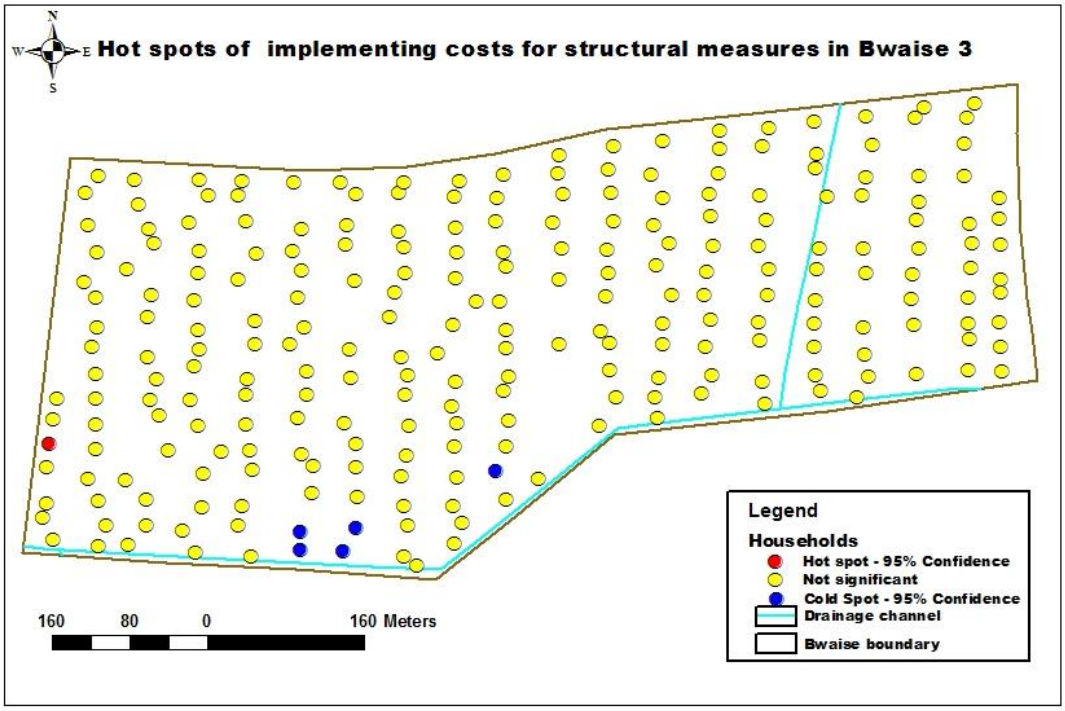


Figure 5.5b: Hot spot analysis for cost perception

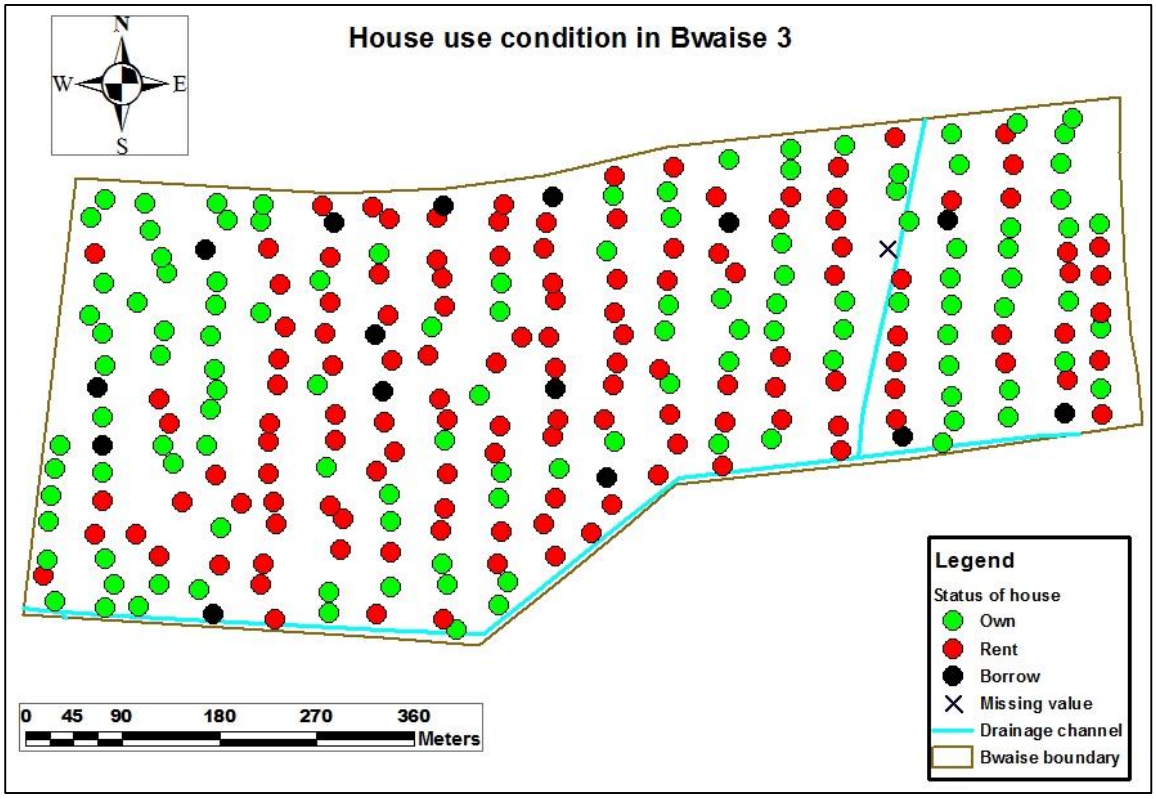


Figure 5.5c: House use conditions in Bwaise 3

5.8. Flood benefit as a determinant of mitigation level

Very few respondents indicate that they derive some form of benefit from flooding as shown in figure 5.6 below. Such people include metal welders who pick metal carried from other places by flood water, traditional doctors who treat people when they get sick, labourers who scoop water out of other people's houses for a fee and bicycle operators who carry people for a fee. Figure 5.6 below shows frequency distribution of benefit level among the respondents.

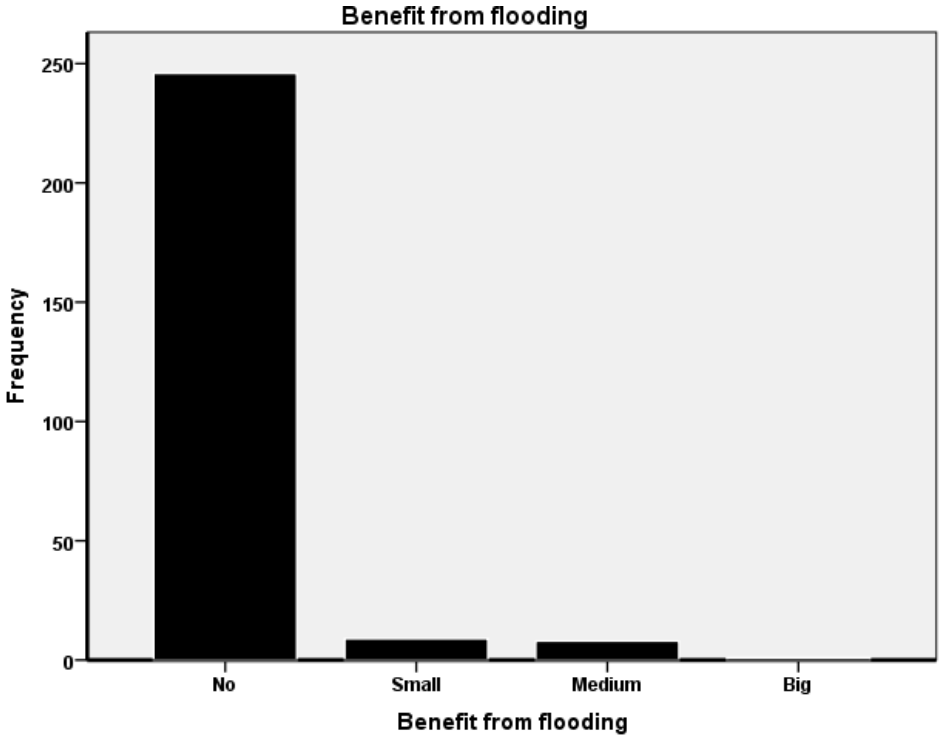


Figure 5.6: Frequency distribution of flood benefits

Although there is very low variability in the data, correlation analysis was still done to assess the nature of relationship the variable has with flood damage mitigation. Table 5.7 below shows no correlation between flood risk benefit and flood mitigation level. Therefore the hypothesis that flood benefit reduces mitigation level is rejected.

Table 5.7: Relationship between flood benefits and mitigation level

			Communitarian mitigation	*Non-structural mitigation*	*Structural mitigation*
Spearman's rho	***Benefit from flooding***	Correlation Coefficient	.002	.025	.071
		Sig. (2-tailed)	.975	.704	.283

a. List wise N = 227

5.9. Discussion and conclusion

Perception about response efficacy; distance from primary and secondary drainage channel; time cost; and flood benefit are not significantly related to flood damage mitigation. This is summarised in table 5.8 below. The finding on response efficacy is in line with Poussin et al., (2014)'s observation in France. Distance to drainage was not much used in PMT literature. With regards to it, Botzen et al., (2013) established that it negatively influences flood damage mitigation. The observation in Bwaise is an eye opener to the fact that neighbourhood planning must thoroughly investigate local processes rather than relying on city wide flood modelling. For example in Sliuzas, Flacke, & Jetten, (2013) potential flood areas largely coincide with areas close to the primary and secondary drainage channel since the researchers did not have data on tertiary channels. Furthermore at city level it was not easy for them to take note of some small swampy areas within the settlement which are crucial risk factors at local level. The lack of relationship between perception of time cost and flood damage mitigation contradicts Poussin et al., (2014). A possible explanation for this is that since the people in Bwaise 3 are mainly employed in the informal sector, they can easily create time for

gradual implementation of measures. Additionally, the amount of household labour (5 people on average as shown in table 4.1) is sufficient for sharing livelihood and flood damage mitigation activities.

Table 5.8: Summary of correlation

		Communitarian mitigation	Non-structural mitigation co-efficient	Structural mitigation co-efficient
Spearman's rho	Perception of implementation cost	0.088	-0.148*	-0.32
	Perception of response efficacy	-0.062	-0.089	-0.021
	Perception of damage likelihood	0.033	0.198*	-0.010
	Perception of flood likelihood	0.074	0.155*	0.030
	Distance from drainage channel	0.026	0.028	0.014
	Perception about mitigation time cost	-0.069	-0.141	-0.018
	Perception about self-efficacy	0.236**	-0.084	0.378**
	Benefit from flooding	-0.02	0.025	0.071

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Osberghaus, (2014) noted a negative correlation between flood benefit and flood damage mitigation. The author concluded that households which expected a benefit from insurance cover did not mitigate. In the case of Bwaise 3, the lack of relationship can be explained by very low variability in the variable. This thesis concludes that the flood benefit variable may not apply even in many non-slum areas of Africa because there is very low adoption of flood insurance. Yet there are not many other types of benefits obtained. Comparing results for distance from the channel and perception of both flood damage probability and flood probability, one can conclude that how people perceive physical risk does not necessarily follow its scientific measurement. One can observe it in the above table where flood probability and flood damage probability show significant positive correlation with non-structural mitigation, the. This can be explained by the fact that the flat terrain of the settlement and the dykes that households put causes inundation through direct rain water. Consequently it has a negative implication on the applicability of the protection motivation theory in this settlement. Firstly it means that the way people appraise threat is not in line with the physical reality of risk except if the assessment takes into consideration other minute components of it. This is however not common in contemporary modelling efforts. Secondly it means that threat appraisal does not necessarily affect levels of structural and communitarian mitigation. However the negative correlation between cost perception and non-structural mitigation level affirms the protection motivation theory since it shows that the higher they perceive the costs the less they mitigate. This coupled with the strong positive relationship between self-efficacy and flood damage mitigation (communitarian and structural) implies that coping appraisal strongly influence flood damage mitigation level. However the high structural mitigation in areas of high perception of response cost is not in line with contemporary literature. It is explained in this thesis by the concentration of lodgers in such areas who enjoy structural mitigation measures put by land lords but them still feeling it generally costs high to implement because of their low economic status. However the overall contribution of these variables to mitigation variability is still to be assessed in chapter 7 in a regression model.

6. INFLUENCE OF GOVERNANCE ON FLOOD DAMAGE MITIGATION IN BWAISE 3

6.1. Introduction

This chapter discusses the contribution of governance to public flood damage mitigation in Bwaise 3. A comparative analysis of two different phases in the governance framework of Kampala City was used to establish the impacts of governance style on flood damage mitigation. The first is the pre-2010 period when the city was governed by the Kampala City Council (KCC) and the second is the post 2010 period. In the latter, the city is governed by the Kampala Capital City Authority (KCCA). The Water Governance Assessment Tool was used as the basis for codifying interview data from ministerial department officers, municipal officers, informants from Civil Society Organisations, informants from Non-governmental Organisations and representatives from Bwaise community.

6.2. Influence of governance on flood damage mitigation

6.2.1. Levels and scales

Both before and after the changeover to KCCA the levels and scales of governance differ. During the time of KCC the city was run by a council with 4 levels. The first one is LC (Local Council) 1 which is constituted by community representatives headed by a chairperson). On a higher level there was a LC 2 which was mainly an administrative council. Level three (LC 3) which is also called the Division level was chaired by the Town Clerk who is directly elected. LC 4 is applicable in the urban context. At City level (LC 5), the Major chaired and worked with the Executive committee and council. All these levels had both a technical wing and a political wing. During the time of KCC, politicians, mainly councillors were taking over technical roles and the system was marred with corruption (Interview with Bwaise Ward Administrator).

In the current set up the afore-mentioned levels still exist but there is an addition of the Minister for Kampala, executive director and deputy executive director at city level. This according to the Ward administrator has brought sanity to the city because the directorate monitors activities of the council while the Minister monitors it. This has resulted in an increase in power in the technical wing. At LC 2, since the ward administrator is a nonvoting member in the higher level – the LC 3 council, he liaises with the ward councillor and updates him on key technical things that need to be brought to the full council.

The appointment of the executive directors to work with the political wing of the municipality KCCA through the KCC Act closed an accountability gap which was formerly resulting in corruption. There is therefore an enormous behavioural change on the part of politicians and also the communities which used to dump much garbage (interview with the Public Health Officer at KCCA. Since there is alleged corruption and domination by politicians before the transformation to KCCA, suspicion is still characterising the relationship between the political wing and administrative wing. However, the ward administrator and the councillor responsible for Bwaise 3 show a high degree of mutual dependence in their work. When asked to comment on his working relationship with the councillor. The ward administrator said, "….our relationship is mutual, if I have development concerns that I would want to be discussed I speak though the councillor since I do not speak in council meetings." Although down scaling and up scaling of flood damage mitigation efforts were/are still possible, the current authority largely uses a top-down approach. This has resulted in solutions that are not sensitive to the community, for example the primary drainage channel was widened to an extent which makes it difficult to dredge. There is also no safety barriers of the channel banks

which possess even more threat when it is full. And as more and more sediments accumulate the probability of flooding increases.

Figure 6:1 Siltation in the primary channel

Source: Researcher (September 2015)

6.2.2. Actors and networks

The actors include KCCA, Buganda Kingdom, international development agencies and Non-Governmental Organisations (NGOs). The NGOs include AMREF, Act together and World Vision. Although these organisations do a lot at grass roots level, their entry point is the KCCA headquarters for purposes of approval. They then work with lower levels, for example LC2. They also have their own consortium which coordinates activities. At the moment it is headed by AMREF (interview with Act Together official). The NGOs and community representatives also meet the KCCA representatives in fora that are organised by KCCA occasionally to discuss development issues of which flood damage mitigation is one, (interview with an official in the disaster management unit of the Prime Minister's Office). Such meetings are organised, for example if there is much rain expected or after very high rainfall for different ideas on how to prepare and deal with floods and other issues. This level of stakeholder involvement was not established for the KCC era. However both regimes show flexibility, for example, allowing NGOs and civil society organisations to work in the area and even lead some projects. A case in point is the Buganda kingdom which leads the *Bulungi Bwansi* (for the good of everyone) cleaning campaign. As a result there is intensity in the campaign for behavioural change from grass roots level to city level. Nonetheless there is still less participation by households as shown in the graph below:

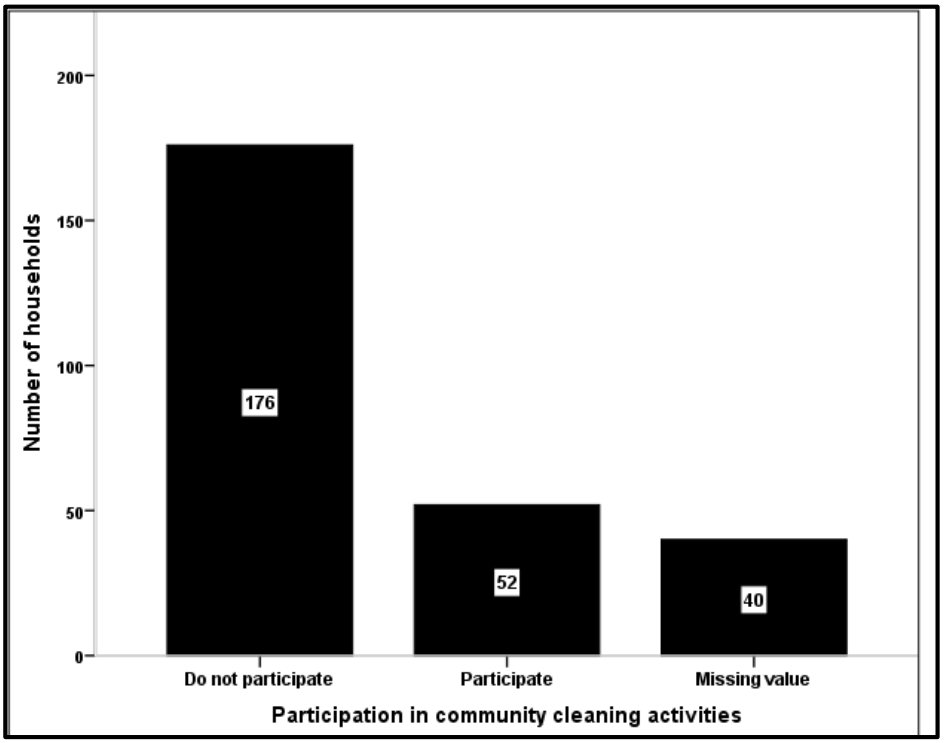


Figure 6.2: Participation in cleaning activities

As shown above, of the 228 households who responded, 77% do not participate in public cleaning activities

6.2.3. Problem perspectives and goals

There is a disagreement between the community and KCCA on the causes of flooding. While KCCA blames everything on informal settlement and dumping of waste by Bwaise residents and other communities upstream, the residents are blaming it on KCCA (interview with community leader). Their reason is that flooding started after construction of the Northern bypass and developments upstream. To them, the project did not take into consideration environmental impacts. A political activist in Bwaise 3 mentioned that the European Union project of constructing the northern by pass resulted in increased flooding. On the other hand, when the health official in charge of prevention and preparedness in KCCA and the ward administrator for Bwaise were asked to comment on the cause of flooding, they were quick to mention the illegal dumping by residents.

At the municipal authority level, the flood problem orientation did not change. The only difference now is the increased level of community engagement and sensitisation. It is worth noting that community engagement here does not imply a perfect bottom up approach since a considerable amount of command is used by the KCCA administration. Goal ambitions changed from 'vote protection' orientation during the KCC regime to sustainability in the current regime (Interview with ward administrator).

6.2.4. Strategies and instruments

Again the planning instruments are the same and what differed is the degree of enforcement and integrity of the system. For example both authorities used Statutory Instrument 246-1 of the Regional Town and Country Planning Act, specifically Part 1, Section 2, Subsection 1. It stipulates that "after any area has been declared to be a planning area under section 5 of the Act, no person shall erect any building or develop any land in that planning area unless he or she first obtains from the planning committee permission to do so." http://www.kcca.go.ug/uploads/acts/Town%20and%20Country%20planning%20regulations.pdf.
Addition of an administrative legislation (KCC Act 2010) and subsequent reconfiguration of the city

authority administrative system re-invigorated the use of this and other related instruments to control development and reduce illegal dumping of garbage. Both regimes (KCC and KCCA) show flexibility in combining instruments evidenced by inclusion of Buganda Kingdom cultural cleaning rituals. There is increasing development control and sensitisation of communities about bad practice that propagate flooding (interviews with the Director of Gender, Production and community Service, Physical planner of KCCA Kawempe division, and the Ward Administrator of Bwaise 3). This has resulted in reduction of illegal dumping and less growth of illegal structures.

6.2.5. Responsibilities and resources for implementation

One prominent change in governance style is the emphasis in the present authority of separation between the technical wing and the political wing of governance. During the time of KCC, politicians were left to decide on physical planning issues despite the fact that many if not all of them do not have planning education. The situation opened a gap for graft, depriving the authority of crucial revenue streams. Consequently informal development became wide spread and revenue dwindled, further incapacitating the authority to exercise development control. The current arrangement brought remarkable sanity and integrity in the system. Accordingly, there is enforcement of development control regulations and revenue generation. The ward administrator approximates an increase of 200%. However the resources are still not enough to combat the problem, for example dredging the primary drainage channel. There is also limited synergy of NGO activities and their appropriateness for communities.

6.2.6. Flood damage mitigation

Influence of governance on flood damage mitigation is mainly felt at community level. The separation of responsibility between the political arm and the technical arm reduced flooding by plummeting further informal development, availing of resources for desilting of secondary and tertiary drainage channels before heavy rains, sensitisation of communities about dumping of garbage and encouraging paving of yards. Paving of yards closer to the drainage is intended to reduce soil erosion and in turn siltation of the primary drainage. However as already noted siltation in the primary channel is proving to be a problem still.

6.2.7. Summary of qualitative evaluation for governance context and flood management performance

Table 6.1 below gives a summarised view of the trend of flood management performance from the time of KCC to the time of KCCA as responsible authorities in Kamapla city. This is based on interview data obtained from planning authorities, politicians, civil society organisations and community members. As already highlighted, the evaluation followed Bressers et al, (2013, p. 15)'s evaluative criteria in Appendix 10.

Table 6.1: Visualisation of qualitative governance context and flood management performance

Governance dimension	Quality of the governance regime				Performance
	Extent	Coherence	Flexibility	Intensity	
Levels and scales	=	=	=	↑	↑
Actors	=	↑	=	↑	
Perceptions	↑	=	=	↑	
Instruments	=	=	=	=	
Resources	=	↑	=	↑	
Colours Red: negative; Orange: Neutral; Green: positive					
Arrows up: Positive trend from KCC to KCCA time; Down: negative trend; Equal: stable					

Source: Adapted from Bressers et al, (2013)

Table 6.1 above shows a visualisation of trend in flood governance and mitigation context from the time of KCC to the time of KCCA. It shows that the extent and intensity of flood governance levels and scales are positive but the former is stable while the latter depicts a positive trend. Regarding actors and networks all qualities are on the positive but showing steadiness in extent and flexibility. A positive trend shows in coherence and intensity. Problem perspectives and goal ambitions show both a positive state and trend in extent and intensity and stead trend in coherence and flexibility. However while flexibility shows a positive state, coherence ranks neutral. Strategies and instruments are positive in state and on a steady trend in all quality criteria. Resources show both a neutral state and a steady trend in extent and flexibility. In resource use coherence the regime shows a positive state with a positive trend while resource use intensity is in negative state but positive trend. The state and trend of governance is resulting in a neutral state and positive trend of flood mitigation as shown in the last column on performance.

6.2.8. Discussion

This chapter shows that there is a difference in the quality of governance across all dimensions except on strategies and instruments. Consequently there is a positive state in performance and positive trend in flood mitigation. This supports the hypothesis that governance context influences mitigation level. It also shows a good fit in the protection motivation theory except that since the approach is qualitative it is not easy to combine it with other variables in testing applicability of the theory in Bwaise 3. The improvement of flood mitigation efforts with the transformation from KCC to KCCA strengthens the desirability of this form of New Public Management with a bit of recentralisation and command (Madinah et al., 2015). However they noted a disadvantage relating to bottom-up accountability while this study observed a reduced inclusion of grassroots organisations in choice and design of mitigation efforts. Having said this, it is still novel to push further this school of thought which in this thesis is coined the Bounded New Public Management.

7. APPLICABILITY OF THE PROTECTION MOTIVATION THEORY IN BWAISE 3

7.1. Determinants of structural mitigation in Bwaise Parish 3

To assess the applicability of the PMT, the researcher used structural mitigation measures as the dependent variable. The reason behind this is that it is the one predominantly used in previous literature. Perception about time requirement, perception about implementation cost, perception about self-efficacy, perception about response efficacy, flood experience, likelihood of flood damage, per capita income, household size, mitigation measures caused by social networks and age. The results of the hierarchical regression model shows a very weak correlation of the predictor variables and the dependent variable – structural flood damage mitigation measures. In table 7.1 below the R^2 change statistics are very low – the highest is 0.81. When all the 9 predictor variables are loaded, The R^2 is just 0.124 which means they can explain only 12.4% of the variability in the dependant variable. Since the Dublin-Watson statistic is close to 2 which confirms independence of errors.

Table 7.1: Linear regression model results (structural mitigation)

Model Summary

					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.285[a]	.081	.076	.795	.081	17.379	1	197	.000	
2	.315[b]	.099	.090	.789	.018	3.943	1	196	.048	
3	.325[c]	.105	.092	.788	.006	1.337	1	195	.249	
4	.325[d]	.105	.087	.790	.000	.011	1	194	.917	
5	.335[e]	.112	.089	.789	.007	1.528	1	193	.218	
6	.337[f]	.114	.086	.791	.001	.316	1	192	.575	
7	.341[g]	.116	.084	.792	.002	.538	1	191	.464	
8	.348[h]	.121	.084	.791	.005	1.018	1	190	.314	
9	.354[i]	.125	.084	.792	.004	.893	1	189	.346	1.738

a. Predictors: (Constant), Structural self-efficacy

b. Predictors: (Constant), Structural self-efficacy, Mitigation measures caused by social networks

c. Predictors: (Constant), Structural self-efficacy, Mitigation measures caused by social networks Structural Implementation Cost

d. Predictors: (Constant), Structural self-efficacy, Mitigation measures caused by social networks Structural Implementation Cost Structural response efficacy.

e. Predictors: (Constant), Structural self-efficacy, Mitigation measures caused by social networks Structural Implementation Cost Structural response efficacy, Likelihood of flood damage

f. Predictors: (Constant), Structural self-efficacy, Mitigation measures caused by social networks Structural Implementation Cost Structural response efficacy, Likelihood of flood damage, Age

g. Predictors: (Constant), Structural self-efficacy, Mitigation measures caused by social networks Structural Implementation Cost Structural response efficacy, Likelihood of flood damage, Age, Time requirement for structural mitigation

h. Predictors: (Constant), Structural self-efficacy, Mitigation measures caused by social networks Structural Implementation Cost Structural response efficacy, Likelihood of flood damage, Age, Time requirement for structural mitigation, Per capita income

i. Predictors: (Constant), Structural self-efficacy, Mitigation measures caused by social networks Structural Implementation Cost Structural response efficacy, Likelihood of flood damage, Age, Time requirement for structural mitigation, Per capita income, Household size.

j. Dependent Variable: Structural mitigation

Table 7.2: Analysis of variance (structural mitigation)

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.978	1	10.978	17.379	.000[b]
	Residual	124.439	197	.632		
	Total	135.417	198			
2	Regression	13.432	2	6.716	10.791	.000[c]
	Residual	121.985	196	.622		
	Total	135.417	198			
3	Regression	14.262	3	4.754	7.652	.000[d]
	Residual	121.155	195	.621		
	Total	135.417	198			
4	Regression	14.269	4	3.567	5.712	.000[e]
	Residual	121.148	194	.624		
	Total	135.417	198			
5	Regression	15.220	5	3.044	4.888	.000[f]
	Residual	120.197	193	.623		
	Total	135.417	198			
6	Regression	15.418	6	2.570	4.111	.001[g]
	Residual	119.999	192	.625		
	Total	135.417	198			
7	Regression	15.755	7	2.251	3.592	.001[h]
	Residual	119.662	191	.627		
	Total	135.417	198			
8	Regression	16.392	8	2.049	3.271	.002[i]
	Residual	119.025	190	.626		
	Total	135.417	198			
9	Regression	16.952	9	1.884	3.005	.002[j]
	Residual	118.465	189	.627		
	Total	135.417	198			

7.2. Discussion

It can safely be concluded that the PMT does not apply in Bwaise. The reason behind this might be that it was developed in the United States of America and had a flood management application mainly in Europe. The socio-economic characteristics of citizens in these countries are way higher than that of Africa, let alone that of an informal settlement like Bwaise 3. Another possibility is that the model has been affected by little

variability in the dependent variable. However, the PMT stands a better application chance in Africa if used to assess damage mitigation in non-slum areas.

8. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter summarises the objectives and findings of this study. It also draws conclusions and recommendations for practitioners and highlights areas for further research.

8.1. Summary and reflection

The gap identified by this research is related to the inadequacy of application literature for the Protection Motivation Theory in the developing world context. Secondly it relates to the lack of focus on motivation for public mitigation and the very low level of synopsis in considering spatial and perceptual elements of risk. This gap was addressed using a mixed methods approach to understand the determinants of flood damage mitigation in Bwaise 3. Mixing methods in the analysis of data enabled the researcher to gain a rich understanding of determinants of in situ flood damage mitigation from different angles. For example the use of perception maps alongside correlation and regression analysis enabled the identification of spatial patterns of perception, experience and social status. This helped in the reflection where previously observed trends in literature were not confirmed. For example the poor correlation between distance from drainage channel and flooding experience was better explained by results from transact walks after heavy rain which showed that flooding in the settlement does not only occur because of overflow from the drainage channels. Instead the dense morphology and use of small dykes reduces runoff and caused inundation from direct rainfall. Furthermore when households which indicated that they perceive structural mitigation to be costly turned out to have implemented more, the use of mapping easily revealed that such households were renting. The inclusion of governance context was also enabled by the embracing of a mixed-methods approach. Since quantification is not easy, the adapting of the Governance Assessment Tool proved useful although it could not necessitate inclusion of the variable in a regression model.

8.2. Conclusions

The objectives were addressed as follows:

8.2.1. To establish the relationship between community perceptions and flood risk mitigation

The study established no significant correlation between flood probability; flood damage probability; flood benefits on one hand and damage mitigation on the other. This implies that threat appraisal is not a determinant of flood damage mitigation in Bwaise 3. Consequently it poses some questions on the applicability of the Protection Motivation Theory in this informal settlement.

Bwaise 3 residents are sceptical about the efficacy of capturing rain water and grassing the yard on the grounds of costs and small plot sizes respectively

8.2.2. To establish the relationship between distance to drainage channel and implementation of mitigation measures

Distance from the drainage channel is not related to mitigation level. This means that flooding in this area is not only intense closer to the drainage channel but there are other factors like ground water level, which speed up inundation, for example on the western part of the settlement. It was also established that although some damage mitigation measures like small dykes are effective in barring run off from the yards, if not designed properly they speed up the accumulation of rain water.

8.2.3. To establish the relationship between social and socio-economic factors and flood risk mitigation.

While social networks have an influence on level of mitigation, income, a proxy for socio-economic status does not.

8.2.4. To establish the relationship between flood experience, risk attitude and levels of adaptation

Risk attitudes, measured by assessing willingness of households to spend on mitigation, is not significantly correlated to flood experience. In turn flood experience is not significantly correlated to mitigation level.

8.2.5. To establish the relationship between community governance and flood adaptation.

Governance context directly influenced flood damage mitigation at community level. When KCC was transformed into KCCA, a separation of power between the political and the technical wing of the municipality reduced corrupt activities. This resulted in more effective development control and more revenue streams. Flood damage mitigation activities like construction of the primary channel, desilting of the drainage channels, paving of the road sides and yards of people living closer to the channels became widespread.

8.3. Recommendations

8.3.1. General recommendations

a. To increase levels of mitigation, the local authority and civil society organisations must encourage the residents of Bwaise to join the slum dwellers federation and participate in saving groups.
b. Since self-efficacy and social networks influences levels of mitigation, sensitisation, support of their enterprises and more membership in civil society organisations must be done by both the municipality and Non-governmental Organisations for effective mitigation.
c. Since the western and north eastern parts of the settlement are swampy and prone to flood water from the hills respectively, the municipality must consider removing people in this area and accommodate them in the central part of the settlement using a land sharing technique with densification.

8.3.2. Principles which can guide the design of community adaptation measures in Bwaise

a. Basing on the conclusion under 8.2.2 above that small dykes cause inundation from direct rainwater it is recommended that in redesigning the settlement by KCCA, raising of yards and houses must be prioritised compared to small dykes. Those who have neither raised their house floors and yards nor built small dykes must prioritised in such an exercise.
b. The qualitative analysis of flooding risk showed that the ineffective tertiary channels are in the western part of the settlement. Therefore, the city authority bust re-design effective tertiary channels to reduce inundation in the area since the area has a very low gradient.
c. Since capturing rainwater is perceived to be very costly (conclusion 8.2.1), in redesigning the settlement the local authority must come up with house designs that promote and are compatible with capturing rainwater.
d. Given the general perception that grassing the yard as a mitigation measure is not possible because of very small yards, densification techniques can be used by the planning authority to relieve some ground of developments and create room for grass.
e. In the light of the qualitative evaluation of mitigation efforts by KCCA in chapter 6 – that the width of the primary channel impedes desilting efforts, the same should have a width which makes de-silting easier given available technologies. In future planning, KCCA must consider this.
f. Safety precautions must be put in place on the channels by KCCA to effectively reduce risk of people being taken away by water since Bwaise residents perceive more risk associated with the primary channel.

8.4. Limitations of study

Since the thesis is based on a single case, caution must be exercised in broader application of results and conceptual propositions coined from the results. It therefore applies to the Bwaise case and probably other slum settlements in Africa and its conclusions can be used as hypotheses for a broader study. The reason behind this is that since the study is based on a slum set up, the characteristics of its inhabitants are not similar to those of non-slum areas. For example in figure 4.5, about 60% of them rely on small enterprises like baking and selling *chapatti* (traditional bread). Only about 22% are in low to medium formal employment and no one is in high income job.

8.5. Areas for further research

There is need for broader research on the determinants of in-situ flood damage mitigation covering many cases and developing countries. The conceptual framework proposed in section 8.3.1 above can be used to guide the boundaries of study. This may assist to produce a theory which precisely represents what is happening in their flooding communities

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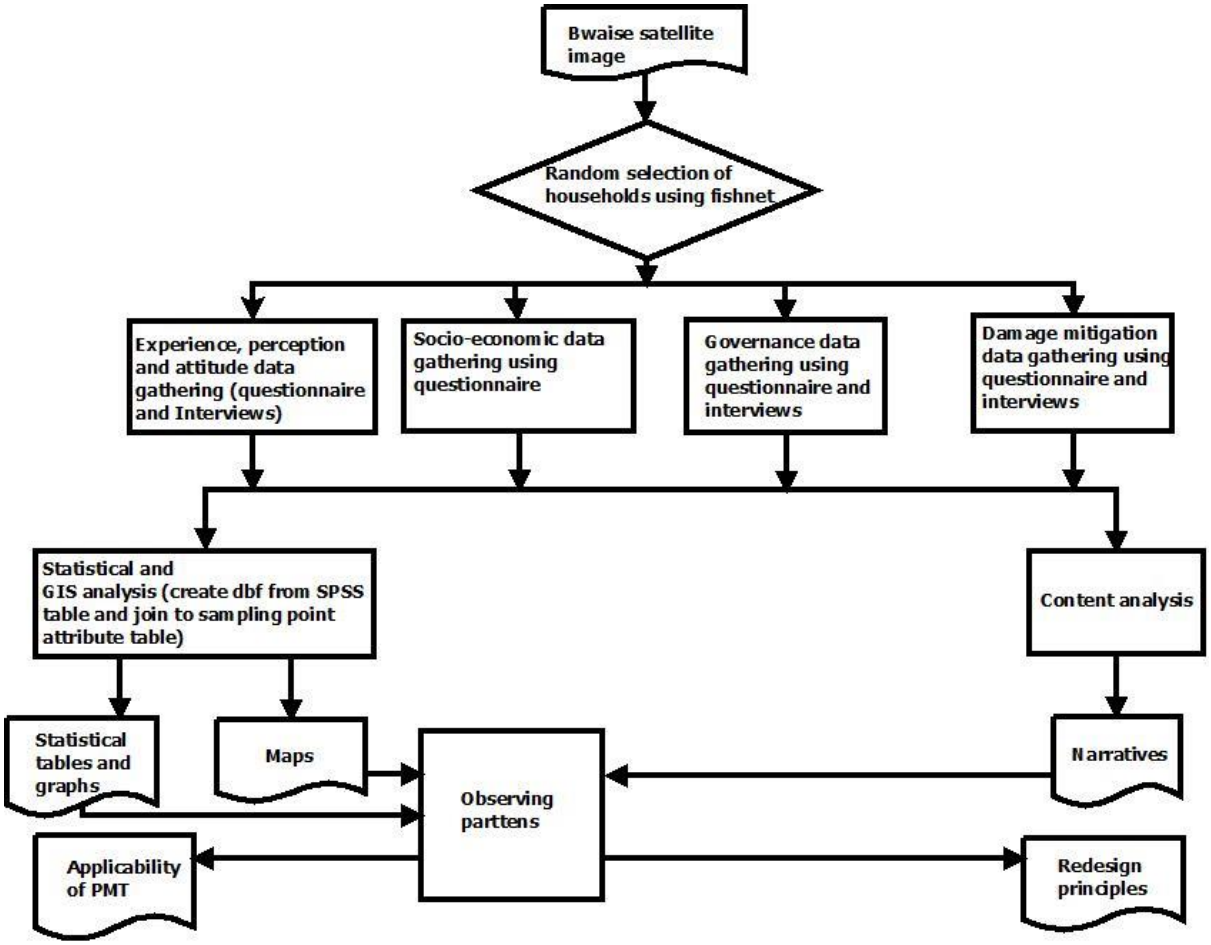
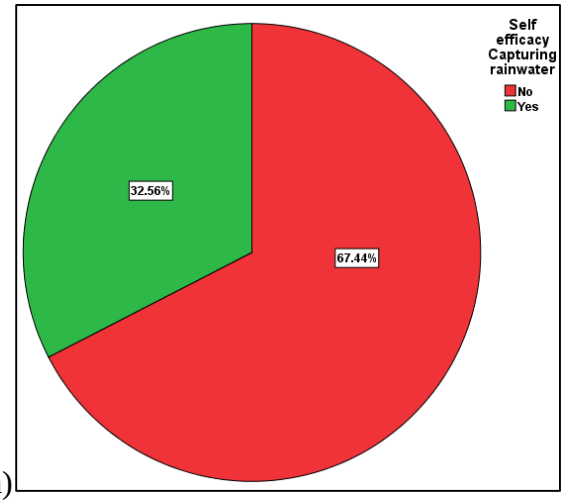
Appendix 1: Methodological flow chart

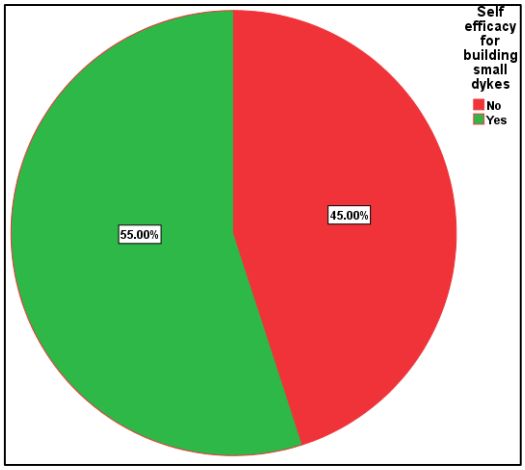


Appendix 2: Perceptions of self-efficacy for different mitigation measures

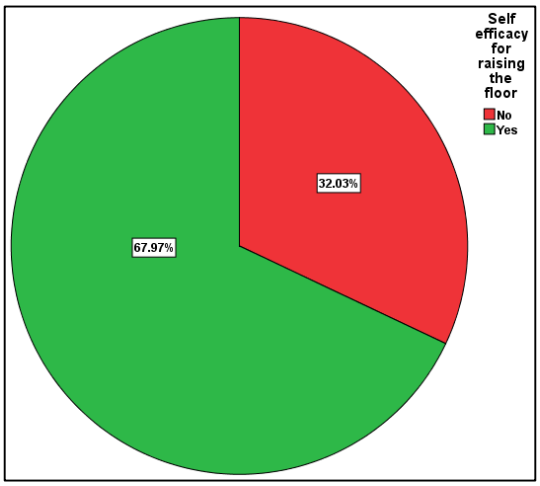
a)



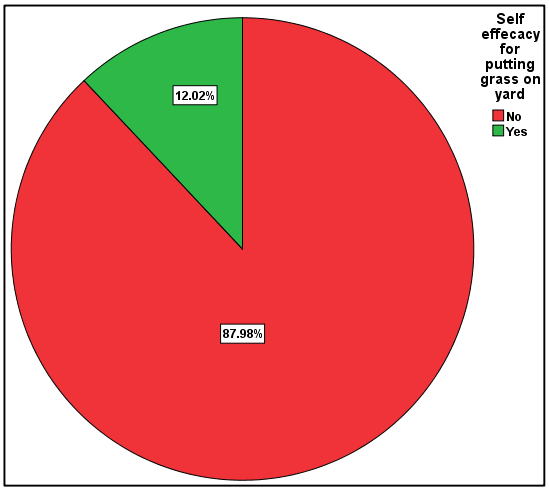
b)



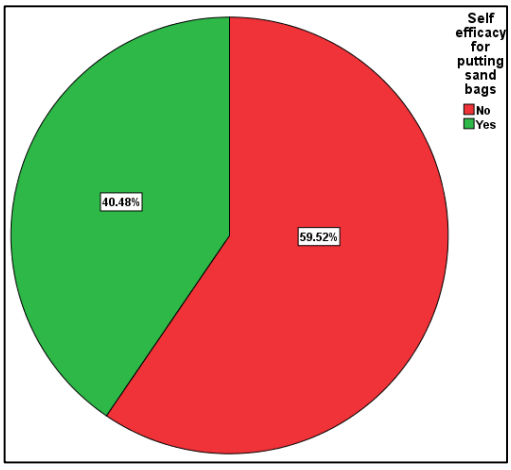
c)



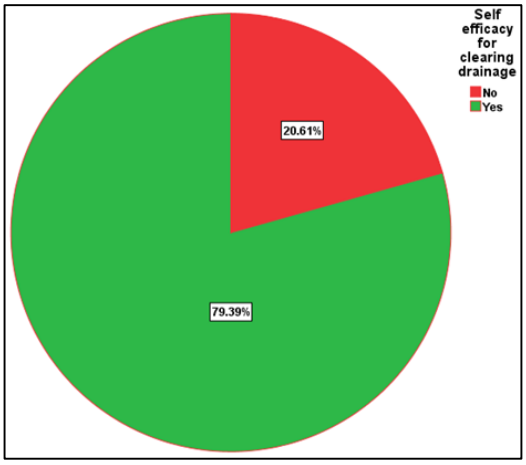
d)



e)

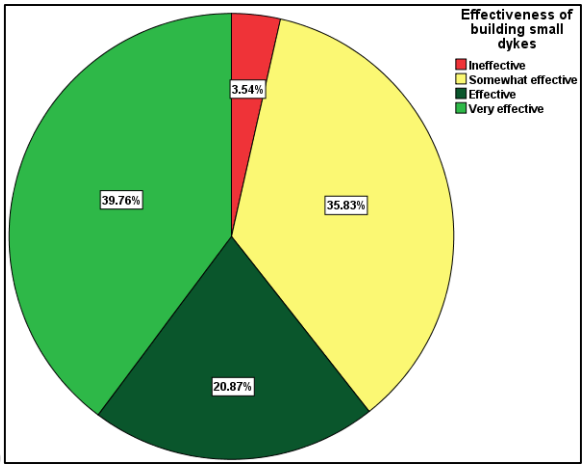


f)

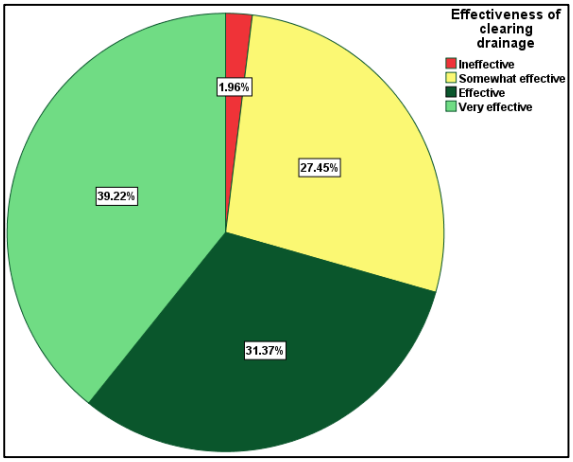


Apendix 3: Perceptions about effectiveness of different mitigation measures

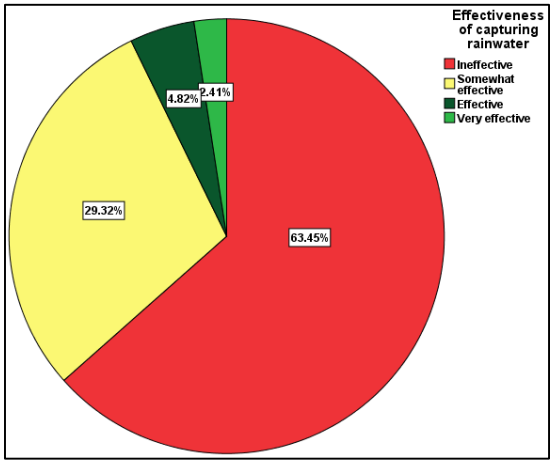
a)



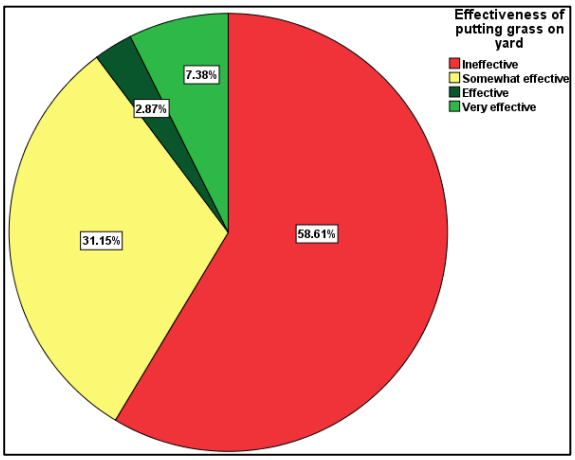
b)



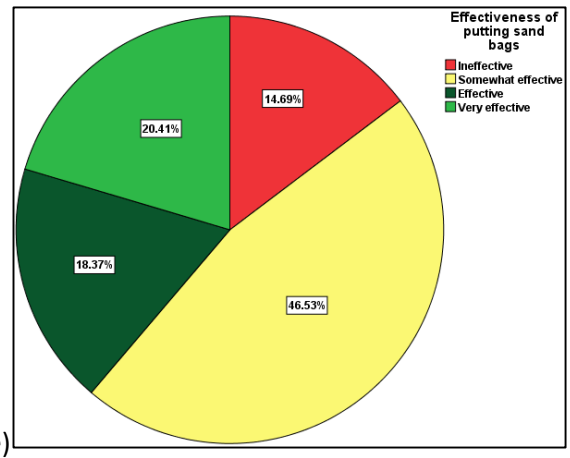
c)



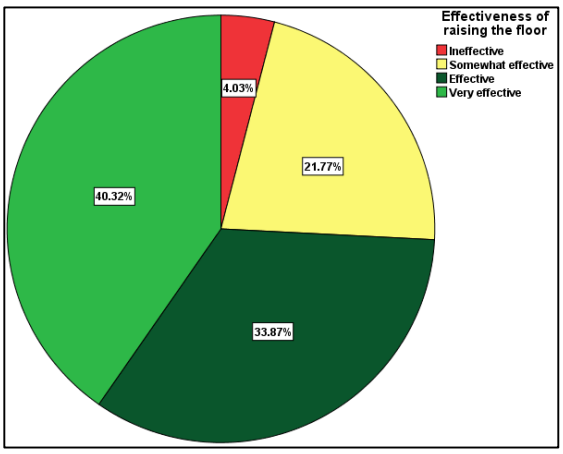
d)



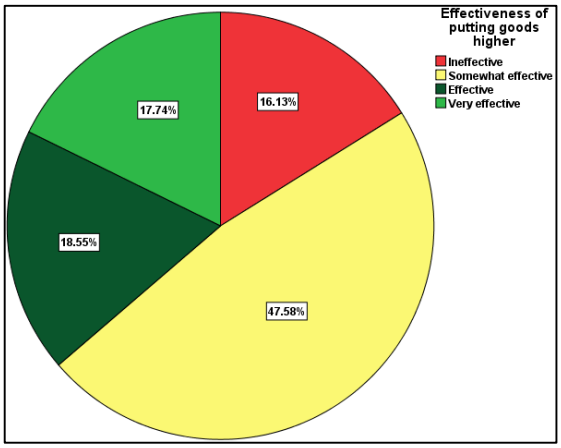
e)



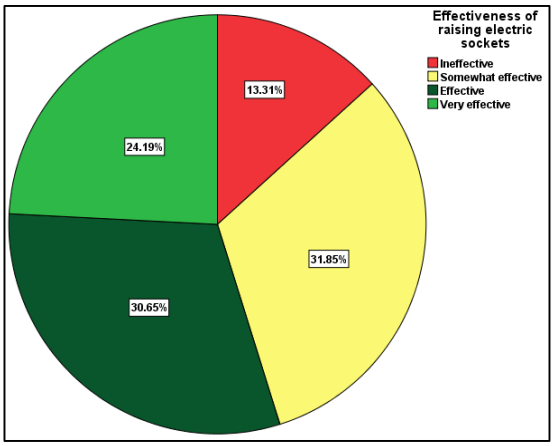
f)



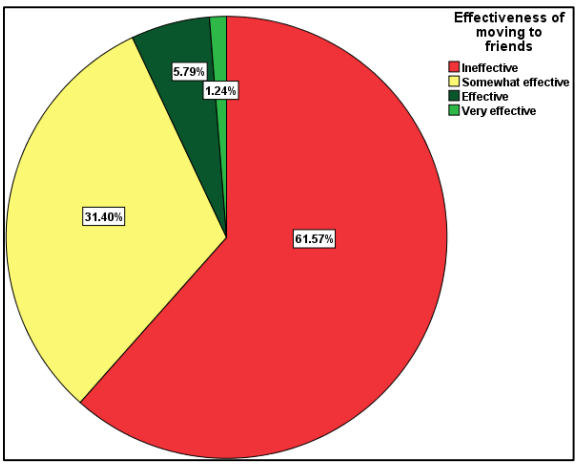
g)


Effectiveness of putting goods higher
Ineffective
Somewhat effective
Effective
Very effective
16.13%
47.58%
18.55%
17.74%

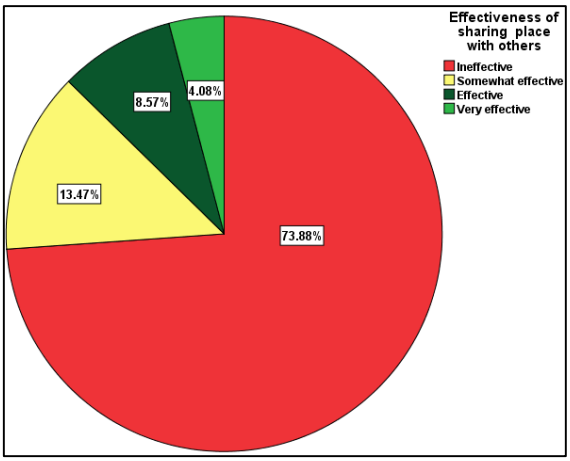
h)


Effectiveness of raising electric sockets
Ineffective
Somewhat effective
Effective
Very effective
13.31%
31.85%
30.65%
24.19%

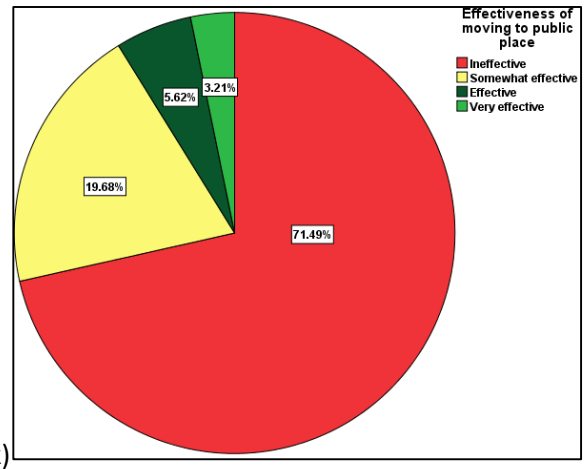
i)


Effectiveness of moving to friends
Ineffective
Somewhat effective
Effective
Very effective
61.57%
31.40%
5.79%
1.24%

j)

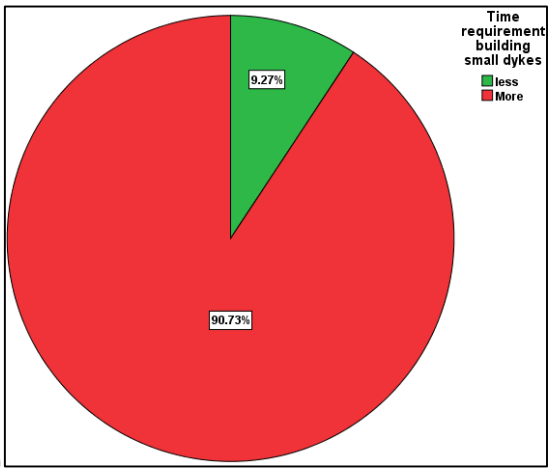

Effectiveness of sharing place with others
Ineffective
Somewhat effective
Effective
Very effective
73.88%
13.47%
8.57%
4.08%

k)

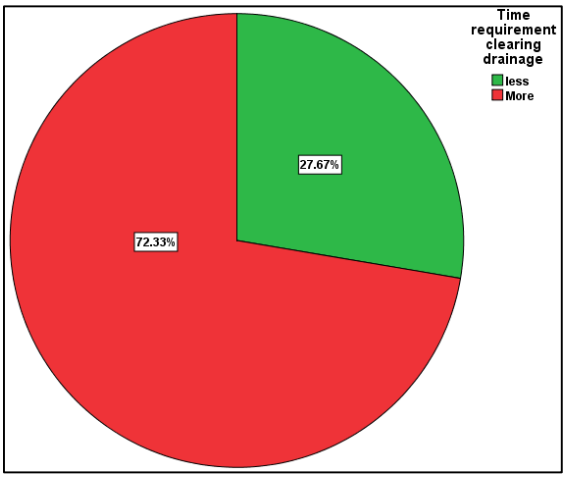

Effectiveness of moving to public place
Ineffective
Somewhat effective
Effective
Very effective
71.49%
19.68%
5.62%
3.21%

Appendix 4: perception of time requirement for implementing different mitigation measures

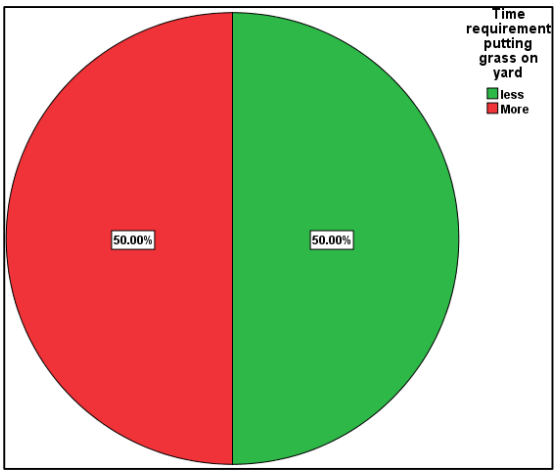
a)



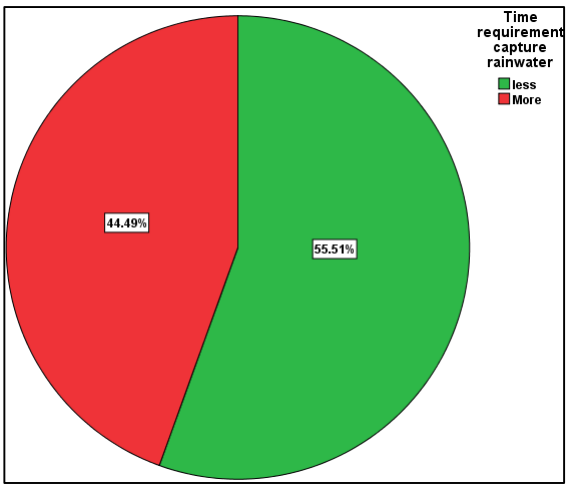
b)



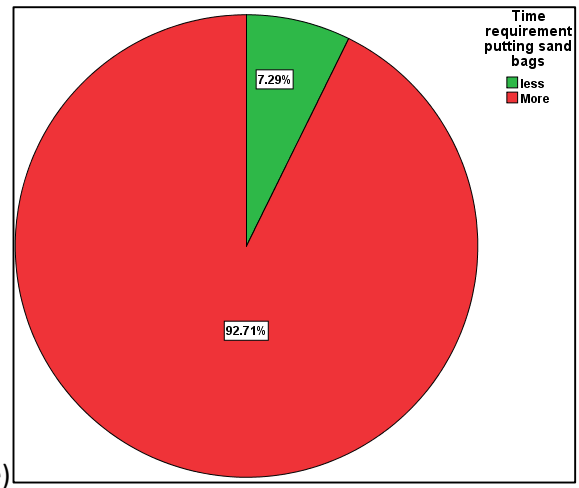
c)



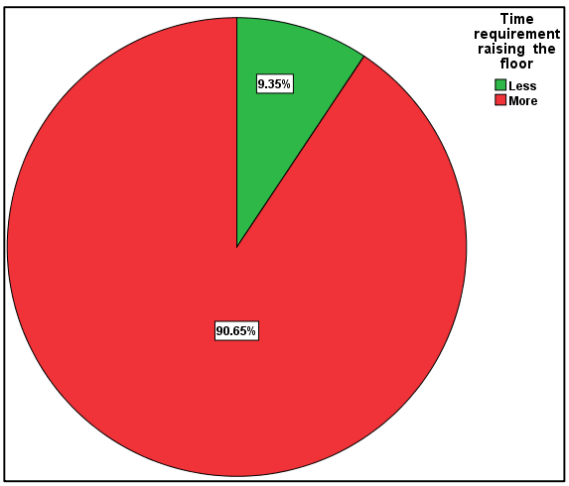
d)



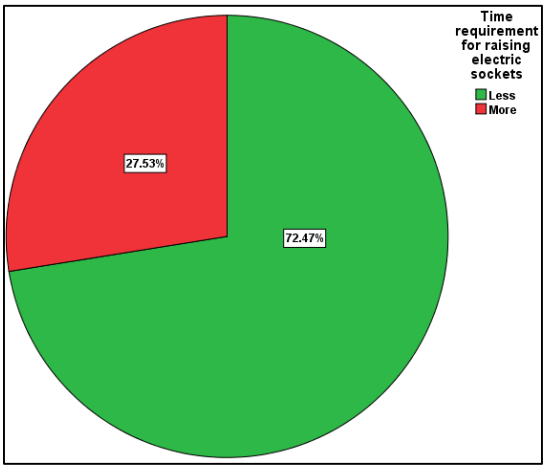
e)



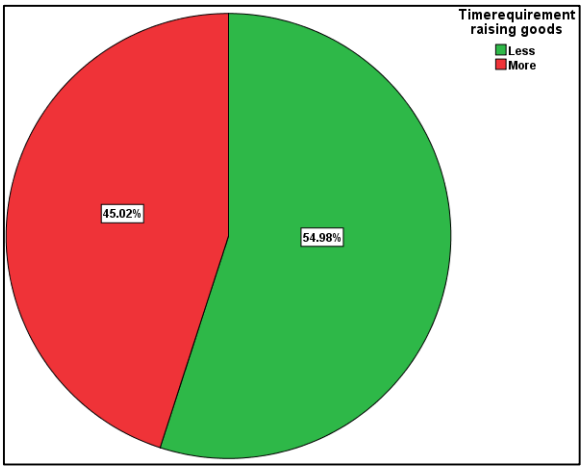
f)



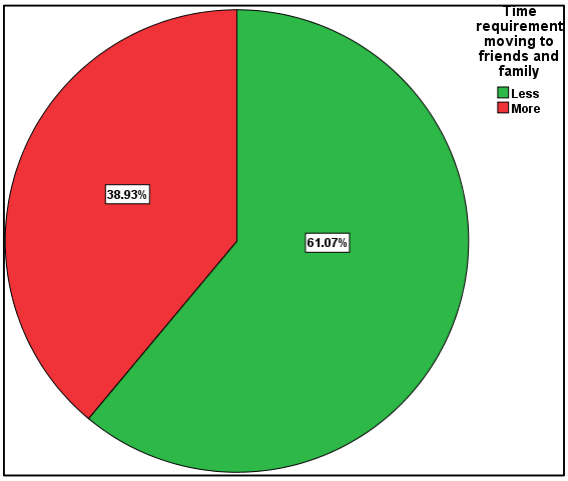
g)


Time requirement for raising electric sockets
Less
More
27.53%
72.47%

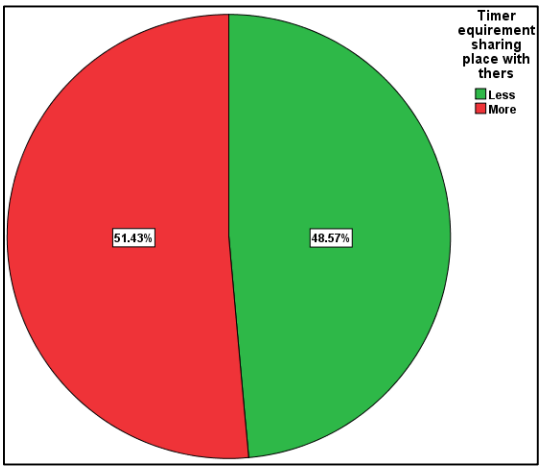
h)


Timerequirement raising goods
Less
More
45.02%
54.98%

i)

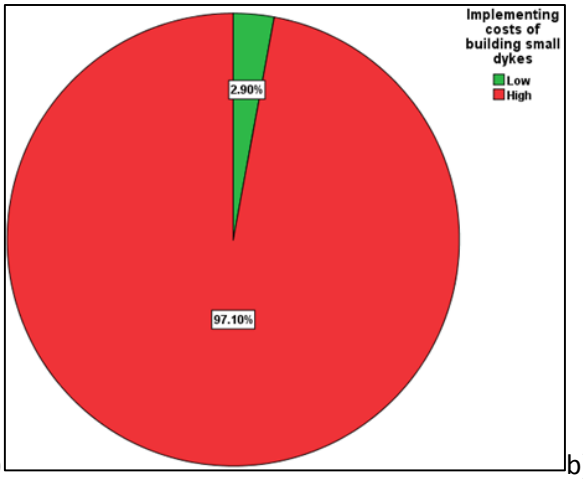

Time requirement moving to friends and family
Less
More
38.93%
61.07%

j)

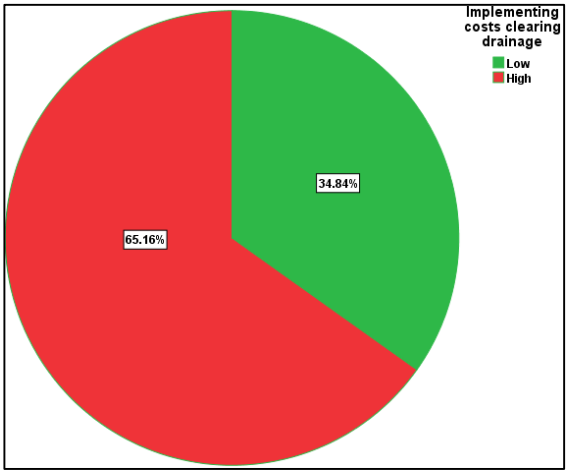

Timer equirement sharing place with thers
Less
More
51.43%
48.57%

Appendix 5: Perception of implementing costs of different mitigation measures

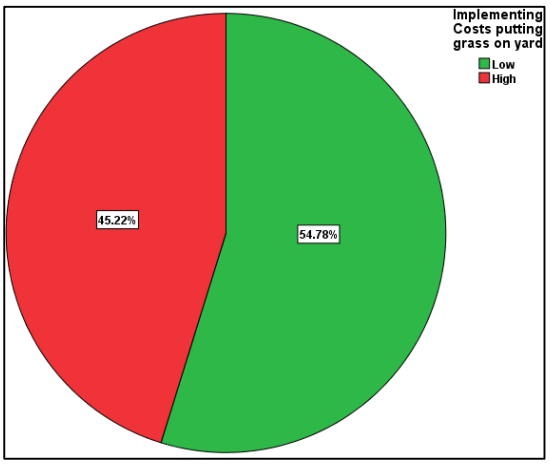
a)



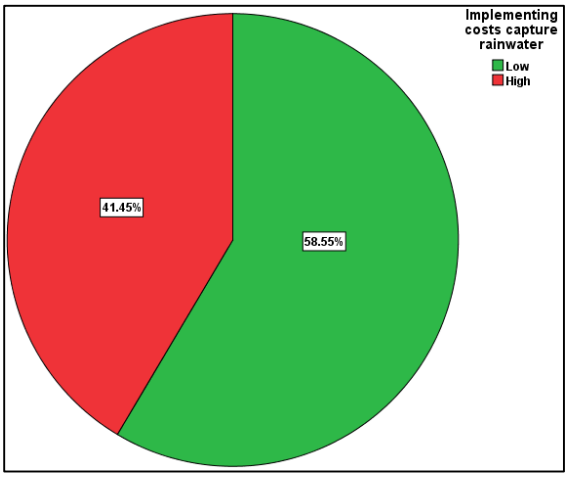
b)



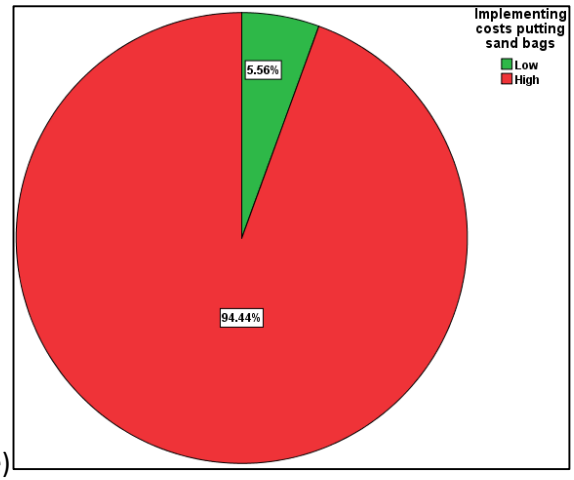
c)



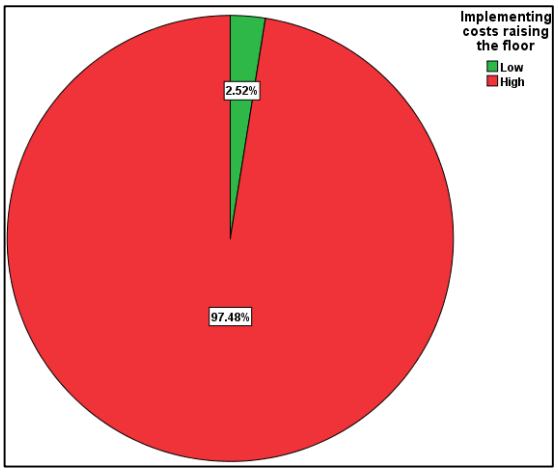
d)



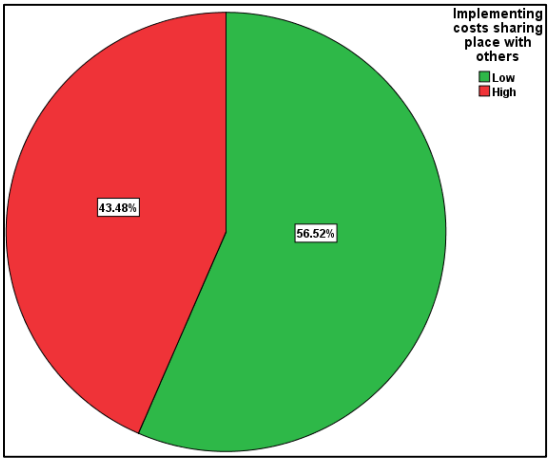
e)



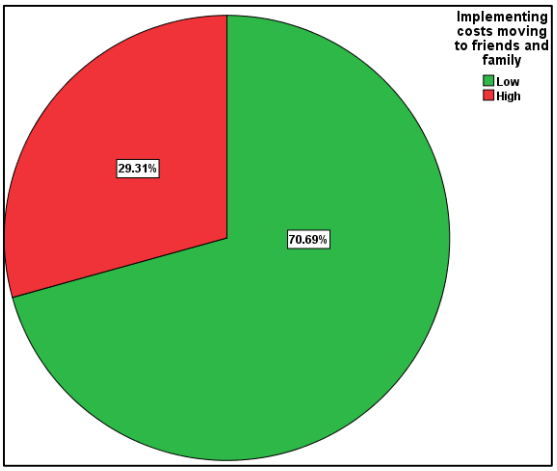
f)



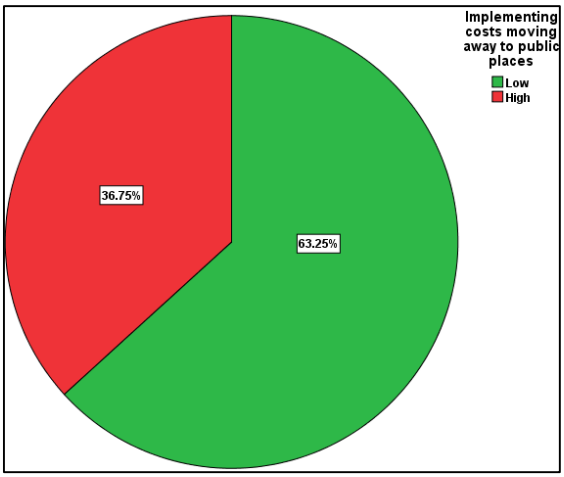
g)


Implementing costs sharing place with others
Low
High
43.48%
56.52%

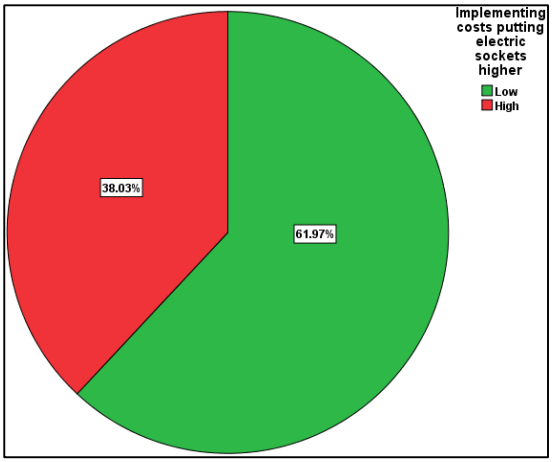
h)


Implementing costs moving to friends and family
Low
High
29.31%
70.69%

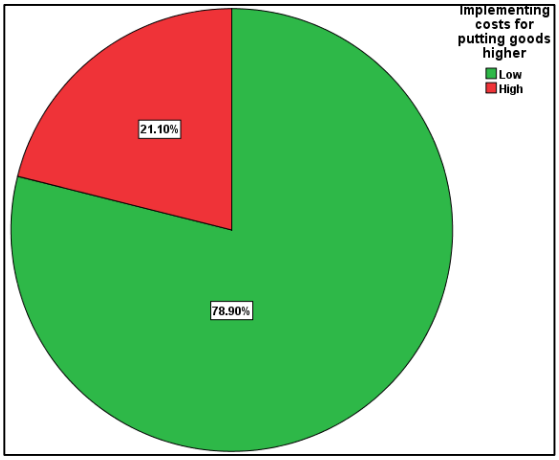
i)


Implementing costs moving away to public places
Low
High
36.75%
63.25%

j)

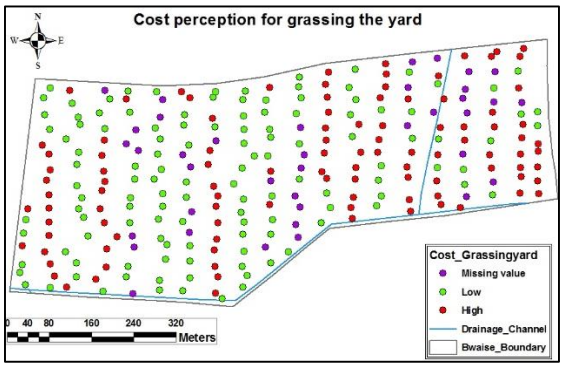

Implementing costs putting electric sockets higher
Low
High
38.03%
61.97%

k)

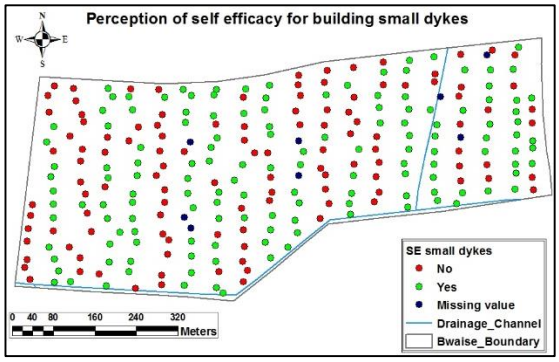

Implementing costs for putting goods higher
Low
High
21.10%
78.90%

Apendix 6: Visualisation of perception about self efficacy

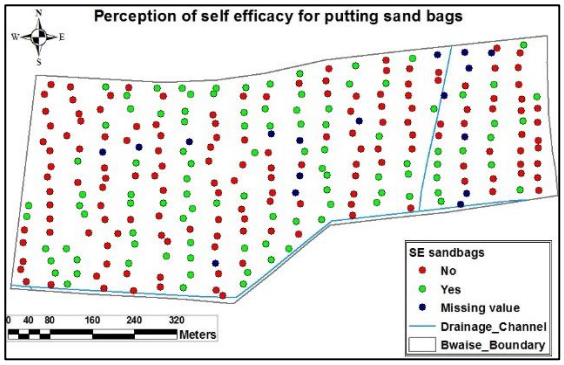
a)



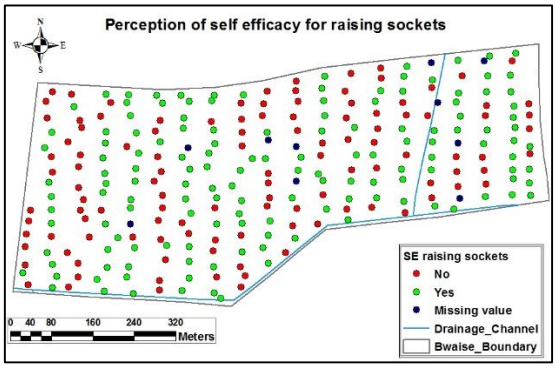
b)



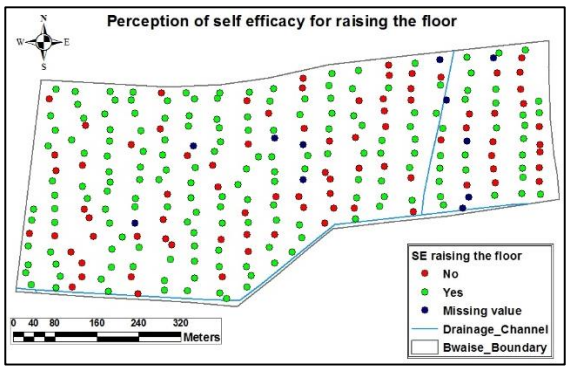
c)



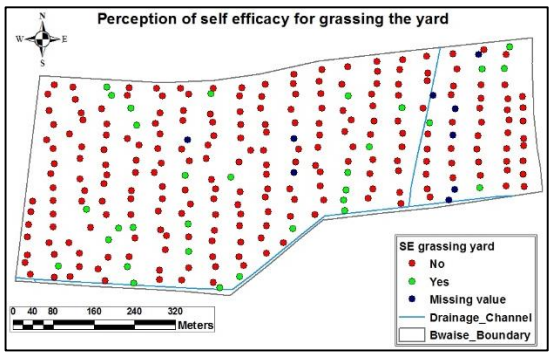
d)



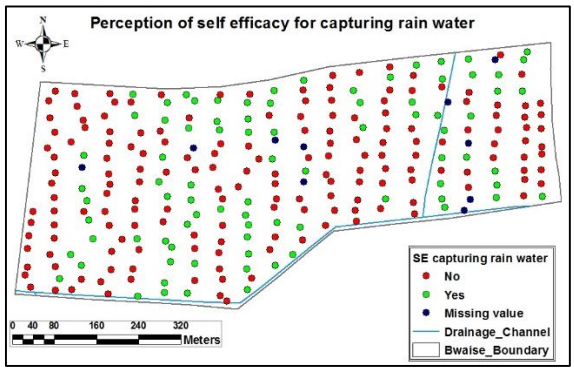
e)



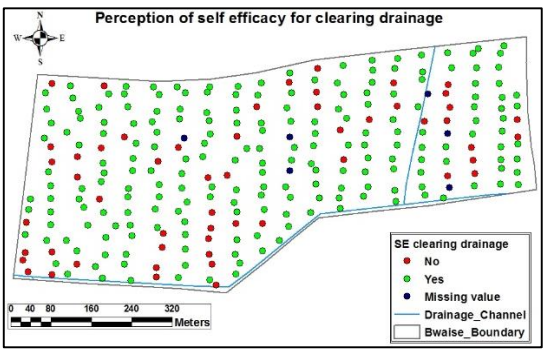
f)



g)

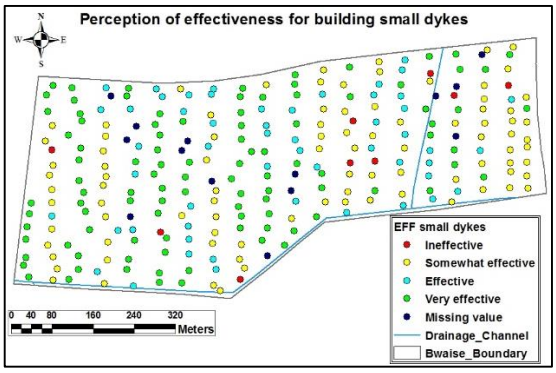


h)

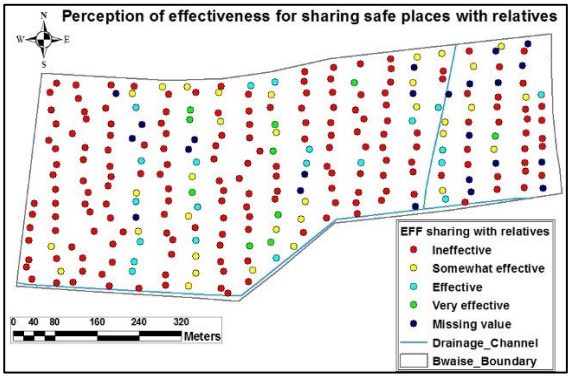


Appendix 7: Perception of response efficacy

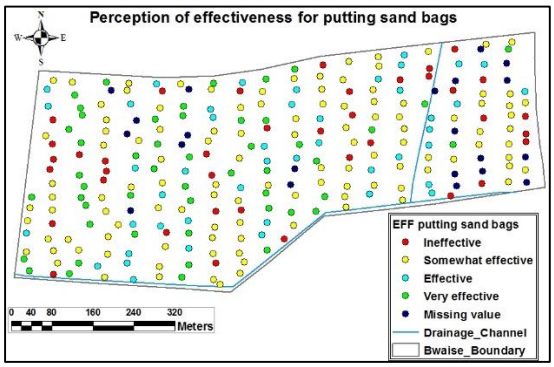
a)



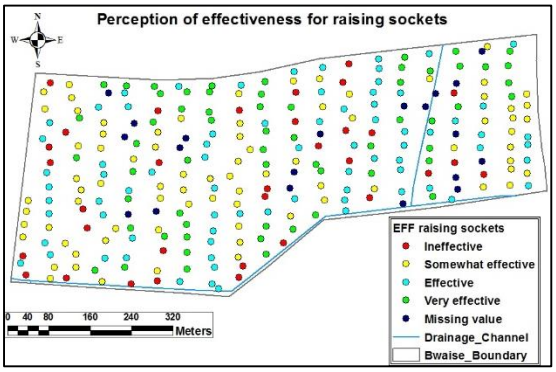
b)



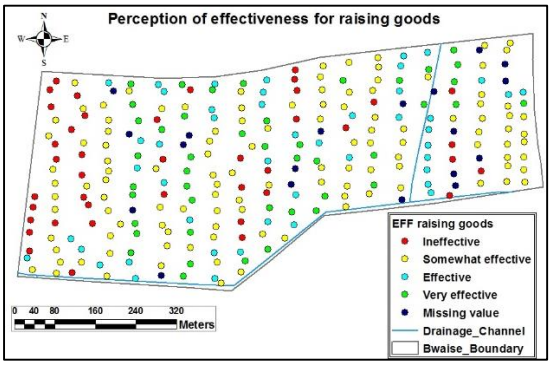
c)



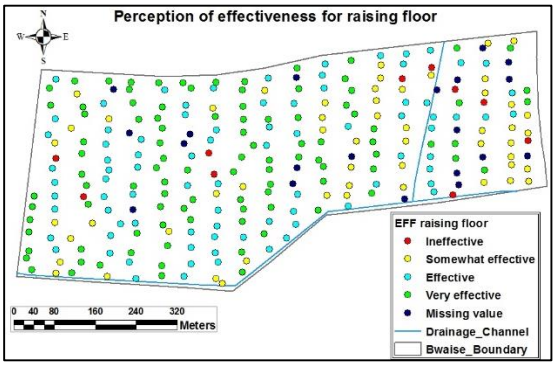
d)



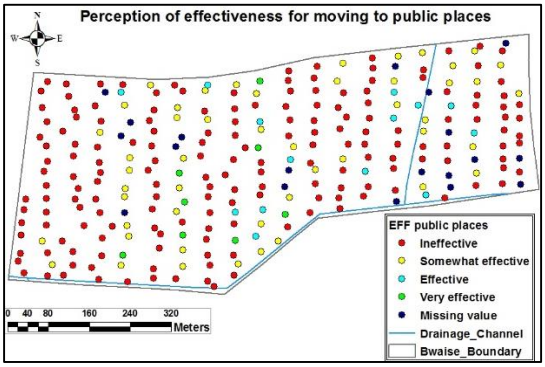
e)



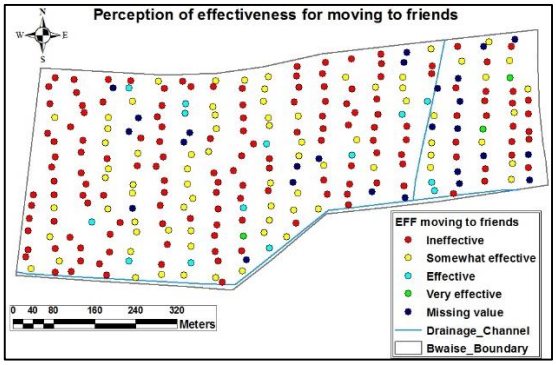
f)



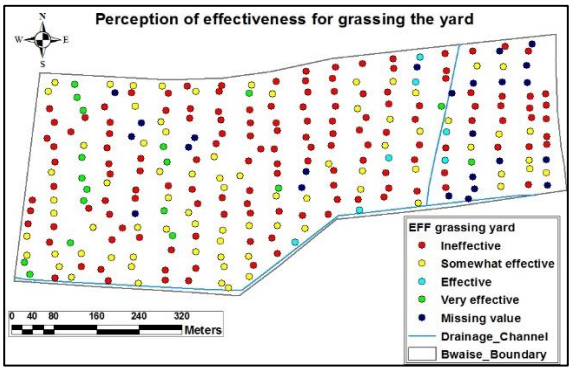
g)



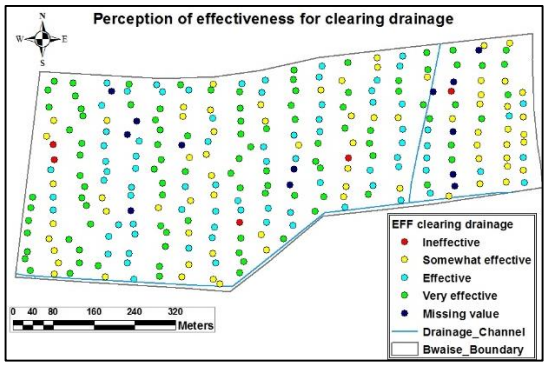
h)



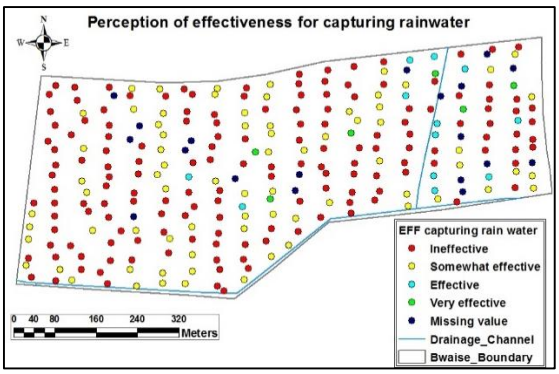
i)


Perception of effectiveness for grassing the yard
N
W
E
S
EFF grassing yard
Ineffective
Somewhat effective
Effective
Very effective
Missing value
Drainage_Channel
Bwaise_Boundary
0 40 80 160 240 320
Meters

j)

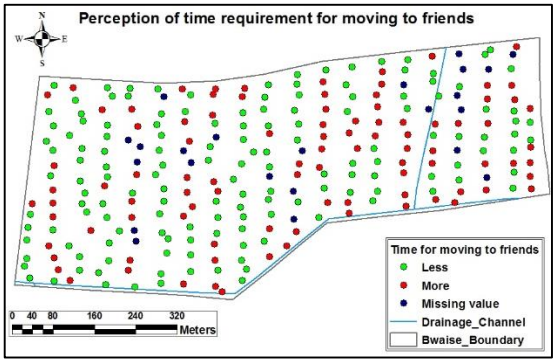

Perception of effectiveness for clearing drainage
N
W
E
S
EFF clearing drainage
Ineffective
Somewhat effective
Effective
Very effective
Missing value
Drainage_Channel
Bwaise_Boundary
0 40 80 160 240 320
Meters

k)

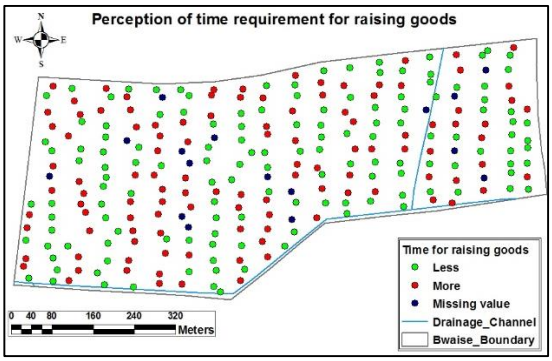

Perception of effectiveness for capturing rainwater
N
W
E
S
EFF capturing rain water
Ineffective
Somewhat effective
Effective
Very effective
Missing value
Drainage_Channel
Bwaise_Boundary
0 40 80 160 240 320
Meters

Appendix 8: Visualisation of time requirement perception for mitigation measures

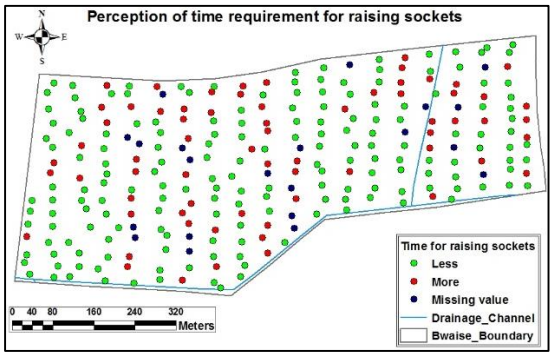
a)



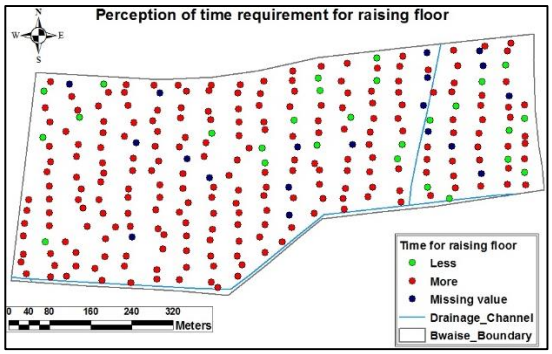
b)



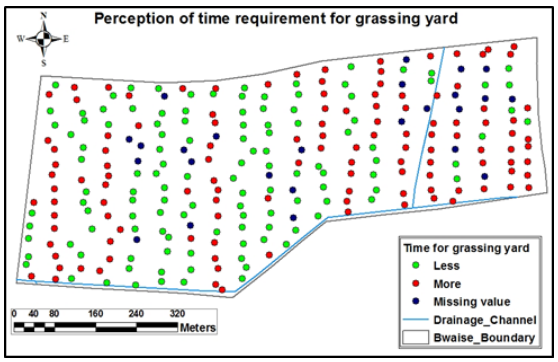
c)



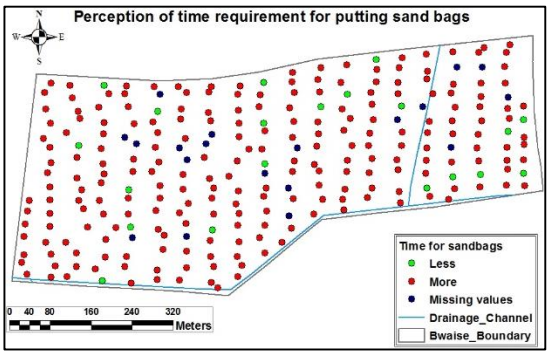
d)



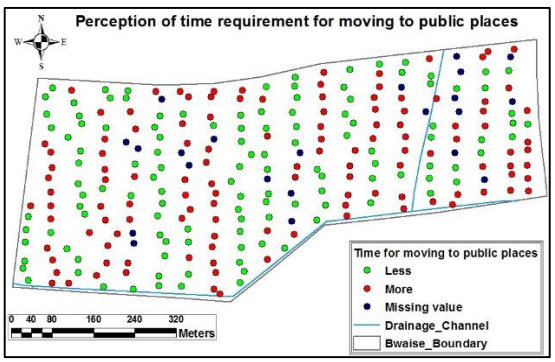
e)



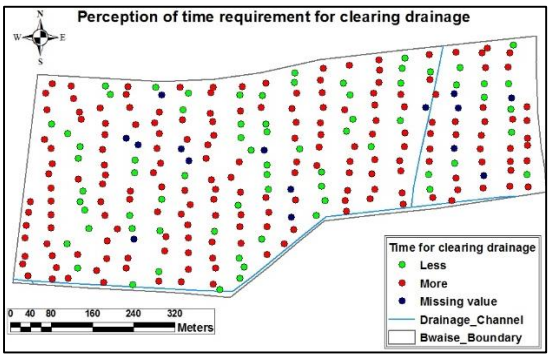
f)

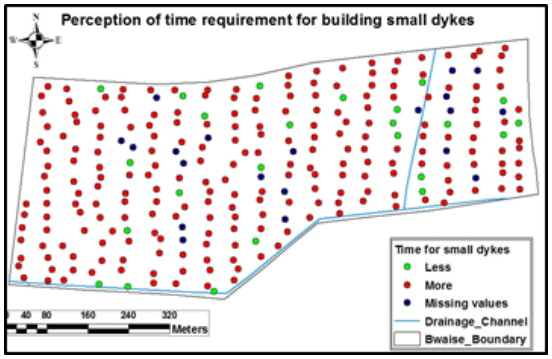


g)



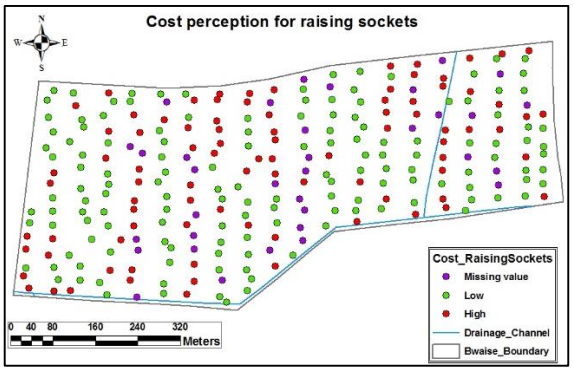
h)



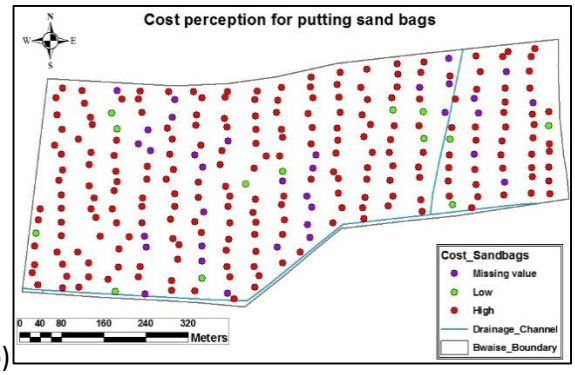
i) 
Perception of time requirement for building small dykes
N
W
E
S
Time for small dykes
Less
More
Missing values
Drainage_Channel
Bwaise_Boundary
0 40 80 160 240 320
Meters

Appendix 8: Perception of monetary costs for implementing mitigation measures

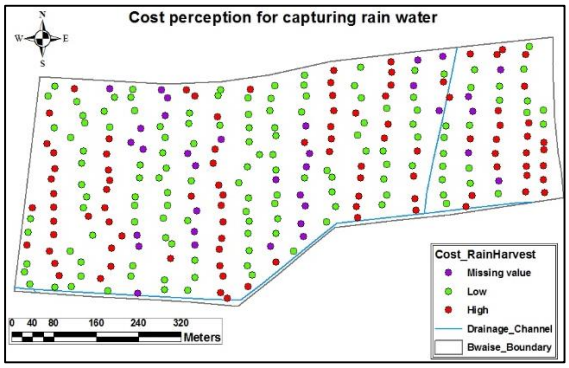
a)



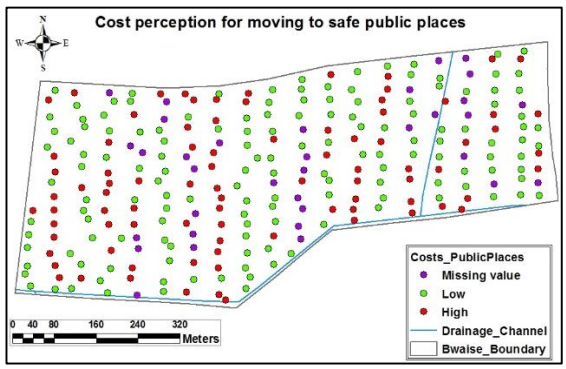
b)



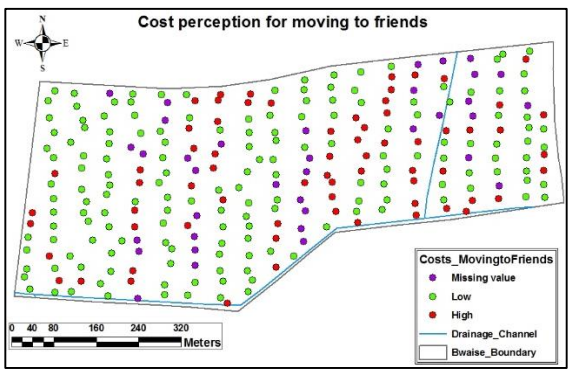
c)



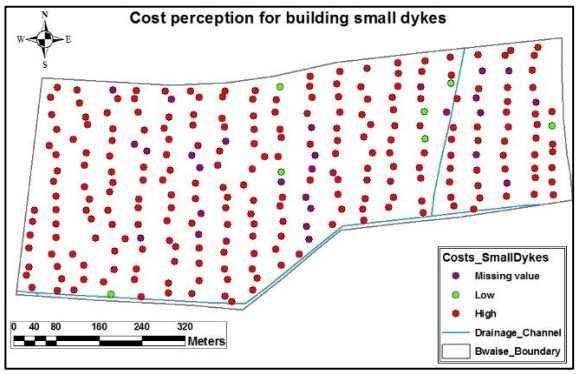
d)



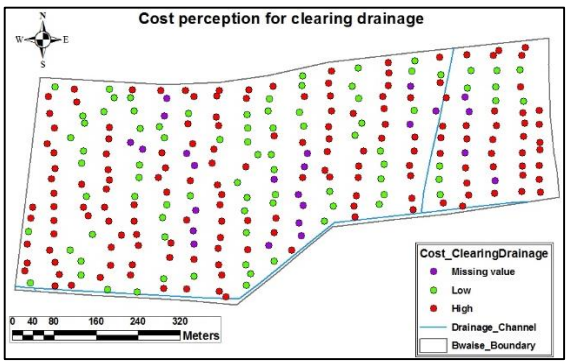
e)



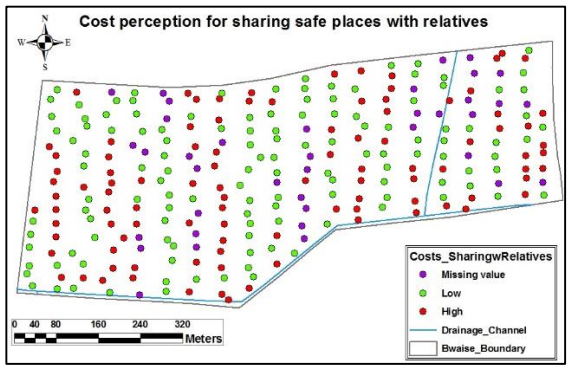
f)

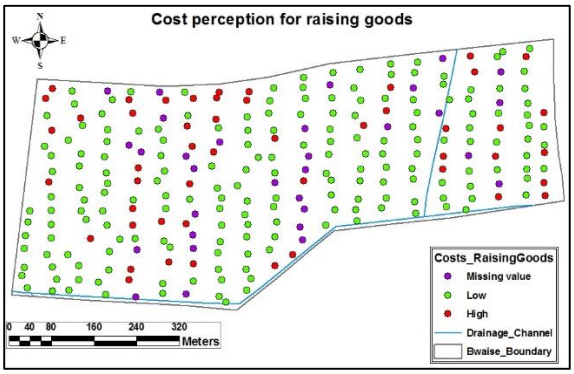


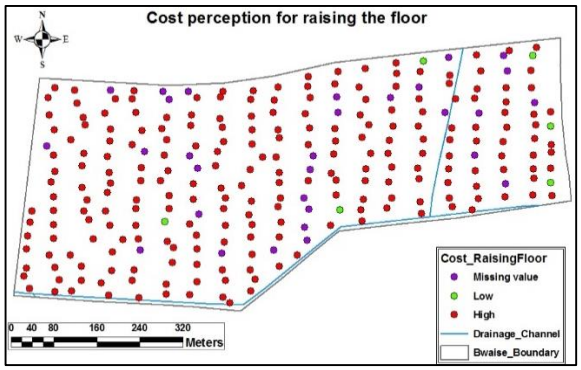
g)



h)



i) 
Cost perception for raising goods
N
W
E
S
Costs_RaisingGoods
Missing value
Low
High
Drainage_Channel
Bwaise_Boundary
0 40 80 160 240 320
Meters

j) 
Cost perception for raising the floor
N
W
E
S
Cost_RaisingFloor
Missing value
Low
High
Drainage_Channel
Bwaise_Boundary
0 40 80 160 240 320
Meters

APPENDIX 9: QUESTIONNAIRE FOR ASSESSING DAMAGE MITIGATION IN BWAISE 3

Good day. Simbarashe Chereni and Glen Olli - students from the University of Twente in the Netherlands are studying flood mitigation processes in Bwaise community. This research is a partial fulfilment of the requirements of The Master of Science degree in Geo-information Science and Earth observation. You have been selected as one of the people who can contribute the required information. We kindly request your time to provide answers for the questions below. The information gathered will be used for solely academic purposes and no names will be publicly used without your consent.

Contacts:

Simbarashe Chereni, *Faculty of Geo-Information Science and Earth Observation, University of Twente, Enschede, The Netherlands. Email: s.chereni@student.utwente.nl*

Glen Olli, *Faculty of Geo-Information Science and Earth Observation, University of Twente, Enschede, The Netherlands. Email: g.olli@student.utwente.nl*

Questions on socio-economic status

1. Gender: Male ☐ Female ☐ Location of House: ☐
_____X_____Y
2. Age: Years
3. Family composition: ☐ People
4. How long have you been living here? ☐ years
5. What is the reason that you moved here:
   - ☐ Job Opportunity
   - ☐ Access to services/Infrastructure
   - ☐ Family/Relatives located nearby
   - ☐ Displaced
   - ☐ Other
6. How many people work in this house?
   ☐ People in formal sector ☐ People in informal sector
7. What type of activity/job is the source of income?
   ☐
8. What is your income level per month?
   ☐ **0-50.000** UGX ☐ **50.000-75.000** UGX ☐ **75.000-100.000** UGX ☐ **00.000-150.000**UGX
   ☐ **100.000-150.000** UGX ☐ **150.000-175.000** UGX ☐ **175.000+** UGX
9. What is the status of this house?
   - ☐ Own
   - ☐ Rent (if rent How much is rent price in UGX/month?) ☐
   - ☐ Borrow
10. What is the status of your land?
    - ☐ Own
    - ☐ Rent (if rent How much is rent price in UGX/month?) ☐
    - ☐ Borrow
11. What is the land tenure status of this house?
    ☐ Formal ☐ Informal
12. What is the highest education level reached by any member of your household?
    ☐ Primary ☐ High School ☐ University ☐ None

Questions on threat appraisal

13. In your opinion, what is the likelihood of your house being flooded?
    No (0) ☐ (1) low ☐ (2) Medium ☐ (3) High ☐

14. What is the likelihood of flood damage on your house?
    No (0) ☐ (1) small ☐ (2) Medium ☐ (3) High ☐

15. How do you rate the benefit you are likely to get in case of flooding? If no skip Qn 16.
    No (0) ☐ (1) small ☐ (2) Medium ☐ (3) big ☐

16. Please write in the space provided, the type of benefits you get during flooding.
    (a)……
    …….
    (b)……
    …….
    (c)……
    …….

Questions on coping appraisal

17. Which damage mitigation measures does your family adopt to deal with flooding?
    ……
    ……
    ……
    ……
    ……
    ……..

18. Are you or any member of the family able to implement the following damage mitigation measures?

(a) Building small dykes	(0) No	☐	(1) Yes	☐
(b) Clearing the drainage	(0) No	☐	(1) Yes	☐
(c) Putting grass on your yard	(0) No	☐	(1) Yes	☐
(d) Capture rainwater to reduce runoff	(0) No	☐	(1) Yes	☐
(e) Putting sand bags to protect the yard	(0) No	☐	(1) Yes	☐
(f) Raising the floor of your house	(0) No	☐	(1) Yes	☐
(g) Putting electric sockets higher	(0) No	☐	(1) Yes	☐

19. How do you perceive the effectiveness of the following mitigation measures?
    (a) Building small dykes
    (0) Ineffective ☐ (1) Somewhat effective ☐ (2) Effective ☐
    (3) Very effective ☐

    (b) Clearing the drainage
    (0) Ineffective ☐ (1) Somewhat effective ☐ (2) Effective ☐
    (3) Very effective ☐

(c) Putting grass on your yard
(0) Ineffective ☐ (1) Somewhat effective ☐ (2) Effective ☐
(3) Very effective ☐

(d) Capture rainwater to reduce runoff
(0) Ineffective ☐ (1) Somewhat effective ☐ (2) Effective ☐
(3) Very effective ☐

(e) Putting sand bags to protect the yard
(0) Ineffective ☐ (1) Somewhat effective ☐ (2) Effective ☐
(3) Very effective ☐

(f) Raising the floor of your house
(0) Ineffective ☐ (1) Somewhat effective ☐ (2) Effective ☐
(3) Very effective ☐

(g) Putting electric sockets higher
(0) Ineffective ☐ (1) Somewhat effective ☐ (2) Effective ☐
(3) Very effective ☐

(h) Putting your goods on high place
(0) Ineffective ☐ (1) Somewhat effective ☐ (2) Effective ☐
(3) Very effective ☐

(i) Moving away to friends & family
(0) Ineffective ☐ (1) Somewhat effective ☐ (2) Effective ☐
(3) Very effective ☐

(i) Sharing high places with others
(0) Ineffective ☐ (1) Somewhat effective ☐ (2) Effective ☐
(3) Very effective ☐

(k) Moving away to public places
(0) Ineffective ☐ (1) Somewhat effective ☐ (2) Effective ☐
(3) Very effective ☐

20. How do you perceive the time requirements for implementing these measures?

(a) Building small dykes	(0) Less	☐	(1) More	☐
(b) Clearing the drainage	(0) Less	☐	(1) More	☐
(c) Putting grass on your yard	(0) Less	☐	(1) More	☐
(d) Capture rainwater to reduce runoff	(0) Less	☐	(1) More	☐
(e) Putting sand bags to protect the yard	(0) Less	☐	(1) More	☐
(f) Raising the floor of your house	(0) Less	☐	(1) More	☐
(g) Putting electric sockets higher	(0) Less	☐	(1) More	☐
(h) Putting your goods on high place	(0) Less	☐	(1) More	☐
(i) Moving away to friends & family	(0) Less	☐	(1) More	☐

(j) Sharing high places with others (0) Less ☐ (1) More ☐
(k) Moving away to public places (0) Less ☐ (1) More ☐

21. What is your judgement of the costs of implementing such measures?

(a) Building small dykes	(0) low	☐	(1) High	☐
(b) Clearing the drainage	(0) Low	☐	(1) High	☐
(c) Putting grass on your yard	(0) Low	☐	(1) High	☐
(d) Capture rainwater to reduce runoff	(0) Low	☐	(1) High	☐
(e) Putting sand bags to protect the yard	(0) Low	☐	(1) High	☐
(f) Raising the floor of your house	(0) Low	☐	(1) High	☐
(g) Putting electric sockets higher	(0) Low	☐	(1) High	☐
(h) Putting your goods on high place	(0) Less	☐	(1) High	☐
(i) Moving away to friends & family	(0) Less	☐	(1) High	☐
(j) Sharing high places with others	(0) Less	☐	(1) High	☐
(k) Moving away to public places	(0) Less	☐	(1) High	☐

Questions on flood experience

22. Have you ever experienced flooding or inundation No (0) ☐ (1) Yes ☐
23. Please explain the extent of the flooding in the space provided below (Nature, level & duration
……
……
……
……
……

24. Have you ever incurred health problems (e.g. Malaria, dengue, diarrhoea, skin problems)? If yes please explain in the space provided
25. No (0) ☐ (1) Yes ☐
……
……
26. Have you ever incurred financial loss during flooding? If yes please explain in space provided No (0) ☐ (1) Yes ☐
……
……

Questions on Risk attitudes

27. How willing are you to spend resources in order to protect your property against flooding?

(0) Not willing ☐ (1) somewhat willing ☐

(2) Willing ☐ (3) highly willing ☐

28. Please explain your answer in the space provided below:
……
……

Questions on Risk management policies

29. Have you ever looked for information about flood risk?
No (0) ☐ (1) Yes ☐

30. Have you ever received information about flood protection

No (0) ☐ (1) Yes ☐

31. What is your feeling about flood protection from the government/municipality?
    (0) Not protected ☐ (1) somewhat protected ☐
    (2) Protected ☐ (3) highly protected ☐

32. Have you ever received an incentive to implement mitigation measures? If yes please explain in the space provided
    No (0) ☐ (1) Yes ☐
    …….

33. Please explain the type of incentive you got in the space provided below:
    ……
    ……
    ……
    ……
    ……

Question about social networks

34. Have you taken/intended to take mitigation measures because your family/friends/relatives did the same at their houses?
    No (0) ☐ (1) Yes ☐

Questions about mitigation measures

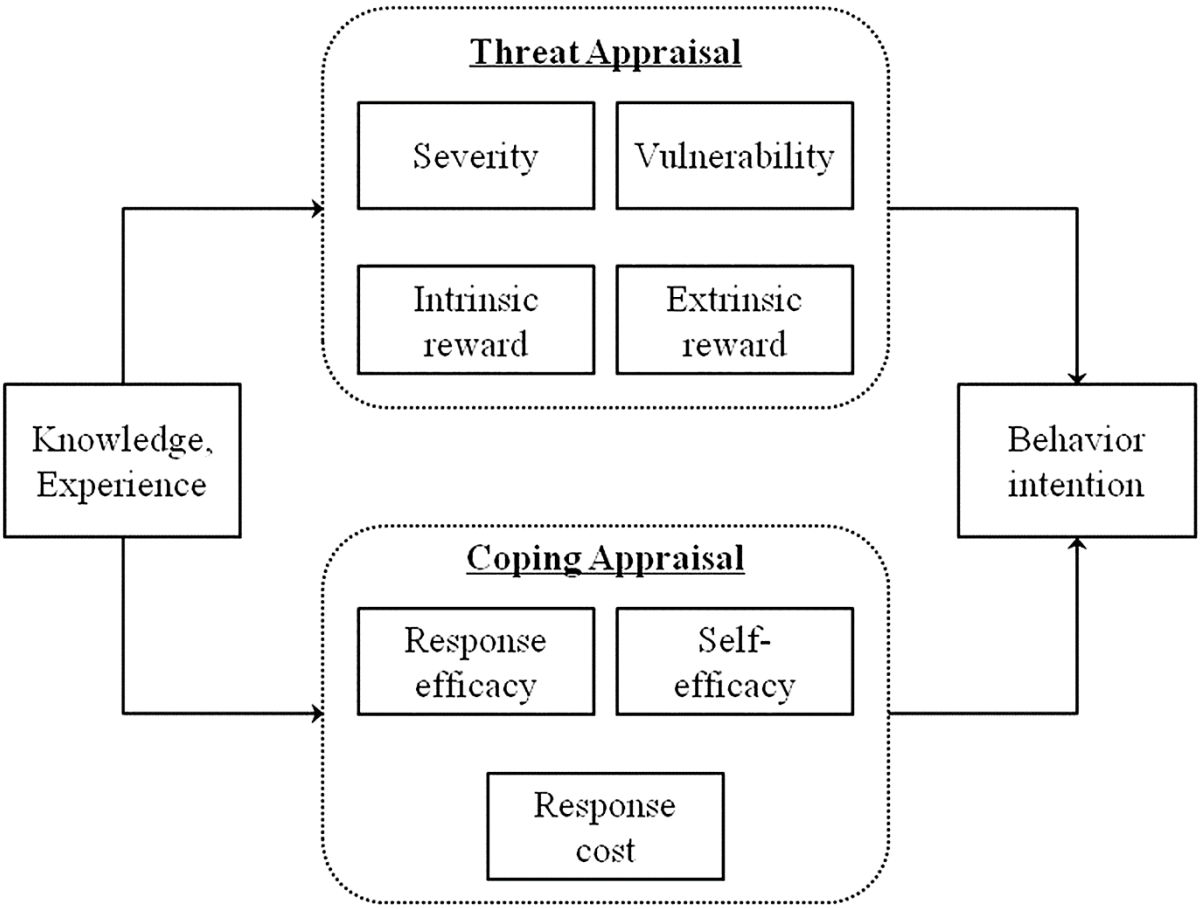
35. Which flood damage mitigation measures have you implemented
    ……
    ……
    ……
    ……..
36. Which other flood damage mitigation measures do you intend to implement?
    ……
    ……
    ……
    ……..

Appendix 10: Evaluative criteria for assessing governance context.

Governance dimension	Quality of the governance regime			
	Extent	Coherence	Flexibility	Intensity
Levels and scales	How many levels are involved and dealing with an issue? Are there any important gaps or missing levels?	Do these levels work together and do they trust each other between levels? To what degree is the mutual dependence among levels recognised?	Is it possible to move up and down levels (up scaling and downscaling) given the issue at stake?	Is there a strong impact from a certain level towards behavioural change or management reform?
Actors and networks	Are all relevant stakeholders involved? Are there any stakeholders not involved or even excluded?	What is the strength of interactions between stakeholders? In what ways are these interactions institutionalised in stable structures? Do the stakeholders have experience in working together? Do they trust and respect each other?	Is it possible that new actors are included or even that the lead shifts from one actor to another when there are pragmatic reasons for this? Do the actors share in 'social capital' allowing them to support each other's tasks?	Is there a strong pressure from an actor or actor coalition towards behavioural change or management reform?
Problem perspectives and goal ambitions	To what extent are the various problem perspectives taken into account?	To what extent do the various perspectives and goals support each other, or are they in competition or conflict?	Are there opportunities to re-assess goals?	How different are the goal ambitions from the status quo or business as usual?
Strategies and instruments	What types of instruments are included in the policy strategy? Are there any excluded types? Are monitoring and enforcement instruments included?	To what extent is the incentive system based on synergy? Are trade-offs in cost benefits and distributional effects considered? Are there any overlaps or conflicts of incentives created by the included policy instruments?	Are there opportunities to combine or make use of different types of instruments? Is there a choice?	What is the implied behavioural deviation from current practice and how strongly do the instruments require and enforce this?
Responsibilities and resources	Are all responsibilities clearly assigned and facilitated with resources?	To what extent do the assigned responsibilities create competence struggles or cooperation within or across institutions? Are they considered legitimate by the main stakeholders?	To what extent is it possible to pool the assigned responsibilities and resources as long as accountability and transparency are not compromised?	Is the amount of allocated resources sufficient to implement the measures needed for the intended change?

Source: (Bressers et al, 2013, p. 15)

Appendix 11: Original PMT framework



Source: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4199519/figure/pntd-0003246-g001/

Appendix 12: Coefficients of the Regression Models

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	.829	.131		6.324	.000	.570	1.087					
	Self-efficacy (structural)	.225	.054	.285	4.169	.000	.119	.332	.285	.285	.285	1.000	1.000
2	(Constant)	.766	.134		5.723	.000	.502	1.030					
	StructuralSE	.188	.057	.238	3.320	.001	.076	.300	.285	.231	.225	.893	1.120
	Mitigation measures caused by social networks	.240	.121	.142	1.986	.048	.002	.478	.220	.140	.135	.893	1.120
3	(Constant)	.814	.140		5.812	.000	.538	1.090					
	Self-efficacy (structural)	.190	.057	.240	3.353	.001	.078	.302	.285	.233	.227	.893	1.120
	Mitigation measures caused by social networks	.221	.122	.131	1.816	.071	-.019	.461	.220	.129	.123	.877	1.140
	Implementation cost (structural)	-.005	.004	-.079	-1.156	.249	-.012	.003	-.101	-.083	-.078	.982	1.018
4	(Constant)	.811	.143		5.669	.000	.529	1.094					
	Self-efficacy (structural)	.190	.057	.240	3.328	.001	.077	.302	.285	.232	.226	.888	1.126
	Mitigation measures caused by social networks	.223	.123	.132	1.808	.072	-.020	.466	.220	.129	.123	.860	1.162
	Implementation cost (structural)	-.005	.004	-.083	-1.058	.292	-.014	.004	-.101	-.076	-.072	.749	1.336
	Response efficacy (structural)	.001	.006	.008	.104	.917	-.011	.012	-.053	.007	.007	.736	1.359

5	(Constant)	.919	.167		5.494	.000	.589	1.248					
	Self-efficacy (structural)	.200	.057	.252	3.474	.001	.086	.313	.285	.243	.236	.871	1.149
	Mitigation measures caused by social networks	.246	.124	.146	1.978	.049	.001	.492	.220	.141	.134	.840	1.190
	Implementation cost (structural)	-.005	.004	-.084	-1.070	.286	-.014	.004	-.101	-.077	-.073	.748	1.336
	Response efficacy (structural)	.000	.006	.003	.038	.970	-.011	.011	-.053	.003	.003	.734	1.363
	Flood damage likelihood	-.069	.056	-.087	-1.236	.218	-.180	.041	.000	-.089	-.084	.930	1.076
6	(Constant)	.837	.222		3.767	.000	.399	1.275					
	Self-efficacy (structural)	.199	.058	.252	3.460	.001	.086	.313	.285	.242	.235	.870	1.149
	Mitigation measures caused by social networks	.238	.125	.142	1.901	.059	-.009	.486	.220	.136	.129	.830	1.205
	Implementation cost (structural)	-.005	.004	-.086	-1.092	.276	-.014	.004	-.101	-.079	-.074	.747	1.339
	Response efficacy (structural)	.000	.006	.004	.053	.958	-.011	.012	-.053	.004	.004	.733	1.364
	Flood damage likelihood	-.070	.056	-.088	-1.252	.212	-.181	.040	.000	-.090	-.085	.929	1.077
	Age	.003	.005	.039	.562	.575	-.006	.011	.065	.041	.038	.979	1.021
7	(Constant)	.858	.224		3.827	.000	.416	1.301					
	Self-efficacy (structural)	.198	.058	.251	3.437	.001	.084	.312	.285	.241	.234	.870	1.150
	Mitigation measures caused by social networks	.236	.126	.140	1.876	.062	-.012	.484	.220	.135	.128	.829	1.206
	Implementation cost (structural)	-.003	.005	-.047	-.491	.624	-.013	.008	-.101	-.036	-.033	.512	1.953
	Response efficacy (structural)	-.001	.006	-.015	-.184	.854	-.013	.011	-.053	-.013	-.013	.658	1.519
	Flood damage likelihood	-.073	.056	-.092	-1.301	.195	-.185	.038	.000	-.094	-.088	.924	1.083

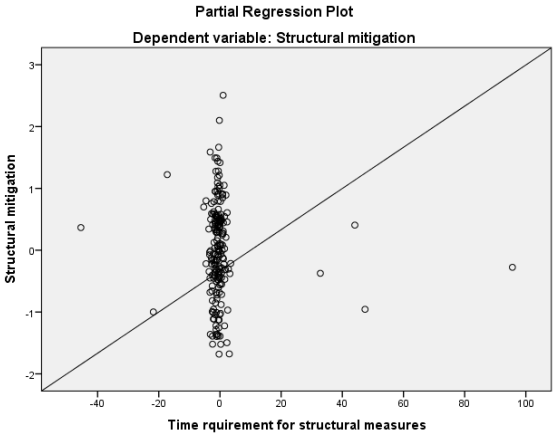
	Years	.003	.005	.041	.599	.550	-.006	.012	.065	.043	.041	.977	1.024
	Time requirement (structural mitigation)	-.004	.006	-.061	-.733	.464	-.016	.007	-.098	-.053	-.050	.675	1.481
8	(Constant)	.943	.240		3.938	.000	.471	1.416					
	Self-efficacy (structural)	.197	.058	.250	3.425	.001	.084	.311	.285	.241	.233	.870	1.150
	Mitigation measures caused by social networks	.233	.126	.138	1.853	.065	-.015	.481	.220	.133	.126	.829	1.206
	Implementation costs (Structural)	-.003	.005	-.053	-.555	.580	-.014	.008	-.101	-.040	-.038	.510	1.961
	Response efficacy (Structural)	-.001	.006	-.016	-.191	.848	-.013	.011	-.053	-.014	-.013	.658	1.519
	Likelihood of flood damage	-.074	.056	-.093	-1.318	.189	-.186	.037	.000	-.095	-.090	.923	1.083
	Age	.002	.005	.034	.499	.619	-.007	.011	.065	.036	.034	.967	1.034
	Time requirement (structural)	-.004	.006	-.059	-.715	.475	-.016	.007	-.098	-.052	-.049	.675	1.482
	Per capita income	-3.926E-6	.000	-.069	-1.009	.314	.000	.000	-.076	-.073	-.069	.981	1.019
9	(Constant)	.817	.274		2.980	.003	.276	1.358					
	Self-efficacy (structural mitigation)	.192	.058	.243	3.318	.001	.078	.306	.285	.235	.226	.862	1.160
	Mitigation measures caused by social networks	.249	.127	.148	1.960	.051	-.002	.499	.220	.141	.133	.815	1.227
	Implementation cost (structural)	-.003	.005	-.050	-.525	.600	-.014	.008	-.101	-.038	-.036	.509	1.963
	Response efficacy (structural)	-.002	.006	-.021	-.250	.803	-.013	.010	-.053	-.018	-.017	.656	1.525
	Flood damage likelihood	-.084	.057	-.105	-1.463	.145	-.197	.029	.000	-.106	-.100	.895	1.117
	Age	.001	.005	.022	.306	.760	-.008	.011	.065	.022	.021	.931	1.074
	Time requirement (structural)	-.004	.006	-.062	-.751	.454	-.016	.007	-.098	-.055	-.051	.674	1.484
	Per capita income	-9.783E-7	.000	-.017	-.196	.845	.000	.000	-.076	-.014	-.013	.598	1.673
	Household size	.027	.029	.086	.945	.346	-.030	.084	.099	.069	.064	.559	1.790

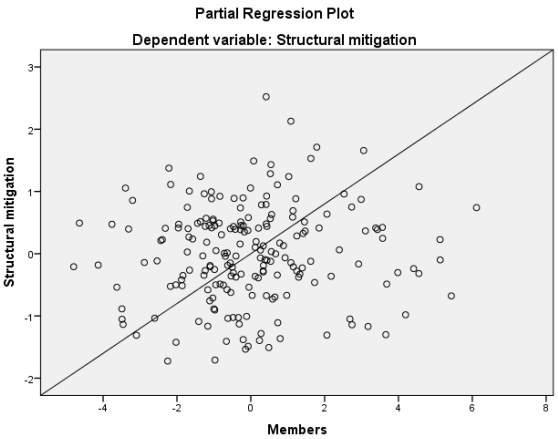
a. Dependent Variable: Structural mitigation

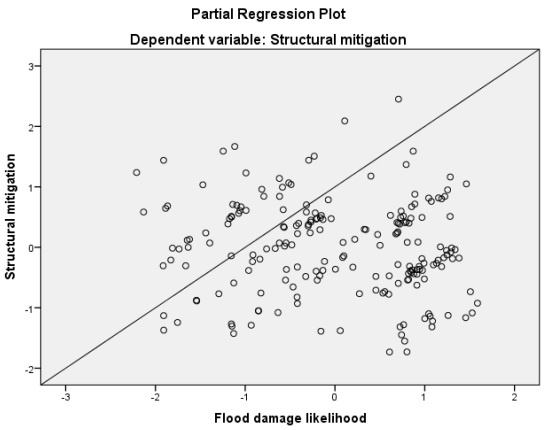
Likelihood being flooded	-.117	.063	-.139	-1.853	.066	-.242	.008	-.079	-.140	-.131	.887	1.128
People	.012	.066	.015	.188	.851	-.118	.143	.068	.014	.013	.811	1.233
Income (Uganda Shillings)	.003	.036	.006	.076	.939	-.069	.074	.024	.006	.005	.932	1.072
Mitigation measures caused by social networks	.271	.158	.158	1.716	.088	-.041	.583	.220	.130	.121	.583	1.716
Members	.037	.025	.114	1.471	.143	-.013	.087	.117	.111	.104	.831	1.203

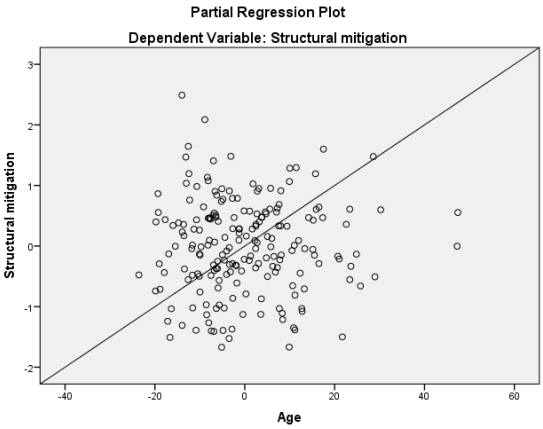
a. Dependent Variable: Structural mitigation

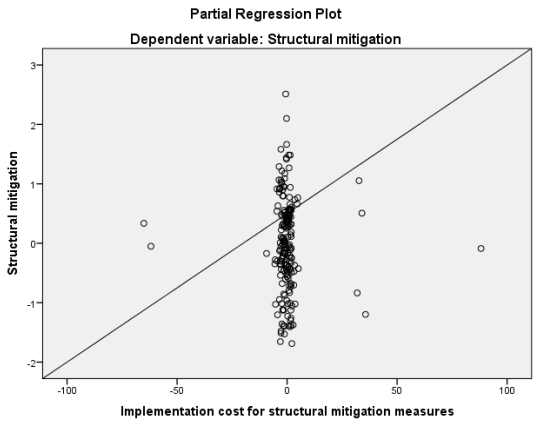
Appendix 13: Partial plots

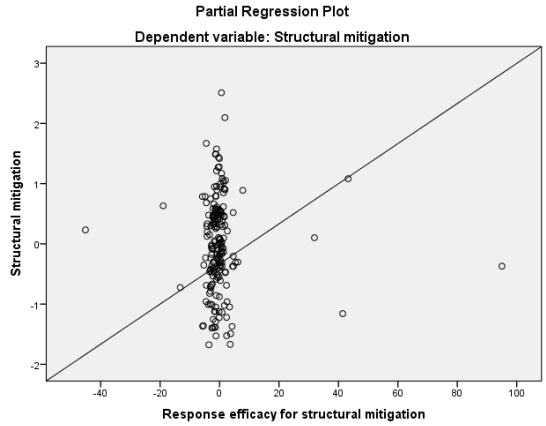


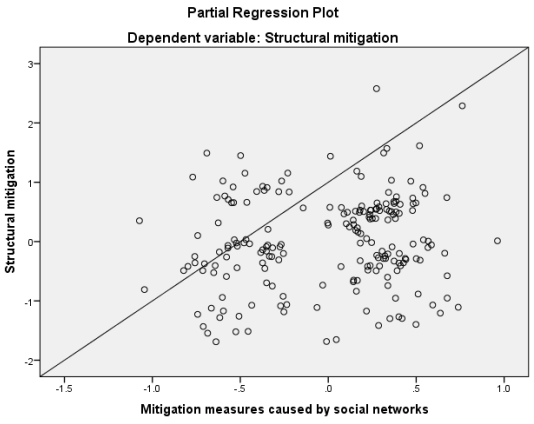


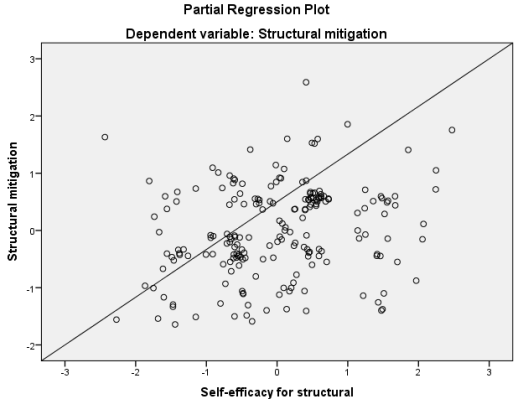


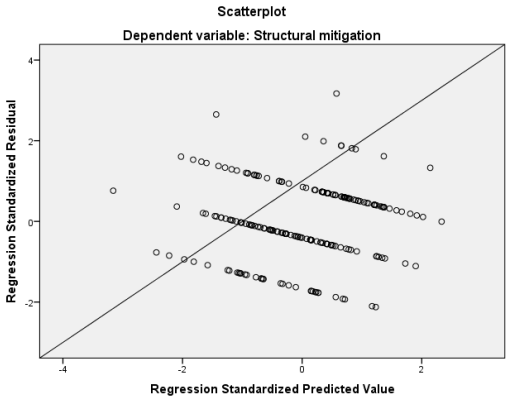








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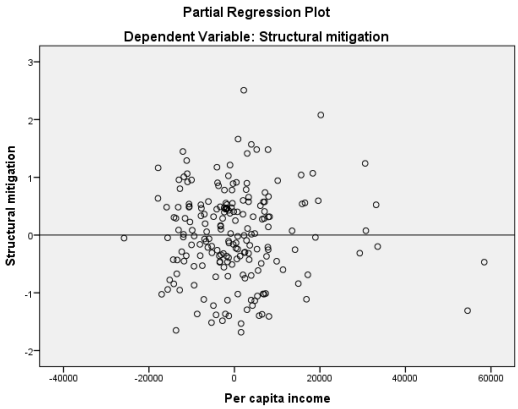
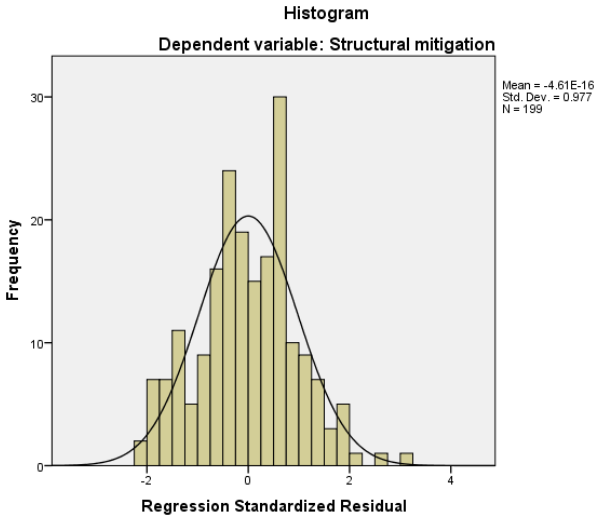
Regression Standardized Residual
Regression Standardized Predicted Value


Partial Regression Plot
Dependent Variable: Structural mitigation
Structural mitigation
Per capita income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Dependent variable: Structural mitigation
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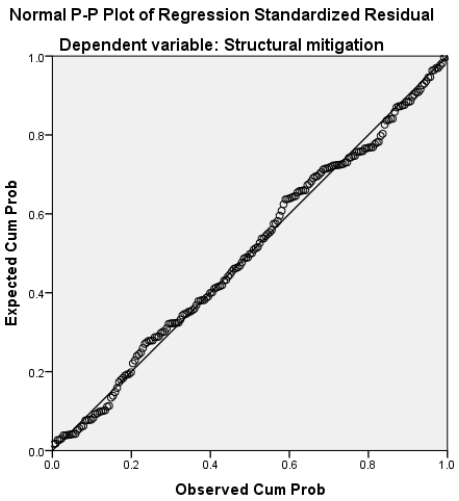
Std. Dev. = 0.977
N = 199
Frequency
Regression Standardized Residual


Normal P-P Plot of Regression Standardized Residual
Dependent variable: Structural mitigation
Expected Cum Prob
Observed Cum Prob