INVESTIGATING PROSPECTS OF INTEGRATING SPATIAL PLANNING WITH DISASTER RISK REDUCTION IN FLOOD PRONE SETTLEMENTS OF GREATER TZANEEN MUNICIPALITY OF LIMPOPO PROVINCE IN SOUTH AFRICA

By

TLADI MAZWI THAPELO

A Master's Dissertation is Submitted to the Department of Urban and Regional Planning in the School of Environmental Sciences, in Fulfilment of the Requirements for the Award of Master of Urban and Regional Planning (MURP) Degree.

SUPERVISOR: MR T. GONDO

CO-SUPERVISOR: PROF P. BIKAM

June 2019

School of Environmental Sciences

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June 2019

DECLARATION

I **Tladi Mazwi Tladi**, declare that this research proposal is my original work and has not been submitted for any degree at any other university or institution. The proposal does not contain another persons' writing unless specifically acknowledged and referenced accordingly.

Signed student………………………………………………………….. Date ………/………/………

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Co-Supervisor………………………………………………………..Date……./………../………

Prof. P Bikam

DEDICATION

I dedicate this work to the following three special people in my life:

My late nephew **Moatlegi Mphela Papanki** this is to say I will always be the uncle you wanted me to be

My late aunt **Dineo Peta** this is to say wherever you are you always wanted best out of me

My newly born son **Atlegang Mufunwa Tladi** I prayed to have you and I promised to give you this on your birthday

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“***Mana a mutukana asi vhu matshelo hawe***”

ABSTRACT

Disaster is posing serious threats to both human lives, infrastructure and the environment at large. Greater Tzaneen Municipality (GTM) is one of the many municipalities that suffer from flood related disasters. Lack of integration between Disaster Risk Reduction (DRR) and spatial planning has compounded the disaster risk situation in the municipality. This study sought to investigate the prospects of integrating spatial planning with disaster risk reduction in flood prone areas of GTM. The study is guided by three research objectives. First, the study sought to analyse spatial planning attributes that can be valorised for DRR in flood prone areas; Secondly, it sought to analyse spatial planning factors that define vulnerability attributes of households occupying flood prone areas. Finally, the study sought to perform a cluster analytical creation of a typology of households whose resilience to flooding could be enhanced through spatial planning. Twenty-five flood prone areas were analysed on the basis of four main flood vulnerability attributes. In order to identify such vulnerability attributes, the study borrowed critical insights from literatures on flood vulnerability, spatial planning and DRR. Such a critical review of literature was complemented by the use of pattern matching as a qualitative research instrument. Quantitative that was gathered using a structured observation checklist.

Quantitative data generated was first subjected to various statistical tests that included Normality and Reliability Tests. Common measures of Normality test used included measures of skewness, kurtosis and the use of Normal Q-Q plots. To assess flood vulnerability, Hierarchical Cluster Analysis (HCA) was used. HCA was used to identify clusters of flood prone areas which had common characteristics in terms of the four main study constructs proposed by the study which included the physical/engineering, socio-economic, ecological/natural and political or governance conditions characterizing each area. HCA was then used to identify main clusters exhibiting similar characteristics and the associated level of vulnerability of such of communities occupying such clusters.

Study results revealed 2 main clusters of flood prone areas whose differences lay in interactions that existed between the physical/engineering, socio-economic, ecological/natural and political or governance conditions characterizing each area. Such clusters depicted 2 levels of vulnerability that is high, and moderate. A number of opportunities and constraints were generated using the SWOT matrix strategy with the main results showing that spatial planning elements characterizing flood prone areas could be transformed into critical urban risk management options for DRR. This is because a spatial planning elements were found to have a direct influences on critical factors of DRR such as location of activities. The study concluded by recommending a number of spatial planning strategies that can be vaporized for DRR. Such strategies are systematically aligned to the unique vulnerability context conditions associated with the two flood vulnerability solution arrived at using HCA.

***Key words**: Spatial planning; flooding; vulnerability; disaster risk reduction; resilience, sustainability.*

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LIST OF ACRONYMS

ACCCRN	Asian Cities Climate Change Resilience Network
AMCEN	African Ministerial Conference on the Environment
ANC	African National Congress
AU	African Union
CBO	Community-Based Organisation(s)
CDDRMC	Capricorn District Disaster Risk Management Centre
CDM	Capricorn District Municipality
CPC	Council for Civil Protection
DDRMAF	District Disaster Risk Management Advisory Forum
DDRMC	District Disaster Risk Management Centre
DMA	Disaster Management Act, 2002 (Act No 57 of 2002)
DMTP	Disaster Management Training Programme
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
HCA	Hierarchical Cluster Analysis
HFA	Hyogo Framework for Action
ICDRM	Intergovernmental Committee on Disaster Risk Management
IDP	Integrated Development Planning
ISDR	International Strategy for Disaster Reduction
KPA	Key Performance Area(s)
KPI	Key Performance Indicator(s)
LPDRMF	Limpopo Provincial Disaster Risk Management Framework
MDRMAF	Municipal Disaster Risk Management Advisory Forum
MDRMC	Municipal Disaster Risk Management Centre
MDRMF	Municipal Disaster Risk Management Framework
MEC	Member of Executive Council
MIDRMC	Municipal Interdepartmental Committee on Disaster Risk Management
NDRMAF	National Disaster Risk Management Advisory Forum

NDRMC	National Disaster Risk Management Centre
NDRMF	National Disaster Risk Management Framework
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organisation (s)
NICDRM	National Interdepartmental Committee on Disaster Risk Management
PDRMAF	Provincial Disaster Risk Management Advisory Forum
PDRMC	Provincial Disaster Risk Management Centre
PDRMF	Provincial Disaster Risk Management Framework
PIDRMC	Provincial Interdepartmental Disaster Risk Management Committee
REC	Regional Economic Community(s)
SALGA	South African Local Government Association
UN	United Nations
UNDP	United Nations Development Programme
UN-ISDR	United Nations International Strategy for Disaster Reduction
WCDR	World Conference on Disaster Reduction

CHAPTER ONE: PROBLEM AND IT'S SETTING

1.0 Introduction and Background

This study seeks to investigate the prospects of integrating spatial planning with disaster risk reduction (DRR) in flood prone settlements. Internationally, disaster is posing serious threats to both humans, infrastructure and the environment at large (Sutanta et al., 2010), on the other hand, Davies *et al*., (2009) are of the view that the most vulnerable groups are the poor and marginalised as they are settling in hazardous areas and are mostly affected by natural disasters. Furthermore, the lack of social, economic, environmental and physical factors is a leading factor to the groups in failing to develop effective strategies towards DRR to improve their capacity so that they can withstand the impacts of natural hazards such as flooding (Wisner et al., 2003, TEARFUND, 2008). Amman (2012) argued that today's cities are confronted with tremendous increase of risk associated with large scale of disasters. While, Musyoki, Thifhufhelwi and Murungweni (2016) stretched much further by saying the current frequency of climate-related disasters such as floods are in a rapid growth due to environmental and human factors where natural disasters, floods in particular are becoming more frequent and destructive (Garcia-Castellanos *et al.* 2009; Li *et al.* 2014; Miller, 1997; Smith, 2001). Flooding alone accounts for about 40% of fatalities from natural disasters where floods are the most common and widespread of all-natural disasters (Bhanumurthy & Behera, 2008).

The rate of causalities and other form of loses caused by disasters are rapidly increasing (UNISDR, 2004). In the past decades, disasters were viewed as natural processes (dominant approach) which were triggered by various hazards outside the knowledge of development, which could be controlled by engineering, technology and post disaster relief intervention (ISDR, 2005). As such the rate of disasters kept on increasing, destroying and posing numerous threats to human lives and other development initiatives (infrastructure) in the world. Statistics from the Emergency Events Database (EM DAT; available from http://www.emdat.be) depicts that there were more than 500,000 casualties in the past 15 years from different types of natural disasters, including earthquakes, tsunamis, floods, droughts, wind storms and landslides.

According to Oliver-Smith (1999: 31, 32), majority of the existing disasters are not literally disasters or the natural extraordinary events would not become disasters, even if they had to be disasters they would cause far less damages if it were not for the characteristics of the settlements pattern where people are forced to live while striving to adapt to socio-economic conditions that are far beyond their control. Today, the same olden days natural phenomenal are viewed as the product of socio-economic, political and environmental products which cause vulnerability to extreme, but normal, natural events (Wisner et al., 2004). Furthermore, all this socio-economic, political and environmental aspects pose negative threats on the livelihoods of victims, especially in developing countries because majority of households still depend on smallholder agriculture practices for survival (Balgah & Buchen rieder 2011; Barrett, Sherlund & Adesina, 2008). Moreover, at about 240 million people's livelihoods are estimated to have been disordered by natural disasters worldwide between the year 2000 and 2005 (Feron, 2012).

Natural disasters such as floods are counted among the most disastrous form of nature's unexpected events, usually posing threats to human lives and infrastructure. Floods incidents are estimated to have increased worldwide by 145.1% in 2010 compared to the annual averages between 2000 and 2009 (Guha-Sapir *et al*. 2011). This is because floods are regarded as the most common natural disasters in Europe and Africa as a consequence of poor spatial planning practices and climate change (Guha-Sapir *et al*. 2011; Guha-Sapir *et al*. 2014; World Health Organization [WHO] 2002). On the other hand, researchers argued that the increasing frequency and severity of natural disasters affect livelihoods especially of the poor around the world, further creating poverty traps (Carter & Barrett 2006).

1.1 Regional perspective

According to African Union et al. (2008), majority of the disasters in Sub-Saharan Africa are predominately hydro-meteorological and climatological, as such, they comprise of cyclones, storms, floods, landslides, extreme temperatures, wild fires and droughts. The disaster reports show that Africa is the only continent whose share on disaster events has rapidly increased over the past decades (UN-ISDR, 2004b:3). Furthermore, AU (2004) is of the view that incidence of natural disasters in Africa is rapidly increasing and the number of people who are affected is also rising. Being specific the (ISDR), argued that Africa as continent is exposed to disaster risk from various natural causes, particularly those arising from hydro-meteorological hazards (ISDR 2004: 149). Furthermore, the AU, has recognized that institutional frameworks, risk identification, knowledge management and emergency response are critical to the DRR agenda (African Union, 2004). Although, different policies and mechanisms (spatial planning) might be in existence in Africa, yet the mechanisms and strategies are ineffective to the rising vulnerability and impacts of disasters. In addition, Musyoki et al (2016) are of the belief that looking at all these determinations are often incomplete and are exaggerated by people's views, which they turn to impact their responses. As the results, the African Union has established an overarching Africa Regional Strategy for Disaster Risk Reduction to address these issues of disaster risk reduction (African Union, 2004).

Africa, like any other continents, suffers disaster damages which set back development by undermining the government's efforts and end up leaving communities to reside in a continuous state of risk (African Union, 2004). Africa has come a long way since the global arena emphasized the need for multi-stakeholder disaster risk reduction rather than the on-going unsustainable cycle of disaster management, furthermore, many countries in Africa relates particularly to the vulnerability of communities living in densely populated informal settlements, which are poorly sited and unplanned even though they are within the jurisdiction of local governments (Municipalities). Housing structures are built with improvised materials which are flimsy and highly flammable. Structures have poor, if any, foundations and are built in close proximity to each other. This poor physical/engineering vulnerability attribute exposes people to hazards such as landslides, floods, fires, wind, disease and epidemics. In addition, poor planning and the proximity of structures limits access to emergency services during disaster period.

1.1.1 Local perspective

South Africa, like any other country in the world is confronted with challenges of natural disasters and their impacts. Natural disasters are continuously imposing threats on the environment, human lives, property, livelihoods and infrastructure utilities globally (Sutanta et al., 2012). Apparently, disasters have increased in both numbers and frequency. The need for spatial planning to prepare for both natural and manmade disasters is vital. Flood disasters are growing in frequency worldwide due to a variety of environmental and human factors. Natural disasters, floods in particular are becoming more frequent and destructive (Garcia-Castellanos et al. 2009; Li et al. 2014; Miller 1997; Smith 2001). Natural disasters pose an enormous threat for achieving the Millennium Developmental Goals in the overarching target of halving extreme poverty by 2015 is at risk UNDP (2004:5).

1.2 Justification of the study

According to the UNISDR, (2001), spatial planning is assumed to be of great significant in mainstreaming disaster risk reduction in development planning. As such, a need to investigate the prospects of integrating spatial planning with disaster risk reduction in flood prone settlements became important, this is because MDDMC (2015) states that there is no integration between spatial planning and disaster management strategies within the district, as such, disasters affect different settlements in different ways depending on the causes and nature of the event. Furthermore, socio-economic, physical -engineering, geographical and institutional components of vulnerability and adaptation are very contextual and operate within the context of specific socio-economic and physical environments.

Literature depicts that disaster related studies have been conducted at all levels ranging from global, regional, national, provincial and local level (*An assessment of community flood vulnerability and adaptation: A case study of Greater Tzaneen Local Municipality, South Africa. (Munyai, 2015*), (*prospects of integrating planning with disaster risk reduction in flood prone areas: a case study of Tshaulu ha-Gondo; Thulamela local municipality (Semani, 2015*). Although less studies have been conducted in relation to the role of spatial planning with disaster risk reduction in both global, regional and local perspective (*Sutanta, H., A. Rajabifard, et al. (2010). Integrating Spatial Planning and Disaster Risk Reduction at the Local Level in the Context of Spatially Enable Government.).* As such, there is no study that has been conducted on the prospects of integrating spatial planning with disaster risk reduction in the study area (GTM). The investigation on prospects of spatial planning with disaster risk reduction in these local areas will help local planners, community leaders, municipalities and different stakeholders to manage flood hazards and vulnerability. This study will enhance their planning and decision-making processes by helping all the spheres of planning in addressing disaster risk related issues through spatial planning. Limpopo province (MDDMC) specifically will benefit a lot as it is one of the provinces that is prone to disasters such as floods and drought to mention few.

Since spatial planning is regarded as the best tool for development, it has powers to decide on future use of space (Greiving, Fleischhauer et al. 2006). Therefore, this study aligns with the development strategies and policies of both the country and the world at large as they are aimed at addressing the climatic change constraints that results in disasters in the world. As such some of these strategies include the Sendia Framework, UNISDR, NDP 2030, SDGs, LNP, National Disaster Management Centre, MDDMC and also the Spatial Planning and Land Use Management Act 16 of 2013 (SPLUMA 16 of 2013). In a nutshell, this study will be crucial in aiding new ideas on how spatial plaining can be utilised as an instrument towards disaster risk related concerns on flood prone settlements of rural communities in South Africa.

1.3 Statement of the problem

At the more conceptual level, spatial planning is assumed to play a significant role in terms of DRR in general and it is always assumed that were spatial planning is effectively implemented exposure of people and property to hazards could manage the negative impacts of flooding (Bloch et al., 2012; Su, 2016). Spatial planning in most developing countries (more in rural communities even those are under the jurisdiction of the local municipalities) is poorly managed when it comes to clear guideline on how to deal with disaster related issues from spatial planning perspective (UNDP, 2004). A case in point is the empirical evidence from MDDMC which is also showing a gulf between spatial planning and disaster risk reduction, yet spatial planning can be harnessed for the benefits of the community who are at risk of a disaster in the district.

Disaster related issues can be enhanced by good practice in spatial planning at the local and regional level (King et al., 2013). Furthermore, Su (2006) is of the view that enhanced risk-based spatial planning plays a significant role in reducing the impacts of flooding. Therefore, this study seeks to fill in the existing knowledge gap by investigating the prospects of integrating spatial planning with disaster risk reduction.

According to GMD (2015) argued that there is no integration between spatial planning and disaster management at GTM, while the municipality is prone to flooding (cyclones). Such has resulted in communities residing in disaster prone areas, 'floods in particular'.

1.4 The general and specific research objectives

1.4.1 Aim of the study

The main aim of this study is to investigate the prospects of integrating spatial planning with disaster risk reduction in flood prone settlements of GTM.

1.4.2 Specific objectives

The above research aim will be addressed through the following specific objectives

- **i.** To Analyse spatial planning attributes that can be valorized for DRR in flood prone areas.
- **ii.** To Analyse spatial planning factors that define vulnerability attributes of households occupying flood prone areas

iii. To develop a cluster analytical creation of a typology of households whose resilience to flooding can be enhanced through spatial planning

1.4.3 The hypotheses

i) Spatial planning measures that are targeted at reducing ecological, socio-economic, physical and institutional vulnerabilities of households occupying flood prone areas are critical in building resilience.

1.5 Significance of the study

The total outcomes of this study will provide in-depth knowledge on how spatial planning as a planning and development tool from urban and regional perspective can be utilized or be integrated with disaster risk reduction in order to address issues of disasters (flooding in particular). At the same time, this study will help in adding knowledge to the global targets and priorities for action set in the Sendai Framework. Were the study will contribute substantially to the achievement of the SDGs, NDP, SPLUMA, LNP, NDMC, MDDMC and other concerned bodies on disaster risk reduction and targets through its stronger focus on resilience-building and risk reduction measures.

1.6 Description of the study area

The location of the study area, Greater Tzaneen Municipality, is within Mopani District Municipality of South Africa. The area is situated in the North-Eastern part of the Limpopo province at about 50 and 70km from Polokwane, the name Mopani originates from the abundance of nutritional Mopani worms found in the area and it is the home of Greater Tzaneen Municipality where the area is situated in the eastern quadrant of the Limpopo Province, together with Greater Giyani, Ba-Phalaborwa and Greater Letaba municipality, Polokwane municipality to the west, Greater Letaba municipality to the north, Ba-Phalaborwa and Maruleng municipalities to the east, and Lepelle-Nkumpi to the south border to Greater Tzaneen Municipality and Giyani municipality border. Furthermore, the GTM encompasses the proclaimed towns of Tzaneen, Nkowankowa, Lenyenye, Letsitele and Haenertsburg. The area constitutes of 35 wards and 125 rural villages, where almost 80% of household's population is found within the 80% of the rural villages.

The area comprises of Lowveld, informal settlements and poor spatial layout within the jurisdiction of the Greater Tzaneen and will be selected because of recurrence of floods events that occurred from 2011 to 2014. The total households' number is 1 860 (Statistic South Africa, 2011).

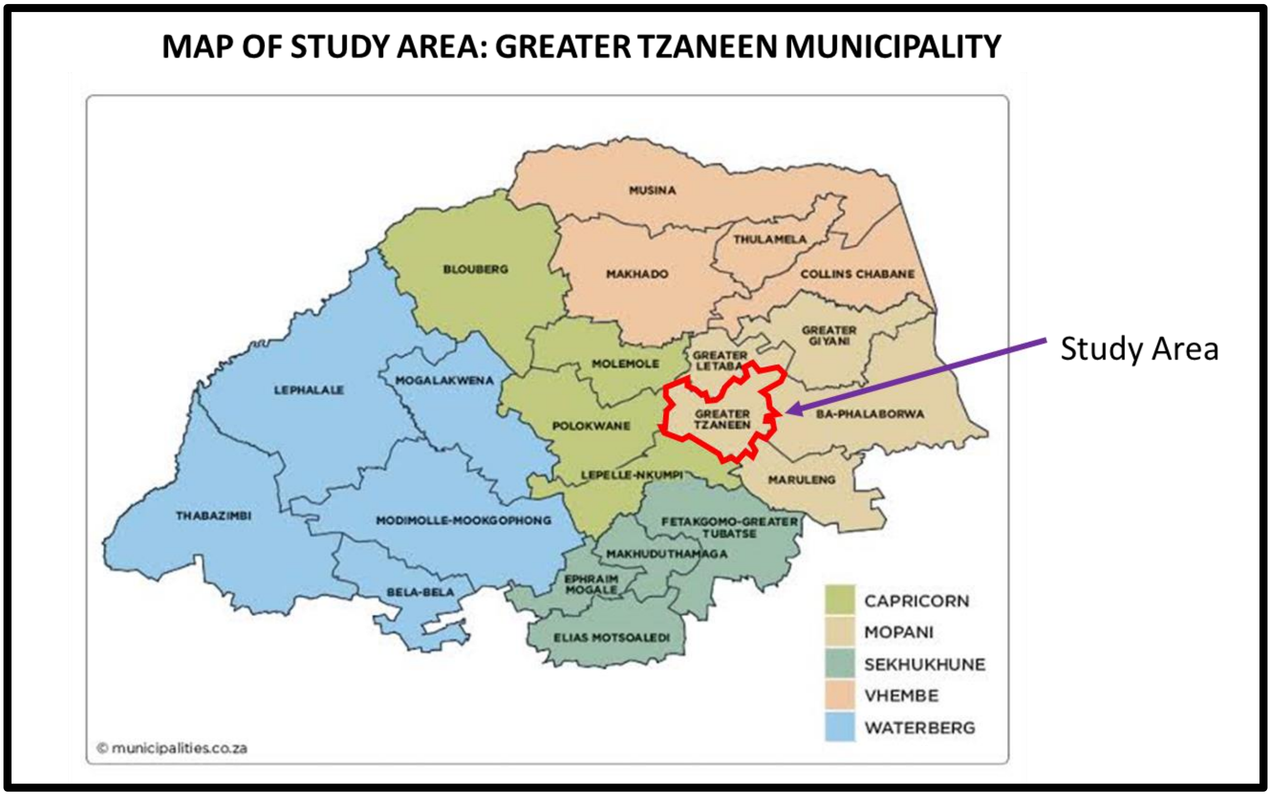


Figure 1.1: study area

Source: (GTZ SDF: 2017/202)

Basically, this study will be conducted in Greater Tzaneen Local where the rural villages of the area have a serious backlog of service delivery such as water, electricity and roads. Furthermore, these communities are vulnerable to various natural disasters including floods (Mopani District Disaster Management Centre, 2015). The proximity of the area to the South Indian Ocean makes it vulnerable to landfilling tropical cyclones. The study will laid its focus on the 25 villages within the municipality (*see figure 1.1)*.

1.7 Definition of key terms

Disaster Risk Reduction*:* Defined as the systematic development and application of policies, strategies and practices to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) adverse impact of hazards, within the broad context of sustainable development as reported in ISDR (2002:25).

Disaster: Disaster is defined as the set of adverse effects caused by social-natural and natural phenomena on human life, properties and infrastructure within a specific geographic unit during a given period of time (Serje, 2002).

Exposure: The process of estimating or measuring the intensity, frequency, and duration of exposure to an agent. Ideally, it describes the sources, pathways, routes, magnitude, duration, and patters of exposure; the characteristics of the population exposed; and the uncertainties in the assessment (EEA, 2005).

Hazard: A potentially damaging physical event, phenomenon or human activity, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation (ISDR, 2002:24).

Resilience: The ability to resist downward pressures and to recover from a shock. (Alwang, et al., 2001).

Risk: Risk can be defined as the likelihood, or more formally the probability, that a particular level of loss will be sustained by a given series of elements as a result of a given level of hazard (Alexander, 2000).

Spatial planning: Is a process of allocating, forming, sizing and harmonizing space or land for multifunction uses (Albrechts, 2006).

1.8 chapter summary

This chapter introduced the spatial planning and disaster risk reduction attributes that affects the sampled flood prone areas of GTM. This was followed by the statement of the problem, general research aim, specific research objectives, hypothesis, research design and description of study area. Furthermore, this chapter outlined the significance and justification of the study, research limitations, definition of key terms and the structure of the dissertation

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This section of the study reviews existing literature relating to prospects of integrating spatial planning with disaster risk reduction in flood prone areas. It reviews previous research papers, journals, articles municipal, provincial and national documents related to spatial planning integration with disaster risk reduction. The objective is to contextualise the research topic and identify relevant spatial planning and disaster risk management policies or legislations in South African local municipalities and outlines concepts and theories related to the prospects of integrating spatial planning with disaster risk reduction. The chapter will also look at the community experience in addressing disasters hoping that their experience would identify the existing knowledge gap in the area. Moreover the reviewed literature will provide significant information on the identified flood and vulnerability indicators.

2.1 Conceptual framework

The conceptual framework is designed in such a way that it provides a robust understanding on the prospects of integrating spatial planning with disaster risk reduction. Furthermore, Miles & Huberman; (1994) defined conceptual framework as visual product that explains graphically or in narrative form the main factors that are to be studied such as key factors, concepts, variables and the apparent relationship between them. The conceptual framework guide this study towards achieving study objectives as indicated in section 1.4.2; (*see figure 2.1).*

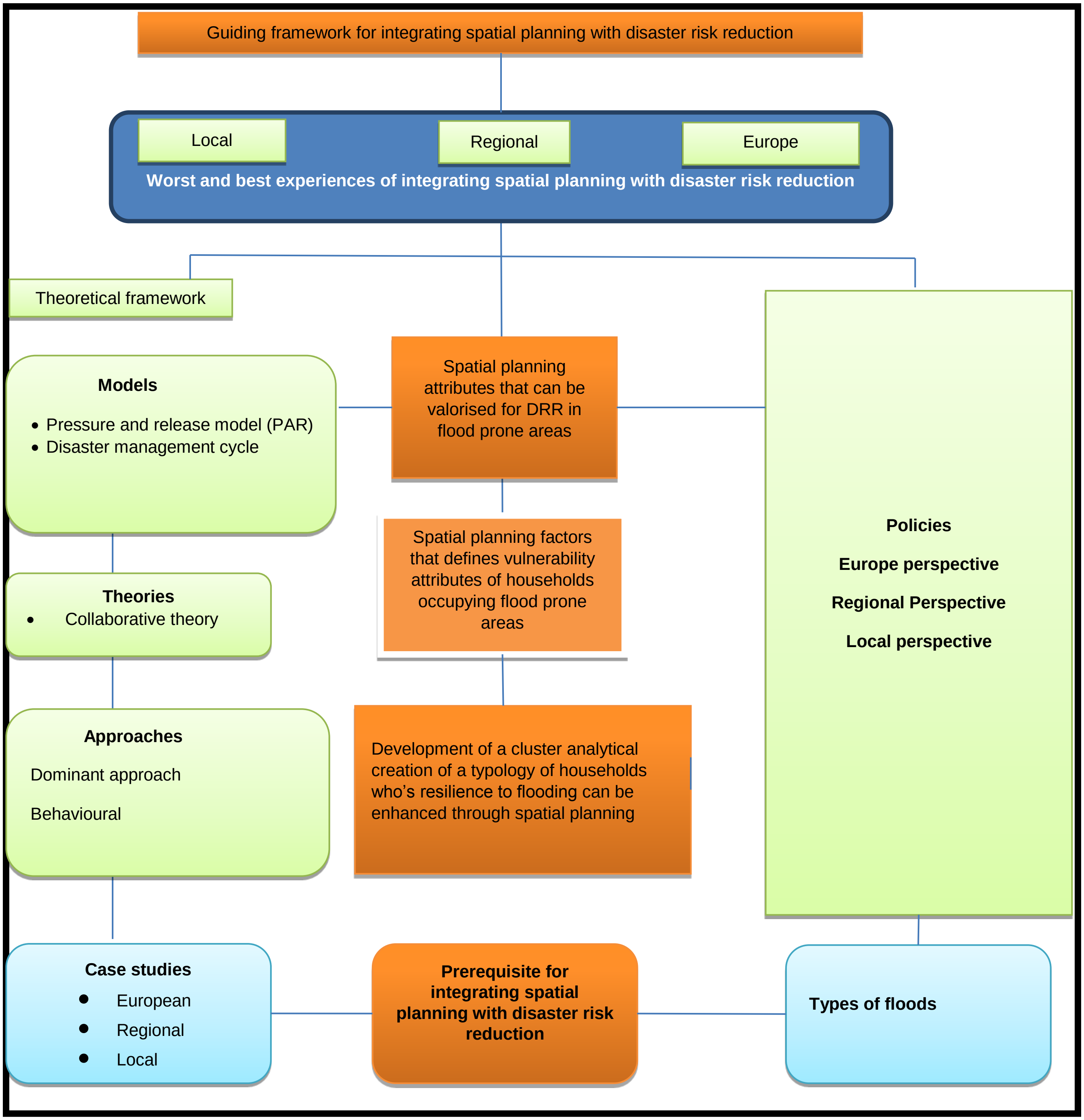


Figure 2.1: Conceptual framework

Source: Author construct, (2019)

Figure 2.1: above indicates the conceptual framework that provides road map on how to go about investigating the prospects of integrating spatial planning with disaster risk reduction. Given that there is minimal literature relating to the integration of spatial planning with disaster risk reduction.

2.2 Vulnerability

According to Adger, (2006); Smit and Wandel, (2006) argued that the concept of vulnerability has been used in different research traditions, but still the concept does not have that universal accepted definition as it depends on the research area being used. Vulnerability concept has been recently linked and applied to climate change impact assessments and is a multifaceted and contested construct (Nathalie *et al*., 2011: 22). Furthermore, Winchester, (1992); Shrubsole, (2000); Jones and Shrubsole, (2001); Pearce, (2001). Conquered that the concept has recently become an important component although it appears as the new approach to disaster studies. Although, Luers *et al*, (2003: 225) shared their view by defining the concept of vulnerability as the degree to which human and environmental systems are likely to experience harm due to perturbation or stress. On the other hand, Eakin & Luers, (2006) argue that the nature of vulnerability caused by climate change typically depends on two factors; exposure and sensitivity to calm stress and the capacity to deal with the effects of that stress.

Balica (2012: 18) argued that vulnerability firmly describes the function of exposed system (community), its failure and resilience capacity. Vulnerability quantifies the associated risk within the context of environmental and socio-economic capacity to adapt to floods (Munyai 2015: 9). While on the other hand, (Nethengwe, 2007; Cardona, 2003), is of the view that flood vulnerability goes hand in hand with the ability, capacity, response and recovery of the system in a population experiencing floods.

Kasperson *et al*. (2005:146) approach vulnerability from three major dimensions: “exposure to stresses, perturbations, and shocks. A system is exposed and becomes vulnerable to a specific hazard which in this case, it is floods (Balica, 2007). Gbetibouo and Ringler (2009: 1) established that, vulnerability is conceptualized as a function of three factors: exposure, sensitivity and adaptive capacity. Klein (2004) developed a conceptual framework on factors affecting vulnerability, describing vulnerability and its components and interaction. This framework clearly indicates that sensitivity, exposure and adaptive capacity are the major driving forces behind the vulnerability of a system, whether the vulnerability is low, medium, high or very high; these factors are responsible for such an extent

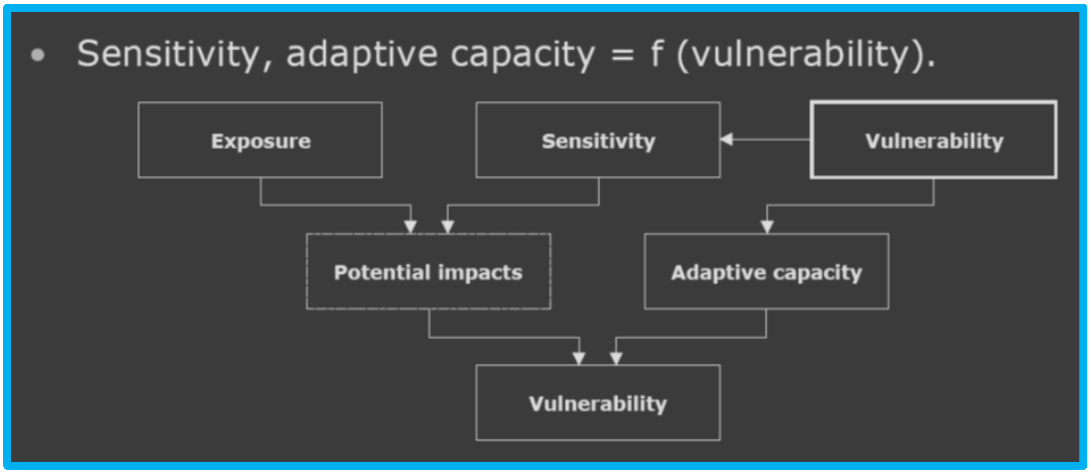


Figure 2.2: Interaction between the components of vulnerability (Klein, 2004)

Source: adopted from Nethengwe, (2007); Cardona, (2003)

Vulnerability concept is composed of terms such as risk, natural hazards, coping and adaptive capacity, sensitivity, resilience, poverty and even food security in disaster and development studies literature as well as in climate change discourses (Nathalie *et al*., 2011:22). Vulnerability is a multiple structure, with various integrations of spheres such as physical, environmental, institutional and social (O'Brien *et al*., 2007). In a general presentation, natural hazards are a threat to human life.

Table 2.1: selected definitions of vulnerability

Definition of Vulnerability	Author(s)
Characteristics of a person or group in terms of their capacity to anticipate, cope with, resist, and recover from the impact of a hazard	Blaikie *et al*., (1994, p.9)
The degree to which human and environment systems are likely to experience harm due to perturbation or stress	Luers *et al*, (2003: 225)
The degree of susceptibility and resilience of the community and environment to hazards	Buckle, Mars, and Smale, (2000) in Jones and Shrubsole, (2001, p.16)
Vulnerability is the measure of the capacity to weather, resist, or recover from the impacts of a hazard in the long term as well as in the short term	(Mileti, 1999, p. 106)
Vulnerability refers to the social and economic characteristics of a person, a household, or a group in terms of their capacity to cope with and to recover from the impacts of disaster	(Zaman, 1999, p.194)
Vulnerability is defined in terms of exposure, capacity and	Watts and Bohle

potentiality. Accordingly, the prescriptive and normative response to vulnerability is to reduce exposure, enhance coping capacity, strengthen recovery potential and bolster damage control (i.e. minimize destructive consequences) via private and public means.	(1993)
Vulnerability, in ordinary language, is a measure of possible future harm.	Wolf, *et al*., (2013)
Vulnerability refers to the inability to withstand the effects of a hostile environment.	Ciurean, *et al*., (2013)
Vulnerability is the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt.	Adger (2006)
By vulnerability we mean the condition of a given area with respect to hazard, exposure, preparedness, prevention, and response characteristics to cope with specific natural hazards. It is a measure of capability of this set of elements to withstand events of a certain physical character	Weichselgartner and Bertens (2000)
Vulnerability are those circumstances that place people at risk while reducing their means of response or denying them available protection	Comfort, *et al*., (1999)
Vulnerability represents the sensitivity of land use to the hazard phenomenon	Gilard and Givone. (1997)
Vulnerability is the differential susceptibility of circumstances contributing to vulnerability. Biophysical, demographic, economic, social and technological factors such as population ages, economic dependency, racism and age of infrastructure are some factors which have been examined in association with natural hazards.	Dow and Downing (1995)

Source: Adopted from Cutter (1996), Weichselgartner (2001), Hogan and Marandola (2005), Adger (2006), Wolf, et al., (2013).

The above synthesised definitions of vulnerability are extracted from various studies that refer to social conditions of exposure, adaptive capacity and resilience with varying capacities to recover from the impact of natural hazards. These variables, therefore, encompass the social, economic, cultural, political, environmental, and geographical contexts in which people live (McEntire, 2001; Pelling and Uitto, 2001; Wisner *et al*., 2006). These are also consistent with what other authors have identified looking at the four dimensions of vulnerability, physical/engineering, political/institution, socio-economic and ecological vulnerability.

Table 2.2: Flood vulnerability indicators

Variables	Indicators	Assumption	Author (s)
Physical /Engineering	Structural condition	The older the building is the higher the chances of being vulnerable to disasters	Owoeye (2013); Adelekan (2010); Birkmann (2006b); Grosh and Glewwe (2000); Ayoola and Amole (2014); Ologunorisa (2004); Grosh and Glewwe (2000); Balica and Wright (2010); Vojinović (2015) Brouwer *et al.* (2007); Ouma and Tateishi (2014); Agbola *et al.* (2012)
	Housing type	Households constructed using weaker material are likely to be affected compared to those constructed with concrete	
	Construction materials	Structures constructed using concrete are less prone to disaster compared to those constructed in card box	
	Land ownership/ Land tenure	Land under the ownership of the municipality is more resilient as compared to the one other traditional ownership as they follow all planning principles/guidelines	
	Adherence to building codes	Structures that are built in adherence to building codes are less vulnerable compared to those constructed near the flood prone areas	
	Road connectivity	A place that provide higher road connectivity promotes access for emergency services compared	

		to those that do not have connectivity	
	Developmental control	Evidence of structures built close to flood prone areas are more vulnerable compared to those that are far away from each other	
	Proximity of structures next to the flood prone area	The closer the structure are to the river bank the more vulnerable they are to disasters	
	Frequency of floods in the last 10 years	The more frequent the flood has happened the more vulnerable the area is to disasters	
	Elevation of settlement	The higher the settlement is based the safer it is from disasters, the lower the settlement is the higher the chances of disasters	
	Storm water drainage systems	Were the storm water drainage is blocked, the rate of disasters is high, compared to when the storm water drainage is open	
	Causes of flood	Residing along the flood plan areas can be other causes of flooding	
Socio-Economic	Level of Education	The higher the level of education the higher the chances of understanding the	Govender *et al.* (2010) Agbola *et al.* (2012)

		impacts of residing on flood prone areas	Grosh and Glewwe (2000) Birkmann (2006a) Wisner (2006), Jean-Baptiste *et al*. (2013) Adger (2006)
	Gender	Females along the 500m radius flood line are more likely to be victims of disasters compared to those far from the flood line	
	Population	The more the population in one place the higher rate the chances of vulnerability to disasters	
	Community participation	Community that participate in the planning of their environment is less likely to be vulnerable to disasters compared to those who are not involved in the planning process	
	Assistant received	Individuals who gets assistance after disaster are likely to relocate after such rather than those who are not	
	Total injuries	Communities that have high number of injuries are likely to be more vulnerable to disasters	
	Number of drowning and deaths	The more the number of deaths or drowning the more the population is vulnerable to disasters	
	Population growth	the higher the population in one	

		vulnerable it cause more causalities and damages due to disasters	
	Preparedness	A well-informed community will always be alert of disasters compared to those who lack information	
	Evacuation route	Evacuation routes can reduce the impact of disasters	
Political/Institutional	Protection and response	A reliable politician will always care for the interest of their people before, during and after disasters	Birkmann *et al*. (2006b); Wisner (2006), Pelling and Wisner, (2012), Jean-Baptiste *et al*. (2013); Balica and Wright (2010
	Warning systems	Effective municipality will have warning systems in place for in case of emergency	
	Collaboration with NGO, CBO etcetera	A strong collaboration of various stakeholders helps in preventing, preparing, reducing and helping in disaster times	
	Preparedness	A well-prepared institution is always ready to deal with any form of disasters that comes their way	
Ecological/Environmental factors	Waste management	Poor waste collection can result in blocking drainage systems leading to flooding	Kellens *et al*. (2011); Marfai *et al*. (2008); Ologunorisa and; Adeyemo
	Drainage systems	Blocked and absence of	

		drainage systems can increase the vulnerability of communities to flooding	(2005); Agbola *et al*. (2012); Ho *et al*. (2008)
	Environmental management	Poor environmental management can lead to degradation of trees that protects communities from floods	
	Climate change	Rapid climate change results in unexpected heavy rainfalls that leads to flooding	
	Land use	Residing on areas demarcated for agriculture or public open space can leads to high risk of being vulnerable to disasters	
	Topography	The gentle the slope the lower the impact of disasters	

Source: Adopted from Cutter (1996), Weichselgartner (2001), Hogan and Marandola (2005), Adger (2006), Wolf, et al., (2013).

2.3 Vulnerability attributes of households occupying flood prone areas

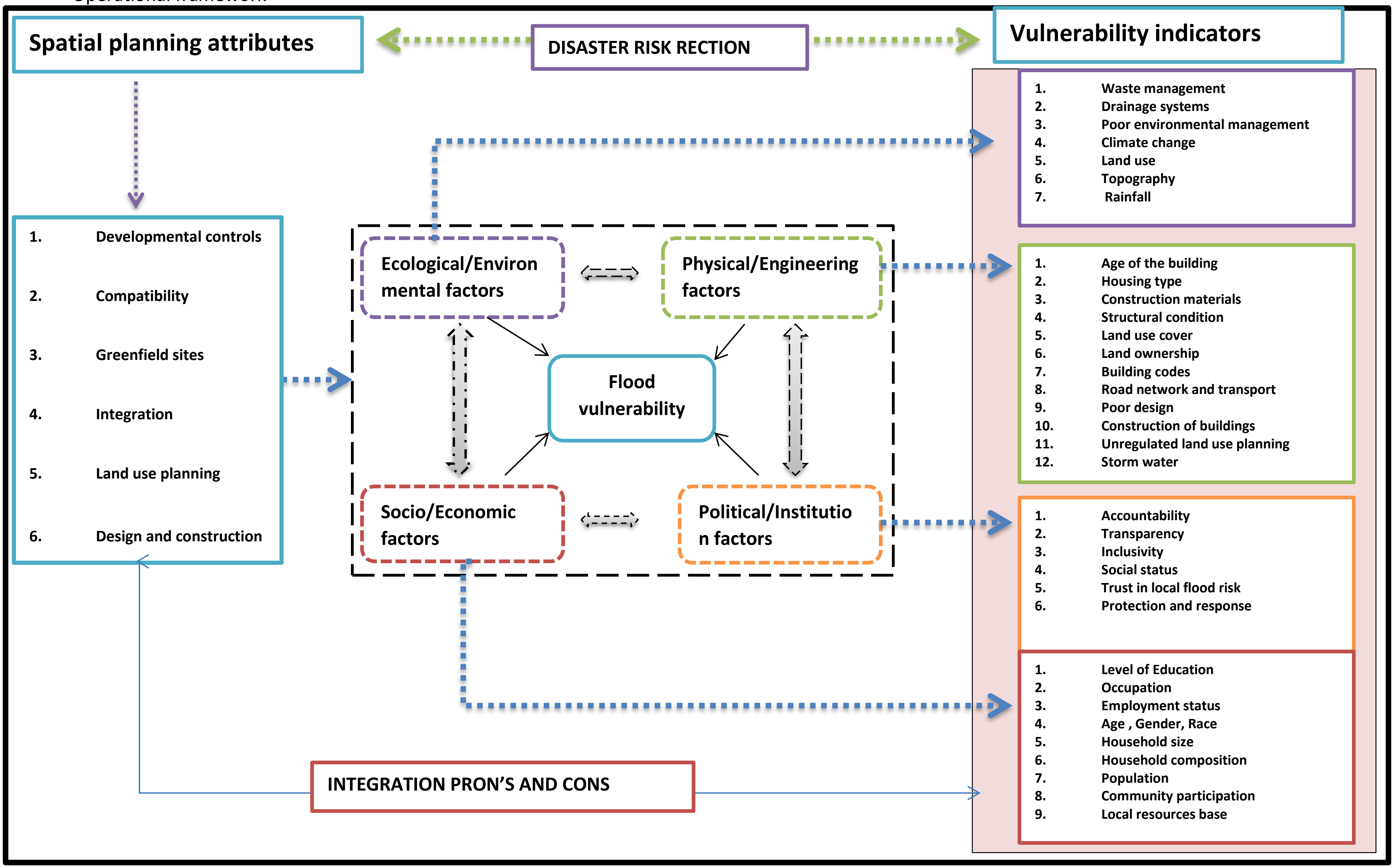
This section presents multiple dimensions of exposure and vulnerability to hazards, disasters, climate change, and extreme events. Wherein some frameworks consider exposure to be a component of vulnerability (Turner *et al*., 2003a), and the largest body of knowledge on dimensions refers to vulnerability rather than exposure, but the distinction between them is often not made explicit. Okayo.; et al (26) & Mendel . (2006). Argues that the concept of vulnerability doesn't have that universal accepted definition as is seen being defined in many ways and from their perspective they will go with the description of vulnerability being a concept that determines how people will be affected and where they are spatially located. Under this study, vulnerability will be looked at from various aspects ranging from flood, political, social, environmental and physical perspective. Flood vulnerability is regarded as one of the significant components in disaster risk reduction (Connor and Hiroki 2005). Various scholars and researchers developed several mechanisms towards evaluating flood vulnerability.

Floods are the serious threat that is still very prevalent despite increased awareness about the vulnerability Birkmann (2007). Furthermore, Vulnerability measurement is a complex process because it is influenced by several environmental, socio-economic, physical and political attributes at the local level (Jixi Gao 2007). In a nutshell Pandey *et al. (*2010) highlighted that vulnerability is affected by numerous factors such as settlement conditions, infrastructure, authority's policy and capabilities, social inequalities, economic patterns.

2.4 Operational framework

Figure 2.3: shows the operational frame work. It provides a robust detail about the integration of spatial planning with disaster risk reduction, vulnerability indicators, vulnerability attributes and spatial planning factors.

Operational framework



2.4.1 Political/institutional vulnerability

According to UNDP, (2004) argued that political vulnerability is fundamental to DRR, as any community can be both directly and indirectly affected by the political will and the commitment to development concerns. Vulnerability as a concept is concerned more about the exposure to a given hazard as the decision-making linked to development which will address conditions of Vulnerability, UNDP (1992:6). Political vulnerability can be traced from a set of deep-rooted socio-economic elements which includes aspects such as denial of: human rights, access to power structures, access to quality education, employment opportunities, land tenure, availability of and access to resources, access to infrastructure, basic services and information, all these aspects have a strong ability to create and maintain extreme levels of Vulnerability.

Political vulnerability can be traced from the South African perspective from 1994 when the country embarked on a new approach to the management of disasters and risk. This transformation led to the total reform of the country's disaster risk management policy and legislation. Reference can be drawn from countries such as Mozambique, Lesotho, Madagascar and the Seychelles, where politically the will to change drove the disaster risk reduction agenda and reformed the process (Christoplos *et al*., 2001:195).

2.4.2 Socio- Economic Vulnerability

The UNISDR (2002:47) argued that the level of both socio-economic status of the community relates not only to the degree of losses in terms of lives, property and infrastructure but also to the capacity to cope with and recover from adverse effects. The level of socio-economic well-being of individuals, households and communities directly impacts on their level of vulnerability to hazards. E.g. the level of education, literacy and training, safety and security, access to basic services, social equity, information and awareness, strong cultural beliefs and traditional values, morality, good governance and well-organized cohesive civil society, all contributes to socio-economic wellbeing with physical and psychological health being critical aspects, as such vulnerability is not equally distributed (UNDP, 1992:6).

Furthermore, from the economic perspective, poverty, lack of access to land and basic services turn to clearly explain why people in developing communities are forced to live on the hills, disaster prone areas such as landslides and flood lines. Poverty explains why floods and droughts results in poor subsistence farmers as victims and rarely wealthy, and why famine, often, is the result of a lack of purchasing power to buy food rather than the absence of food (UN 1992:6). Moreover, lack of access to basic services, like water and sanitation, forces people to use unsafe water sources for cooking and drinking and places them at risk of disease and epidemics (UNISDR, 2002). There is also an obvious connection between the increase in losses from a disaster and the increase in population. A rapid increase in population makes it inevitable that more people will be affected by the impact of hazards because more will be forced to live and work in unsafe areas. If there are more people and structures where a disaster strikes, then it is likely there will be more of an impact. Increasing numbers of people competing for a limited amount of resources (such as employment opportunities and land) can lead to conflict. This conflict in turn may also result in crisis-induced migration (UN 1992:6).

2.4.3 Environmental- Ecological Vulnerability

According to the UNISDR (2002:47). Argued that the concept of environmental vulnerability covers a very broad range of issues in the interacting social, economic and ecological aspects of sustainable development relating to disaster risk reduction. Over time environmental factors can increase vulnerability further by creating new and undesirable patterns of social discord, economic destitution and eventually forced migration of entire communities" (UNISDR, 2004:43). Furthermore, UN (1992:9) argued that majority of disasters are frequently caused or exacerbated by environmental degradation. As such, deforestation leads to rapid rain run-off, which contributes to flooding.

There are important links between development, environmental management, disaster reduction, and climate adaptation (e.g., van Aalst and Burton, 2002), also including social and legal aspects such as property rights (Adger, 2000). Some of the environmental aspects are:

- Potentially vulnerable natural systems (low-lying islands, coastal zones, mountain regions, drylands, and Small Island Developing States (Dow, 1992; UNCED, 1992; Pelling and Uitto, 2001; Nicholls, 2004; UNISDR, 2004;)
- Impacts on systems (flooding of coastal cities and agricultural lands, or forced migration)
- The mechanisms causing impacts (disintegration of ice sheets) (Füssel and Klein, 2006; Schneider *et al*., 2007).
- Responses or adaptations to environmental conditions (UNEP/ UNISDR, 2008).

2.4.4 Physical-Engineering Vulnerability

Within the environmental dimension, physical aspects refer to a location specific context for human-environment interaction (Smithers and Smit, 1997) and to the material world (e.g., built structures).

According to UNISDP (2002:47) argued that physical vulnerability refers to the susceptibility of individuals, households and communities to loss due to the physical environment in which they find themselves. The aspect of physical environment is clear that spatial planning can be utilized as it is concerned with the physical layout and arrangement of structures on the site. The physical exposure of human beings to hazards has been partly shaped by patterns of settlement of hazard-prone landscapes for the countervailing benefits they offer (UNISDR, 2004). Physical vulnerability comprises aspects of geography, location, and place (Wilbanks, 2003); settlement patterns; and physical structures (Shah, 1995; UNISDR, 2004) including infrastructure located in hazard-prone areas or with deficiencies in resistance or susceptibility to damage (Wilches-Chaux, 1989).

Physical vulnerability may be determined by aspects such as population density levels, remoteness of a settlement, the site, design and materials used for critical infrastructure and for housing (UNISDR, 2002)

2.5 Flood vulnerability

Janssen & Ostrom (2006), argued that the main aim of any vulnerability assessment is to identify why a population, or a system is vulnerable to single or multiple hazards. As such, Blaikie *et al*. (1994) highlighted that the proposed flood vulnerability assessment framework illustrates how urban settlements get to interact with natural and human-induced hazards which could cause a disaster.

Birkmann (2006b) argued that the major purpose of developing flood vulnerability assessment tool is to capture the real conditions of a specific population group in flooded area that is directly affected or likely to be affected by floods.

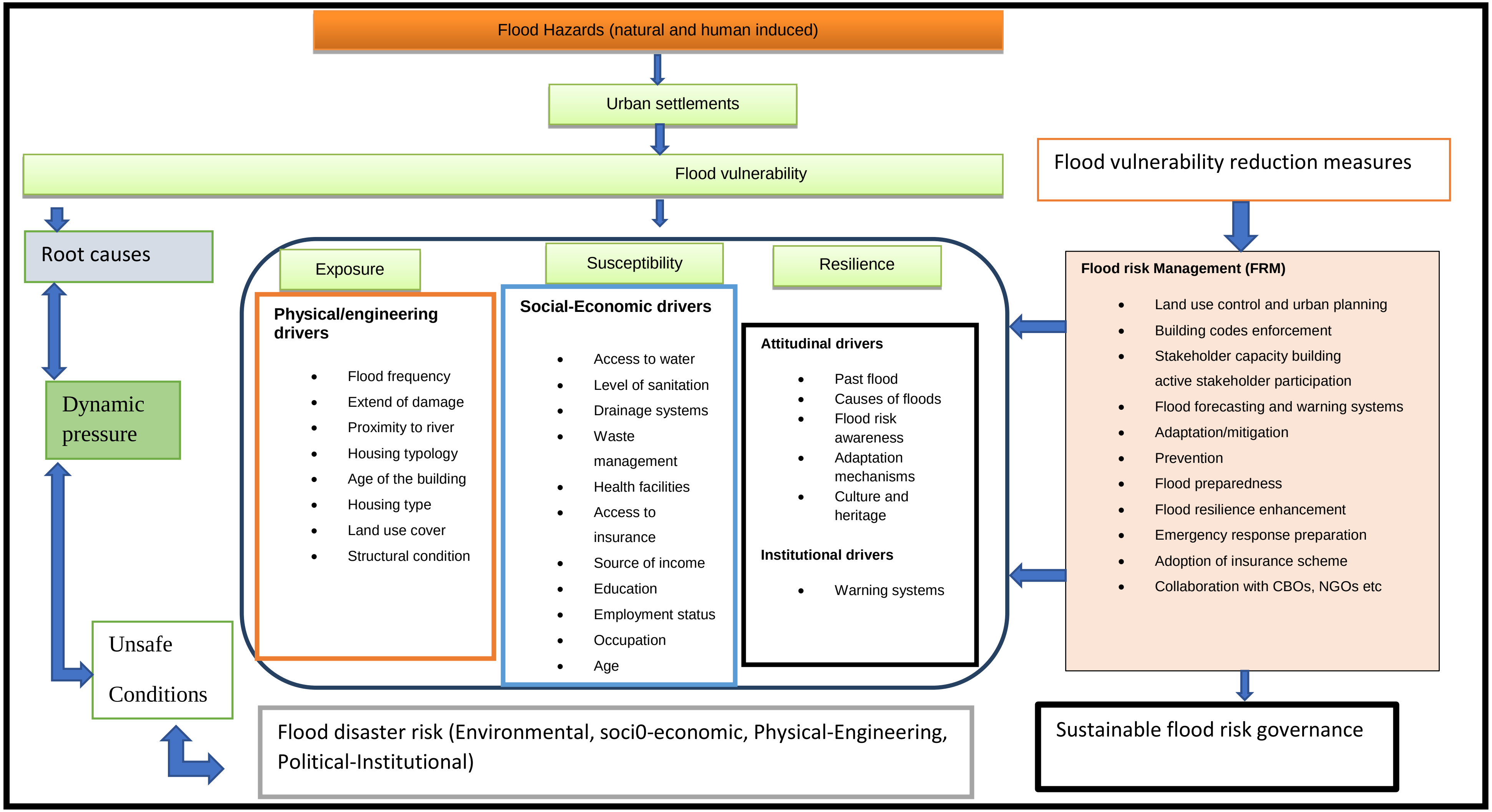


Figure 2.4: Flood vulnerability assessment framework

Source: *Adopted from Birkmann (2006a); Chambers (1989); Jean-Baptiste et al. (2013); Vojinović (2015) and Wisner et al. (2004)*

According to Birkmann (2007); Milly *et al*. (2002); Seyoum *et al*. (2011); Vojinović (2015); Vojinović & Abbott (2012), most flood related disasters are not mainly caused by natural disasters alone. The major determinant factors are largely attributed to human activities that involves the sociological/economic, physical/engineering, political/institutional and ecological/environmental forms.

2.6 Spatial planning versus disaster risk reduction

According to Davidoff & Reiner, (1962); Steiner, Butler, & American Planning Association, (2012) defined spatial planning as a systematic process that guides the public and private actions by influencing the future by identifying and analysing alternative and outcomes. On the other hand, Kidd, (2007); Larsson, (2006). Referred spatial planning to a type of a planning tool that is concerned with the physical arrangement of space and guiding on future land use activities by considering the principle of sustainability and other accepted principles. However, White & Richards, (2007). Stretched much further by saying spatial planning has that significant role in disaster risk reduction, more especially in the field of prevention by aiding to reduce the level of exposure and vulnerability of societies to natural hazards.

The UNISDR (2001), is of the view that spatial planning plays a significant role in mainstreaming disaster risk reduction in development. Furthermore, spatial planning plays a vital role in mitigating disasters in flood prone areas (Howe &White, 2004; White & Richards, 2007). Although, spatial planning is considered as a significant tool towards disaster risk reduction, Davidoff & Reiner, (1962). They are of the view that spatial planning is usually referred to as land-use planning or urban/regional planning. Where spatial planning seeks to achieve sustainable development and enhance quality of life (UNECE, 2008). In the other hand spatial planning as tool for development plays a fundamental role in reducing the level of exposure of elements (communities) at risk to disasters (Greiving, Fleischhauer *et al*. 2006). Furthermore, Fleischhauer, Greiving *et al*. (2005). Identified four potential roles that spatial planning can play in reducing disasters, such roles range from prohibiting future development in certain areas by classify different land use zoning for different levels of disaster-prone areas and regulating land use or zoning plans with legally binding status to be able to modify hazards.

Spatial planning on its own is responsible for development of a particular spatial area (where the sum of hazards and vulnerabilities defines the overall spatial risk) and not for a particular object or threat (e.g. sectoral engineering sciences), although, spatial planning need to adopt a multi-hazard approach in order to appropriately deal with risks and hazards in a spatial context (Greiving, 2002; Schmidt-Thome´, 2005). The main functions of spatial planning in disaster risk reduction are to reduce the exposure of the elements at risk to disaster sources and to modify the pathway of the disaster event. Furthermore, spatial planning has been highlighted in several publications as the effective tool towards disaster risk reduction (Godschalk *et al*., 1999 or Burby, 1998, both with further references).

Researchers argued that spatial planning is unquestionably one of the major contributors to DRR, were in an appropriate allocation of the different land uses can therefore influence exposures to natural hazards and minimize or prevent damages to life and property (Sutanta *et al*., 2010). Spatial planning can either increase or decrease risk through decisions taken on how and where to build houses, infrastructure and facilities (Sutanta *et al*., 2010). This is because spatial planning can influence the incidence of flooding and its consequential damage by regulating the locations of activities, types of land use, scales of development, and designs of physical structures (Neuvel & Van Der Knaap, 2010; White & Richards, 2007).

Spatial planners are responsible for decisions regarding the long-term utilisation of land and the interaction between people and space. However their powers and ability to direct land use allocation in ways that are beneficial to risk reduction, and to reject proposals that increase the vulnerability of people and infrastructures has made them realize that they are not directly responsible for disaster risk reduction, yet the effective strategic planning process plays a fundamental role in disaster risk reduction (Cutter *et al*., 2003). Moreover, through spatial planning, it is vital for planners to capture hazards in terms of their location, magnitude and frequency to assist them towards reducing disasters effectively. In a nutshell, spatial planners must consider site capability in terms of location, density, type and design of development and determine whether re-siting of land use is needed to reduce disaster risks (Berke & Smith, 2009).

2.7 Disasters versus communities

According to Dunne and Mhone (2003:3), the impact of disasters at the household level, disrupts normal livelihoods, displaces families, destroys infrastructure and disentangles social and community networks. Syed (2008:111) asserts that disasters can seriously disrupt development initiatives in several ways, including loss of resources, interruption of programmes, impact on the investment climate, impact on the informal sector and political destabilization. This suggests that the budget for development initiatives such as housing construction can be deviated or channelled to respond to other areas affected by disasters. Furthermore, disaster impacts can cause social activism resulting in political disruption, especially during interminable period of disaster recovery.

According to Oosterberg *et al*. (2005) the impact of disasters is extensive and practically immeasurable. Natural disasters result in deaths, displacement of people, destruction of houses and other infrastructure, and isolation of vast areas of the country due to destruction of vital social and economic infrastructure, including bridges, roads, power stations, water supply systems, hospitals and schools. Disasters contribute to the retardation of development in the affected regions (Dunne and Mhone, 2003:34).

2.8 Spatial planning attributes that can be valorised for DRR in flood prone areas

There has been a lack of attention to the importance of spatial planning for disaster risk reduction (Sanderson 2000). Although, the strategic value of incorporating spatial planning in disaster risk reduction is more evident given the relationship between disaster, spatial planning, mitigation and adaptation. Spatial planning principles are developed to overcome the impact of disaster and the results are important for spatial plan development. Mitigation means lessening the adverse impact of hazards by implementing various strategies and principles (UN/ISDR 2009). The principles to be looked at are as thus:

According to ISDR, (2010) argued that the severity of the impact by natural disasters is directly linked to unplanned urban development. Furthermore, the Secretary-General (2006) has identified the importance of incorporating disaster risk reduction strategies in all development activities, policies, programmes and investments for national and local governments. While Ofori, (2004) is of the view that the physical damage from disasters is products of construction industry and therefore construction industry and built environment professionals have a vital role in the rectification of physical damages of disasters (Ofori, 2004

Planning for DRR typically takes place prior to a disaster, at the mitigation or preparation and prevention phase, but planners also have a role in post-disaster recovery and reconstruction (Donovan 2013). These are the zoning of current and future land uses whereby development controls and building codes are applied as appropriate to the type of land and its structures, urban infrastructure and settlement design, and information and mapping (Chang *et al*, 2010).

2.8.1 Land use planning

According to El-Masri and Tipple, (2002:163) history has shown clearly that land-use planning was one of the earliest tools used to encourage mitigation. Hazardous sites are often favoured by the poor because of their low economic potential and the high chance of avoiding eviction, as well as proximity to employment opportunities in surrounding commercial and industrial areas (Burby 1998, Mileti 1999, Godschalk *et al*. 1999, White and Howe 2002, Hooijer *et al*. 2004). Furthermore, the IPCC (2012) stated that “Urban land use and spatial planers should incorporate knowledge of the potential effects of disasters caused by hazards, so that most disaster risks in the area can be addressed through measures such as risk sensitive development/redevelopment policies, development control instruments and disaster risk reduction-related public investments”.

In Rabaul, Papua New Guinea, the government has made land available to volcano victims at a safe distance of 20 km from the vulnerable site (IDNDR, 1996: 19). Also, a relocation process has been established to reduce risks of landslide and flooding in Lima, Peru (Leandro & Miranda, 2000:7). In South Africa, areas affected by disasters are upgraded or people living in those informal settlements are relocated to the peripheral of urban areas (NDMC 2015). In the other hand, S.C. Sandhu and R.N. Singru. (2014) argued that to effectively integrate land use planning in disaster risk reduction they are few basic elements one need to take care of

- *Collaboration of multi stake holders:*

To identify hazards and understand how disaster risk changes with urbanization and climate change. This element is in line with the political/institution vulnerability dimension that is concerned about the consultation and participation of communities and other stakeholders in issues that affects them (Birkmann *et al*. 2006b).

- Capitalizing on disaster risk information:

This includes the locational and temporal nature of risks from hazards in every stage of the land use plan formulation: situation analysis, visioning and goal setting, land development scenario analysis, and land use policy formulation (Jean-Baptiste *et al*. 2013).

- *Development of land use policies:*

According to Owoeye; (2013), argued that the existing developments in hazard-prone areas, land use policies should encourage investments and development control regulations to strengthen disaster risk management, through practices such as retrofitting critical facilities and high-occupancy buildings, redevelopment, and the establishment and enforcement of appropriate building codes. This aspect is in line with the physical/engineering vulnerability dimension that is concerned more about the adherence to building codes

- *Information sharing:*

Elected and appointed officials, government staff, civil society organizations, and the business community to develop consensus on how current and future disaster risk will impact the city’s vision and strategic development priorities, and what type of policies, investments (including investments for emergency management), and practices are required to reduce those risks. This element is in line with the socio-economic vulnerability dimension that is looking at the preparedness and infirmity of the society on issues that affects them.

2.8.2 Settlement Design

Donovan 2013, & Olshansky 2008. Argued that the Urban and settlement design enhance DRR at the levels of disaster recovery, resilience and social capital enhancement (Godschalk 2003, Lavell and Oppenheimer in IPCC 2012) and through the design of resilient infrastructure (Donovan 2013, Measham at al 2011) including protective structures and measures (DCC 2010). Settlement layouts, heights of houses, the design and landscaping of drainage and flood retention areas are integral to flood, flash flood and surge control.

2.8.3 Information and mapping

Local government strategic planning requires comprehensive hazard mapping that informs land-use decisions (Godschalk 2010, Burby 2000, Measham *et al* 2011) and provides supportive information to communities, thereby empowering both the community and its residents (King 2008) and the institutions responsible for their care (Burby 2005, Godschalk 2003) Communication is an essential aspect of hazard education (ISDR 2012) that emerges as a critical need after a natural disaster (Donovan 2013). This link up well with the political/institutional vulnerability attribute that talks more on the accountability and participation of community members in issues that affects them.

2.8.4 Zoning

Land is zoned through strategic plans that specify preferred development and modify existing zones. Land-use zones are driven by economic considerations, with pressures from developers and entrepreneurs on the one hand, and infrastructural, environment and heritage issues on the other. Burby (2000), Godschalk (2003), Cardona and Maarten (in IPCC 2012), Handmer *et al* and Cutter and Ossman-Elasha (in IPCC 2012) identify reduction of vulnerability through control or curtailment of new developments in hazard prone areas. Climate change adaptation and associated hazards have placed greater emphasis on the legacy issues of settlements in risk prone areas. Floodplains, bushfire and coastal zones are subject to increasing risk

Romain, M. (2013). Zoning can be an effective tool to regulate development in hazard-prone areas and thereby reduce the exposure of people and property to hazards. For example, on unstable slopes, development can be restricted, and the area zoned for open green space for public use. In areas with flood risk, zoning can require the ground floors of new buildings to be built above the base flood elevation to avoid future flood damage, and further through incentives that encourage homeowners to include a freeboard (elevate a building's lowest floor above the base flood elevation) in anticipation of a future change in flood characteristics.

2.8.5 Design and construction

According to El-Masri and Tipple (2002:163), sustainable land use policies for the mitigation of natural disasters should be complemented by appropriate housing design, construction methods and use of building materials. These policies should be tailored to strengthen structural conditions of the dwellings and reduce physical vulnerability, and to create employment and generate income for the poor. Moreover, they should reduce construction costs, employ locally available materials, construction methods, enhance community participation and quality control.

Design and construction applications as a mitigation strategy help government to regulate any infrastructural construction by implementing coding systems that supports risk reduction.

Haddow *et al*. (2006:59) emphasize that this strategy is governed by building codes, architecture and design criteria, and soil and landscaping considerations. Furthermore, code criteria that support risk reduction usually apply only to new construction, substantial renovations or renovation to change the type or use of the building.

McMahon and Faen (2007: 95) argue that poor communities have few resources for robust construction, inadequate disaster warning systems, communications technology or disaster response. Roads and bridges may be unable to withstand earthquakes or floods in developing countries.

According to Agbola *et al*; (2012), buildings are often constructed of the most economical materials, predisposing them to the collapse of houses and spread of fires. Enactments of buildings codes are the responsibility of the states which reflect geographical differences across the United States. The building codes in different countries are not the same, mainly because topography, landscapes, climate, types of soils and underlying rocks vary (Balica and Wright 2010). This argument is directly in support of the physical/engineering vulnerability dimension that is concerned about the adherence to building codes.

2.8.6 Structural control

Structural control is basically not meant to reduce risks but is used to protect existing development. There are different types of structural control that vary in terms of the nature of the disaster which encapsulates the following: levee, seawalls, bulkheads, breakwaters, groins and jetties (Bullock *et al*., 2006:62-63).

Haddow *et al*. (2006:62) states that the US Army Corps of Engineers have designed and built levees as flood control structures across the United States. The authors further allude that levees as mitigation strategies had limitations which was experienced in the 1993 Midwest floods, where they were breached. Such floods gave residents a false sense of safety that increased property development, and exacerbated the hazard in other areas. Structural control as a mitigation strategy such as levees is equally controversial because they protect in one place and increase damage in another (Haddow *et al*., 2006:62).

2.8.7 Developmental control in flood prone areas

According to Wynn (2005) stated that rapid development in the rural and urban communities pose a serious challenge towards the effective developmental control implementation. Furthermore, White and Richards (2007) argued that UK is a long way from translating central guidelines into local planning practices with respect to flood mitigation. In the Netherlands, Neuvel and Van Den Brink (2009) pointed out that spatial planning is rarely considered as a flood mitigation measure and that flood mitigation measures, particularly those addressing adaptation to and recovery from flood hazards, are usually not well implemented into planning practices.

Therefore, the relationship between planning systems and flood-risk management is weak and should be strengthened and better coordinated. Involving more stakeholders with interests in flood mitigation might improve the quality and implementation of existing plans (Baker, Hincks, & Sherriff, 2010; Veraart *et al*., 2010). This could be an initial step towards an approach to flood mitigation that integrates spatial planning with flood risk management.

2.9 Flood risk versus settlement development

According to Smith & Petley, (2009), argued that even though the population is at the rapid increase at almost 1.2 billion people already live in informal settlements and this population is expected to grow. Furthermore, World Bank, (2011) highlighted that most cities with rapidly increasing populations, particularly in developing countries, see minimal changes in the management of urbanization processes and disaster risk over extensive time periods, which sees an increase in risk to residents as city populations grow (The World Bank, 2011).

Ooi and Phua (2007) highlighted that the lack of capacity and lack of understanding on disasters risk results in local communities being prone to disasters. In the other hand (Few, 2003) argued that urbanisation process has significant impact on changing the environment where it occurs. The process it put more pressure on the land where high population densities are combined with inadequate infrastructure and basic services, increasing disaster risk.

According to Health, *et al*., (2012) argued that many cities in developing countries, the urban poor often find themselves living on marginalized parts of the city, in ecologically fragile zones, forming informal settlements. Furthermore, Turpie and Visser, (2012) highlighted that the vulnerability assessment in the Limpopo province depicts that rural municipalities are commonly more vulnerable than other types of municipalities.

Maponya and Mpandeli, (2012a) argued that Limpopo is one of the poorest provinces in the country the province is prone to massive natural disasters due to climate change that poses threats to settlements and agricultural activities that takes place in the context of developmental stress, including poverty and unemployment. The assessments reflect that the most vulnerable areas were also found to generally contain most of the country's rural poor, which can in turn be linked to the lack of socio-economic capacity seen as an important part of adaptive capacity (Turpier and Visser, 2012).

2.9.1 Development control as a device for reducing disaster risk

The primary purpose of development control instruments is to regulate the location, density, layout, and design of permitted development (Stevens *et al* 2010). Stevens *et al* (2010) argued that the developmental control instruments support the implementation of land use policies, especially policies that require binding rules and are aimed at protecting public interest measures, such as health, safety, social equity, environmental quality, and energy efficiency. Furthermore, IPCC (2013) development control instruments commonly used in the urban areas of Asian countries include zoning, land subdivision, land acquisition, and building control.

However, if ignored, these factors can also potentially increase disaster risk by increasing the vulnerability of citizens and the exposure of assets to hazards (Berke *et al* 2009). Conversely, if development control instruments have hazard considerations factored into their design and implementation, they can contribute substantially to reducing or at least containing urban disaster risk. For example, through land acquisition, the full bundle of development rights of a hazard-prone area can be purchased, development restricted, and the area converted into public parks. Similarly, the development rights for hazard-prone areas can be transferred to rights for less hazard prone areas, with commensurate compensation to landowners where necessary, for instance in the form of higher density allowances for less hazard-prone areas (Burby 2006).

The ISDR (2007 p6) argued that for effective integration of disaster risk reduction with development control instruments requires:

• Work closely with engineers, scientists, and hazard specialists to factor in hazard-related information during the design phase of development control instruments. For example, indicate hazard-prone areas in zoning maps, factor hazards into the calculation of permissible density, and include locally relevant hazard-resilient design specifications in building codes.

• Understand how patterns of urban development influence the local land market and what the short- and long-term implications of disaster risk reduction regulatory decisions will be, especially on informal settlement areas where the poor and most vulnerable reside. These patterns include, among others, location of development zones, land subdivisions, land and housing prices, rents, and infrastructure development.

• Understand the linkage between disaster risk and the relevant legislation in order to ensure that legal instruments appropriate to the context are applied consistently and comprehensively to address disaster risk. Urban development control is typically enabled through various pieces of legislation (e.g., laws related to town and country planning, land, environment, and public health).

2.9.1.1 Land subdivision

A land subdivision ordinance is used to regulate the conversion of raw land into building sites and to propose the type and extent of improvements required (ISDR 2011 p28). It is a particularly important tool for areas where the outskirts of a city have received sporadic bursts of residential development (sometimes retaining rural residential features), and which are in small and/or scattered parcels making it difficult to put together viable projects to improve infrastructure (Donovan 2013).

Land subdivision controls the density, configuration, and layout of divisions, helping to regulate development in hazard-prone areas and to adjust the layout of development sites in ways that minimize exposure to hazards. Moreover, since it deals with new development, it can be an important tool to prevent the creation of new risks (Godschalk 2003).

2.9.1.2 Greenfield sites as opportunities for reducing disaster risk

According to Gencer, (2013) greenfield site is undeveloped land. It offers the opportunity to take into full account any constraints posed by hazards in the site selection for different land uses and infrastructure, as well as in the individual site layout. Furthermore, Hamada, M., ed. (2014) stretched much further by saying Developing greenfield sites should factor in hazard risks while formulating site design concepts and development control regulations, and, where needed, prioritize disaster risk reduction investments such as flood defenses and green buffers. This will ensure the location and nature of proposed investments if greenfield areas are disaster resistant and will encourage resilience strengthening of additional individual investments by the public and private sectors (Johnson, et al. 2005). Matthews (2011) argued that the greenfield development provides the potential to reduce disaster risks for the following reasons:

Being vacant sites, greenfield development offers flexibility in site selection for different land uses and infrastructure, individual site layout, building and infrastructure design. It is ideal to factor in various development constraints, including those imposed by hazards in the area.

It is more cost-effective to factor in disaster risk-related considerations in the design of new infrastructure and buildings than to retrofit later. Experience from school buildings in Nepal has shown that using seismically resistant techniques increase the construction costs by only 4%–8% whereas the cost of retrofitting a building later is in the 25%–50% range of the cost of the building.

2.10 Urban redevelopment as a strategy for reducing disaster risk

According to Mitchell, et al. (2013) argued that all the urban development projects should be required to include hazard considerations so as to ensure that all the project sites incorporate the element of disaster risk reduction measures into their basic design and do not increase existing level of vulnerability (e.g., by relocating informal settlements to hazard-prone areas).

Mitchell (2013) argued that the urban redevelopment projects provide the potential to reduce disaster risks for the following reasons:

- ❖ In many cases, urban redevelopment projects are designed to address socioeconomic issues, such as informal settlements, substandard structures, and deteriorated areas in the city centre (infill sites, etc.). Such issues often contribute to increases in hazard vulnerability.

- Large-scale urban redevelopment may be carried out in phases. With a good understanding of how disaster risk changes over time, phased development can help to incrementally embed investments targeted at disaster risk reduction.
- In areas with very high disaster risk, urban redevelopment as a tool can be adopted to retrofit buildings and strengthen the overall resilience of a city.

2.10.1 Redevelopment of formal built-up areas

According to Pondard, et al. (2011) argued that the redeveloping area is often a political process and involves the reshaping and improvement of previously developed areas which, over time, have deteriorated in physical condition and usage, as well as the improvement of underutilized areas within the city center. Depending on the objective of the redevelopment project, interventions may include demolition of smaller-scale structures tied to economically inefficient land utilization and their replacement with larger modern buildings with improved infrastructure. Redevelopment may also include the renovation or restoration of unsightly or historical buildings to improve the visual character of an area (Romain, 2013).

2.10.2 Upgrading of informal settlements

Urban redevelopment may include interventions to upgrade informal settlements with the objective to improve living standards of low-income populations, ensure accessibility to municipal services, and reduce urban poverty (Satterthwaite, 2011). Three types of upgrading are common:

(i) In situ upgrading, in which the public sector supports communities in informal settlements to improve a settlement in its present location;

(ii) A public social housing or relocation strategy whereby the government moves informal settlements into subsidized housing that is either sold or rented to them at below-market rates; and

(iii) Sites and services, whereby governments provide sites, with services and utilities in place (water and electricity) to households for subsequent development by the household itself.

Stannard, M. (2014), argued that all types of upgrading initiatives can contribute to disaster risk reduction. However, it will be important to prioritize based on

(i) Settlements that are located in hazard-prone areas;

(ii) Interventions that have high levels of public and political support; and

(iii) Settlements with well-established community groups, because this will facilitate linking disaster risk reduction with community needs, lend legitimacy to disaster risk reduction decisions, and generally lead to more sustainable, long-term reduction of disaster risk.

2.11 Spatial planning theories and models

Under this section the study reviewed literature relating to models, theories and approaches to aid in providing meaningful insights into the integration of spatial planning with DRR.

Models on Disaster Risk Reduction

Models play a significant role in aiding researchers towards understanding the nature of disasters and their characteristics. As such Kelly, (1998) argued that a well-articulated model offers advantages as it provides clear thoughtful on different concepts relating to DRR at large.

2.11.1 Pressure and Release Model/ Crunch Model (PAR model)

The Pressure and Release (PAR) model, was firstly developed by Blaikie, Cannon, Davis and Wisner in the mid 1990's, the model provides a basic analysis of vulnerability in relation to specific hazards. Furthermore, Blaikie *et al* (1994) published the model for the first time then followed by Wisner *et al.*, 2004. The most important links are those that affect livelihood strength and social protection, both of which are largely dependent on governance to determine how effective they are. Cannon argues that vulnerability should be defined in terms of five interrelated components that capture all aspects of the exposure to risk from natural hazards: livelihood strength and resilience; well-being and base-line status; self-protection; social protection, and governance. The linkages between these are important in understanding the causes of vulnerability.

According to Hai et al (2012). Argue that a framework that can be useful for understanding and reducing disaster risk is the "disaster pressure and release model also known as the disaster "Crunch Model". The model (PAR) shows that vulnerability attributes (pressure), which is rooted in socio-economic, political, environmental and ecological processes, has to be addressed (released) to reduce the risk of disaster from accruing. In the other hand Wisner, et al (2004) they are of the view that the PAR model operates at the different spatial, functional and temporal scales and takes into account the interaction of the multiple perturbations and stresses.

The disaster pressure and release model states that a disaster happens only when a hazard affects vulnerable people. A disaster happens when these two elements of hazards and vulnerability come together (Hai et al. 2012). However, Wisner (2004) is of the view that the

PAR model views disasters as product of socio economic pressures rather than natural events such as floods.

2.11.2 The Pressure and release model

The PAR model has a significant role in providing in-depth understanding towards different levels of vulnerability of a community and its capacity to resist or adapt. However, through its application, spatial planners can identify a suitable land free from any hazards while communities and different households must identify their vulnerability indicators and the level of capabilities from disasters. Furthermore, Hassen (2008) stresses that the framework of the PAR model is primarily to explain vulnerability to disaster to identify strategies for DRR. Regardless of the criticism, the PAR model can be used as a combination (multi-hazards approach) or separately (single approach), with the analysis of vulnerability in a society, to organise the research on vulnerability to disasters (Mudinda, 2010).

A natural phenomenon on its own is not a disaster; similarly, a population maybe vulnerable for many years, yet without the "trigger event", there is no disaster. We can therefore see that vulnerability (pressure) that is rooted in socio-economic, political, environmental and ecological processes are built up and has to be addressed, or released, to reduce the risk of a disaster (Hassen 2008).

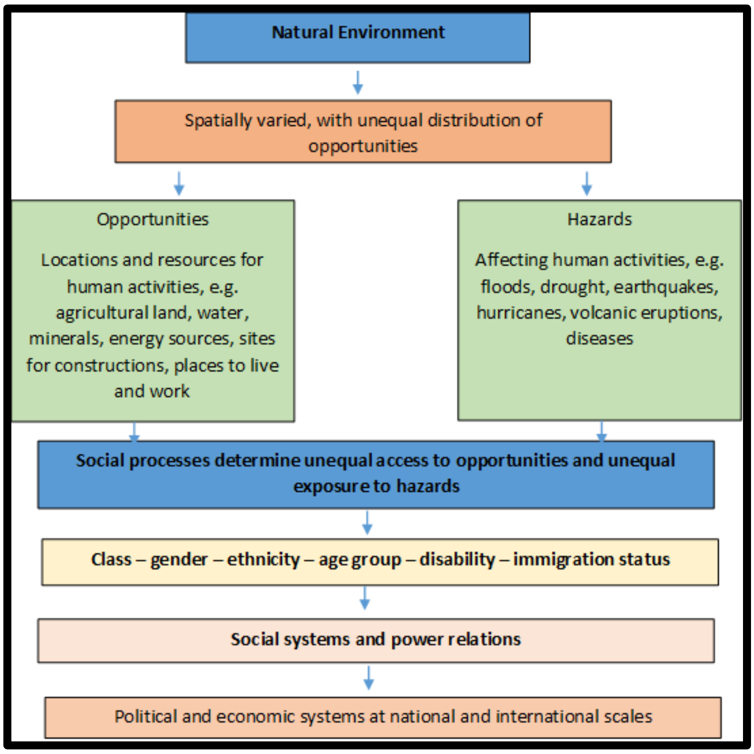


Figure 2.5 Pressure, Access, and Release mode

Source: Blaikie et al., (1994: 51)

This models is of importance looking at the integration of spatial planning with disaster risk reduction, this model provides clear explanation on the progression of vulnerability which under this study helps in addressing the first objective which looks at the existing spatial planning attributes that can be taken advantage of towards addressing disaster risk reduction. Furthermore, this models goes deep to the second study objective were it seeks to analyse specific spatial planning factors that defines vulnerability attributes of communities. Regardless of the criticism towards the model shares the same role as spatial planning were they can both being used through the multi hazards approach or single approach (Mudinda, 2010). Moreover Morrow (1999) argued that the model of is significant as it reflects the vulnerability attributes from socio-economic, political, physical and environmental conditions within a population that is residing in unsafe conditions. The pressure is exerted by such factors ranging from poverty, inequitable resource allocation, lack of employment opportunities and rural/urban migration, which influence the capacity to prepare and respond to mitigate risk. Access in the model examines the factors that influence the capacity of local people, or communities to respond or mitigate risk.

2.11.3 The progression of vulnerability

Progression of vulnerability provides an explanation for the interrelationships between different elements that cause vulnerability ranging from the root causes, dynamic pressure and unsafe conditions (vulnerability attributes).

2.11.3.1 Root causes

Twigg, (2007) defined root causes as a deep-rooted set of factors within a particular community that together form and retain vulnerability. Therefore, the most vital root causes in this study are going to be looked at from the vulnerability indicators that serves as the main root causes which are stimulated by the vulnerability attributes.

2.11.3.2 Dynamic pressure

According to Wisner *et al*., (2004) defined dynamic pressure as any process or activities that translate the effects of root causes both temporally and spatially into unsafe conditions. Under this study the dynamic pressure will be looked at from the first study objective were the researcher will look at the vulnerability attributes that's becomes the leading drivers of the vulnerability indicators. For In the diagram the dynamic pressure are represented by demographic or social changes in time and space (e.g. rapid population decrease, rapid urbanization, lack of local institutions, appropriate skills or training).

2.11.3.4 Unsafe conditions

An unsafe condition, which is the specific form in which the vulnerability of a group of population is expressed, is the third link in the progression of vulnerability as illustrated in the PAR model. These conditions are posed by the physical environment (e.g. unprotected buildings and infrastructure, dangerous slopes) or socio-economic context (e.g. lack of local institutions, prevalence of endemic diseases). Under this study the unsafe conditions will be clearly a way of addressing or being addressed through the third study objective that seek to develop a hierarchical cluster creation of different house hold typologies who's unsafe (vulnerability) resilience to flood can be enhanced through spatial planning

2.11.4 Progression of safety

Progression of safety is the reversal process of pressure and release model (Mudinda 2010). However, the model is aimed at reducing the risks by addressing the root causes (vulnerability indicators) of disasters and dynamic pressures (vulnerability attributes) which result in unsafe conditions (disasters). In addition, it simply means that the PAR model can be reversed to provide security or safety instead of risk (Wisner, 2004 & Mudinda, 2010). This model has now been accepted internationally for the explanation of the progression of safety (risk reduction) (Van Niekerk et al 2005).). Each community is assessed for its vulnerability to various hazards and the progression of safety model will provide solutions to address the identified hazards (Twigg, 2004).

- *Addressing root causes*:

Addressed in a developmental manner, the negative consequences caused by the legacy of the "Apartheid" regime. This to be achieved through the application of national governmental programs, which main focus areas should be poverty reduction and sustainable development

- *Achieving dynamic pressures:*

Focusing on developmental orientated programs on the provincial sphere, which supports the national initiatives

- *Achieve safe conditions:*

Local community orientated programs that would focus on the enhancement of a safer environment for all its inhabitants as well as the establishment of resilient and safe communities.

- *Hazard reduction:*

The application of a range of measures that would lead to the reduction of hazards that could cause disasters

Progression of Vulnerability

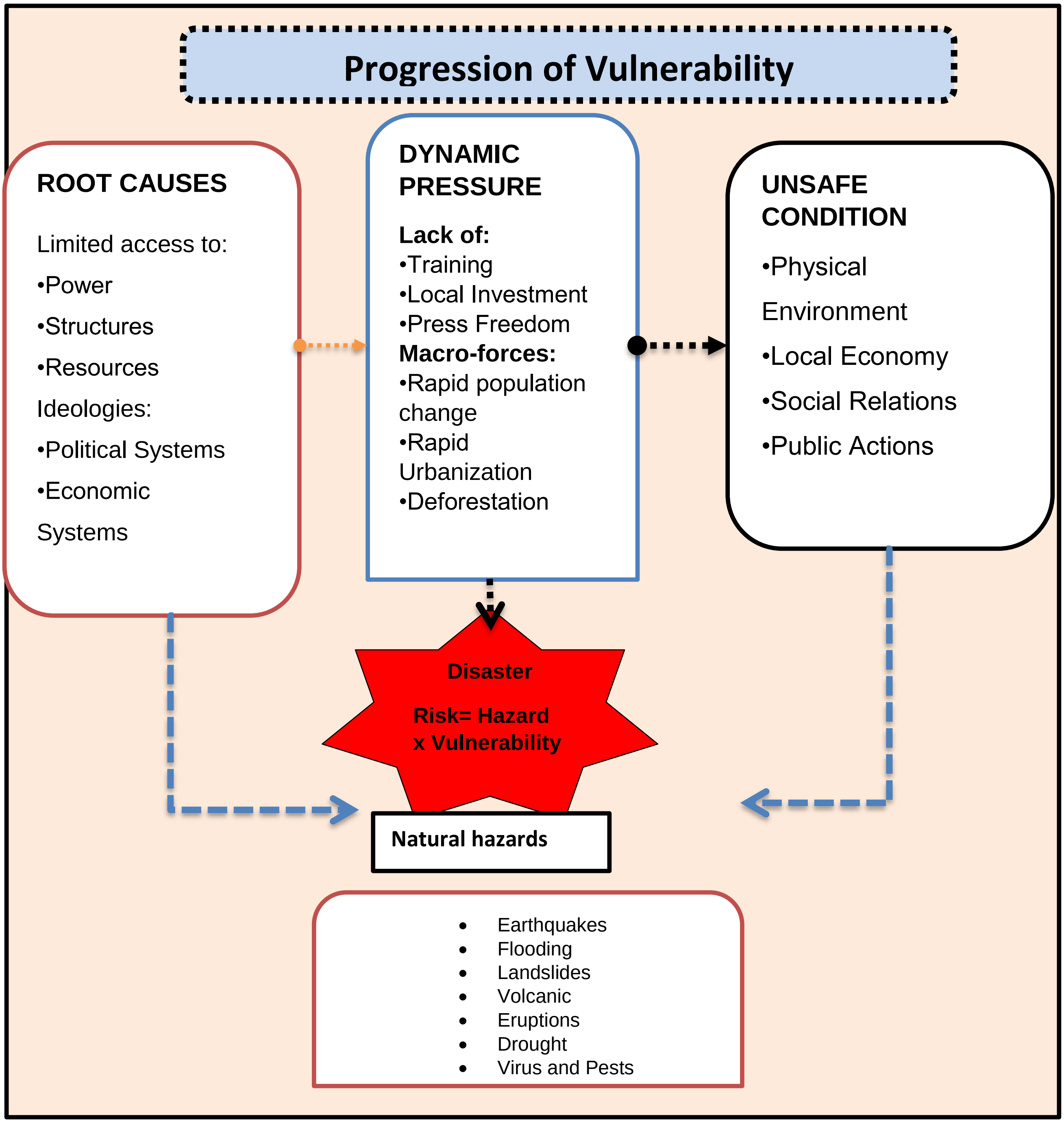


Figure 2.6 Progression of Vulnerability

Source: Blaikie *et al*., (1994: 51)

This model is the reversal process of pressure and release model (Mudinda 2010). Meaning disasters process can be mitigated, released and addressed through effective spatial planning practice.

2.11.5 Disaster management circle

Disaster management Cycle (DMC) it has been one of the most widely and frequently used model towards disaster management processes. DMC is the interconnection of different phases that aims at easing or evading disasters and promoting effective recovery mechanisms (Sengezer, 2001). As such, the cycle seek to identify various activities to be undertaken before, during and after a disaster has occurred. Disaster management is a continued activity, which needs to be dealt with comprehensively. Thus the cycle consists of activities in the pre-disaster, during disaster and post-disaster phase. In general, the disaster management cycle is accepted by numerous agencies worldwide as it consists of four interconnected phases namely: mitigation, preparation, response and recovery (Vanneuville *et al*., 2011; Zlatanova and Fabbri, 2009; Lumbroso, 2007).

Mother Nature cannot be controlled since one can hardly predict when and where the next disaster will strike (Borkulo *et al*., 2005), the subsequent phases of the disaster management cycle, i.e. preparation and effective response, they are of greatest importance for minimizing the consequences of a potential flood. Spatial planning knowledge and awareness becomes crucial in all stages of the disaster management cycle including pre-disaster prevention and mitigation, and post-disaster response, relief, reconstruction and recovery (Gupta and Nair, 2011). In short, the four phases of disaster management cycle are interrelated, but simultaneously, they have their own distinct characteristics. Furthermore, Zlatanova and Fabbri (2009) describe the phases of the cycle as thus:

- ***Prevention and mitigation*****:** These two phases concentrate on measures in the long-term horizon capable to reduce vulnerability and/or exposure to flood hazards towards minimizing flood risks.

- ***Preparation****:* This phase is about framing the institutional and organizational arrangements which underpin the emergency response operations. Furthermore, this phase deals with preparation activities which include evacuation plans, early warning systems, temporary physical measures, training sessions, preparatory field exercises.

- ***Response**:* The response phase looks at the operations taking place after the occurrence of a flood event and it is the most challenging phase of the cycle due to the complex, unpredictable and dynamic nature of emergencies

- ***Recovery:*** is the phase after the response operations and in particular after the normalization of an emergency situation. It includes all the required measures for removing damages as well as the long term supply of irreversible detriments.

The cycle aims at aiding the communities and stakeholders in decreasing or preventing the potential losses of hazards, by ensuring the strong level of access of immediate and proper assistance to possible victims of disasters, and implementing prompt and effective recovery measures. Any appropriate measures adopted at all step warnings, lower vulnerability or the disaster control in the next round of the cycle. The entire cycle of disaster management is comprised of articulating public policies, presenting plans that can either ease the roots of disasters or reduce their impacts on people, buildings, and infrastructure (Sengezer, 2001).

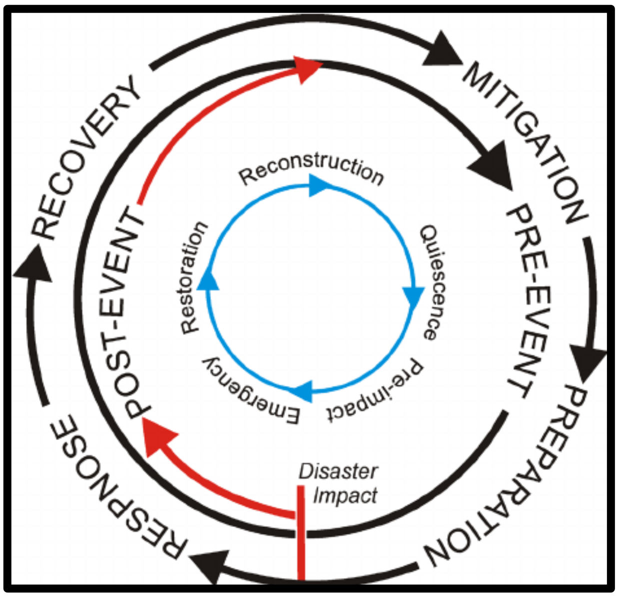


Figure 2.7: Disaster Management Cycle

Source: Palatino, (2015).

According to figure 2.7 above it indicates disaster management cycle were spatial planning has a role to prepare and make decision in regards of the future land use. So by doing spatial planning has a role to take in consideration disaster risk when deciding about the usability of a particular portion of land. In doing so, spatial planning will be mitigating risk, (keeping hazards threatened area free from future and further developments and taking in to account the building protection which are exposed to hazards).

2.12 Approaches to natural hazards

There are several approaches to natural hazards. The major themes include hazard as being caused by both nature and other causes being the people's behaviour and how they manage their lives in relation to the geographical environment in which they live (Chisola, 2012). Wisner *et al*. (2004) and Chisola (2012) outlined three major approaches to natural hazard namely: the dominant approach, behavioural approach and the structural approach. Although within this study only two approaches will be adopted being: behavioural and the dominant approach.

2.12.1 Dominate approach

The dominant approach is directly proportional to the act of nature which states that disasters are acts of nature were Mother Nature is to be blamed for all the disasters taking place on earth. Furthermore, Tobin and Montz, (1997) they are of the view that disaster are natural process and as such nothing can be done about them, they went much further to give a natural example when it rains a lot, rivers overflow, and there is flooding, equating to simple cause and effect. In the other hand, the dominant approach is naturally based because floods are regarded as a phenomenon caused by the natural environment. Hazards are caused by nature, and thus there must be control, monitoring and prediction of natural events to find a solution (Wisner *et al*., 2004). The natural environment is uncontrolled and dynamic according to dominant theory. However, modern studies have criticised this approach due to further understanding of floods phenomenon. Wisner, *et al*. (2004) suggested that vulnerability is socially constructed, pointing out, that not only has the natural environment caused vulnerability but there was a need to consider the social side of natural hazards.

2.12.2 Behavioral approach

The behavioural approach is closely related to the joint effects approach of both nature and the society which states that disasters exist as the results of their join effects. The approach argues that disasters would not be disasters if society doesn't get on the way of nature (Carr, 1932). Furthermore, for a disaster to occur "It takes both a hazardous physical event system and a vulnerable human use system to produce disasters. If either one is missing, disasters do not occur." (Carr, 1932, p. 211). In the other hand the behavioural approach explains the response by human beings to hazards (Chisola, 2012). This theoretical approach is more about adaptation than considering the causality. The main idea is the relationship between humans and the environment, and their reaction to any natural hazard. The interconnection between human beings and their living environment and resilience which is produced by their efforts is considered as the behavioural approach (Burton *et al*., 1978). The most critical aspects are vulnerability attributes of a population, livelihood, utilization of the natural resources and coping mechanism to flood hazards (Burton *et al*., 1978). There is a great link between human beings' reaction to natural risks, hazards and vulnerability attributes.

Table 2.3:* Measures *of disaster management phases

Disaster phases	Earthquake	Flood	Storm (cyclones, typhoon, hurricane)	Landslides
Prevention/Mitigation	▪ Seismic design Retrofitting of vulnerable buildings Installation of seismic isolation/seismic response control systems	▪ Construction of dike ▪ Building of a damn ▪ Forestation ▪ Construction of flood control basins/reservoirs	▪ Construction of tide wall ▪ Establishment of forests to protect against storms	▪ Construction of erosion control dams ▪ Construction of retaining walls
Preparedness	Construction and operation of earthquake observation systems	Construction and operation of meteorological observation systems	Construction of shelter Construction and operation of meteorological observation systems	Construction and operation of meteorological observation systems
	▪ Preparation of hazard maps ▪ Food & material stockpiling ▪ Emergency drills ▪ Construction of early warning systems ▪ Preparations of emergency kit			
Response	▪ Rescue efforts ▪ First aid treatment ▪ Fire fighting ▪ Monitoring of secondary disasters ▪ Construction of temporary housing ▪ Establishment of tent villages			
Rehabilitation/Reconstruction	▪ Disaster resistant reconstruction ▪ Appropriate land use planning ▪ Livelihood support ▪ Industrial rehabilitation planning			

Table 2.3 indicates the role the disaster management cycle phases can play in addressing or mitigating disasters of different types

Source: Asian Disaster Reduction Centre (2000)

2.13 Theories on spatial planning and disaster risk reduction

2.13.1 Collaborative planning theory

The collaborative theory as championed by Godschalk and Mills in 1996. They argued that the theory will be of great significant in the planning process, as it focus more on human activities (settlements) and land use (allocation of activities). In addition, Margerum (2002). Defined collaborative planning as an interactive process of consensus building, plan design and implementation. Furthermore, Healey (2006) stretched much further, collaborative planning as multifunctional process is not only about the process of having consensus building, but also taking into consideration the inclusion of mechanisms of governance. In constructive addition Dale (2005) is of the view that collaborative planning emphasizes more on the process of planning, in fact that is how planning is done as it includes a set of various actors from different disciplines.

According to Healey; (1997). The other developer of the theory is of the view that the theory emphasizes more on the communication between the community and spatial planners in practice. In addition Healey on his collaboration theory he points a way forward for spatial planning activities, from a narrow technical and procedural focus towards a communicative and collaborative model for achieving common goal in the shared space. Traditional models of planning (technocratic and bureaucratic planning models) based on scientific ways of reaching at decisions have been criticised for imposing plans and policies that does not represent people's interests. Furthermore, Chakwizira (2014) is of the view that the theory requires drawing of knowledge and relational resources from multiple stakeholders, mobilizing capacity to develop new institutional capacity to guide how to undertake collaborative planning.

Under this study the theory is of significant as it has the element of integration or bringing multiple stakeholders to share ideas on how to mitigate and reduce disasters before they happen. The theory stress out that the planning process that encompasses the spatial planning process have a vital role in mitigating and reducing disasters through the collective and integrated unit of multi stakeholders involved. Given that the collaborative theory as it has been championed in various sectors of the government it helps in guiding the process in which the professional and stakeholders would engage to come up with a sustainable settlement to live, work and invest in.

Collaborative planning cites numerous advantages over other traditional planning models (Selin and Chaves 1995: Innes 1996: Wondolleck and Yaffee 2000: Susskind *et al.* 2000: Frame *et al.* 2003).

- Collaborative planning is more likely to reach a decision on a plan because stakeholders are constructively incorporated into the process to reach a solution, instate of remaining as critics outside the process.

- Collaborative planning is more likely to develop a plan that is in the public interest because more alternatives are generated for consideration through dynamic interaction of stakeholders and the consensus decision rule ensures that mutual interests of all parties are at least partially met in the final plan

- Collaborative planning is more likely to results in successful plan implementation because stakeholders who may otherwise attempt to block implementation, develop the plan will help to implement it because they have a stake in the outcomes.

2.14 Integrating Disaster Risk Reduction with Spatial Planning

According to White and Richards, (2007), Neuvel and Van Der knaap, (2010). Argued that there is a crucial need in integrating spatial planning in to disaster risk reduction. Although for effective integration of the two, four major aspects must be taken in to account being *policy, organizational, data and platform*. This is because spatial planning influences the critical factors of DRR such as location of activities, type of land use, and scale of development and design of physical structures. Burby (1998), Godschalk *et al*. (1999). They are of the view that the integration of spatial planning with disaster risk reduction it involves active participation from various government agencies and public engagement. Moreover, Spatial planning as a tool for allocating, sizing and creating harmonies space to live, work and develop at, it has been regarded as reliable tool for development, which has to decide on future use of space which can be suitable instrument in addressing disaster risk reduction (Albrechts 2006).

In the other hand Sutanta, (2012). Argued that the integration of spatial planning with disaster risk reduction becomes important this is because spatial planning can reduce the vulnerability of development by minimizing exposures to natural hazards, provides ample time to study different options and choose the best strategy to provide the greatest benefit to the community with the least cost. Additionally, the integration of spatial planning with DRR will increase the safety of citizens in disaster prone areas (Cozzani *et al*, 2006).

2.15 Disaster Risk Reduction

The concept of DRR is relatively new approach yet not a new idea in particular as it emanated from the older emergency management approach which laid its focus mainly on the response phase of disasters (Pearce, 2003). Disaster risk reduction is a strategy that aims at minimizing both the economic losses, human casualties and ensuring sustainability of development. As such the strategy laid its focus on three main interconnected components of disaster risk, hazards, vulnerability and exposure (DFID, 2006). Furthermore, the ISDR (2004). Under the section on DRR the strategy stresses more on the significance of ensuring that effective measures are set in place towards reducing risks to both hazard and disaster. The ISDR framework it outlines the main components that are linked with disaster risk reduction which includes the following:

2.15.1 Development Knowledge

The ISDR (2004) it looked at the knowledge regarding development from the perspective of getting education, training, dissemination of information about awareness of disasters and hazards. It went much further to say communities require skills and training in relation to disaster risk reduction. Development knowledge can be accessed through workshops that includes all relevant stakeholders.

2.15.2 Change in behavior awareness

The ISDR (2004) states that for people's behavior towards the hazards to change it depends on the knowledge and awareness towards the disasters or risk set in place. As such, risks associated with hazards and disasters have to analyzed and assed so as to be able to determine to what extend the people's behavior change is required.

2.15.3 Public commitment

The ISDR (2004) saw public commitment as a significant aspect in disaster risk reduction. The framework emphasized more on public participation and also formulation of policies, institutional framework strengthening, effective land use planning/ spatial planning, legislations and principles development

2.15.4 Application of risk reduction measures

Disaster can be reduced in many ways as such, the ISDR (2004) highlighted only few methods that can be used in reducing hazards or disasters such ranges from environmental management, land use planning, protection of critical facilities, networking, partnerships and financial tools.

2.16 Case studies on flood scenarios

This section looks at various cases associated with disaster risk to flooding in various nations.

2.16.1 The international perspective

This section reviews international case studies on disasters flooding in particular. Further, strategies, mechanisms implemented to readdress such disasters will also be addressed to give a highlight on how in the international perspective this kind of disasters are addressed. The final section will be on the lesson learned this include what other nations can learn from this kind of disaster and what are the best alternative solutions that have been implemented internationally.

2.16.1.1Indonesia

This section seeks to outline the flood disaster experienced in the Republic of Indonesia. It further highlights how the disaster has affected the country and how such disasters was addressed. This leads to the lesson learned towards how the Republic of Indonesia has reacted and resolve such flood disasters.

Box 1: Indonesia experiences on flooding

CASE STUDY 1	PROBLEM IN INDONESIA
The Republic of Indonesia is located in South East Asia, between the Indian and Pacific oceans. The country has the world's largest archipelago, with more than 17,500 islands with a total coastline of about 80,000 km. it covers an area of approximately 1,900,000 km with a population of 250 million, which makes it the world's fourth most populous. Furthermore, CIA, (2013); UN, (2013) due to its geographical and climatic conditions, the country faces a high variety of natural hazards, such as floods, storm surges, droughts, tsunamis, earthquakes, volcanic eruptions and forest fires.	According to Marfai & King, (2008) Semarang is faced with two main natural hazards that are strongly inter-related being flooding and land subsidence. Marfai & King, (2007) both problems are directly linked to pressures on the available natural resources, in particular urbanization for residential, recreational and industrial purposes. ACCCRN (2011) argued that flooding damages local infrastructure as well as coastal settlements and agricultural lands, threatening the livelihoods of local people and resulting in socio-economic losses.
LESSON LEARNED	
According to Syahrani, (2011), the municipality of Semarang and the Government of Indonesia implemented both structural and non-structural measures to mitigate the flooding problem. Furthermore, Marfai & King, (2008a) the structural measures implemented in the area include floodway's, dikes and drainage systems, coastal-land reclamation, pump stations and polder systems in the low-lying areas. The non-structural measures include coastal planning and management, public education, and the establishment of an institutional framework for disaster management (Harwitasari, 2009).	

Source: Author's Construct. (2019)

Box 1 above gave an overview on the disaster management strategies the Republic of Indonesia has implemented as a way of addressing the flood disasters. The physical/engineering (distance of structures from the flood line) and ecological/environmental (poor drainage system) vulnerability construct have been improved towards mitigating disasters.

2.16.1.2 Netherland

This section seeks to provide an over view on disaster management in Netherland. This looks at the general overview of the area, what type of disasters are affecting the area and also what type of solutions have been put in place towards mitigating such disasters.

Box 2: Netherland experiences on flooding

CASE STUDY 2	**PROBLEM IN** NETHERLAND
According to Syahrani, (2011); Marfai & King, (2007) Netherlands is highly populated with 496 inhabitants per square kilometre (Statistics Netherlands, 2013). The country's total surface area of 41'528 km mainly composed of coastal lowland and reclaimed land, the lowest point being at 7 meters below sea level (CIA Factbook, 2013).	Delta Programme, (2006a), the growing flood risk has been largely attributed to a combination of unusually heavy rains and human altered landscapes throughout the river basin. The increase in precipitation quantity and frequency has been putting pressure on rivers to discharge larger amounts of water.
LESSON LEARNED	
Biesboer, (2012) argued that the alternative way to resolve the flood risk in the area is by providing sufficient space in terms of the flood line so that increases in river discharge would be countered by lateral outflow of excess water, thus maintaining the water levels.	

Source: Author's Construct. (2019)

Based on box 2 above the highlighted on how Netherland resolved the challenge of river discharges that results in flash floods to structures around the flood lines. The physical/engineering (distance of structures from the flood line) have been improved towards disaster risk mitigation.

2.16.2 Regional case studies

Africa is on a rapid population growth and most people are poor living in squatter settlements, extreme hydro meteorological events such as floods are common in African countries. Floods affect large numbers of people with loss of life, disease outbreaks and damage to infrastructure as seen in the past disaster incidents (UNEP, 2010:276).

2.16.2.1 West Africa

The Red Cross; (2010: 3) the west part of African region is highly exposed to risk of natural disasters that include floods. During the annual rain season, increasingly unpredictable rainfalls often result in floods, displacing hundreds of thousands and destroying houses and road infrastructure.

2.16.2.2 Ghana

According to Ghana Floods Situation Report; (2015); argued that Ghana is affected by various disasters as such floods sits on number two after epidemics with regards to loss of lives. About 415 people out of 3.86 million people have been killed since 1968-2015, this section looks at the flooding disaster that has affected Ghana and how such disasters have been mitigated.

Box 3: Ghana experiences on flooding

CASE STUDY 3	**PROBLEM IN NETHERLAND**
Ahadzie and Proverbs; (2015) Accra is the capital city of Ghana its flooding emanates from the natural factors of intense rainfall, landslide and human factors such as urbanisation, land use and poor drainage.	The SWITCH Accra City Story, (2008) the major causes of flooding in the Accra ranges from the haphazard construction of residential buildings on watercourse; inadequate drainage and a poor waste management system which chokes the open drains with refuse.
LESSON LEARNED The Ghana Floods Situation Report; (2015) Ever since the introduction of the national sanitation day in 2014 which aimed at cleaning/unblocking all the chocked gutters and keep the city clean from the heaped piles of garbage has been one monumental step taking towards address one major widely reported means by which flood can occur in Accra. Furthermore, the government has shown so much commitment to construct hundreds of kilometres of storm drains along the major river basins and also to construct water retention reservoirs in the capital. (Ghana- Floods Situation Report.	

Source: Author's Construct. (2019)

Based on box 3 above. Presented the general experience of Accra city in Ghana on how Ecological/Environmental (poor drainage system and poor land use planning policy), and physical/engineering (poor storm water management) has resulted in the city being exposed to disasters. The Ghana country initiated the improvements on this vulnerability construct towards mitigating disasters in the areas.

2.16.3 East Africa

According to the UNFCCC, (2006:17), argued that the East part of African region has experienced severe floods causing more than 200 deaths and 250 people missing were encountered in the part of Africa in the year 2006 August.

2.16.3.1 Tanzania

According to Kijazi, A.L. and Reason, C.J.C. (2009); argued that over the last few decades most parts of Tanzania have experienced an increased incidence of extreme climatic events, particularly floods and droughts that have been associated with severe socio-economic and ecological implications.

Box 4: Tanzania experiences on flooding

CASE STUDY 4	PROBLEM IN TANZANIA
According to Wisner & Pelling, (2009:128) Tanzania is confronted by what many authors describe as human-induced disasters and disaster risks. Poor infrastructure services and uncoordinated urban development, particularly in urban housing areas, which are reinforced by among other factors poor urban governance, often make urban dwellers, their properties and the environment in general more vulnerable to the impacts of a number of hazards like flooding, diseases, fires and pollution	Kiunsi *et al*., (2009:138), Most of the flood incidences affect houses developed in low-lying areas that were either wetlands or river courses. Informal settlements experience floods during the rainy season. For instance, Msimbazi valley in Dar es Salaam City in Tanzania is a flood prone area. However, about 6,187 households accommodating about 26,000 people stay within this flood prone area (Ngware, 2003). The majority of houses constructed within Msimbazi valley are also poor in their resistance to floods. This means that the area is in itself vulnerable to floods and the households staying within the valley are also vulnerable to the impacts of flooding, which may include loss of lives and properties

Source: Author's Construct. (2019)

Based on box 4 above represent the Tanzania disaster risk. As such, physical/engineering (poor construction material) and socio economic (adherence to building standards) vulnerability attributes has been major factors exposing communities to disasters. As such, this two factors have been revised and improved to increase the level of resilience of communities to disasters.

2.16.4 Southern Africa

The UNEP, (2010:176). Argued that the Southern Africa region experiences floods mostly during the rainy season, less vegetation is more of a reason for food vulnerability in drier areas that receive heavy rainfall with little absorption considering the massive water brought about by flooding.

2.16.4.1 Mozambique

According to Ehrhart and Twena, (2006); argued that Mozambique disasters emanates from the ecological/environmental vulnerability context this involves topography as varying levels of infrastructure and socio-economic development.

Box 5: Mozambique experiences on flooding

CASE STUDY 5	PROBLEM IN MOZAMBIQUE
According to Christie and Hanlon (2001:18) Tropical cyclone, Connie was no longer officially a cyclone when it hit Southern and central Mozambique on Friday to Monday (February 4-7, 2000). Nevertheless, she brought substantial local damage, huge ravines were cut into several neighbourhoods in Maputo and houses were washed away. The heavy rains flooded the commercial centre of Maputo (Vaz, 2000:1).	During the 2000 and 2001 flood events, despite the fact that some affected areas had land use plans, Areas had land use plans, including measures to mitigate against erosion and landslides, these were often not followed or enforced. Insecurity of land and shelter tenure was also a major issue for flood-affected communities (Vaz, 2000:1).
LESSON LEARNED	
Multiple initiatives in Maputo have been implemented as a way of addressing disaster risk reductions such includes non-structural measures. A Disaster Risk Reduction (DRR) strategy which incorporates climate change concerns has been in place since 2003. Other measures included the construction of flood resilient buildings: The building serves as temporary refuge during floods but is otherwise used as a school or for other community services	

Source: Author's Construct. (2019)

Based on box 5 above it highlights how the ecological environment vulnerability construct (poor land use planning) has resurfaced as the major constrains to disasters affecting the Mozambique. The ecological/environmental construct has been improved to mitigate such disasters risks.

2.16.5 South Africa

According to Midgley *et al*, (2005). Argued that South African Country Study on Climate Change (2004) has identified the Northern and Western Cape provinces as being at greatest risk from projected climate change induced warming and rainfall change. As such this section looks at Northern part of the Free State Province on how it experienced the disaster and how such disaster has been mitigated.

2.16.5.1 Ngwathe Local Municipality (NLM)

This section looks at disaster risk faced by Ngwathe Local Municipality. It further looks at how such disasters have affected the municipality, which mitigation strategies has been implemented and what lessons can be learned from such municipality.

Box 6: Ngwathe Local Municipality experiences on flooding

CASE STUDY 6	PROBLEM IN MOZAMBIQUE
NLM is the largest local municipality of Fezile Dabi District Municipality which is in the Northern part of the Free State Province. It is comprised of five towns, namely Parys, Vredefort, Heilbron, Koppies and Edenville as well as the rural areas as demarcated by the Demarcation Board of South Africa. These settlements are represented by an organisation called Abahlali baseMjondolo (People living in shacks).	According to MATS'ELISO L; (2011) argued that floods in Ngwathe pose a serious threat not only to the lives of the residents, but also to the environment and economy. The main problem lies within the municipality's ability to deal with these floods. The inability of the municipality to implement preparedness and mitigation. Furthermore, With the lack of expertise in disaster management amongst the authorities, Ngwathe suffers a backlog in terms of economy and community trust (Fezile Dabi District Spatial Development Framework 2011/12).
The community started using timber for building as a way of preventing flooding in their area	

Source: Author's Construct. (2019)

Based on box six above it reflects the disaster risk affecting the Ngwathe local municipality and how such disaster has affected the municipality. It further outlined the mitigation strategies implemented by the municipality towards resolving such disasters. In this case the major element that exposed the communities to disaster was the physical/engineering vulnerability element of construction material used to construct.

2.17 Study context

According to the IPCC, (2014), argued that the concept of climate change has been given so much attention and understanding upon it is growing and today scientist are 95% certain that the perceived increases in global temperature are mostly caused by the concentration of Greenhouse Gases1 (GHG) in the atmosphere and other human activities. Furthermore, SA Explorer Tzaneen climate, (2014), highlighted that the annual rainfall in the Mopani district turn to vary from 400 and 900mm, this is largely caused by the complex topography. The GTM is surrounded by large hills that receive mean annual precipitation of 881mm (Kruger, 2006).

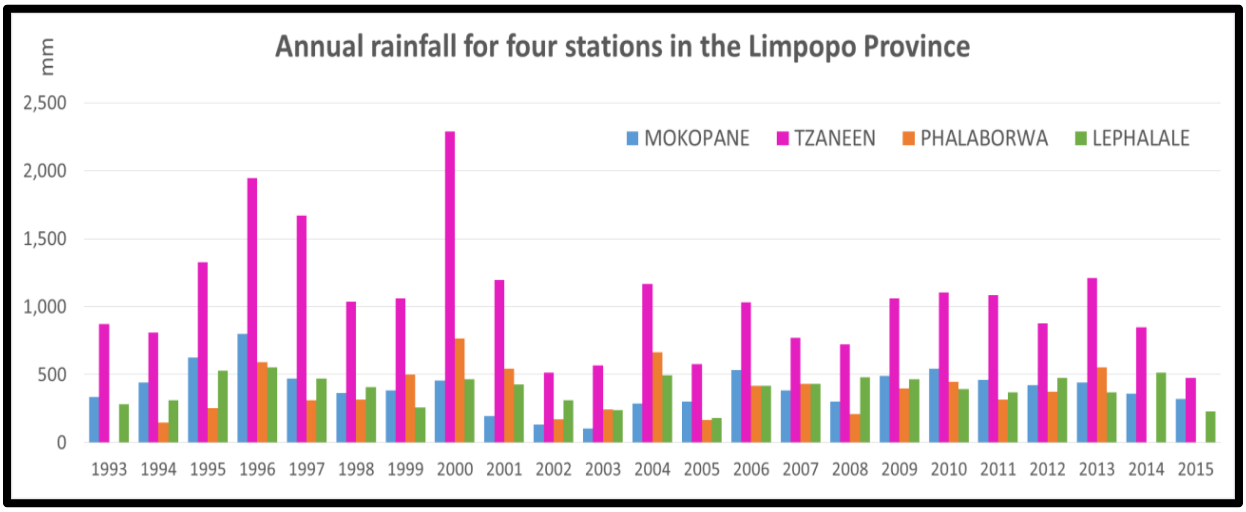


Figure 2.8: Limpopo annual rainfall based in 4 weather stations from 1993-2015

Source: Limpopo Environmental Outlook Report (2016).

2.17.1 Rainfall vulnerability in the study area

According to a study conducted by Mudau (2016); argued that more than 85% of the total rainfall in the Limpopo province is received during austral summer from October to March, as such the annual cycle of monthly rainfall in the Tzaneen is reflected with the peak during the austral summer months from November to March though the months from May to September are largely dry with little rainfall Malherbe *et al* (2012). Furthermore the Limpopo

Department of Agriculture (2014), the Limpopo province experience annual rainfall of less than 500mm in most parts of the province as influenced by the semi-arid climatic conditions.

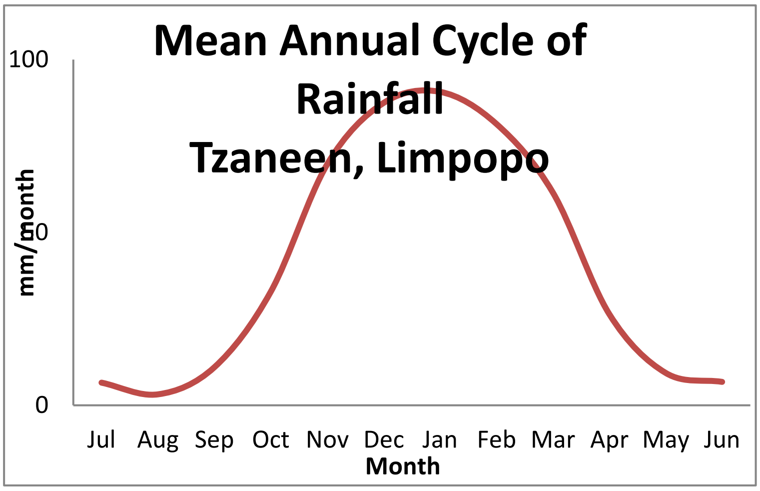


Figure 2.9: reflects the mean annual cycle of rainfall in Tzaneen

Source: Limpopo Environmental Outlook Report (2016).

Mudau, (2016) state that in seasonal bases the rainfall in Tzaneen is inconstant, as such in the years 1988, 1996, 2000, 2011 and 2013 high rainfall occurred mainly associated with the tropical storms or remnants of the tropical cyclones from the southwest Indian Ocean.

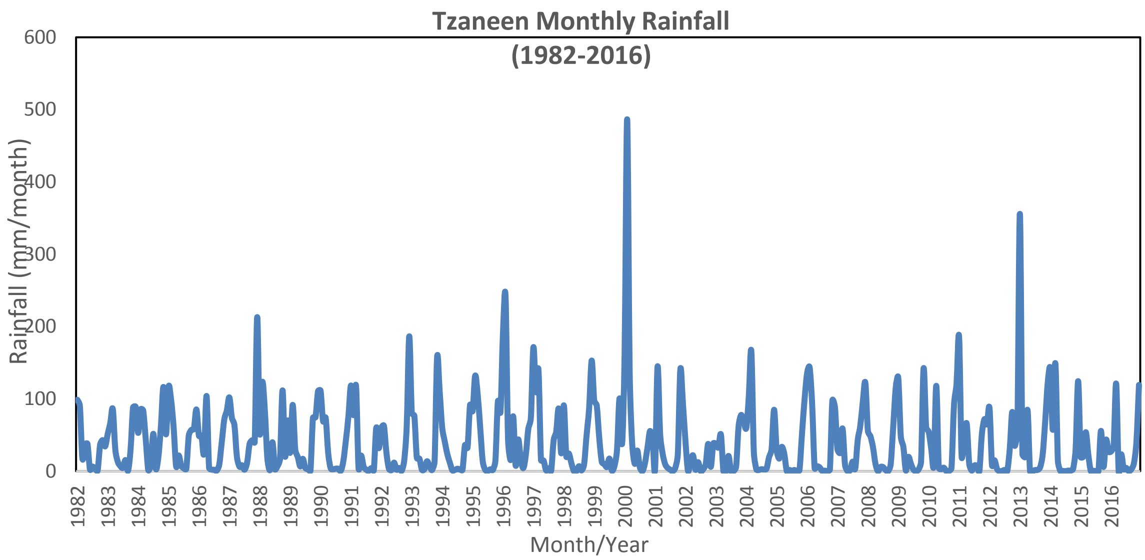


Figure 2.10: Inter-annual variability of rainfall (mm) in the study area from 1982 to 2016

Source: Limpopo Environmental Outlook Report (2016).

Heavy rainfall from ex-cyclone Bonita produced more than 240 mm in Tzaneen in 1996. Whilst tropical storms in January 2011 and January 2013 also resulted in excessive rainfall in Tzaneen and the surrounding areas.

2.17.2 Flooding in Mopani District Municipality

A Tropical Low Pressure system developed over the Indian Ocean West of Madagascar and moved inland over the southern part of Mozambique and entered the Republic of South Africa on the 16th January 2012 over Maputo. Maruleng and Greater Tzaneen Municipality was the hardest hit, major infrastructure damage to roads and bridges were caused by the floods and communities in the area were also severely affected.

2.17.2.1 Impacts of the flood

According to Mopani Disaster management centre 2016 reported that, a total amount of 662 households have been affected by the rain, Molalane village had the hardest hit. The Disaster Management Centre, with the assistance of SASSA, Department of Social Development, Community Development Workers and Working on Fire Teams did the assessment and distribute food parcels.

Table 2.4: Impacts of the flood

Affected families	**Community**
Affected Households	662
Amount of assistance received in the previous floods	
Food Packages/parcels	662
Bread	1556
Blankets	1946
Tents provided	71

Source: Mopani disaster management centre report (2015)

Table 2.4 above reflects the impacts the floods has caused within the Mopani district and also type of assistance the affected communities received after such disasters.

2.17.2.2 Initial assessment of damages

Table 2.5: Flood damages

Infrastructure Category	Damage reported	Damage verified (Occurred due to flooding / storms in specified window period)
Housing	No figure provided	R 11 401 240.00
Schools	No figure provided	R 1 516 174.77
Municipal Infrastructure (Roads)	No figure provided	R 5 000 000.00
Municipal Infrastructure (Buildings)	No figure provided	R6 000 000.00
Tourism (infrastructure)	No figure provided	R80 000 000
Roads and bridges	R94 700 000.00	R 52 180 000.00
Agriculture	R54,000,000.00	R 20 622 609.91

Source: *Mopani disaster management centre report (2015)*

Table 2.5 above reflects the cost of damages the disasters has caused within the Mopani District.

2.17.2.3 2013 report on Drowning's

Table 2.6: Impacts of the flood

DATE	EVENT
16 January 2013	One child drowned at Dzumeri near Giyani. He was pronounced dead on Arrival at the local clinic.
17 January 2013	Two children drowned at GaPhooko. Both bodies were recovered.
18 January 2013	One child drowned at Homu. Body of the 9yearold Child was recovered.
20 January 2013	One person reportedly drowned at Sekgopo, Majeje and Thakgalane (Sekgosese).
22 January 2013	One person drowned at Loloka, Mnghonghoma and two children at Mayepu.
24 January 2013	A man drowned at Mpayeni.
25 January 2013	A person drowned at Mapayeni.
27 January 2013	One person drowned at Sephukhubye.

Source: Mopani disaster management centre report (2015)

Table 2.6 above reflects the statistics of people drowning during the 2013 floods within the Mopani District.

2.17.2.4 2013 flooding Damages records

Table 2.7: Impacts of the flood

Households affected	1678
Total injuries	18
Total deaths	16
Tents required	465
Food parcels required	1187

Source: Mopani disaster management centre report (2015)

Table 2.7 above reflects the damages that the municipality has managed to record due to 2013 floods within Mopani District Municipality.

2.18 Chapter Summary

This chapter explored relevant existing literature on spatial planning and disaster risk reduction on flood prone areas. It outlined the four study construct on vulnerability and the policy framework in South Africa that provides insights on disaster risk reduction. The chapter also explored case studies of successful disaster risk management, in developed countries, as well as local case in South Africa, indicating the lessons that were learnt.

CHAPTER THREE: POLICIES AND LEGISLATION ON DRR

3.0 Introduction

This section of the study sought to outline various policies and legislations in relation to spatial planning and disaster risk reduction.

3.1 AN INTERNATIONAL PERSPECTIVE

According to Housner, (1989: 45) argued that internationally natural disaster exert an enormous toll on human development. In doing so they pose a significant threat to every part of the country. Furthermore, natural disasters do not only affect the country way of surviving yet it pose an enormous threat for achieving the Millennium Developmental Goals. The following section will discuss the most prominent of these institutional arrangements as they apply to modern disaster risk reduction in South Africa.

3.1.1 International Decade for Natural Disaster Risk Reduction

According to UN-ISDR, (2007); Housner, (1989:45); Lechat, (2007), Argued that the rapid increase impact of disasters, such as human casualties and properties damaged in the early 1980s, has led the United Nations General Assembly to declare 1990-1999 the International Decade for Natural Disaster Reduction. The declaration of the International Decade for Natural Disaster Reduction (IDNDR) represented one of the more visible expressions of the commitment and concern by the international community and was a significant factor in stimulating more concerted preoccupation with the study and analysis of disaster causation, the essence of which was captured in the idea of risk (Lavell, 1999:4).

3.1.2 International Strategy for Disaster Reduction

According Christoplos in Pelling, (2003:101) argued that the ISDR, shows signs of shifting to a more midway position between scientific knowledge and policy formulation and highlights better the role of vulnerable communities in risk management. Furthermore, the policy provides a forum for major agencies involved in several aspects of disaster risk reduction (The World Bank and UN-ISDR, 2007:20) to ensure an effective and coordinated approach for the implementation of disaster risk reduction at international to national levels. In other words, the ISDR is a multidisciplinary and multi-stakeholder platform that enables societies to increase their resilience to natural, technological and environmental disasters, and to reduce any associated environmental, and social risks.

3.1.3 The Global Platform for Disaster Reduction

The Global Platform for Disaster Reduction is the global forum for accelerating the worldwide momentum in disaster risk reduction. The forum is made up of the stakeholders for all parties involved in DRR (UN-ISDR, 2007:2).

It has been mandated by the United Nations General Assembly (A/RES/62/192) to assess the progress made in the implementation of the HFA, to enhance the awareness of disaster risk reduction, to share experiences and lessons learnt from good practice, and to identify any remaining gaps, and to recommend targeted action to accelerate the national and local implementation programme of DRR (UN-ISDR, 2007:2).

3.2 Institutional arrangements in Africa

The African continent is highly vulnerable to disasters from natural causes, particularly from hydro-meteorological ones that regularly result in drought and floods (UN-ISDR, 2004a:98; 2004b:2). The following section will review the progress made by regional and sub-regional institutions in Africa in the field of disaster risk reduction.

3.2.1 The African Union

Africa is the only continent whose share of reported disasters in the world total has increased over the past decade (UN-ISDR, 2004b:3). More people are being affected by these natural hazards, and the economic losses incurred are rising. In addition, disaster impacts have become an impediment to sustainable development in Africa. Despite the challenges, intensive efforts to reduce the risk of disasters have been gathering pace in Africa over the past half-decade. African commitments to disaster risk reduction are taking place through the African Union (AU) and its Constitutive Act (UN-ISDR, 2004a:1).

3.2.3 Institutional arrangements at the sub-regional level

According to Twigg (2004: 22-26) argues that each organisation must institutionalise risk reduction at its policy level, the strategic level, the operational guideline, geographical and sectoral plans, programme and projects proposals, structures and systems and external relations if such a country is taking disaster risk reduction seriously as part of its development agenda.

3.2.4 National Platform for Disaster Risk Reduction in Africa

The National Platform for DRR is a multi-stakeholder national mechanisms to those services as an advocate of DRR at different levels (UN-ISDR, 2007:1). In other words, a National Platform for DRR is multi-disciplinary and inter-sectoral in nature; and it has contributed in developing national strategies for their countries and served as a basis for sub-regional,

regional and international co-operation with regard to disaster reduction management. According to the UNDP-DMTP (1998:3), the National Platform is the key agency that has the authority and resources to co-ordinate all related bodies for disaster management, such as ministries, international donor agencies, NGOs and the private sectors. Furthermore, a National Platform contributes to the wide dissemination of disaster reduction messages. A National Platform can play a role in liaising with line ministries and other actors in shaping the risk reduction policies of a country (Pelling & Holloway, 2006:9).

Table 3.1: National Platform for DRR in selected of the African countries

Country	**Disaster Risk Reduction Institution**
Botswana	National Disaster-Management Office in the Office of the President
Burundi	Department of Disaster-Prevention and Management under the Ministry of the Interior and Public Security
Cameroon	Ministry of Territorial Administration and Decentralization
Cape Verde	Ministry of the Interior and Civil Protection
Democratic Republic of Congo	Council for Civil Protection (CPC) in the Ministry of Interior
Republic of Congo	Ministry of Forestry, Economy and Environment
Ethiopia	National Disaster-Prevention and preparedness committee chaired by the
The Gambia	National Disaster, Emergency Relief and Resettlement Committee
Guinea Bissau	Institute of Biodiversity and Protected Areas and Ministry of Natural Resources
Liberia	Ministry of Internal Affairs
Madagascar	CNS: Chaired by the Minister of Interior Department and Reform Administration
Malawi	Department of Poverty and Disaster Management
Mauritius	Prime Minister’s office as the coordinating structure
Namibia	National Disaster-Management System
Mozambique	National De Gestao De Calamidades
Rwanda	National Service for Disaster Management
Seychelles	Department of Risk and Disaster Management
Sierra Leone	Office of Security
South Africa	National Disaster Management Centre – Department of Co-operative Governance and Traditional Affairs
Zimbabwe	National Civil Protection Committee

Source: World Bank & UN-ISDR, (2007).

Besides a national co-ordinating mechanism, each country needs to have organised decentralized structures which can deal with the day-to-day running of disaster reduction activities. The next section will discuss the disaster risk reduction institutional arrangements in South Africa.

3.3 Disaster risk reduction institutional arrangements in South Africa

The Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996) is the legislative base for the organisation of the South African people. Various sections of the Constitution relate to Disaster Risk Management and Public Awareness. Section 7 comprises of the Bill of Rights and specifies the 'rights of all people' in South Africa 'and affirms the democratic values of human dignity, equality and freedom' (South Africa, 1996: 1245). Sections 9, 10 and 11 expounds that all South Africans are equal, have the right to dignity and to life (South Africa, 1996: 1247). Section 24 provides for 'an environment not harmful to a citizen's health or well-being' and Section 29 states that 'everyone has a right to an education', (South Africa, 1996: 1257)

According to Van Neikerk, (2005:124) argued that the historical development of disaster risk management policies in South Africa laid more focus on a reactionary for many years. As the result this was due to the fact that the structure and legislative framework that existed were totally inadequate and in most cases inoperable, for the entire population.

The South African policies on DRM dates back to the early 1994, during this era South Africa has overhauled its disaster risk management policies. As early as 1990, South Africa had aligned itself with the global developments which focused on risk reduction strategies to build resilience and promote sustainable livelihoods amongst the communities (IFRC, n.d).

Table 3.2: The change-over of policy related to disaster risk management in South Africa

Year	Policy
1998	Green Paper on Disaster Risk Management
1999	White Paper on Disaster Risk Management
2000	First Draft Bill on Disaster Risk Management
2000	Second Draft Bill on Disaster Risk Management
2003	15 January: Promulgation of the Disaster Management Act 57 of 2002
2004	28 May: Draft National Disaster Risk Management Framework published for public comments
2005	May: Publication of the final National Disaster Risk Management Framework

Source: Adapted from Van der Waldt et al., (2007:241)

3.3.1 Disaster Risk Management Structures at a National Government Sphere

The Green Paper on Disaster Management (South Africa, 1998: 38) indicates that the lack of any clear co-ordination at the political and departmental levels, has led to ineffective systems of disaster risk management. This is often reflected in the poor responsiveness to deal with disasters, and mixed signals from sources of expert information. To avoid such dubious practices, it now calls for change which will result in some kind of permanent risk reduction focus and disaster risk management or co-ordination capacity at national, provincial and local levels (South Africa, 1998:38).

The Disaster Management Act, 2002 (Act No 57 of 2002) is quite specific in relation to the different structures that must be created at national level. In addition, the Intergovernmental Relations Framework Act, 2005 (Act No 13 of 2005), indicates that all spheres of government must provide effective, efficient, transparent, accountable and coherent government for the Republic to secure the wellbeing of the people and the progressive realisation of their Constitutional rights (South Africa, 2005b:2). Furthermore, Pelling & Holloway, (2006:4); Van Niekerk, (2006:96); Visser & Van Niekerk, (2009:6). They are of the view that the promulgation of the Disaster Management Act, 2002 (Act No 57 of 2002) was heralded as a new era for disaster risk management in South Africa. This is because the Disaster Management Act, 2002 (Act No 57 of 2002) calls for the establishment of structures, frameworks, plans, procedures and strategies that cut across all government structures. Furthermore, the publication of the National Disaster Risk Management Framework (NDRMF) of 2005 (South Africa, 2005a:2) – with its particular emphasis on disaster risk reduction and disaster risk management once again proved that the South African Government is committed to the ideal of creating safe and sustainable communities, through integrated, multi-disciplinary and holistic approaches in the management of disasters in the country.

3.3.2 The Intergovernmental Committee on Disaster Risk Management

In terms of section 4 of the Disaster Management Act, 2002 (Act No 57 of 2002), the National Disaster Risk Management Centre (NDRMC) is responsible for establishing effective institutional arrangements for the development and approval of integrated disaster risk management policies. One way of achieving this is through intergovernmental structures. In this regard, the Disaster Management Act, 2002 (Act No 57 of 2002) calls for the establishment of an Intergovernmental Committee on Disaster Risk Management (ICDRM). The ICDRM must be established by the President; and it includes representatives from all three spheres of government (South Africa, 2005a:8; South Africa, 2003:10; UN-ISDR, 2004a:103; UN-ISDR, 2004c:35). It must be chaired by the Cabinet member designated by the President to administer the Disaster Management Act, 2002 (Act No 57 of 2002).

3.3.4 The National Disaster Risk Management Advisory Forum

According to The World Bank and the UN-ISDR (2007:77), integrated DRR in development is a collaborative effort that depends on the participation of a wide range of actors. In the same vein, Twigg (2009:2) pointed out that disasters are complex problems demanding a collective response from different disciplinary and institutional groups. Furthermore, Van Niekerk (2006:96) and Visser & Van Niekerk (2009:6), indicate that disaster risk management in South Africa consists of a labyrinth of cross-cutting facets that require the participation of a host of sectors and disciplines not only from within the sphere of government (national, provincial and local) but involving the private sector, civil society, non-governmental organisations (NGOs), community-based organisations (CBOs), research institutions and institutions of higher learning. This is due to the broad ranges of activities that DRR requires, such as vulnerability and risk assessment, capacity building, establishing social and economic infrastructures and the use of early-warning systems (Van Riet & Diedericks, 2009:2). As a result of this, no single group or organisation can address every aspect of DRR.

Under section 5 of the Disaster Management Act, 2002, there is a call for the Minister responsible for the administration of the Disaster Management Act, 2002 (Act No 57 of 2002) to create a NDRMAF. The forum is a body in which national, provincial and local government and other disaster risk management role-players consult one another and co-ordinate their actions on any matters relating to disaster risk management (South Africa, 2003:12; 2005a:33; UN-ISDR, 2004c:37). South Africa is not the only country that fosters broad-based participation in disaster risk management issues. Many disaster risk management organisations/countries in Africa recognise the importance of broad-based representation. For example, other countries across the African continent which have demonstrated a clear promotion of broad-based representation are: Ethiopia, Lesotho, Uganda and Djibouti. Their policy frameworks and co-ordination mechanisms include the private sector, NGOs and civil society organisations in their structures (UN-ISDR, 2004c:38). The above professional disciplines need to operate within the policy framework. The next section will discuss the policy framework for disaster risk management.

3.3.5 The National Disaster Risk Management Framework

The Disaster Management Act, 2002 (Act No 57 of 2002) recognises the wide-ranging opportunities in South Africa to avoid and reduce disaster losses through the concerted energies and efforts of all spheres of government, civil society and the private sector (South

Africa, 2005a:2). It also acknowledges the crucial need for uniformity in the approach taken by such a diversity of role-players and partners. In order to provide uniform approaches in dealing with disaster risk management in South Africa, the Disaster Management Act, 2002 (Act No 57 of 2002) calls for the development of a policy document that must provide direction on the management of disaster risks. In other words, disaster risk management requires an enabling and supportive institutional framework (Yodmani, 2001:5).

The NDRMF is divided into four Key Performance Areas (KPAs) and three "enablers" (South Africa, 2005a:4). Each of the KPAs is informed by specific objectives, as set out in the Disaster- Management Act, 2002 (Act No 57 of 2002). Similarly, each enabler is informed by specified objectives, as required in the Disaster-Management Act, 2002 (Act No 57 of 2002). Both Van Niekerk (2005:132) and South Africa (2005a:4) indicate that in order to measure the progress in the implementation of the different KPAs, the framework specifies Key Performance Indicators (KPIs) for each of the KPAs.

3.3.6 The National Disaster Risk Management Centre

The Disaster Management Act (No 57 of 2002) calls for the establishment of a National Disaster- Risk Management Centre (NDRMC) to achieve the objective of promoting an integrated and co-ordinated system of disaster risk management. The NDRMC is the principal functional unit for disaster risk management in the national sphere. In essence, the NDRMC is responsible for guiding and developing frameworks for Government's disaster risk management policy and legislation, facilitating and monitoring their implementation, as well as facilitating and guiding across functional and multidisciplinary disaster risk management activities among the various organs of State

At National level, disaster risk management in South Africa is located within the Ministry of Co-operative Governance and Traditional Affairs (previously known as the Department of Local Government and Housing). The location of NDRMC within the line ministry is not exceptional in South Africa. On the same line of thinking, the location of disaster risk management is also found within the Ministries in countries such as India (Department of Home Affairs), Gabon (in Social affairs), Zimbabwe (Labour, Manpower and Social Welfare) and Mozambique (Foreign Affairs) (The World Bank & UN-ISDR, 2007:75-76).

3.3.7 The National Interdepartmental Committee on Disaster Risk Management

Both the Green Paper and the White paper emphasise the importance of the establishment of the National Interdepartmental Committee on Disaster Risk Management (NICDRM). The Interdepartmental committees – consisting of senior staff members of each national department meet regularly to discuss and facilitate decisions regarding disaster risk management-related matters (Van Riet & Diedericks, 2009:5; Van Niekerk, 2005:139), such as the preparing of disaster risk management plans.

Furthermore, the NICDRM needs to function as an administrative executive forum for all internal disaster risk management planning and activities. According to Van Niekerk (2005:139) and the UN-ISDR (2004a:102), the forum allows technocrats to ensure better co-ordination among government departments, to compile disaster risk management plans and strategies; and, in addition, it provides an accountability vehicle between the various departments. The NICDRM forms the foundation of the NDRMAF, whereas the NDRMAF is merely an advisory body (Van Niekerk, 2005:135; Van der Walt et al, 2007:246). On the other hand, the NICDM should stand as the executive body. The provinces also have a crucial role to play in the implementation of disaster risk management plans. The Disaster Management Act, (No 57 of 2002) is quite specific in relation to the different structures that must be created at provincial level. These structures at provincial level will now be discussed.

3.4 Disaster Risk Management Structures at Provincial Government Sphere

Many aspects that are national Government‟s responsibility, such as environmental and agricultural issues, are also "concurrent power" (exercised jointly by national and provincial bodies) in terms of the Constitution of South Africa (Act 108 of 1996). For this reason, the role of provincial government in some areas is well-established, while in others it is not. According to the Green Paper on Disaster Management (South Africa, 1998:51), the provincial government may choose to appoint or establish co-ordinating structures of its own, to ensure that there is an integrated approach to disaster risk management at the provincial level. Van Niekerk (2006:107) alluded to this by indicating that to ensure continuity in disaster risk management practices and principles throughout South Africa, the structures that are developed at national level should also be developed at the provincial level.

3.4.1 The Provincial Political Forum for Disaster Risk Management

Both the Disaster Management Act, 2002 (Act No 57 of 2002) and the NDRMF are unclear on the structure that should be responsible for the development and adoption of a disaster risk management policy at the provincial sphere of government. However, section 41 of the Disaster Management Act, 2002 (Act No 57 of 2002) gives power to the Premier of the province, to declare a provincial state of disaster. Because of the political obligation to deal with disaster risk management in the province, it makes more sense to give the Premier of the provinces the responsibility of dealing with disaster risk management policies

The Premier must do this after due consultation with the other MECs within the province. The best forum where consultation can take place is the Premier‟s Intergovernmental Forum. The Premier‟s Intergovernmental Forum is a consultative forum for the Premier of a province and local governments in the province (South Africa, 2005b:18).

3.4.2 The Provincial Disaster Risk Management Advisory Forum

According to Twigg (2009:1; 2004:61), the scale, frequency and complexity of disasters, such as physical and social phenomena, can only be addressed by deploying a wide range of skills and resources, both in the development and disaster risk management programmes. At the same time, disaster risk reduction initiatives must be multidisciplinary partnerships involving a range of stakeholders. Vermaak & Van Niekerk (2004:556) state that the DRR is a multidisciplinary actor. As such, it should not be the responsibility of one government department or sub-department. This is due to the broad range of activities that DRR requires, including vulnerability and risk assessment, capacity building, establishing the social and economic infrastructure and the use of early-warning systems (Van Riet & Diedericks, 2009:2).

To accommodate the range of stakeholders at provincial level, the MEC responsible for disaster risk reduction may establish a Provincial Disaster Risk Management Advisory Forum (PDRMAF) (See section 37 of Disaster Management Act, 2002).

3.4.3 The Provincial Disaster Risk Management Framework

In pursuance of the national objective, each province must establish and implement a framework for disaster risk management in the province. This should be aimed at ensuring an integrated and uniform approach to disaster risk management (Van Niekerk, 2005:142), in the province by all provincial organs of state, provincial statutory functionaries, non-governmental organisations involved in disaster risk reduction in the province – and by the private sector (see section 28 of Disaster Management Act) (South Africa, 2003:34-35).

A Provincial Disaster Risk Management Framework (PDRMF) must be consistent with the provisions of the Disaster Management Act, 2002 (Act No 57 of 2002) and the NDRMF (of 2005). In other words, the structure of PDRMF comprises four KPAs and three enablers pertaining to the provincial government sphere (see section 2.5.1.3 discussed above). To ensure integration and the co-ordination of disaster risk management activities at the provincial government sphere, according to the Disaster Management Act, 2002 (Act No 57 of 2002) and NDRMF of (2005) each province, the national government sphere must establish mechanisms for the integrated direction and execution of disaster risk management policies and legislation in the various provinces.

3.4.4 The Provincial Disaster Risk Management Centre

Both the Disaster Management act, 2002 (Act No 57 of 2002) and the NDRMF (of 2005) require the integration and coordination of disaster risk management activities in the provinces (NDMC & Reid, 2008a:18). Subsequently, section 1.2.4 of the NDRMF (of 2005) compels the MEC of each province who is responsible for disaster risk reduction to establish institutional capacity for disaster risk reduction in the province (South Africa, 2005a:25). In other words, each province must establish a Provincial Disaster Risk Management Centre (PDRMC). A PDRMC forms part of, and functions within, a department designated by the Premier in the provincial administration. Such arrangement must be consistent with the National Government and must further provide the appropriate vehicle to allow for the application of co-operative governance to facilitate both intergovernmental and provincial interdepartmental relations for the purpose of disaster risk reduction in South Africa (South Africa, 2005a: 25).

As with the NDRMC, all provinces have already established these centres within their administration (Van Niekerk, 2006:107; South Africa, 2009). The functions and responsibilities of the PDRMC are similar to that of the NDRMC but as it pertains the provincial level (Van Niekerk, 2005:145; 2006:107). Furthermore, the PDRMC must maintain a strategic overview of disaster risk management projects and programmes in the province.

3.4.5 The Provincial Interdepartmental Committee on Disaster Risk Management

According to the NDMC & Reid (2008b:26), the greatest challenges in the implementation of the Disaster Management Act, 2002 (Act No 57 of 2002) and the NDRMF is to achieve integrated and holistic planning and practices within the departmental structure of the government. In the context of provincial government departments, in order to overcome the above challenges, it is imperative for each of the provincial department and the public entities to establish the Provincial InteThe PIDRMC is less of a legal obligation than the PDRMF (Van Niekerk, 2005:144). However, both Van Niekerk (2006:107; 2005:144), the NDMC & Reid (2008a:26) are of the opinion that it is necessary for the provincial departments to establish a PIDRMC. The PIDRMC is a structure that provides the provincial department with an internal arrangement for disaster risk management. The committee consists of all the government departments that serve on the PIDRMC (or some similar structure) Departmental Disaster Risk Management Committee (PIDRMC).

Van Riet & Diedericks (2009:5), is of the view that the PIDRMC is simply a committee consisting of senior staff members of each provincial department, which meets regularly (normally quarterly) to discuss and facilitate decisions regarding disaster risk management and any related matters. In addition, the core functions and responsibilities of the PIDRMC are similar to those of the NIDRMC, but these issues pertain to the provincial sphere of government.

3.5 The Disaster Risk Management Structures at Local Government Sphere

Both Van Niekerk (2005:144) and Van der Waldt et al. (2007:242) indicate that the local government sphere is the most important sphere for the effective implementation of disaster risk management in South Africa. UN-ISDR (2004a:127) alluded to this by pointing out that municipal structures are well placed to reduce the human and financial costs of disaster. The reason is that the local government is more directly linked with key services delivery to the communities. As such, it should also be the best-organised (institutional arrangement), in such a way that the issue of disaster risk reduction forms part of the broad developmental goals.

Besides the provincial structures alluded to above, disaster risk management also manifests as the function at local government sphere. The following section will discuss the role of district municipal disaster risk management structures, as mandates by both the Disaster Management Act, 2002 (chapter 5) and the KPA 1 of the NDRMF (of 2005).

3.5.1 The Municipal Political Forum dealing with Disaster Risk Management

In order to ensure continuity in disaster risk management practices and principles throughout South Africa, structures that are established at both provincial and national levels are also implemented at local government levels (Van Niekerk, 2006:107). In other words, to be consistent with the arrangements in the national and provincial spheres, it is imperative to have institutional arrangements which will give effect to the same responsibilities in the Metropolitan and in the District Municipalities" spheres, as those of the NICDRM and PIDRMC.

Section 50 (1) of the Disaster Management Act, 2002 (Act No 57 of 2002) obliges the Municipal Disaster Risk Management Centre (MDRMC) to report back to council on an annual basis. This reporting should be done through the appropriate portfolio or mayoral committee (Van Niekerk, 2005:146; Van der Waldt et al., 2007:243). The council of both the metropolitan (see section 54 (a) of the Disaster Management Act, 2002) and district municipalities (see section 54 (b) of the Disaster Management Act, 2002) hold primary responsibility for the co-ordination of the events in the case of a local state of disaster. The District municipality handles the co-ordination responsibility after consultation with the relevant local municipalities (South Africa, 2003:63).

3.5.2 The Municipal Disaster Risk Management Advisory Forum

The Disaster Management Act, 2002 (Act No 57 of 2002) places no legal obligation on the local government sphere for the establishment of an MDRMAF (see section 51 (1). In other words, the Disaster Management Act, 2002 (Act No 57 of 2002) [section 51 (1)] leaves it to the discretion of a metropolitan or district municipality to constitute formal structures, such as an MDRMAF. The MDRMAF is established to provide interaction between internal and external stakeholders on the issue of disaster risk management within the local government sphere (South Africa, 2005a:35).

A MDRMAF envisaged by section 51 of the Disaster Management Act, 2002 (Act No 57 of 2002) is a structure in which a district municipality and the relevant role-players consult one another and co-ordinate their activities on matters relating to disaster risk management. However, a number of studies (Van Niekerk, 2005:149; South Africa, 2005a:35; Van der Waldt et al., 2007:245; Van Niekerk & Visser, 2010:6) question the practicality in the implementation of disaster risk management activities within the local government sphere in the absence of MDRMAF. Both Van Niekerk (2005:149) and South Africa (2005a:6) are of the opinion that it is imperative for the local government sphere to establish such a structure. In case the local government chooses not to establish an MDRMAF, it is imperative to use appropriate alternative structures.

3.5.3 The Municipal Disaster Risk Management Framework

Section 42 of the Disaster Management Act, 2002 (Act No 57 of 2002) calls for each metropolitan and each district municipality to establish and implement a Municipal Disaster Risk Management Framework (MDRMF) for disaster risk management in the municipality aimed at ensuring an integrated and uniform approach to disaster management in its area (South Africa, 2003:50). A district municipality must establish its disaster risk management framework after consultation with the local municipalities in its area. In addition, a municipal disaster risk management framework must be consistent with the provisions of the Disaster Management Act, 2002 (Act No 57 of 2002) the NDRMF and the disaster risk management framework of the province concerned (South Africa, 2003:51.

3.5.4 The Municipal Disaster Risk Management Centre

The establishment of a disaster risk management centre is compulsory (see section 43 of Disaster Management Act). Each Metropolitan and each District municipality must establish in its administration a disaster risk management centre for its municipal area (South Africa, 2003: 51; Van Niekerk, 2005:148). The key responsibility of such a Municipal Disaster Risk Management Centre (MDRMC) is to provide support to the relevant PDRMC and the NDRMC on issues partnering to disaster risk management. These include, among others, ensuring that local disaster risk management policy is implemented, and that the objectives and priorities of provincial and national disaster risk management are attainable.

In terms of section 44 (a-j) of the Disaster Management Act, 2002 (Act No 57 of 2002), a MDRMC must specialise in issues concerning disasters and disaster risk management in its municipal areas. It must also promote an integrated and coordinated approach to disaster risk management in the municipal area with special emphasis on prevention and mitigation (South Africa, 2003:51). Furthermore, it must act as a repository of, and conduit for, information concerning disasters, impending disasters and disaster management in the municipal areas. The MDRMC must make recommendations, regarding the funding of disaster risk management in the municipal area, and initiate and facilitate efforts to make such funding available. In addition, the MDRMC must promote the recruitment, training and participation of volunteers in disaster risk management in.

The municipality may also act as an advisory and consultative body on issues concerning disasters and disaster risk management in the municipal area. Again, the MDRMC may make recommendations to any relevant organ of State or statutory functionary on matters related to draft legislation affecting the Disaster Management Act, 2002 (Act No 57 of 2002), the NDRMF or any other disaster risk management issues (South Africa, 2003:52).

3.5.5 The Municipal Interdepartmental Committee on Disaster Risk Management

As indicated in the past sections, the greatest challenges in the implementation of the provisions of the Disaster Management Act, 2002 (Act No 57 of 2002) and the guidelines provided by NDRMF (of 2005) are to achieve integrated and holistic planning and practices. According to NDMC & Reid (2008c:25); Van Niekerk (2005:149; 2006:108), Van der Waldt et al. (2007:340), one way to address the above challenges is to establish an internal mechanism to facilitate the integration of a plan and practices among the key institutional role players within the district or metropolitan municipalities, particularly when it comes to core functions.

3.6 Chapter Summary

The chapter outlined the research methodology approach that was adopted by the researcher. The methodology more relevant to achieving the objectives of the study was discussed. This chapter also outlined the tools used to collect both primary and secondary data of different dimensions. Further, the chapter outlined the research method that were adopted in sampling collected data and identified analysis tools used to understand collected data.

CHAPTER FOUR: RESEARCH METHODOLOGY

4.0 Introduction

The chapter present research methodology that was adopted and the specific methods and instruments/tools that were utilised to gather, organize and record data. The section also elaborates, and describes the methods used for data analysis. Kothari (2004) defined research methodology as a systematic way of solving the research problem. Furthermore, research methodology presented here entails the procedure on how the study was undertaken to collect valuable data needed for solving the problem of disaster risk reduction which is negatively imposing threats towards human lives and property of vulnerable households of GTM.

4.1 Research Design

Different research designs can be conveniently described if we categorize them as: (1) research design in case of exploratory research studies; (2) research design in case of descriptive and diagnostic research studies, and (3) research design in case of hypothesis-testing research studies (Kothari, 2004).

4.1.1 Exploratory

This study becomes exploratory in a sense that, there has not been any study on the integration of spatial planning with disaster risk reduction in flood prone areas. Furthermore, the study has explored, gained more insights, established priority areas prone to disasters, and developed an operational framework. Therefore, this study contains an exploratory element in it.

4.1.2 Explanatory

The study has element of explanatory in a sense, also known as a causal research design as it established cause effects relationships and identify vulnerability indicators that explain the integration success or failure of spatial planning with disaster risk reduction. This study has deployed an explanatory design to explain and meet the objective of the study. Such explanatory research design made use of hierarchical cluster analysis to categorise communities with similar characteristics which determine the community vulnerability.

4.1.3 Deductive

According to Wilson, (2010) deductive approach is concerned with developing a hypothesis based on existing theory, and then designing a research strategy to test the hypothesis.

Therefore, under this study the hypothesis was that "Spatial planning measures that are targeted at reducing ecological, socio-economic, physical and institutional vulnerabilities of households occupying flood prone areas are critical in building resilience". While the main assumption here was that certain spatial dynamic elements that characterize flood prone areas interact in such a way that one is able to map unique clusters of such flood prone areas. In this study, a deductive research approach was adopted through reviewing theories about disaster risk reduction. By reviewing theory, this research looked at four study constructs concerning the integration of disaster risk reduction (*Physical/Engineering, Political/Institution, Ecological/Environmental and Socio/economic)*.

4.1.4 Inductive research

Goddard, et al. (2004) explains that inductive research starts with the observations and theories that are proposed towards the end of the research process because of observations. In this study , observations on specific vulnerability indicators was first made by simply identifying what vulnerability factors play significant role in making communities more vulnerable to disasters. Thereafter, a framework was then developed for best practice.

4.1.5 Mixed approach

Mixed approach was utilised in this study this was because the study was both inductive and deductive in the sense that a vulnerability assessment theory (here referred to as a framework) was first developed that depicted important flood vulnerability attributes requiring further analysis. Such a framework was then operationalized to test the extent to which communities occupying flood prone areas in GTM were vulnerable. The same framework was used to deduce the extent to which such communities were resilient to problems associated with flooding. The study had an element of inductive research in the sense that it used field experiences on flooding to identify important spatial planning strategies that could be employed to reduce Risks associated with flooding. The use of such a mixed approach to research has been praised by several scholars including: (Creswell, J.W, 2013: Andrew and Halcomb, 2012, Simons and Lathlean, 2010). For instance, Hayes et al., (2013); argued that a mixed approach can unveil important numerical data It is known as mixed research as it incorporates both quantitative and qualitative approaches.

4.2 Observational research design

Several research paradigms were critical in investigating the prospects of integrating spatial planning with disaster risk reduction. As such, Kothari (2004) argued that they are two basic approaches to research design and such being both quantitative approach and the qualitative approach. The study was mainly aligned to the quantitative research paradigm. Most of the variables related to flood vulnerability are quantitative in nature and therefore required some form of quantification. Since most of the study variables were measured using a series of Likert scales, quantification was made possible. The main statistical tool of analysis employed was Hierarchical Cluster analysis (HCA). Other quantitative analytical tools that complemented the analysis included the use of Means Analysis and data screening statistical tools related to Normality and reliability tests such as measures of skewness and kurtosis. Normal Q-Q plots, and the Cronbach Alpha statistic. Not all variables developed by the study were quantitative in nature. The qualitative Research Paradigm was employed at a conceptual level to identify important study concepts to be studied. It was instrumental in identify the main study constructs and their associated indicator variables. The main instrument of analysis under this paradigm was pattern matching. Pattern matching as defined by Yin (2011); is a qualitative research instrument that was used in this study to develop a series of theoretical propositions about what the literature assumed was ideal or less than ideal relationship between flood vulnerability and associated impacts on communities.

4.2.1 Quantitative research

Kothari (2004); quantitative research is based on the measurement of quantity or amount. It is applicable to phenomena that can be expressed in terms of quantity. The qualitative method was used to obtain individuals' social reality in the form of meanings and interpreting their experiences of life.

The quantitative approach was also used to perform normality tests for the data collected. Normality tests was used to determine Q-Q plots for the identified study constructs as statistical analysis assuming that data is normally distributed. Reliability tests was done using a statistical measure referred to as Cronbach Alpha through scales for the extent to which data is reliable. Brink and Wood (1998) argue that data that is quantitative in nature can be altered into a systematic process, objectives, and numbers to obtain relevant information and define variables and their relationships. The quantitative research paradigm made use of statistical data to determine the skewness and kurtosis for data distribution and was graphically represented through a histogram.

4.2.2 Qualitative research

Myers (2009) states that qualitative research design is meant to assist researchers with understanding social and cultural contexts and understanding phenomenon. As such, qualitative research refers to inductive, holistic, emic, subjective and process-oriented methods used to understand, interpret, describe and develop a theory on a phenomenon or setting. It is a systematic, subjective approach used to describe life experiences and give them meaning (Burns & Grove 2003:356; Morse & Field 1996:1999). The qualitative approach lay its focus on the acquisition of descriptive information from respondents or from conducting observations in the study area that can be further narrated by the author. In the qualitative approach, the collection of data was done through questionnaires, key informant interviews (KII) and field observation.

4.3 Operational research matrix

Table 4.1 below presents the research design matrix which provides a rational structure on the specific research objectives. Furthermore, various methods, techniques and tools that were utilised to attain main research objectives were also articulated.

Table 4. 1: Research design matrix.

Research objectives	**Research questions**	**Data collection** Primary and secondary	**Target group**	**Data Analysis**	**Data presentation**
To analyse spatial planning attributes that can be valorised for DRR in flood prone areas.	i. What are the spatial planning variable that are critical to consider in DRR?	• Literature review (Municipal documents, Internet, journals)	• Literature	• Pattern Matching	• Diagramming
To Analyse spatial planning factors that define vulnerability attributes of households occupying flood prone areas	i. What are the spatial planning factors that define vulnerability attributes of households occupying flood prone areas?	• KII • Household Survey	• Municipal officials • Households occupying flood prone areas.	• Normality Test (Skewness, Kurtosis, Normal Q-Q Plots) • Pattern matching • Reliability Test • Cronbach alpha	• Table • Diagram • Dendrogram • Pie chart

To develop a cluster analytical creation of a typology of households whose resilience to flooding can be enhanced through spatial planning	i. What are the common characteristics that define households whose resilience to flooding can be enhanced through spatial planning?	• Household Survey	• Households occupying flood prone areas.	• Hieratical cluster analysis • Comparison of means .	• Frequency distribution tables • Dendrogram • Normal Q-Q plots • Scree Plot • Man Whitney U Test

Source: Author's Construct field work (2019).

4.4 Achievement of research Objectives

This study is based on three main objectives and to ensure the achievement of these objectives a variety of primary and secondary data collection instruments was utilized to attain relevant information. This section discussed how each objective of the study used different tools, methods and sources to extract information and reliable data.

Table 4.2 Method used to achieve research objective

Research objective	Method used to achieve objective
Spatial planning attributes that can be valorised for DRR in flood prone areas	***Pattern matching*** Pattern matching instrument was used to develop a series of theoretical propositions about what the literature assumed was ideal or less than ideal relationship between flood vulnerability and associated impacts on communities.
Spatial planning factors that define vulnerability attributes of households occupying flood prone areas	**Hierarchical cluster Analysis (HCA), Scree Test, Normality, Reliability tests and Man Whitney U Test.** Before the HCA was applied, the study variables were subjected to normality and reliability tests. This was to enable the HCA to identify, unique clusters of flood prone areas that had common physical/engineering, ecological /environmental, socio/economic and political/institution. To identify the number of such distinct clusters that also portrayed varying degrees of vulnerability, the study performed a Scree Test. In order to ensure that

	there was no possible overlap between the generated cluster solution, the study performed a Man Whitney U Test.
Cluster analytical creation of a typology of households whose resilience to flooding can be enhanced through spatial planning	***Hierarchical cluster Analysis (HCA)*** HCA was used to identify, unique clusters of flood prone areas that had common physical/engineering, ecological /environmental, socio/economic and political/institution. Scree test was performed to determine the number of unique clusters that exhibited common resilience characteristics in relation to four broader categories of spatial dynamic elements. The map was then developed using two distinct clusters of flood prone areas that depicted two distinct levels of resilience and associated vulnerability levels.

Source: Author's Construct field work (2019).

4.5 Sampling research design

Kothari (2004) defined sampling design as a plan for obtaining a sample from a given population. It refers to the technique or the procedure the researcher would adopt in selecting items for the sample. Sample design may as well lay down the number of items to be included in the sample i.e., the size of the sample. Sample design is determined before data are collected

4.5.1 Sampling unit of analysis

According to May (2001) describes the sampling unit as the list of the population that exists. In this section the sample unit of the analysis will be the total of flood areas. As such, sample unit of the study was 25 flood prone (mostly affected) areas of GTM villages, government departments and municipal officials, where its population is estimated at about 416 146 (GTM/IDP 2016/17).

4.5.2 Determining of sample size

This refers to the number of flood prone areas that were selected from the sampling unit to constitute a sample. Since the main sampling unit analysis was communities located in flood prone areas, there was no need for sampling as the study assessed all the highly affected flood prone areas in the municipality as attached as **Annexure 2**. This is motivated by the unknown number of households residing next to flood prone areas, the study purposively interviewed 15 municipal officials during the interview stage. The total number of officials dealing with or responsible for subject under study were interviewed and it was deemed adequate given the available time, willingness of officials and financial resources.

4.5.3 Sampling procedure

Systematic random sampling method was used to select the population that the observations and questionnaires were administered to. As such, convenience sampling procedure was employed. The researcher visited the next conveniently located flood prone area within the GTM until all the 25 flood prone areas were investigated

Purposive sampling was employed to identify key municipal officials to include in the interviews. 15 municipal officials were purposively selected because of their knowledge and expertise in the subject at hand.

4.6 Statistical research design

This section deals with how the study variables were identified and the specific variable measurement criteria that was employed. It also looks at how a number of statistics were analysed in this study.

4.6.1Variable identification

According to Gondo (2012) a variable is a certain potion of testing condition that can change or take on different characteristics with different conditions. Dependent variable is a measure of the behavior of the subject or respondent that reflects the effects of the independent variable. However, independent variable is the condition manipulated or selected. Various variables were considered under these study that are mainly related to the topic understudy as guided by the conceptual framework identified in chapter two: The main method of identify such variables was pattern matching. It was complemented by content analysis and thematic mapping. A review of content literature in the area of flood vulnerability and spatial planning enabled the researcher to identify emerging important themes which were later transformed into variables through the method of pattern matching. Table 4.3 summarizes such study variables, including their measurement criteria and supporting references.

Table 4.3 Variable identification

Study constructs	Code	Specific variables	Assumption	Data collection instrument	Measurement criteria	Supporting references
Physical/Engineering	PE	**Housing type**	Households constructed using weaker material are likely to be affected compared to those constructed with concrete	**Observation / Check list**	Likert scales ordinal)	Owoeye (2013); Adelekan (2010); Birkmann (2006b); Grosh and Glewwe (2000); Ayoola and Amole (2014); Ologunorisa (2004); Grosh and Glewwe (2000); Balica and Wright (2010); Vojinović (2015) Brouwer et al. (2007); Ouma and Tateishi (2014); Agbola et al. (2012)
		Structural condition	The older the building is the higher the chances of being vulnerable to disasters			
		Construction materials	Structures constructed using concrete are less prone to disaster compared to those constructed in card box			
		Land ownership/ Land tenure	Land under the ownership of the municipality is more resilient as compared to the one other traditional ownership as	**Questioner/ KII**		

			they follow all planning principles/guidelines			
		Adherence to building codes	Structures that are built in adherence to building codes are less vulnerable compared to those constructed near the flood prone areas	**Observation / Check list**		
		Road connectivity	A place that provide higher road connectivity it promotes access for emergency services compared to those who doesn't have connectivity			
		Elevation of settlement	The higher the settlement is based the safer it is from disasters, the lower is settle the higher the chances of disasters			
		Developmental control	Evidence of structures build close to flood prone areas are more vulnerable			

			compared to those far away from each other			
		Proximity of structures next to the flood prone area	The closer the structure are to the river bank the higher vulnerable they are to disasters			
		Frequency of floods in the last 10 years	The more frequent the flood has happened the more vulnerable the area is to disasters	**Questioner/ KII**		
		Storm water drainage systems	Were the storm water drainage is clocked the rate of disasters are high, compared to when the storm water drainage is open	**Observation / Check list**		
		Causes of flood	Residing along the flood plan areas can be other causes of flooding			
Environmental/Ecological factors	EE	**Waste management**	Poor waste collection can results in blocking drainage systems leading to flooding	**Observation / Check list**	Likert Scales (, ordinal)	Kellens et al. (2011); Marfai et al. (2008); Ologunorisa and; Adeyemo (2005); Agbola et al. (2012);
		Drainage systems	Blocked and absence of drainage systems can increase the			

			vulnerability of communities to flooding			Ho et al. (2008)
		Environmental management	Poor environmental management can lead to degradation of trees that protects communities from floods			
		Climate change	Rapid climate change results in unexpected heavy rainfalls that leads to flooding	**Questioner/ KII**		
		Land use	Residing on areas demarcated for agriculture or public open space can leads to high risk of being vulnerable to disasters			
		Topography	The gentle the slope	**Observation / Check list**		
Socio-Economic Factors	SE	**Level of Education**	The higher the level of education the higher the chances of understanding the impacts of residing on flood prone areas	**Observation / Check list**	Likert scales (Ratio, ordinal)	Govender et al. (2010) Agbola et al. (2012) Grosh and Glewwe (2000) Birkmann (2006a) Wisner (2006),
		Gender	Females along the 500m radius	**Questioner/**		

			flood lone are more likely to be victims of disasters compared to those far from the flood line	**KII**		Jean-Baptiste et al. (2013) Adger (2006)
		Population	The more the population in one place the higher rate the chances of vulnerability to disasters			
		Community participation	Community that participate in the planning of their environment is less likely to be			
			Vulnerable to disasters compared to those who are not involved in the planning process			
		Assistant received	Individuals who gets assistance after disaster are likely to relocate after such rather than those who are not			
		Total injuries	Communities that have high number of injuries is likely to be more vulnerable to			

			disasters			
		Number of drowning and deaths	The more the number of deaths or drowning the more the population is vulnerable to disasters			
		Population growth	the higher the population in one vulnerable area is directly to cause more causalities and damages due to disasters			
		Preparedness	A well informed community will always be alert of disasters compared to those who lack information			
		Evacuation route	Evacuation routes can reduce the impacts of disasters	**Observation / Check list**		Ouma and Tateishi (2014); Agbola et al. (2012)
Political/Institution factors	PI	**Protection and response**	A reliable politician will always care for the interest of their people before during and after disasters	**Questioner/ KII**	Likert scales (nominal, ordinal)	Birkmann et al. (2006b); Wisner (2006), Pelling and Wisner, (2012), Jean-
		Warning systems	Effective municipality will have warning			

			systems in place for in case of emergency			Baptiste et al. (2013); Balica and Wright (2010
		Collaboration with NGO, CBO etcetera	A strong collaboration of various stakeholders helps in preventing, preparing reducing and helping in disaster times			

Source: Author's Construct field work (2019).

4.6.1 Variable Measurement

The process of assigning numbers to various objects is regarded as Variable Measurement (Kothari, 2004). The scale of the variable measured drastically affects the type of analytical techniques that can be used on the data, and what conclusions can be drawn from the data. There are four scales of measurement, nominal, ordinal, interval and ratio. This research made use of ordinal scale measured through a series of Likert scales ranging from 2 point to 5 point Likert scales. The adopted measurement criterial sought to measure the extent to which a flood prone area selected at any given point was performing favourable or unfavourable on the variable under analysis.

4.6.2 Statistical analysis

The SPSS (Software Package for Statistical Sciences) version 25, it is a comprehensive system used to capture and analyse data. This was done to aid the research towards producing statistical charts, tables and statistical analysis. Through the SPSS the researcher managed to do the following statistical analysis as a way of addressing the research objectives:

- Descriptive statistics
- Data screening
- Normality test
- Reliability Test
- Hierarchical Cluster Analysis (Scree Test & Man Whitney U Test)

4.7 Data analysis

Shamoo and Resnik (2003) defined the process of data analysis as a systematic way of applying both statistical and logical techniques to describe and illustrate, condense and recap, and evaluate data. In simpler terms, the purpose of data analysis is to arrange, make sense of, and reformulate the research data to be able to present it in a logical and clear account (Marshall & Rossman, 1999). The process of data analysis involved both qualitative and quantitative data analysis tools. Three modes of analysis were employed to analyse the collected data which is collaborative theory, disaster management cycle and pressure and release model. However, the primary theory of analysis in the study was based on collaboration theory.

4.7.1 Data presentation tools

- Graphs

Graphical method was used to provide visual impression of the outcomes of data examined, specifically normal Q-Q plots used for normality tests, histogram was used to determine the skewness and distribution of the variables and a dendrogram was also used to describe the cluster groups hierarchically according to their characteristics.

- Tables

Tables were used to represent statistical data. The data includes the means score values, Std. Deviation, Std. Error of Mean, Skewness and Kurtosis

4.7.2 Data analysis tools

4.7.2.1 Normality tests

Normality tests procedures provide tests of data normality. As such, data was tested for normality in terms of kurtosis and skewness. It was represented through normal Q-Q plots and histogram for distribution.

Kurtosis is a measure of whether the data are heavy-tailed or light-tailed relative to a normal distribution. That is, data sets with high kurtosis tend to have heavy tails, or outliers. Data sets with low kurtosis tend to have light tails, or lack of outliers (NST/MATECH, 2013). A uniform distribution would be the extreme case. The histogram is an effective graphical technique for showing both the skewness and kurtosis of data set.

The skewness for a normal distribution is zero, and any symmetric data should have a skewness near zero. Negative values for the skewness indicate data that are skewed left and positive values for the skewness indicate data that are skewed right. By skewed left, it means that the left tail is long relative to the right tail. Similarly, skewed right means that the right tail is long relative to the left tail. If the data are multi-modal, then this may affect the sign of the skewness.

For small samples (n<50), if the absolute z-scores for either skewness or kurtosis are larger than 1.96, which corresponds with an alpha level 0.05, the distribution of the sample is non-normal (UC Davis Psychology Edu, 2017).

4.7.2.2 Reliability tests

For the quality of the study analysis, the data was subjected to reliability test since data is expected to be normally distributed (Student Outcome Assessment, 2006). Moreover, the reliability test stretched much further to use Cronbach Alpha statistic and it was directed by four degrees of reliability scales proposed by Hair *et al.,* (2014). Likert scale study constructs were utilised to measure the level of reliability where study constructs that range from <0.40 and below are considered as not reliable, >0.50 to >0.7 are of high-moderate reliability, >0.70 to >0.9 are of high reliability and >0.90 and below 1 are excellent reliability (Hair *et al.,* 2014).

4.7.3 Hierarchical Cluster Analysis (HCA)

Hierarchical cluster analysis is an algorithmic approach to find discrete groups with varying degrees of similarity. These groups are hierarchically organized as the algorithms proceed and are presented as a dendrogram. The hierarchical cluster analysis in this research was used to identify the relationship between sampled flood prone areas and the four major study constructs this include the physical/engineering, socio/economic, political/institution and ecological/environmental study construct. In principle the study denotes associated outcomes of community vulnerability variable in flood prone area j as Yij this outcome is expressed in equation one as a function of individual characteristics of sampled flood prone areas Xqij, and model error rij (Bryk & Raudenbush, 1992).

$Yij=\beta0j + \beta1jX1ij + \beta2jX2ij + ... + \beta njXnij + rij$ (Equation one)

Where $rij \sim N(0,\sigma2)$.

Wards method (ward, 1963) determines which clusters to merge by evaluating the flood vulnerability attributes of communities occupying flood prone areas of such and merge against an objective function. Merges of community sharing common characteristics are performed at each stage of the algorithm. Typically, this is implemented by evaluating the sum of squared deviations from the cluster centroids.

The test conducted was based on four study constructs as community vulnerability indicators affecting communities occupying flood prone areas (Yij) where cluster analysis was conducted.

4.8 Means analysis

Data collected through the observation stage made use of a structured observation list template that used several measurement scales. In order to make sense out of the generated study results the mean was calculated as a summary measure. The analysis of means then helped to summarize what would have been otherwise large quantities of data into a few understandable observations. Where measurement scales were not equal, the study made use of standardized mean z-score values. Their calculation was based on the following formulae;

$$Z = \frac{M - \mu}{\sigma m}$$

$$\sigma m = \frac{SD}{\sqrt{N - 1}}$$

The above formula made it easy to compare data from different measurement scales. Measures of variation such as the standard deviation and in some cases skewness and kurtosis measures were also calculated to aid the interpretation of the mean as the main descriptive measure used to describe the research findings

4.9 Data collection

This section present various data collection method used. As such, both primary and secondary data methods were utilised to help the researcher in achieving study objectives.

4.9.1 Primary data collection

According to Parab (2015), primary data is collected from the field under the control and supervision of a researcher. Kothari (2004) is of the view that primary data is regarded as data that is collected by the researcher which is, "afresh and for the first time, and thus happen to be original in character" For the purpose of this study, the major primary source of collection was both observation and the associated observation checklist which served as the main method of data collection. Questionnaires were distributed to municipal officials.

4.9.1.1Key informant interviews

Myers (2009) argued that Interviews are methods of gathering information through oral quiz using a set of pre-planned core questions. Furthermore, interviews play a significant role since the interviewer can pursue specific issues of concern that may lead to focussed and constructive suggestions (Myers, 2009). Key informant interviews used targeted 15 municipal officials. Four were selected from the town planning department, five from the disaster management department and three from water and sanitation department while the last three was from housing department. A key informant interview guide was generated to capture their views on (**see Appendix 2**)

4.9.1.2 Questionnaire

Bryman (2008) argued that questionnaire consists of questions for gathering information from individuals. As such the researcher can administer questionnaires by mail, telephone, using face-to-face interviews, as handouts, or electronically (Bryman, 2008). Questionnaires are helpful in gathering information that is unique to individuals, such as attitudes or knowledge (Bryman, 2008). The questionnaire method was used in a structured way to capture information relating to the first study object which aimed at identifying spatial planning attributes that can be valorised for DRR in flood prone areas **Annexure 3**.

4.9.1.3Maps

Cosgrove (1999) argued that a map is a picture or representation of the Earth's surface, showing how things are related to each other by distance, direction, and size. As such for this section, the researcher made use of both ArcGIS tool to produce well detailed maps.

4.9.1.4 Reconnaissance

Patton (1997) defined reconnaissance as all operations undertaken by visual observation or other detection methods, in order to obtain information about the activities and resources of an area such as geographical characteristics and the indigenous population.

4.9.2 Secondary data collection

Parab, (2015) defined secondary data as any data that was collected by someone else other than the user. It is the data that have been already collected by and is readily available from other sources. As such under this study the form of secondary data utilised include maps and literature review, literature review assumes that knowledge accumulates and that we learn from and build on what others have done (Neuman, 1997). Furthermore, since this research required a theory for analysis, an extensive and relevant literature review was conducted to provide a tangible theoretical foundation for the research. The secondary data used for this study was gathered from documentations and archival records of both GTM and MDM, as well as books, articles and journals. Only reliable, valid and adequate secondary data was used to in order attain the study objectives.

4.10 Ethical consideration

According to Babbie (2007), the fundamental rule of social research is that it must bring no harm to research subjects. As such this fundamental rule was adhered to in this study. Participation was based on a voluntary decision by the participant. Additionally, the importance of privacy, anonymity, and confidentially in interviews and questioners was highly considered. The principles of ethics were considered in the study and the study was of no harm to human beings or even animals. For the purposes of maintaining of confidentiality, I used pseudonyms to preserve the anonymity of participants.

4.11 Summary

This chapter described the research methodology adopted and the specific methods and instruments/tools that were used to collect, organize and record data. It also elaborated and described the methods that were used for data analysis. The chapter also provided a research matrix that explained the objectives of the study and how they were achieved.

CHAPTER FIVE: DATA PRESENTATION AND ANALYSIS

5.0 Introduction

This section of the study seeks to provide a presentation and analysis of research findings on the prospects of integrating spatial planning with disaster risk reduction in flood prone areas in Greater Tzaneen Municipality. For this study, the following, five (5) phases of analyses were used. As such, the following structure was followed:

- **Phase 1:** Descriptive statistics
- **Phase 2:** Further statistical analysis (Data screening)
  - Normality test results
  - Reliability Test Results
- **Phase 3:** Hierarchical Cluster Analysis (HCA) Results
- **Phase4:** SWOT Analysis Results
- **Phase5:** TWOS matrix strategies

5.1 Phase 1: Descriptive statistics

Descriptive statistics brings out the statistical analysis of the study in various forms. In this case, the descriptive statistics were utilised to generate the first level of analysis on the flood vulnerability context of the sampled flood prone areas with the GTM. In tables below the researcher presents the analysis associated with the various components of the flood vulnerability assessment and in line with the theoretical framework that was proposed and presented earlier on in chapter two. Furthermore, Vulnerability is viewed as a function of the character, magnitude, and rate of phenomena to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC, 2001; Cutter, 2006; Commission, 2012; Zarafshani, 2016; Van de ven et al, 2016; Fatemia, 2017).

5.1.1 Physical / Engineering

The descriptive statistical analysis on the physical/engineering context was also considered in the analysis. This was to understand the nature and impacts of the physical/engineering study variables conditions that characterised the sampled flood prone areas with the GTM. The study variables under physical/engineering were assessed using a Likert scale ranging from 1 to 5-point. The point 1 scale represent very low performance while the point 5 scale represent very high performance. Table 5.1 below reflects the mean score values of various physical engineering study variables that was generated through the disaggregated means analysis.

Table 5.1 Physical engineering means score value analysis

	Condition of Storm water drainage systems	Housing Typology	Construction Material	Who owns the land (Land Tenure)	Road Connectivity (Permeability)	Distance of Structures from the flood line	Presence of evacuation route
Mean	1.5200	1.8400	1.6800	1.6000	1.7600	3.8800	1.2800
Std. Deviation	.50990	.74610	.47610	.50000	.43589	1.20139	.45826
Std. Error of Mean	.10198	.14922	.09522	.10000	.08718	.24028	.09165

Source: Author's Construct field work (2019)

N=25 Flood prone areas

Based on the study results presented on table 5.1 above, the results shows the means score values analysis of the seven study variables that were analysed under physical engineering. The presence of evacuation route was found to be major constrain on the sampled flood prone areas as it increases the level of exposure that result is sampled flood prone areas to be more vulnerable to disasters. This is due to its mean score value being <1.5. This means that during disaster periods emergency services will struggle to maneuver around due to poor evacuation route network. The absence of evacuation route increases the vulnerability of communities to disasters (African Union, 2004). Although, more education on the significance of building away from the flood line is still required in this communities (Biesboer, 2012). The distance of structures from the flood line was found to be performing very high this is due to its mean score value >3.5. In simple terms its performance is highly moderate (accepted). In the other hand, the mean score values of Land tenure, housing typology, construction material, road connectivity and condition of storm water drainage systems was found to be moderate as it was >1.5. these variables based on their mean score values they have chances of saving communities from disasters, although their functionality need to be improved to avoid the sampled communities to be exposed to disasters.

Source: Author's Construct field work (2019)

Figure 5.1 Community constructed returning walls to block the water

5.1.2 Ecological & Environmental

The descriptive statistical analysis on the Ecological/Environment context was also considered in the analysis. This was to obtain robust understanding on the nature and impacts of the ecological/environment study variables conditions that characterised the sampled flood prone areas with the GTM. The study variables under ecological/environment were assessed through the Likert scale ranging from 1 to 5-point. The point 1 scale represent very low performance while the point 5 scale represent very high performance. Table 5.2 below reflects the mean score values of various ecological/environmental study variables that was generated through the disaggregated means analysis.

Table 5.2 Ecological/Environmental Means score value analysis

	Topography	Level of Waste Management	How well are the Drainage systems functioning	Level of degradation	Effectiveness of land use planning policy
Mean	1.4400	1.6000	1.7200	1.6000	1.6800
Std. Deviation	.50662	.64550	.73711	.70711	.47610
Std. Error of Mean	.10132	.12910	.14742	.14142	.09522

Source: Author's Construct field work (2019)

N= 25 Flood prone areas

Based on the means score value analysis on table 5.2 above, topography is found to be the major element that exposes the communities to disaster due to its low mean score value being (x <1.4) (Balica and Wright 2010). The lower the mean score values of the study variables the higher the rate of exposure of communities to disasters. Although an improvement and rapid maintenance on the drainage systems will be required, the storm water management system was found to be performing moderately due to its mean value of (x>1.7). This means that the collection of water during heavy rain season is not assuring any protection. The well functional drainage systems will help in reducing disasters (Marfai & King, 2008a).

Source: Author's Construct field work (2019)

Figure5.2 Municipal workers draining water due to poor drainage system

5.1.3 Community Vulnerability

The descriptive statistical analysis on community vulnerability context was also considered in the analysis. This was to gain robust understanding on the nature and impacts of the community vulnerability study variables conditions that characterised the sampled flood prone areas with the GTM. The study variables under community vulnerability were assessed through the Likert scale ranging from 1 to 5-point. The point 1 scale represent very lowperformance while the point 5 scale represent very high performance. Table 5.3 below reflects the mean score values of various community vulnerability study variables that was generated through the disaggregated means analysis.

Table 5.3 Community Vulnerability means score value analysis

	Frequency of flooding in the past 10 years	Elevation of structures	Level of adherence to developmental control	Total number of people injured in the previous flood	Combined statistics of people drowning and or dying in the previous flood
Mean	1.1200	1.9200	1.6000	2.0400	1.4400
Std. Deviation	.33166	.70238	.64550	1.09848	.50662
Std. Error of Mean	.06633	.14048	.12910	.21970	.10132

Source: Author's Construct field work (2019)

N= 25 Flood prone areas

According to mean score values of the study variables under community vulnerability presented on table 5.3 above. The results show that five variables under the study construct were analysed. As such, three of study variables were found to be performing moderately, this include (Elevation of structures, adherence to developmental control and the total number of people injured in the previous flood), this was due to their means score value being >1.5. Despite the mean score values results there is still a need to improve the community vulnerably as study construct. This will help in increasing the resilience by reducing exposure and vulnerability through the integration of spatial planning in the municipal planning system. The adherence to developmental control will make it easy for the implementation of land use policy (Stevens et al 2010).

Two of the variables under the study construct were found to be the major constrain in disaster risk reduction due to their low means score value analysis which is <1.5 this include the frequency of flood in previous floods and the combined statistics of people injured and dying in the previous floods. This as the results it emanates from the fact that the area on its origin is prone to disasters (Mopani District Disaster Management Centre, 2015).

5.1.4 Socio-economic

Under the Socio-economic study construct the descriptive statistical analysis was also considered in the analysis. The analysis of this study construct was to enable the researcher to obtain robust understanding on the nature and impacts of the socio-economic study variables conditions that characterised the sampled flood prone areas with the GTM. The study variables under socio-economic were assessed through the Likert scale ranging from

1 to 5-point. The point 1 scale represent very low performance while the point 5 scale represent very high performance. Table 5.4 below reflects the mean score values of various socio-economic study variables that was generated through the disaggregated means analysis.

Table 5.4 Socio-Economic means score value analysis

	Level of Education	Gender	Population/ population density	Level of Disaster relief received last floods	Level of response by municipality during floods	Strength of Collaboration between the surrounding communities with Other stake holders (NGO)	Level of Adherence to building codes
Mean	1.6000	1.4000	3.2000	1.6400	1.4400	1.7600	2.0800
Std. Deviation	.50000	.50000	1.32288	.63770	.50662	.66332	.70238
Std. Error of Mean	.10000	.10000	.26458	.12754	.10132	.13266	.14048

Source: Author's Construct field work (2019).

N= 25 Flood Prone areas

Based on the study results on table 5.4 above, the results reflect the socio-economic mean score value analysis of the five socio economic variables that are performing better since their mean score values are >1.5. This include level of education, population density, level of disaster relief received in the previous floods, strength of collaboration between the surrounding communities with other stake holders and the level of adherence to building codes. Strong collaboration will result in communities being able to receive help from the external stakeholders while the municipality is still waiting for assistance. In the other hand, two of the socio-economic variables are found to be the greatest exposure of community to disasters due to their mean value being <1.5 this include, Gender and Level of response by municipality during floods. The failure of municipality to respond to disasters in time results in more damages and loss of life.

5.1.5 Political Institution

Under political/institutional study construct the descriptive statistical analysis was also considered in the data analysis. The analysis of this study construct was considered to enable the researcher to obtain robust understanding on the nature and impacts of the political institutional study variables conditions that characterised the sampled flood prone areas with the GTM. The study variables under political institutional were assessed through the Likert scale ranging from 1 to 5-point. The point 1 scale represent very low performance while the point 5 scale represent very high performance. Table 5.5 below reflects the means score value of various political institutional study variables that was generated through the disaggregated means analysis.

Table 5.5 Political Institution means score value analysis

	Level of community participation	Level of awareness by the traditional leadership	Extent of Municipal Preparedness	Strength of Collaboration between the surrounding communities with traditional leadership	Strength of Collaboration between the surrounding communities with municipality	Effectiveness of the municipal early warning system in the previous flood	Level of community awareness
Mean	1.8000	1.5600	1.4400	1.5200	1.5600	1.3600	1.7600
Std. Deviation	.64550	.50662	.50662	.50990	.50662	.48990	.66332
Std. Error of Mean	.12910	.10132	.10132	.10198	.10132	.09798	.13266

Source: Author's Construct field work (2019).

N=25 Flood Prone Areas

According to study results on table 5.5 above. The results reflects the mean score values analysis of the seven study variables under the political institutional study construct. In detail, the five of the variables under the study construct were found to be performing in a moderate level this is due to their means score value of (X >1.5) this include level of community participation and level of community awareness. The more the community is involved in the planning and decision-making process it becomes much easier to lead such community. Although in the other hand, two of the variables within the study construct are performing very bad due to their mean value being <1.5. As results, the failure of the municipality being prepared and notifying the communities with early warning systems they are exposing communities to disasters.

5.2 Phase 2: Further statistical analysis

Under section 5.1 of this study the researcher first presented the descriptive statistics that assisted in obtaining the first line impression of the study findings (mean score values analysis). Now in this section of the study, the researcher saw a need for further statistical analysis that will help in scaling the extent to which such findings presented in section 5.2 are significant. This section seeks to do carry out robust and advanced statistical analysis that will focus mostly on significant statistical results. As such, it starts by subjecting research findings to a data screening procedure in which normality tests and reliability tests of study constructs were conducted and analysed. It then proceeds to present further study findings using statistical models such as Hierarchical cluster analysis (HCA).

5.2.1 Normality test

According to section 5.3 of the study, Normality Test was introduced as one of the further statistical method going to be used to test for normality. In this case, the Normality Tests for study constructs were performed as presented. This is because most statistical tests assume that data follows a normal distribution. This was done through measuring of both skewness and kurtosis. Lee (2008:63), argued that "Skewness characterizes the degree of asymmetry of a distribution around its mean". In the other hand, Kurtosis characterises the relative peakedness or flatness of a distribution compared to the normal distribution. As a rule of thumb, if the skewness is within the range of +/- 2.0 and kurtosis is within the range of +/-3, the data is assumed to be normal". Park (2008) cited in Lee (2008) states that normality can be checked in two ways; numerically or graphically. A Q-Q plot for normality was adopted as graphical representation of the analysis conducted for each study construct see table 5.6 for normality test results. .

Table 5.6 Study Normality test

STUDY CONSTRUCT	STUDY VARIABLES	SKEWNESS	KURTOSIS	STD. ERROR OF MEAN	MEASURE
INDEPENDENT STUDY CONSTRUCTS					
Ecological/Environmental	Level of Waste Management	**.606**	**-.480**	**.64550**	Normal
	How well are the Drainage systems functioning?	**.509**	**-.921**	**.73711**	Normal
	Level of degradation	**.769**	**-.538**	**.70711**	Normal
	Effectiveness of land use planning policy	**-.822**	**-1.447**	**.47610**	Normal
	Topography	**.257**	**-2.110**	**.50662**	Normal
Physical/Engineering	Housing Typology	**.274**	**-1.076**	**.14922**	Normal
	Construction Material	**-.822**	**-1.447**	**.09522**	Normal
	Who owns the land (Land Tenure)	**-.435**	**-1.976**	**.10000**	Normal
	Road Connectivity (Permeability)	**-1.297**	**-.354**	**.08718**	Normal
	Distance of Structures from the flood line	**-.535**	**-1.304**	**.24028**	Normal
	Presence of evacuation route	**.257**	**-2.110**	**.10132**	Non-normal***
Political/Institution	Strength of Collaboration between the surrounding communities with municipality	**-.257**	**-2.110**	**.10132**	Non-normal***
	Level of awareness by the traditional leadership	**-.257**	**-2.110**	**.10132**	Non-normal
	Level of community participation	**-.164**	**-1.465**	**.26458**	Normal

Socio/Economic	Level of Adherence to building codes	**-.112**	**-.816**	**.14048**	Normal
	Strength of Collaboration between the surrounding communities with Other stake holders (NGO)	**.302**	**-.612**	**.13266**	Normal
	Level of response by municipality during floods	**.257**	**-2.110**	**.10132**	Non-normal
DEPENDED STUDY CONSTRUCT					
Community vulnerability	Frequency of flooding in the past 10 years	**2.491**	**4.563**	**.06633**	Non-Normal*
	Elevation of structures	**.112**	**-.816**	**.14048**	Normal
	Total number of people injured in the previous flood	**.473**	**-.538**	**.12754**	Normal
	Combined statistics of people drowning and or dying in the previous flood	**.735**	**.161**	**.21970**	Normal
	Level of adherence to developmental control	**.606**	**-.480**	**.12910**	Normal

Source: Author's Construct field work (2019)

N= 25 Flood prone areas

According to the normality tests results on table 5.6 above the results reflect that assessed study variables falls within the accepted range of +/-2 for skewness and +/-3 for kurtosis. Although, the frequency of flooding its skewness is above +/-2 and its kurtosis is above +/-3 this is because floods are not natural events and we cannot expect their value to be normally distributed. In general, the overall study constructs used in the study follow a normal distribution as shown in a sample of normal Q-Q plots presented in **Appendix 1.**

5.3 Reliability analysis

Section 5.3 of the study introduced the reliability analysis as one of the statistical methods going to be used to present some of the statistical finding. In this manner the study construct was subjected to reliability assessment. Reliability analysis should always be performed before commencing any advanced statistical analysis. This is because reliability analysis is of significant to any study and it is impossible to have any reliable analysis associated with the scores of the scales that are not evaluated for validity. In that case, tests for reliability were done to ensure that all scales of measurement used in the questionnaire as the main research instrument employed in this study had internal consistency and stability (Alshehri 2012). Furthermore, Giannakos et.al, (2014), argued that internal consistency is related to the extent to which participant's responses and / or observations are dependable and steady across construct variables of a single data gathering instrument. The main statistical measure for assessing internal consistence that was used is the Cronbach Alpha Statistic.

5.3.1 Cronbach's Alpha assessment

According to section 5.3 it presented various statistical methods to be considered in this study. As such, other statistical tests were considered to measure the reliability of the findings on the study construct. Furthermore, Alshehri (2012), argued that high values of Cronbach's Alpha are desirable and signify the reliability of measures. As such, a four-point-Likert scale measure of reliability was suggested by Hair et al. (2014) as follows; 0.50 and below- low-reliability, 0.50 and below 0.70 high-moderate-reliability which is acceptable, 0.70 and below 0.90 high-reliability and excellent-reliability falls between 0.90 and below 1.0. In this manner, Cronbach's Alpha was used to perform reliability analysis (Cronbach, 1951).

Hair et al. (2014), stated that a Cronbach's Alpha score of 0.70 and above is essential for acceptable internal reliability; whereas Pallant (2013), advocates for any internal reliability score value which is above 0.60. In addition, Nadi et al (2012:103), recommend that all alpha values above 0.50 (acceptable) should be regarded as a true indicator of convergence and any values below 0.50 are unacceptable and should be discarded.

Table 5.7 Cronbach's Alpha Reliability Results

STUDY CONSTRUCT	STUDY VARIABLES	Number of Variables	Number of variables after screening	CRONBACH ALPHA	Variables removed from the analysis (X)	Degree of reliability (according to Hair et al. (2014) degrees of reliability)
INDEPENDED STUDY CONSTRUCT						
Ecological/Environmental	Level Of Waste Management	**5**	**5**	0.795	√	High Reliability
	How well are the Drainage systems functioning				√	
	Level of degradation				√	
	Effectiveness of land use planning policy				√	
	Topography				√	
Physical/Engineering	Condition of Storm water drainage systems	**7**	**6**	0.547	**X**	High-Moderate Reliability (acceptable)
	Housing Typology				√	
	Construction Material				√	
	Who owns the land (Land Tenure)				√	
	Road Connectivity (Permeability)				√	
	Distance of Structures from the flood line				√	
	Presence of evacuation route				√	
Political/Institution	Level of community participation	**7**	**3**	0.511	√	High-Moderate Reliability (acceptable)
	Level of awareness by the traditional leadership				√	
	Extent of Municipal Preparedness				**X**	

	Strength of Collaboration between the surrounding communities with traditional leadership				**X**	
	Strength of Collaboration between the surrounding communities with municipality				√	
	Effectiveness of the municipal early warning system in the previous flood				**X**	
	Level of community awareness				**X**	
	Level of Education				**X**	
	Gender				**X**	
	Population/ population density				**X**	
	Level of Disaster relief received last floods				**X**	
	Level of response by municipality during floods				√	
Socio/Economic	Strength of Collaboration between the surrounding communities with Other stake holders (NGO)	**7**	**3**	0.505	√	High-Moderate Reliability (acceptable)
	Level Of Adherence to building codes				√	
DEPENDED VARIABES						

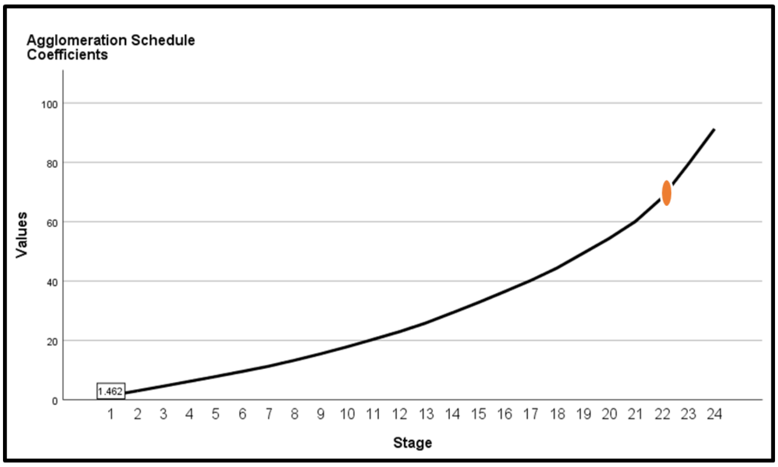
Community Vulnerability	Frequency of flooding in the past 10 years	**5**	**5**	**0.524**	√	High-Moderate Reliability (acceptable)
	Elevation of structures				√	
	Total number of people injured in the previous flood				√	
	Combined statistics of people drowning and or dying in the previous flood				√	
	Level of adherence to developmental control				√	

Source: Author's Construct field work (2019)

Based on the study results presented on table 5.7 above on the overall study Cronbach Alpha. The results depict that four of the study construct/variables are High-Moderate (>0.50) in terms of reliability while only one shows to be high reliable which is (>0.70). It can therefore be concluded that the reliability levels of the adopted study constructs are acceptable if we follow the cut-of limits suggested by Nadi et al (2012:103).

5.4 Phase 3: Hierarchical Cluster Analysis (HCA) Results

HCA was used as one of the statistical analysis to aid the researcher in identifying the exact number of clusters under the sampled flood prone areas which had common characteristics in terms of the five main study constructs proposed by the study. The main assumption here was that the level of vulnerability of each flood prone area will vary according to physical / engineering, socio-economic, ecological/natural and political or governance conditions characterizing each area. HCA was then used to identify main clusters exhibiting similar characteristics and the associated level of vulnerability of such clusters. First a scree plot was constructed to determine the number of emerging clusters (*see Figure 5.3*) Results from the Scree test performed suggest that the point of elbow is found at case 23 meaning this is a two cluster solution (i.e. 25-23 point of elbow=2).



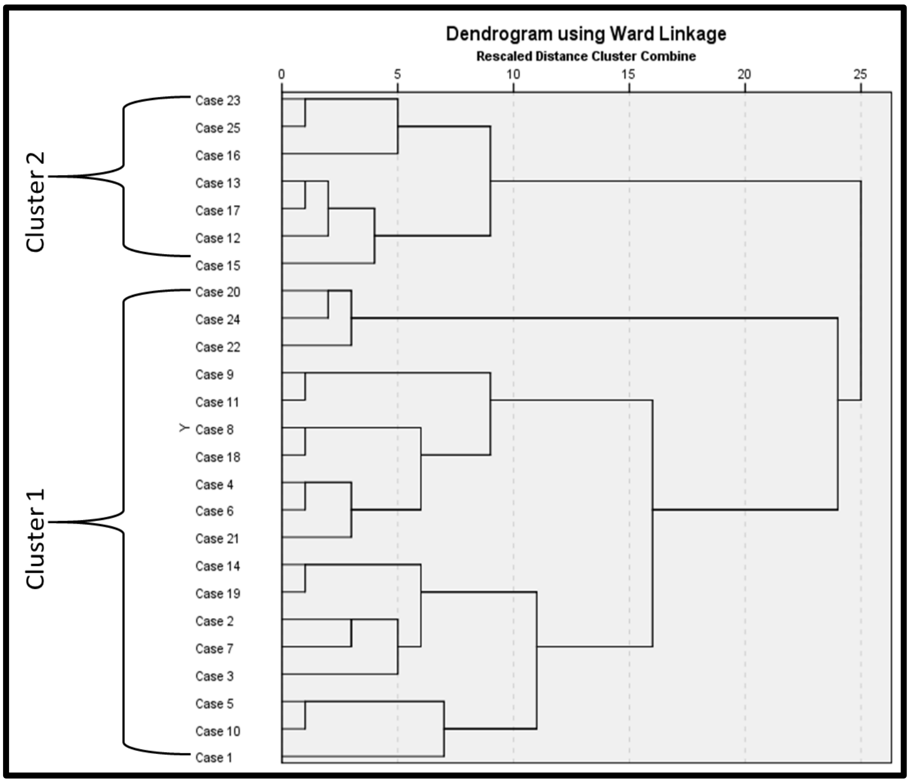
NB: The point of elbow is at case 23 therefore this is 2 cluster solution (i.e. 25-23=2)

Figure 5.3 Scree plot showing a 2-cluster solution

N= 25 Flood prone areas

5.4.1 Cluster Description: An overview on flood vulnerability

Through the HCA it was discovered that the study constitutes of two clusters. As such, the study assumed that the unique settings that characterized each sampled flood prone area and the affected communities were responsible for determining the extent of flood vulnerability. Such unique circumstances as argued in the preceding section were hypothesised to vary according to the proposed for study constructs, including: Physical / engineering, ecological / natural, Political/institution, Socio/Economic and Community Vulnerability attributes. The generated two cluster solution as shown on the screen plot (*See figure 5.1)* is in part an acknowledgement that flood prone areas in Greater Tzaneen municipality fall into two distinct groups of vulnerability. Such two distinct groups are shown in the Dendrograph in figure 5.4.

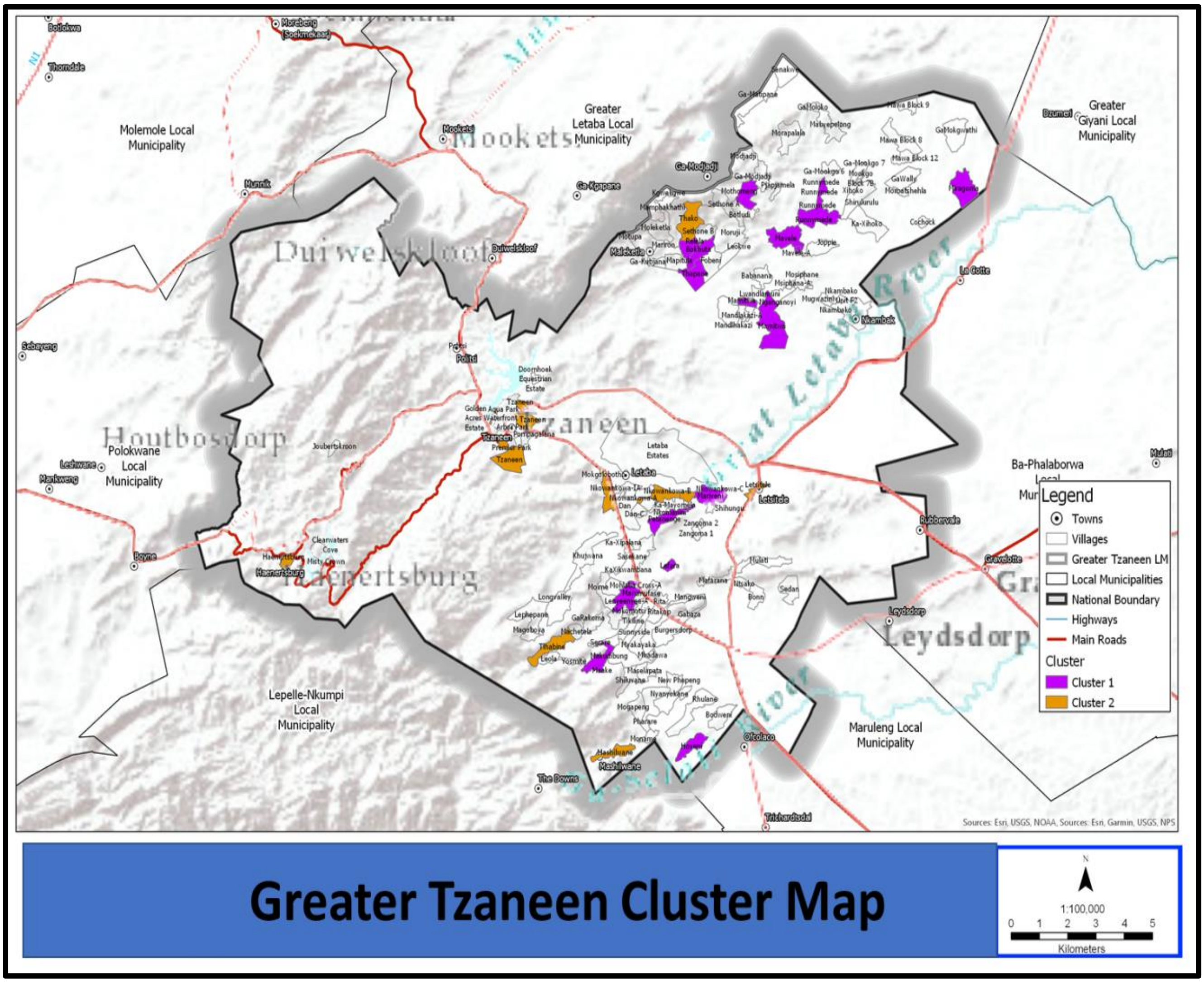


Source: Author's Construct field work (2019)

N = 25 Flood prone areas

Figure 5.4 Dendrogram showing a two-cluster solution

Based on figure 5.4 above, it reflects the two-cluster solution of the total sampled flood prone areas in the GTM. In detail cluster one comprises of 18 cases (flood prone communities) and cluster two comprises of seven cases (flood prone communities). From the cluster membership and Disaster Risk Status vulnerability analysis (*see table 5.8)* it was discovered that communities in cluster two are more vulnerable to disasters as compared to communities in cluster one whose resilience to disaster is high.



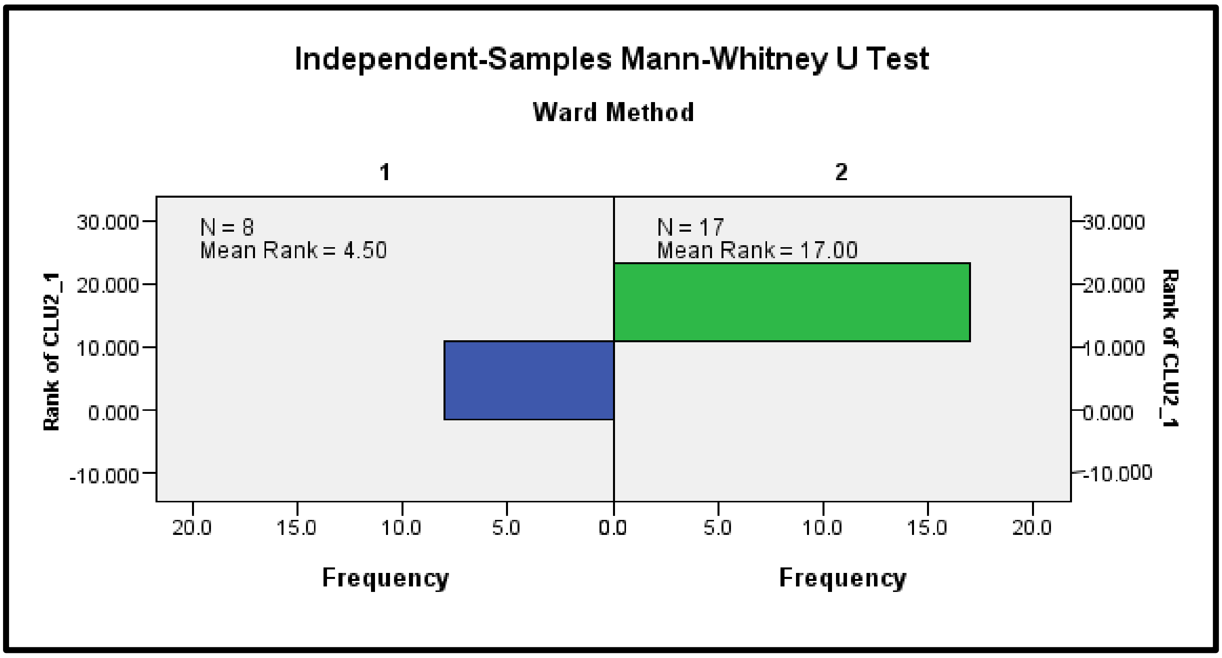
Source: Author’s Construct field work (2019)

Figure 5.5 reflects cluster map of villages prone to flooding in greater Tzaneen Municipality.

The area constitutes of two clusters whose resilience to disaster various based on the five study constructs as discussed in the preceding chapters.

5.4.1.1 A man Witney U test

A man Witney U test was performed to test how statistically different were the two clusters reflecting different levels of vulnerability to flooding. Results are shown in Figure 5.6 below.

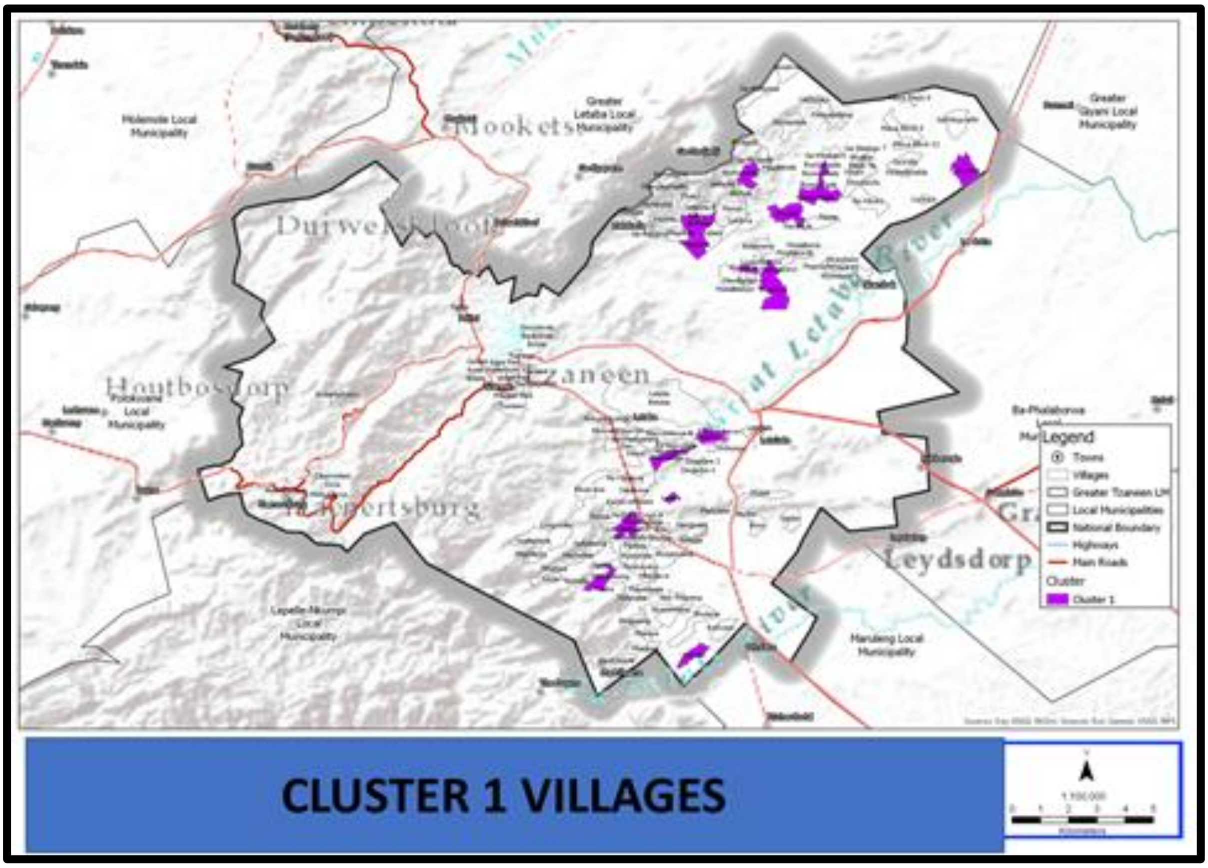


Source: Author's Construct field work (2019)

N = 25 Flood prone areas

Figure 5.6 Mann Whitney U Test results

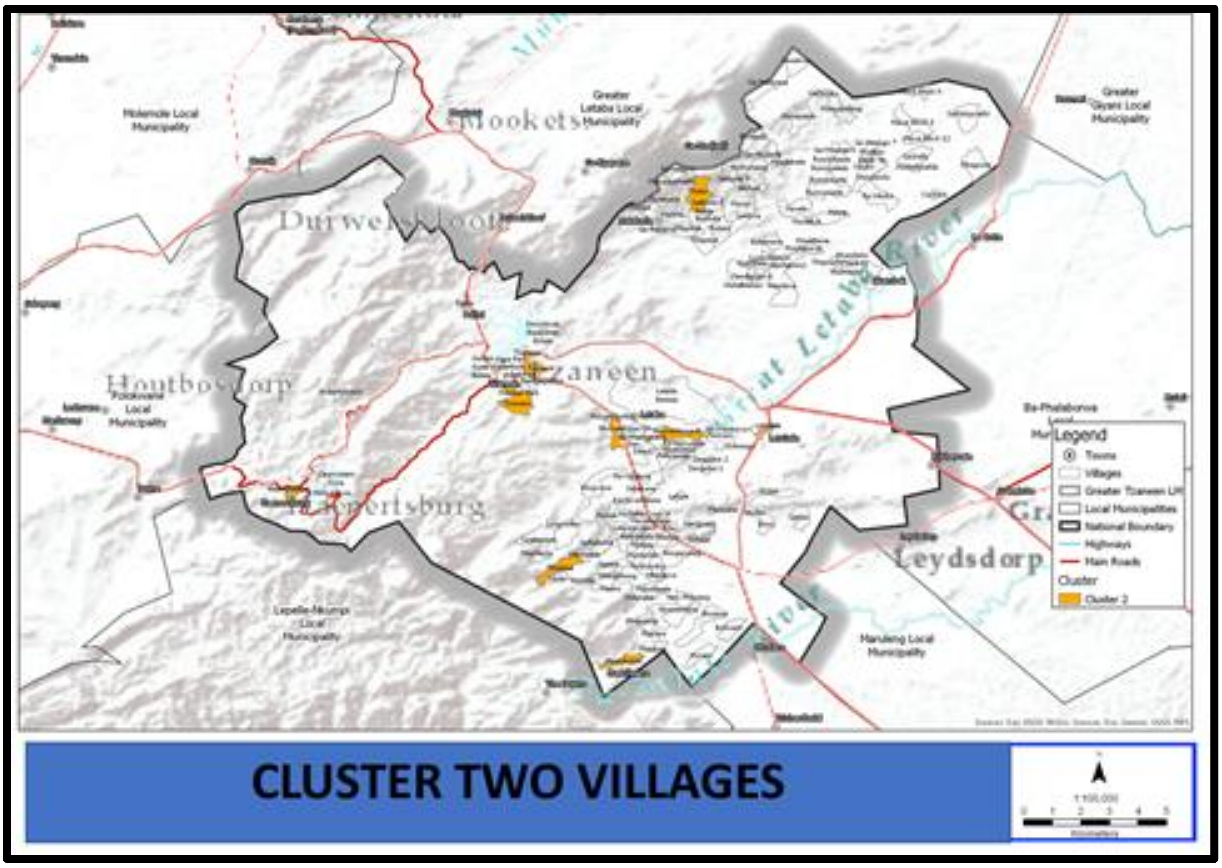
To aid the description of each cluster according to how vulnerable it is to floods, the study computed standardized z-mean score values. Standardized scores were generated since nominal mean values could not be objectively compared as they came for different data measurement scales. Results that also depict the varying levels of disaster risk vulnerability (here referred to as disaster risk status) are shown in table 5.8



Source: Author's Construct. (2019)

Figure 5.7 Cluster one flood prone areas at the GTM

The figure 5.7 above reflects the flood prone areas in cluster one which are prone to flooding though their vulnerability level is low as compared to communities in cluster two whose vulnerability is high.



Source: Author's Construct. 2019

Figure 5.8 Cluster two flood prone areas at the GTM

According to figure 5.8 above it reflects the flood prone areas associated to cluster two whose resilience to flooding is low. This is because the cluster is highly vulnerable to disasters as compared to areas in cluster one whose resilience to flooding is high.

Table. 5.8 Cluster membership and Disaster Risk Status

Cluster Number		Cluster Membership	Physical	Political	Socio	Community	Ecological	Final mean Score	Disaster risk Status
1	Mean	1, 10, 5, 3, 7, 2, 19, 14, 21, 6, 4, 18, 8, 11. 9, 22, 24 & 20	.1193	.1210	-.2723	.0148	.0988		Relatively low compared to cluster 2
	Std. Deviation		.51613	.71477	.60869	.63957	.69915		
2	Mean	23, 25, 16,13,17,12 & 15	-.3068	-.3112	.7001	-.0381	-.2540		Relatively high compared to cluster 1
	Std. Deviation		.41150	.64595	.40924	.47228	.45195		
Total	Mean		.0000	.0000	.0000	.0000	.0000		
	Std. Deviation		.51881	.71093	.70912	.58830	.65073		

Source: Author's Construct field work (2019).

N= 25 Flood prone areas

Based on the cluster membership and Disaster Risk Status presented on table 5.8 above, the results on the two clusters shows that communities within cluster one (*1, 10, 5, 3, 7, 2, 19, 14, 21, 6, 4, 18, 8, 11. 9, 22, 24 & 20*) they poses a very high level of resiliency in terms of community exposure to disasters under all study construct (*Physical, Political, Socio economic, Community Vulnerability and the Ecological attributes*). While in the other hand, the results show that communities within cluster two (*23, 25, 16,13,17,12 & 15*) are performing relatively high in terms of vulnerability as compared to communities in cluster one whom are performing relatively low. In general communities within cluster one are performing well in terms of (*Physical, Political, Community Vulnerability and the Ecological attributes*), while its weakness lies within the Socio-Economic attributes. On the other hand, Communities within cluster two are performing better in Socio Economic aspect and the rest of aspect (*Physical, Political, Community Vulnerability and the Ecological attributes*) are not in relative terms performing well. These results suggest that flood prone areas and surrounding communities occupying cluster type two are the most vulnerable to risks associated with flooding.

5.4.2 Cluster Description: Detailed Analysis

Right from section 5.4 of the study it was discovered that the study constitutes of two clusters. As such, under table 5.8 important variations were noted within each study construct that explain why the generated two cluster solution had distinct clusters. It has already been shown that the general vulnerability status of each cluster varies according to the proposed study constructs. This section attempts to zoom into each study construct and identify specific study variables that make each cluster vulnerable to the risk of flooding. This disaggregated analysis would then help in identifying spatial planning attributes that can be valorised to reduce disaster risk in disaster prone areas. Only variables that passed the normality and reliability tests are analysed.

As far as the physical / engineering study construct is concerned, the study hypothesised that the vulnerability of communities occupying flood prone areas is a function of a number of variables, including, type of housing structures, construction materials used, land tenure, distance of structures from the flood line, and presence of evacuation routes, Standardized z-mean scores were computed for each and results per cluster are summarized in Table 5.9 below.

Table5.9 Disaster risk vulnerability associated with Physical / Engineering study construct

Cluster Type	Statistical Measures	Cluster membership	Housing Typology	Construction Material	Land Tenure	Road Connectivity (Permeability)	Distance of Structures from the flood line	Presence of evacuation route	Disaster risk vulnerability
1	Mean	1, 10, 5, 3, 7, 2, 19, 14, 21, 6, 4, 18, 8, 11. 9, 22, 24 & 20	.2889094	.4387544	-.0888889	-.2141214	.0536417	.2376150	Relatively low compared to cluster 2
	Std. Deviation		.97219776	.67923561	1.02261999	1.11282977	1.00827532	1.09464930	
2	Mean	23, 25, 16,13,17,12 & 15	-.7429098	-1.1282257	.2285714	.5505978	-.1379357	-.6110101	Relatively high compared to cluster 1
	Std. Deviation		.65400000	.79388419	.97590007	.00000000	1.04343164	.00000000	
Total	Mean		.0000000	.0000000	.0000000	.0000000	.0000000	.0000000	
	Std. Deviation		1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	

N= 25 Flood prone areas

Source: Author's Construct field work (2019)

Based on the disaster risk vulnerability associated with physical / engineering study construct presented on table56.9 above. The results show that communities within cluster one (case *1, 10, 5, 3, 7, 2, 19, 14, 21, 6, 4, 18, 8, 11. 9, 22, 24 & 20)* are performing relatively low in terms of disaster risk vulnerability under physical / engineering setting. The physical engineering settings of communities in cluster one is better to such extent that it is only two of its variables that are performing badly this include (Land tenure: x-.0888889 and road connectivity: x-.2141214). These two variables pose elements of exposing communities in cluster one to disasters.

Communities within Cluster two (case *23, 25, 16,13,17,12 & 15*) are performing relatively high as compared to cluster one. In general communities within cluster two are faced with high level of exposure to disasters due to the following variables under physical engineering (housing typology: x-.7429098, construction material: x-1.1282257, distance of structures from the flood line: x -.1379357and the presence of evacuation route: x-.6110101) these elements all contain a negative mean. A review of literature earlier on revealed that these variables are either spatial planning variables or can be influenced directly or indirectly by appropriate spatial planning practices.

5.4.3 Disaster risk vulnerability associated with Political Institution study construct

Table 5.10: Political/Institutional Vulnerability index of flood prone areas

Cluster Number	Statistical Measures	Cluster membership	Level of community participation	Level of awareness by the traditional leadership	Strength of Collaboration between the surrounding communities with municipality	Disaster risk status
1	Mean	1, 10, 5, 3, 7, 2, 19, 14, 21, 6, 4, 18, 8, 11. 9, 22, 24 & 20	.0516398	-.0087727	.3202032	Relatively low compared to cluster 2
	Std. Deviation		.95793896	1.00925183	.90972730	
2	Mean	23, 25, 16,13,17,12 & 15	-.1327880	.0225583	-.8233795	Relatively high compared to cluster 1
	Std. Deviation		1.17108009	1.05506992	.74604710	
Total	Mean		.0000000	.0000000	.0000000	
	Std. Deviation		1.00000000	1.00000000	1.00000000	

Source: Author's Construct field work (2019)

N= 25 Flood prone areas

Based on the disaster risk vulnerability associated with political Institution study construct results as presented on table 5.10 above. The results show that communities within cluster one (case *1, 10, 5, 3, 7, 2, 19, 14, 21, 6, 4, 18, 8, 11. 9, 22, 24 & 20*) are performing relatively low in terms of disaster risk vulnerability under Political Institution context. This is due to the positive performance of the variables under this study construct. Although there is one study variable under this which contain a negative mean such variable is the level of awareness by the traditional leadership: x-.0087727. This variable has an impact of exposing communities within cluster one to disasters as the traditional leadership are one of the major custodians of the land ownership with the municipality. Failure to inform and educate these traditional leaders can result in communities being offered a land for residential in disaster prone areas.

Cluster two, communities within this cluster (case *23, 25, 16,13,17,12 & 15*) are set to be washed away by disasters due to the high level of vulnerability as compared to communities in cluster one. This is because majority of variables under this study construct contain a negative mean which means there is high level of exposure to disaster. Such variables include: (level of community participation: x-.1327880 and strength of collaboration between the surrounding communities with municipality: x-.8233795) these two variables plays a significant role in disaster risk mitigation and preparedness. A well-informed community will never reside on disaster prone areas. And due to failure to involve communities in planning and decision making this has resulted in setting out these two variables to be the major contributors to the high level of vulnerability within cluster two.

5.4.4 Disaster risk vulnerability associated with Socio Economic Vulnerability study construct

Table5.11: Socio & Economic vulnerability index of flood prone areas

Cluster Number	Statistical Measures	Cluster Membership	Level of Adherence to building codes	Strength of Collaboration between the communities with Other stake holders (NGO)	Level of response by municipality during floods	Disaster risk status
1	Mean	1, 10, 5, 3, 7, 2, 19, 14, 21, 6, 4, 18, 8, 11. 9, 22, 24 & 20	-.2720920	-.2244584	-.3202032	Relatively high compared to cluster 1
	Std. Deviation		.96301505	1.05197661	.90972730	
2	Mean	23, 25, 16,13,17,12 & 15	.6996650	.5771789	.8233795	Relatively low compared to cluster 1
	Std. Deviation		.76101943	.56980288	.74604710	
Total	Mean		.0000000	.0000000	.0000000	
	Std. Deviation		1.00000000	1.00000000	1.00000000	

Source: Author's Construct field work (2019)

N= 25 Flood prone areas

According to Table 5. 11 above reflects results on the disaster risk vulnerability associated with socio economic vulnerability study construct. Under the results communities within cluster one (case *1, 10, 5, 3, 7, 2, 19, 14, 21, 6, 4, 18, 8, 11. 9, 22, 24 & 20)* poses the worst Socio-Economic Attributes in comparison to communities within cluster two. This is because three of the variables under this study construct contain negative mean under cluster one. This include (level of adherence to building codes: x-.2720920, level of response by municipality during floods: x-.3202032 and Strength of Collaboration between the surrounding communities with other stake holders (NGO) x-.2244584). Cluster two (case *23, 25, 16,13,17,12 & 15*), communities within this cluster poses a low level of vulnerability to disaster as the above stated variables under study came out positive under this cluster.

5.4.5 Disaster risk vulnerability associated with Community Vulnerability study construct

Table 5.12: Community Vulnerability Index of flood prone areas

Cluster Number	Statistical Measures	Cluster Membership	Frequency of flooding in the past 10 years	Elevation of structures	Level of adherence to developmental control	Total number of people injured in the previous flood	Combined statistics of people drowning in the previous flood	Disaster risk status
1	Mean	*1, 10, 5, 3, 7, 2, 19, 14, 21, 6, 4, 18, 8, 11. 9, 22, 24 & 20*	.1407053	-.0442940	-.1549193	.0141609	.1184313	Relatively low compared to cluster 2
	Std. Deviation		1.15624323	.96301505	.95793896	1.05759808	1.01554006	
2	Mean	*23, 25, 16,13,17,12 & 15*	-.3618136	.1138990	.3983640	-.0364138	-.3045376	Relatively high compared to cluster 1
	Std. Deviation		.00000000	1.16247639	1.06904497	.91034569	.96314266	
Total	Mean		.0000000	.0000000	.0000000	.0000000	.0000000	
	Std. Deviation		1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	

Source: Author's Construct field work (2019)

N= 25 Flood prone areas

According to Table 5.12 above it presents the results on disaster risk vulnerability associated with community vulnerability study construct. The results depict that communities within cluster one (case *1, 10, 5, 3, 7, 2, 19, 14, 21, 6, 4, 18, 8, 11. 9, 22, 24 & 20*) are performing relatively low in terms of disaster risk vulnerability under community vulnerability context. This is because out of the variables under this study construct only two contain the negative means score value: (Elevation of structures: x -.0442940 and level of adherence to developmental control: x-.1549193). Structures situated below water tab level are at high risk of being affected by disasters while poor level of adherence to developmental control will see communities residing on disaster prone areas.

Cluster two communities (case *23, 25, 16,13,17,12 & 15*) these cluster is performing relatively high as compared to cluster one. This is because three of the variables under this study construct contain a negative means score value (frequency of flooding in the past 10 year: x-.3618136, total number of people injured in the previous flood: x-.0364138 and Combined statistics of people drowning and or dying in the previous flood: x-.3045376). the level of resilience is very low in this cluster as results the rate which people are being injured to disaster keeps on increasing with the disasters. The municipality need to improve their disaster warning systems.

5.4.6 Disaster risk vulnerability associated with Ecological & Environmental Vulnerability study construct

Table 5.13: Ecological/Environmental vulnerability index

Ward Method	Statistical Measures	Cluster membership	Level of Waste Management	How well are the Drainage systems functioning	Level of degradation	Effectiveness of land use planning policy	Topography	Disaster Risk Status
1	Mean	1, 10, 5, 3, 7, 2, 19, 14, 21, 6, 4, 18, 8, 11. 9, 22, 24 & 20	.1032796	.1537533	.0157135	.3220644	-.1008859	Relatively low
	Std. Deviation		1.06273786	1.06619591	1.09961372	.80547435	.99014754	
2	Mean	23, 25, 16,13,17,12 & 15	-.2655760	-.3953657	-.0404061	-.8281656	.2594210	Relatively high
	Std.		.82807867	.72515827	.75592895	1.02490008	1.05506992	
Total	Mean		.0000000	.0000000	.0000000	.0000000	.0000000	
	Std.		1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	

Source: Author's Construct field work (2019).

N= 25 Flood prone areas

According to Table 5.13 above it presents the results on disaster risk vulnerability associated with ecological/environmental study construct reflects that communities within cluster one (case *1, 10, 5, 3, 7, 2, 19, 14, 21, 6, 4, 18, 8, 11. 9, 22, 24 & 20*) poses low level of vulnerability as compared to communities in cluster two. This is because out of the variables under this study construct only one contain a negative mean (topography: x-.1008859). while in the other hand, communities within cluster two (case *23, 25, 16,13,17,12 & 15*) poses high level of vulnerability to disasters this is due to the following variables with negative means score values (level of waste management: x-.2655760, functionality of drainage systems: x-.3953657, level of degradation: x-.0404061 and the effectiveness of land use planning policy: x -.0404061). Poor waste management results in the blockage of storm water systems and this becomes more dangerous during rainy seasons as it increases the level of exposure and vulnerability.

5.5 Further spatial planning attributes that can be valorised for DRR in flood prone areas

Tracing back on the previous statistical analysis they have provided useful insights into the many spatial planning attributes associated with the conditions characterising the 25 sampled flood prone areas, this section seeks to explore further spatial planning attributes that can be used to reduce disaster. Such that was generated using survey that sought to hear community voices in terms of what can be done at the spatial planning level to reduce disasters. Table 5.14 summarises some of the major findings on which spatial planning attributes were having positive impact in reducing flooding when implemented.

5.5.1 Spatial Planning attributes

Table 5.14Sspatial Planning attributes that can be valorised for disaster risk reduction

Spatial planning attributes have positive impact in reducing disasters					
	Integration	Greenfield sites	Land use Planning	Urban re-development	Development control/Building standards
Mean	3.3333	2.0667	4.4667	3.6000	4.5333
Std. Deviation	.97590	.79881	.51640	.63246	.63994

Source: Author's Construct field work (2019)

N= 15 Community members

Based on the study results presented on table 5.14 above it reflects the means analysis of the spatial planning attributes that can be valorised for disaster risk reduction. As such, developmental control was found to be performing very good with the means score value of (x>4.533) which means that the developmental control can be used as tool towards improving the resilience of communities in flood prone areas. The second value that can be utilised to reduce the impacts of disaster was found to be land use planning with the means score value of (x>4.4667). This in simple terms it means that land use planning poses high level of resilience meaning the exposure of communities to disaster is very low. In a nut shell the table above shows that land use planning and developmental control or building standards serves as the best spatial planning attributes that can be used to reduce disasters.

5.5.2 Type of floods

Table 5.15 Different types of flooding affecting flood prone areas

Type of flooding					
	River floods	Urban floods	Flash Floods	Costal Floods	Areal Floods
Mean	3.8667	1.6000	4.6667	1.5333	1.2667
Std. Deviation	.74322	.73679	.48795	.51640	.45774
Std. Error of Mean	.19190	.19024	.12599	.13333	.11819

Source: Author's Construct field work (2019)

N= 15 Community Members

Based on the study results presented on table 5.15 above reflects. The results depict that flash floods contain the highest means score value of (x>4.6667). As such, this means that the greatest type of flood being experienced in sampled flood prone areas of GTM is flash floods. The second type of floods with high means score value is the river floods (x>3.8667) river floods comes as the results of extensive heavy rain full that exceed the carry capacity of the rivers as the results communities get to be exposed to flash floods.

5.6 Phase 4: SWOT ANALYSIS RESULTS

The data which was gathered both qualitatively and quantitatively was used towards developing the SWOT matrix to identify the strength, weaknesses, opportunities and threats. As presented in table 5.16 below.

Table 5.16 SWOT Analysis of the study construct on the flood prone areas.

STRENGTHS (S)	Applicable to Cluster descriptor			WEAKNESS (W)	Applicable to Cluster descriptor		
	N/A	1	2		N/A	1	2
1. Moderate strength of Collaboration between the surrounding communities with Other stake holders (NGO)		*	**	1. Poor level of community adherence to building codes		*	*
2. Majority of structures are above water tab level.		*	**	2. Level of community participation is low		**	*
3. Structures are constructed with acceptable material		**	**	3. Municipality does not own enough land		**	*
4. The majority of housing typology are semiformal in nature.		*	*	4. There is poor road connectivity within some of the settlements		*	*
5. Effectiveness of land use planning policy.		**	**	5. Level of awareness by the traditional leadership as other custodians of land is poor		**	*
6. There is moderate level of waste management		*	*	6. Level of response by municipality during floods is very low		**	*
7. Population/ population density		**	**	7. Level of Education is moderate		*	*
8. Majority of structures are above water tab level.		**	**	9. The level of degradation keeps on raising with the development of the informal settlements.		*	*
				10. The drainage systems are performing poorly.		*	*
				11. Poor public participation has led to communities not being aware of the disaster warning systems		*	*
				12. The disintegration of spatial planning with disaster risk reduction has resulted in the low		*	*

				level of adherence to developmental control			
				13. Structures are constructed in a closer proximity to the flood line.		**	*
OPPORTUNITIES (O)	**Applicable to Cluster descriptor**			**THREATS (T)**	**Applicable to Cluster descriptor**		
	N/A	**1**	**2**		**N/A**	**1**	**2**
1. Communities have constructed returning walls on the structures along the flood line		*	*	1. Total number of people injured in the previous flood keeps on increasing		**	*
2. Existing informal settlement require formalization to improve the evacuation routes.		*	**	2. Poor level of community awareness		*	*
3. Formalise the properties on land owned by the Municipality of land is owned by the Municipality.		**		3. Level of adherence to developmental control is moderate		**	*
4. Improve the use of land use planning policy.		*	**	4. Poor building materials		*	*
5. Majority Population has better qualifications to understand if they are educated about the concepts of disasters		**	**	5. The municipality is failing to respond quick during disasters		**	*
6. There is existing Collaboration between the surrounding communities with Other stake holders (NGO)		*	**				

Source: Author's Construct field work (2019)

According to table 5.16 above reflects the SWOT analysis strategy of the study construct that aims at reflecting the true reflection of the study results from data analysis.

Cluster descriptor number informed by k-means cluster solution presented earlier on in the analysis.

N/A: Not applicable to any of the sand mining sites in the cluster.

*** Applicable to some sand mining sites in the cluster.**

****Applicable to all sand mining sites in the cluster.**

5.7 Phase 5: TOWS Matrix strategies

A number of recommendations and strategies were generated that can actually link the spatial planning with disaster risk reduction. This were generated basis on the SWOT elements as shown in table 5.16. The SWOT elements where then transformed in to the TOWS elements which are presented on table 5.17 below.

Table 5.17 TOWS matrix of the study construct on flood prone areas

S-O STARTEGIES	**Applicable to Cluster descriptor**			**W-O STRATEGIES**	**Applicable to Cluster descriptor**		
	N/A	**1**	**2**		**N/A**	**1**	**2**
1. Take advantage of the existing collaboration between the municipality, community and the NGO to build a strong partnership (S1, O6, O5)		*	**	1. Develop community approach strategies to make them aware of the building codes and standards (W1, O5)		**	*
2. Encourage people to build in safer environment (S1, S3, S4, S5, O4)		**	*	2. Improve the level of response during disasters (W4,03)		**	**
3. Improve the waste management systems as it is still performing moderately so (S6)		*	**	3. Educate more people to save more lives (W9, O5)			*
S-T STRATEGIES	**Applicable to Cluster descriptor**			**W-T STRATEGIES**	**Applicable to Cluster descriptor**		
	N/A	**1**	**2**		**N/A**	**1**	**2**
1. Encourage people to build above water level to avoid disasters (S8, T1, T4)				Improve community participation (W1, T2, T3)		*	*
2. Improve the land use policy (S5, t3)				Request for land donation from departments to provide communities with social housing (W3T4)			**
3. Build strong collaboration with communities (S1, T2)						*	**
4. Formalise the semiformal to reduce disasters by improving municipal response (S4, T5)						**	*

Source: Author's Construct field work (2019)

According to table 5.17 above it reflects the TOWS matrix strategy of the flood prone areas and the specific clusters that are affected. Strategies developed varied according to the S-T strategies, W-T strategies. S-T strategies are those strategies which took advantage of the strength and threats and developed strategies towards reducing disasters. While, the W-T strategies are those strategies were the weaknesses and threats were converted in to potential strategies towards reducing disasters.

Cluster descriptor number informed by k-means cluster solution presented earlier on in the analysis.

N/A: Not applicable to any of the sand mining sites in the cluster.

*** Applicable to some sand mining sites in the cluster.**

****Applicable to all sand mining sites in the cluster.**

5.8 Chapter summary

This chapter analysed, presented, and interpreted data related to the integration of spatial planning with disaster risk management in flood prone areas. The aspects that were covered in this chapter include the descriptive statistical analysis, further statistical analysis that included normality test, reliability test and Cronbach's Alpha. HCA, other spatial planning variables that ca be valorised for disaster risk reduction. Data was then presented with respect to the research objectives.

CHAPTER SIX: CONCUSSION AND RECOMMENDATIONS

6.0 Introduction

The chapter discusses the main conclusions of the study. Such a summarised discussion of research findings is anchored around the study objectives outlined earlier on in chapter one. Building on a number of challenges that confront communities occupying flood prone areas in Tzaneen, the chapter will also propose spatial planning interventions that can be valorised to reduce disaster risks in such areas. Future areas of research are also explored in this chapter. The chapter has been conveniently divided into the following three major sections.

- Summary of major findings
- Recommendations
- Areas for future research

6.1 Summary of research Findings

At a more abstract and generalised level, the study sought to investigate the prospects of integrating spatial planning with disaster risk reduction in flood prone areas of GTM. The main assumption behind such study aim has been that there exists a different mosaic of flood prone areas, whose differences are shaped by different spatial planning elements that can (if investigated) valorised for reducing disaster risks associated with flooding in human dominated landscapes of Tzaneen. This section therefore seeks to draw major conclusions in relation to the general study aim and more specifically to the proposed study objectives. Since the study is built on research objectives proposed in chapter one, the section has conveniently been structured according to the study objectives as discussed in section 1.4.1

- Spatial planning attributes that can be valorised for DRR in flood prone areas,
- Spatial planning factors that define vulnerability of households occupying flood prone area
- Developmental of a cluster analytic creation of a typology of households whose resilience to flooding can be enhanced through spatial planning.

The focus of this study was mainly on disaster prone areas within GTM while other focus was on community members whom were asked to complete research questionnaire as they are the ones being affected by disasters. A quantitative research method approach was adopted alongside with a case study research design. Stratified random sampling technique was applied in this study so as to select despondence and the vulnerable communities. Data that was gathered was tested for normality and reliability through the aid of the Statistical Packages for Social Sciences (SPSS) version 25.

6.2 Summary findings on the spatial planning attributes that can be valorised for DRR in flood prone areas.

The first major research objective of this study was to analyse the spatial planning attributes that can be valorised for DRR in flood prone areas. As such, towards achieving this research objective the researcher first did a critical literature review in the related fields of spatial planning and disaster risk reduction. The major crux of this review was to identify what constituted flood vulnerability indicators that would later be used to build a vulnerability assessment framework to be used to assess flood vulnerability and the identification of associated spatial planning strategies to deal with challenges thereof. A series of indicators of flood vulnerability were identified with the aid of the qualitative instrument known as 'pattern matching. Pattern matching as a qualitative research instrument was used to develop a series of theoretical propositions about what the literature assumed was ideal or less than ideal relationship between flood vulnerability and associated impacts on communities. Each reviewed peace of literature was then assessed on the extent to which it conformed (i.e. matched) the proposed theoretical propositions.

Results from the pattern matching process revealed at a more generic level, four main spatial planning related attributes that could be valorised for DRR in flood prone areas. One group of spatial planning related attributes fell under a category that could be defined as physical / engineering (Shah, 1995; UNISDR, 2004) the importance of assessing how the physical /engineering conditions characterizing flood prone areas can be altered DRR has been underscored by several pieces of spatial planning legislative instruments. SPLUMA (2013) under its principle of resilience the act sees the physical and engineering attributes as factors that should promote resilience of communities to withstand stress, survive, adapt, bounce back from a crisis or disaster and rapidly move on (Carpenter et al., 2012 cited in Department of Rural Development and Land Reform, 2015. A complimentary view has also emerged from the National Disaster management Act which requires that all disaster risk assessment efforts taken should recognize the importance of reducing disaster losses through the concerted energies and efforts of all spheres of government, civil society and the private sector (South Africa, 2005a:2). Such legislative instruments however as expected do not provide specific guidance as to what specific physical and / or engineering variable are worth assessing. Results from the pattern matching process overcame such policy deficiency by pinpointing specific spatial and flood vulnerability indicators that can be valorised for DRR. Important physical / or engineering spatial planning related flood vulnerability that are important in building DRR interventions around include: Condition of Storm water drainage systems, Housing Typology, Construction Material, Land Tenure, Road Connectivity (Permeability), Distance of Structures from the flood line and Presence of evacuation route (Birkmann 2006b).

The second group of spatial planning related attributes that could be valorised for DRR include Ecological / natural (Level of Waste Management, functionality of drainage systems, level of degradation, Effectiveness of land use planning policy, and Topography). In such a category, the study found out that they are many ecological and / or natural variables that spatial planning interventions can either influence (directly or indirectly) or which can influence the type of spatial planning measures required to reduce disaster Risks in flood prone areas.

The third group of spatial planning related attributes that could be valorised for DRR include socio/economic (Level of Adherence to building codes, Strength of Collaboration between the surrounding communities with other stake holders (NGO) and Level of response by municipality during floods). In such a category, the study found out that they are many socio/economic variables that spatial planning interventions can either influence (directly or indirectly) or which can influence the type of spatial planning measures required to reduce disaster Risks in flood prone areas.

The fourth group of spatial planning related attributes that could be valorised for DRR include socio/economic (Level of community participation, Level of awareness by the traditional leadership and Strength of Collaboration between the surrounding communities with municipality). In such a category, the study found out that they are many political/institutional variables that spatial planning interventions can either influence (directly or indirectly) or which can influence the type of spatial planning measures required to reduce disaster Risks in flood prone areas.

6.3 Summary findings on the spatial planning factors that define vulnerability attributes of households occupying flood prone areas.

The second major objective of this study was to explore spatial planning factors that define vulnerability attributes of households occupying flood prone areas. Towards achieving this, the study first made a number of conceptual assumptions. First the study assumed that spatial planning measures that are targeted at reducing ecological, socio-economic, physical and institutional vulnerabilities of households occupying flood prone areas are critical to building resilience.

To understand the spatial planning measures that are targeted at reducing socio/economic, physical/engineering, political/institution, community vulnerability, Environmental and ecological attributes, the study made use of Hierarchical Cluster Analysis (HCA). Before the tool was applied, the study variables were subjected to normality and reliability tests. Vulnerability was assumed be a variable that is not uniform from one geographical environment to the next. In other words, the study assumed that different flood prone were characterised by different settings that produced various levels of flood vulnerability. HCA was then used as a tool based on the understanding that it was possible to identify, unique clusters of flood prone areas that had common physical/engineering, ecological /environmental, socio/economic and political/institution, to identify the number of such distinct clusters that also portrayed varying degrees of vulnerability, the study performed a Scree Test. In order to ensure that there was no possible overlap between the generated cluster solution, the study performed a Man Whitney U Test – which is essentially a statistical testing procedure that test means that the value of the variables stipulates that the two groups come from the same population (Kasuya, 2001).

Study findings revealed two main clusters of flood prone areas that varied in nature according to the level of flood vulnerability. One cluster (cluster type 2) was characterised as very high risk. Seventeen flood prone areas were found to exhibit similar flood vulnerability characteristics in this cluster. Similarly communities occupying such clusters were defined as high risk communities. This include households occupying such villages as Lefara, Petanenge, Maake, Lenyenye, Relela, Juliesburg Rikhotso, Lekekgwareng, Mavele, Thapane, Bokhuta, N'wamitwa, Mokgoloboto, Ramatshinyadi, Letsitele, Mariveni, Mothopong and Nwajaheni. Further disaggregated statistical analysis that utilized the standardized z-mean score values revealed that the distinguishing attributes that made such a cluster to be more vulnerable included ecological and / natural (z = -.3486); engineering (z = -.2976) .The other (Cluster 1 type) was characterised as low risk in relative terms. Such a cluster is comprised of eight flood prone areas Haenesburg, Nkowankowa C, Nkowankowa B, Tzaneen, Nkowankowa A, Tours and Thabina.

6.4 Specific vulnerability differences between the two clusters and associated resilience outcomes are discussed according to the proposed four main study constructs below.

The result present by the HCA it shows that they are two different clusters. Under this clusters spatial planning has more challenges in cluster two where the major attributes that spatial planning needs to look at were found to be (*poor community participation and Strength of Collaboration between the surrounding communities with municipality).* While in other hand cluster one spatial planning is faced with a challenge of (Level of awareness by the traditional leadership). As the results spatial planning can be utilised to capitalise on this vulnerability attributes that defines the level of community exposure to disasters.

6.4.1 Physical engineering context

Spatial planning factors that define vulnerability attributes under this study construct were found to be including land tenure and road connectivity in cluster 1. The land that is not own by the municipality has more challenges as it is poorly planned and as the results its road network is not clearly connected.

In terms of the physical and / or engineering spatial planning related attributes, Cluster two type communities can be defined as high in vulnerability (z =-20694835). This is because conditions characterising such spatial planning related issues such as housing typology (z = -.7429098), construction materials used (z = -1.1282257), distance of building structures from the flood line (z = -.1379357) and presence of evacuation route (z = -.6110101) were found to be less favourable. Such results do not come as a surprise as some scholars have also argued that vulnerability of communities tend to be high in human dominated landscapes where communities use poor construction material, occupy informal housing units, build their dwelling structures in flood plain, and where very few options of evacuating are present (Wilbanks, 2003).

A number of engineering attributes characterizing cluster type 1 flood prone areas were found to be favourable, making communities occupying such landscapes less vulnerable and more resilient to flooding consequences. Favourable engineering conditions revolved around housing typology (z=.2889094); construction materials used (z = .4387544), distance of building structures from the flood line (z = .0536417) and presence of evacuation route (z =.2376150) such results are encouraging as studies from elsewhere have revealed that communities that occupy landscapes that are characterized by Strong housing typology, strong construction material, municipal land ownership, proper road connectivity (Permeability), standard distance of Structures from the flood line and good presence of evacuation route are better equipped to deal with problems associated with flooding (Tateishi (2014).

6.4.2 Socio Economic context

Under the socio/economic spatial planning related attributes, Cluster two type communities can be defined as high in vulnerability (z =.-7719731). This is because conditions characterising such spatial planning related issues such as Level of Adherence to building codes (z = -.1976482), Strength of Collaboration between the surrounding communities with other stake holders (NGO) (z = -.1702652) and Level of response by municipality during floods (z = -.4040597) were found to be less favourable. Such results do not come as a surprise as some scholars have also argued that vulnerability of communities tend to be high in human dominated landscapes where land use planning policies are not effective, poor participation between the communities and the municipality and were collaboration between the municipality and the surrounding communities towards disaster risk mitigation is poor (Govender et al. (2010). A number of socio/economic attributes characterizing cluster type 1 flood prone areas were found to be favourable, making communities occupying such landscapes less vulnerable and more resilient to flooding consequences. Favourable socio/economic conditions revolved around Level of Adherence to building codes (z= .4200024); Strength of Collaboration between the surrounding communities with other stake holders (z = .3618136) and level of response by municipality during floods (z = .8586270) Such results are encouraging as studies from elsewhere have revealed that communities that occupy landscapes that are characterized by strong adherence to building codes are better equipped to deal with problems associated with flooding (Birkmann 2006a).

6.4.3 Political/Institution context

In terms of the political/institution spatial planning related attributes, Cluster two type communities can be defined as low in vulnerability (z = .4712636). This is because conditions characterising such spatial planning related issues such as Level of community participation (z = .1275806), Level of awareness by the traditional leadership (z = .0557324) and Strength of Collaboration between the surrounding communities with municipality (z .2879506) were found to be more favourable. Such results do not come as a surprise as some scholars have also argued that vulnerability of communities tend to be low in human dominated landscapes where level of community participation is at the highest level, Level of awareness by the traditional leadership is also flying high and also strength of collaboration between the surrounding communities with municipality is also doing great (Balica and Wright 2010). A number of political/institution attributes characterizing cluster type 1 flood prone areas were found to be less favourable, making communities occupying such landscapes more vulnerable and more exposed to flooding consequences. Less favourable political/institution conditions revolved around Level of community participation (z= -.2711088); Level of awareness by the traditional leadership (z = -.1184313) and Strength of Collaboration between the surrounding communities with municipality (z = -.6118951) Such results are encouraging as studies from elsewhere have revealed that communities that occupy landscapes that are characterized by strong level of awareness by traditional leadership, strong community participation and strong collaboration between the surrounding communities with municipality are better equipped to deal with problems associated with flooding (Wisner, (2012).

6.4.4 Community vulnerability

In terms of the community vulnerability spatial planning related attributes, Cluster two type communities can be defined as low in vulnerability (z = -299766). This is because conditions characterising such spatial planning related issues such as Frequency of flooding in the past 10 years (z = -.0070944), Elevation of structures (z = -.0535995), Level of adherence to developmental control (z = -.1093548), and total number of people injured in the previous flood (z = -.0364138) were found to be less favourable. Some scholars have also argued that vulnerability of communities tend to be low in human dominated landscapes where Frequency of flooding in the past 10 years is low, Elevation of structures is above water tab level strong level of adherence to developmental control, total number of people injured in the previous floods is low and combined statistics of people drowning and or dying in the previous flood is low (Balica and Wright 2010).

A number of community vulnerability attributes characterizing cluster type 1 flood prone areas were found to be more favourable, making communities occupying such landscapes less vulnerable and less exposed to flooding consequences. Less favourable community vulnerability conditions revolved around Frequency of flooding in the past 10 years (z = .0150756), Elevation of structures (z = .1138990), Level of adherence to developmental control (z = .2323790), total number of people injured in the previous flood (z = .0773794) and Combined statistics of people drowning and or dying in the previous flood was found to be unfavourable (z =-.3750325). Such results are encouraging as studies from elsewhere have revealed that communities that occupy landscapes that are characterized by frequency of flooding in the past 10 years being low, Elevation of structures being above water tab level, strong level of adherence to developmental control, total number of people injured in the previous floods being smaller and combined statistics of people drowning and or dying in the previous flood becoming very low. Such communities are better equipped to deal with problems associated with flooding (Wisner, (2012)

6.5 Summary findings on the typology of households whose resilience to flooding can be enhanced through spatial planning.

The last major research objective of this study was to develop a cluster analytical creation of a typology of households whose resilience to flooding can be enhanced through spatial planning. Under this objective, the study hypothesized that

“Spatial planning measures that are targeted at reducing ecological, socio-economic, physical and institutional vulnerabilities of households occupying flood prone areas are critical in building resilience”

The main assumption here was that certain spatial dynamic elements that characterize flood prone areas interact in such a way that one is able to map unique clusters of such flood prone areas. Each unique cluster was hypothesized to possess common resilience characteristics that could be enhanced through spatial planning. The determination of such unique resilience clusters was assessed statistically using HCA as described in the preceding sections. Within HCA, a Scree test was performed to determine the number of unique clusters that exhibited common resilience characteristics in relation to four broader categories of spatial dynamic elements that included physical / engineering, ecological/environment, socio/economic, political/institution and community vulnerability. The map was then developed using two distinct clusters of flood prone areas that depicted two distinct levels of resilience and associated vulnerability levels were mapped. More resilient communities were assumed to occupy flood prone areas that were defined as less vulnerable. Likewise, less resilient communities were assumed to be in flood prone areas that were assumed to be highly vulnerable. Study results revealed two distinct category of households that could be distinguished according to resilience and associated vulnerability levels. One category comprised of households occupying eight flood prone areas based on physical, ecological, socio economic and institutional resilience or vulnerability attributes, such a category was defined as more resilient in relative terms to the problems associated with flooding. The remaining 17 flood prone areas were deemed to be occupied by communities that are less resilient and at the same time highly vulnerable to flooding. Important spatial planning factors that were responsible for such variations community resilience in both clusters varied according to whether the resilience variable under analysis was physical/engineering, ecological/environment, political/institution and the Socio/economic in nature.

Specific variables that were seen to be critical in defining resilience from physical/ engineering perspective included Housing Typology, Construction Material, Land Tenure, Road Connectivity (Permeability), Distance of Structures from the flood line and Presence of evacuation route. Such variables compared well with other resilience attributes commonly identified in community resilience literature (UNISDP (2002:47). From an ecological/environmental perspective resilience defining variables included: Level of Waste Management, functionality of drainage systems, level of degradation, Effectiveness of land use planning policy, and Topography.

6.6 Conclusion remarks on spatial planning attributes that can be valorised for DRR in flood prone areas.

From the findings it can be concluded that there is a need for spatial planning integration with disaster risk reduction within GTM as majority of communities are vulnerable to disaster. They are variety of attributes that exposed communities to disasters due to absence of spatial planning integration with DRR. Such ranges from the adherence to building and developmental control these aspects are exposing communities to disaster and a need for spatial planning to guide communities on where and how to build will be of great significance. In the other hand municipality preparedness or readiness to disasters is very poor as such spatial planning can be utilised as a tool to assist in preparing and mitigating disasters. As for political intuition, and socio economic aspects spatial planning can be utilised to guide the institutions on how to prevent disasters also by accommodating people of various social status.

Spatial planning as a tool to reduce disasters in highly required in GTM to assist the municipality in mitigating disasters and reducing the level of exposure of communities to disasters. Municipality need to integrate their disaster management with spatial planning this will also help in improving the vulnerability attributes that ranges from physical engineering, socio economic, political institution and ecological environment where communities found themselves exposed to disasters. The absence of spatial planning results in communities in both clusters to be exposed to disasters not because they are disasters but because of the environment and characteristics of the settlement they find themselves in

6.7 Conclusion on cluster analytical creation of typology of household whose resilience to flooding can be enhanced through spatial planning

From the cluster analytical map presented it was concluded that out of the 25 assessed communities they are seven communities within cluster two whose resilience to flooding is relatively low as compared to the eighteen communities in cluster one as the results. It can be concluded that spatial planning is highly required in mitigating disaster risk reduction in the above clusters. The eighteen communities in cluster one they are also affected although their resilience in disasters is high as compared to clusters two. In this manner the researcher concludes by saying there is a need for integrating spatial planning with disaster risk reduction in flood prone areas

6.8 Conclusion on spatial planning factors that define vulnerability attributes of households occupying flood prone areas

The vulnerability index gave an over view of what exactly is happening in each cluster as such in conclusion the research concludes by saying communities in cluster two require an urgent attention as they are relatively high in terms of vulnerability and exposure of communities to disasters as compared to communities in cluster one which their vulnerability and exposure level are relatively low. The GTM needs to look at each of the vulnerability index and see how they can use spatial planning to reduce such disasters.

6.8.1 Physical engineering

Spatial planning needs to be implemented so as to assist in mitigating disasters that result from poor physical engineering attributes. Spatial planning can address the challenge of land tenure and road connectivity this can be done through spatial planning being implemented in both state, communal, private and municipal own land by ensuring that for every development is guided by existing building codes and building standards for human habitation. The poor road connectivity is the results of poor planning as such; spatial planning can help in redesigning such settlements to reduce the level of exposure and vulnerability of communities.

6.8.2 Political Institution

Spatial planning is required in GTM to address the vulnerability constrains emanating from political institution. Spatial planning can be used to address poor community participation by ensuring the communities are involved from the initiation/planning stage this will help the communities to know what is expected out of them and which areas are suitable for human habitation. Other attribute include collaboration between the municipality with the surrounding communities. The municipality is planning at an isolation stage wherein the communities as the end users are not involved these challenges expose the communities to disasters. In this manner, spatial planning can utilised as an integration tool to bring together the municipality with communities to plan and prepare together for disasters. The failure to include the communities or collaborating with them makes them more vulnerable as they lack awareness of when can disasters come and what type of disasters to expect.

6.8.3 Socio Economic

Spatial planning is required at GTM to address challenges emanating from poor socio-economic attributes in communities in both clusters. Communities are not adhering to building codes and also the municipality response level is very poor. This is the results of the communities which don't have an idea of what spatial planning can do and as results the municipality in the other hand is responding late as their disaster management is disintegrated with spatial planning which was going to make it easy for them to respond very quick to disasters.

6.8.4 Community Vulnerability

Spatial planning as a tool to address disasters in both rural and urban settlement is highly required in the GTM to address constrains of vulnerability that emanates from the community vulnerability indicators. From the study it was discovered that the frequency of flooding is the past years is highly unpredictable in this manner spatial planning is needed to mitigate and prepare the communities for such natural events before they can be declared disasters. In the other hand the total number of fatalities in the past floods has been increasing this is the results of communities residing in disaster prone areas where spatial planning is not implemented. While in the other hand attributes such as elevation of structures is also a serious factors that can make communities more vulnerable as in cluster one majority of communities are below water level.

6.8.5 Ecological Environment

Ecological and environmental factors play a significant role in vulnerability exposure of communities in both clusters. Spatial planning is required in the GTM to address the challenge of storm water management. Majority of storm water management systems within GTM are blocked and the level of land use planning is highly in inefficient as the results the dysfunctional drainage systems are the results of poor maintenance and wrong placed in areas that requires none. As the results spatial planning is required to guide on what type of storm water drainage system are required and when to place them at the same time the presence of integrating spatial planning with disaster risk reduction will help in improving the efficiency of the land use planning policy

6.9 Study Recommendations

This section of the study seeks to outline the recommendations as drawn from the study conclusion in terms of prospects of integrating spatial planning with disaster risk reduction. As such, the study addressed several recommendations which in this study are referred to as spatial planning options or interventions. The development of such spatial planning options was guided by the SWOT analysis results which were later transformed into the TWOS matrix strategy table. Since at the HCA level it was concluded that there are two unique clusters of flood prone areas which are associated with different levels of risk to flooding as well as different levels of interaction between spatial planning elements, the recommendations presented here are presented according to such clusters.

6.9.1 Cluster one recommendations

Cluster one consist of seventeen communities that are flood prone as such, the major constrains associated with cluster one that poses low vulnerability as compared to communities in cluster two include. The following constrains have been identified as major challenges in cluster one: (*Land Tenure, Road Connectivity (Permeability), Level of awareness by the traditional leadership, Level of Adherence to building codes, Strength of Collaboration between the surrounding communities with other stake holders (NGO), Level of response by municipality during floods, Elevation of structures, Level of adherence to developmental control, Topography).* To deal with the problem of developmental control the study recommends that the municipality must develop policies and strategies that will help in managing the development within the municipality jurisdiction. And also towards addressing the problem of lack of response the municipality must integrate their spatial planning with disaster risk management team. Such proposed urban risk management strategy compares well with the main element of the pressure release model that put more emphasis on the fact that spatial planning can be used through the multi hazards approach or single approach in disaster risk reduction (Mudau, 2010).

6.9.2 Cluster two recommendations

Cluster two consist of eight communities that are prone to flooding. As such, the study results from HCA generally portrayed cluster two flood prone areas as highly vulnerable. Furthermore to that, a number of factors are still putting the surrounding communities at a high risk of flooding. These include: (*Level of Waste Management, Drainage systems functionality, Level of degradation, land use planning policy,* Frequency of flooding in the past 10 years, *Total number of people injured in the previous flood Combined statistics of people drowning and or dying in the previous flood,* Level of community participation, Strength of Collaboration between the surrounding communities with municipality, Housing Typology, Construction Material, Distance of Structures from the flood line, Presence of evacuation route). To deal with the problem of community participation the study proposes that the municipality should extend their invitations to communities in flood lines and those are sensitive areas this will help in sharing ideas on disaster management. Problems such as waste management, level of degradation, total number of people dying during floods can be resolved through strengthening the collaboration between the municipality and the surrounding communities ranging from the traditional leadership to mere residence at remote areas.

Table 6.1 Summary of recommendations

Cluster type	Main challenges	Spatial planning and / or urban management strategy	Responsible authority
Cluster 2 Haenesburg, Nkowankowa C, Nkowankowa B, Tzaneen, Nkowankowa A, Tours, Thabina	• Poor solid waste management system	• Provision of collection bins and designated dumping site	Municipality
	• *Poor storm water management system*	• *Regular maintenance of storm water drainage systems*	
	• *Highly degraded landscapes*	• *Encourage afforestation*	
	• *Weak Developmental control*	• *Develop land use planning policy*	
	• *Rapid increase in fatality rate during disasters*	• *Educate communities on how to deal with flooding to avoid further drowning as a results of panicking*	
	• Poor Community participation	• Invite communities for participation from the initial planning stage	
	• Poor construction material	• Provide Social Housing/ Disaster housing	
	• Structures constructed close to flood lines	• Educate communities on the significance of building far from the flood line	
	• Informal settlements with no poor road network	• Formalise the informal to create evacuation rotes	
Cluster 1 Lefara, Petanenge, Maake, Lenyenye, Relela, Juliesburg Rikhotso, Lekekgwareng, Mavele, Thapane, Bokhuta, N'wamitwa, Mokgoloboto,	• Municipal land is land locked by tribal and private ownership	• Municipality must request for land release that is owned by Departments to provide for integrated sustainable humane settlement	
	• *Poor partnership between traditional leadership and*	• *Develop partnership with the traditional leadership as the other custodian of*	

Ramatshinyadi, Letsitele, Mariveni, Mothopong, Nwajaheni	*the municipality*	*land*	
	• *Weak building codes and building standards in the municipality*	• *Educate the Community on the building codes and building standards*	
	• *Poor collaboration between stakeholders and other NGO's*	• *Establish collaboration with stakeholders and other NGO's*	
	• *Poor response to disasters*	• *Improve the capacity in disaster management division to strengthen*	
	• *Structures are constructed below water tab level*	• *Building standards must be implemented in low lying areas (Below water tab level)*	

Source: Author's Construct field work (2019).

Table 6.1 reflects the summary of the study recommendations that emanates from the study objectives on the prospects of integrating spatial planning with disaster risk reduction in flood prone settlements of GTM.

6.10 Areas of further research

This study is of significant in building resilient communities. As such, a need to look deep into areas of this nature is of high importance. The same topic under study can be used in areas such are Thohoyandou (Thavhani Mall) and Polokwane (Savanna Mall) based on their disaster management strategies and how they deal with flooding during heavy rain seasons. Furthermore, the other areas of study may include the following:

i) The prospect of integrating spatial planning with engineering during the planning phase of integrated settlements

ii) The significant of carrying out engineering studies prior to the construction of integrated developments

6.11 Chapter summary

This chapter summarised the research findings and conclusions with specific reference to the research objectives. It further on provided findings on the tests of the research hypothesises. The study drew the recommendations from the research conclusions. This chapter also provided the research conceptual model in terms of SWOT and TOWS research matrix. The study proposed areas for future research.

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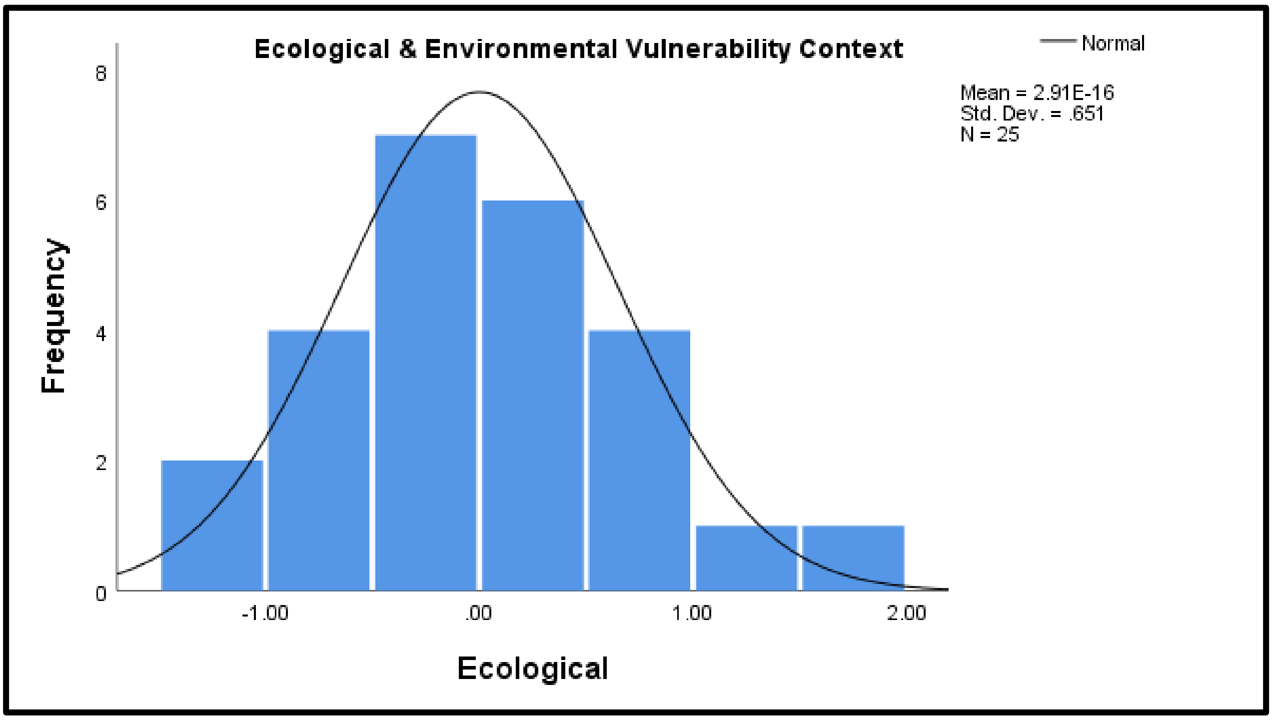
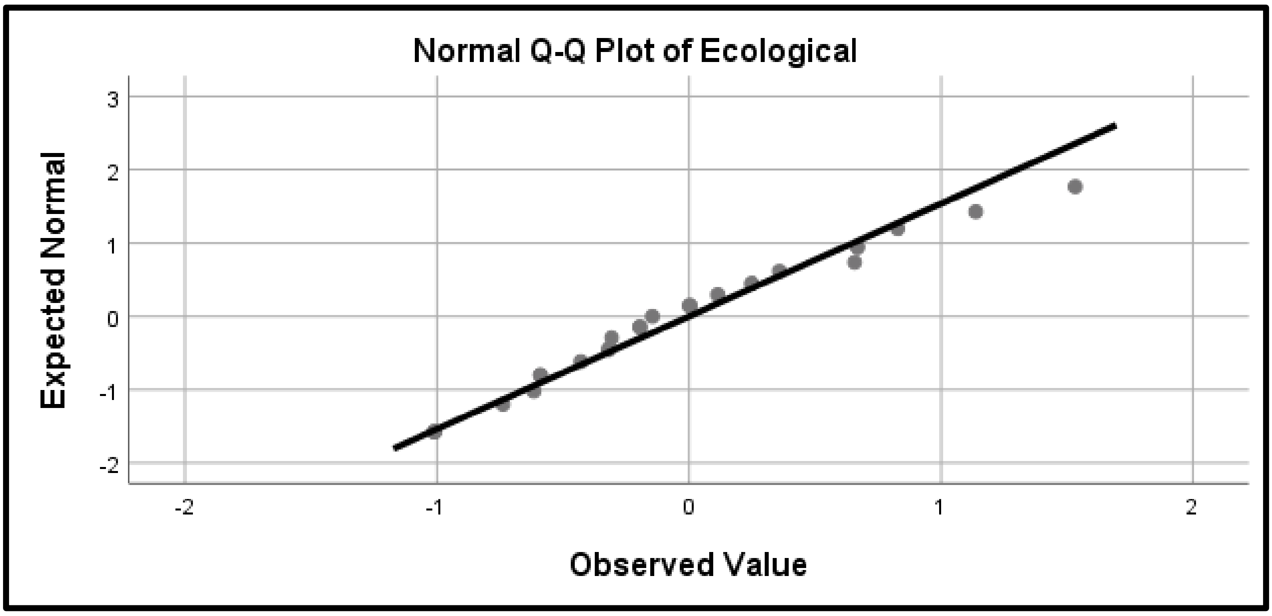
ANNEXURE 1

Normality test charts



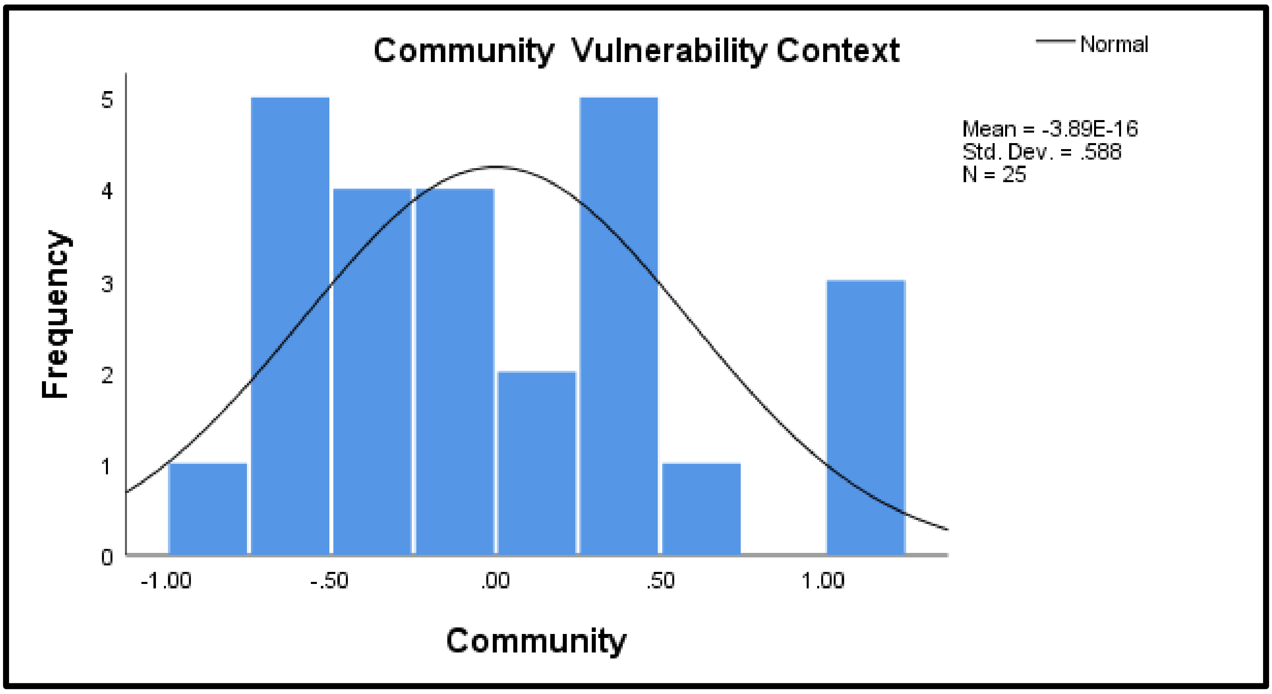
Source: Author's Construct field work (2019)

Appendice 1: Histogram graph for Ecological & Environmental variables



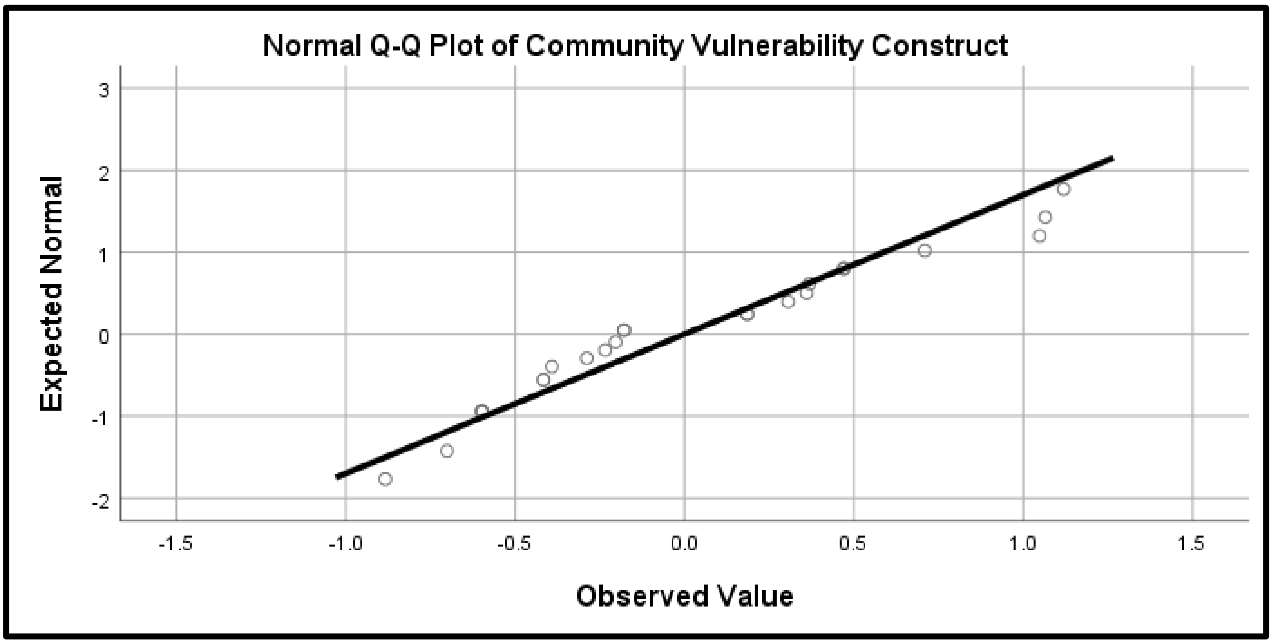
Source: Author's Construct field work (2019)

Appendice 2: Q-Q plot for Ecological & Environmental variables.



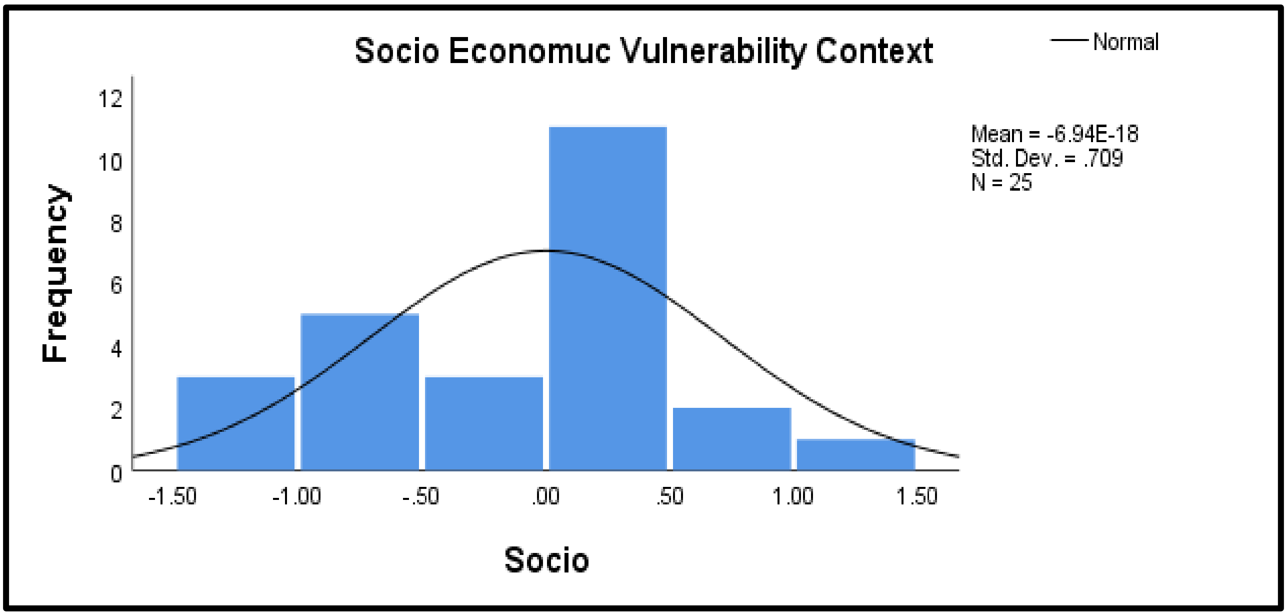
Source: Author's Construct field work (2019)

Appendice 3: Histogram graph for Community vulnerability



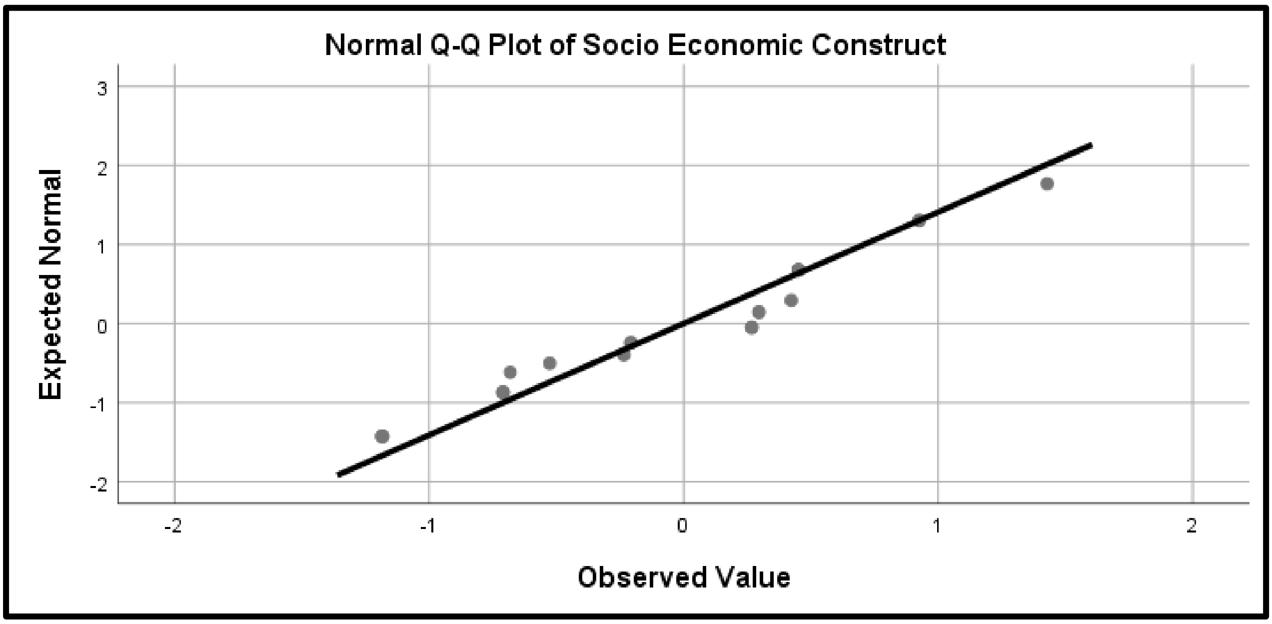
Source: Author's Construct field work (2019)

Appendice 4: Q-Q Community Vulnerability.



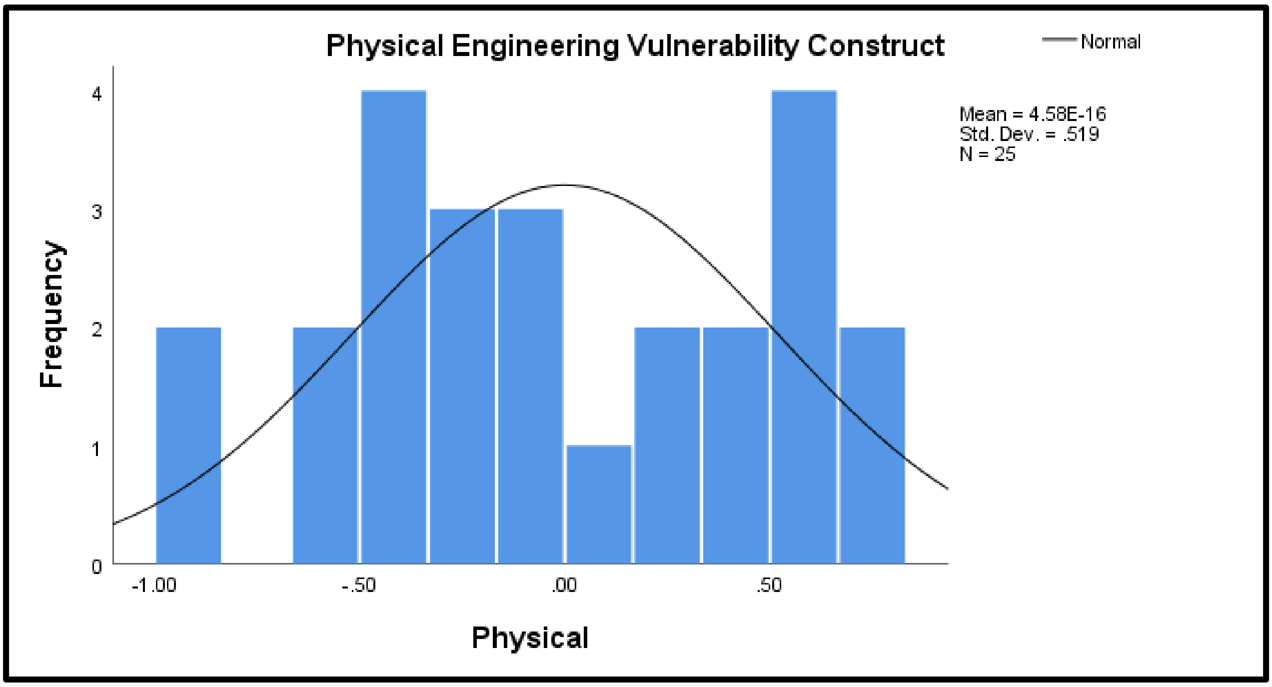
Source: Author's Construct field work (2019)

Appendice 5: Histogram graph Socio Economic variables



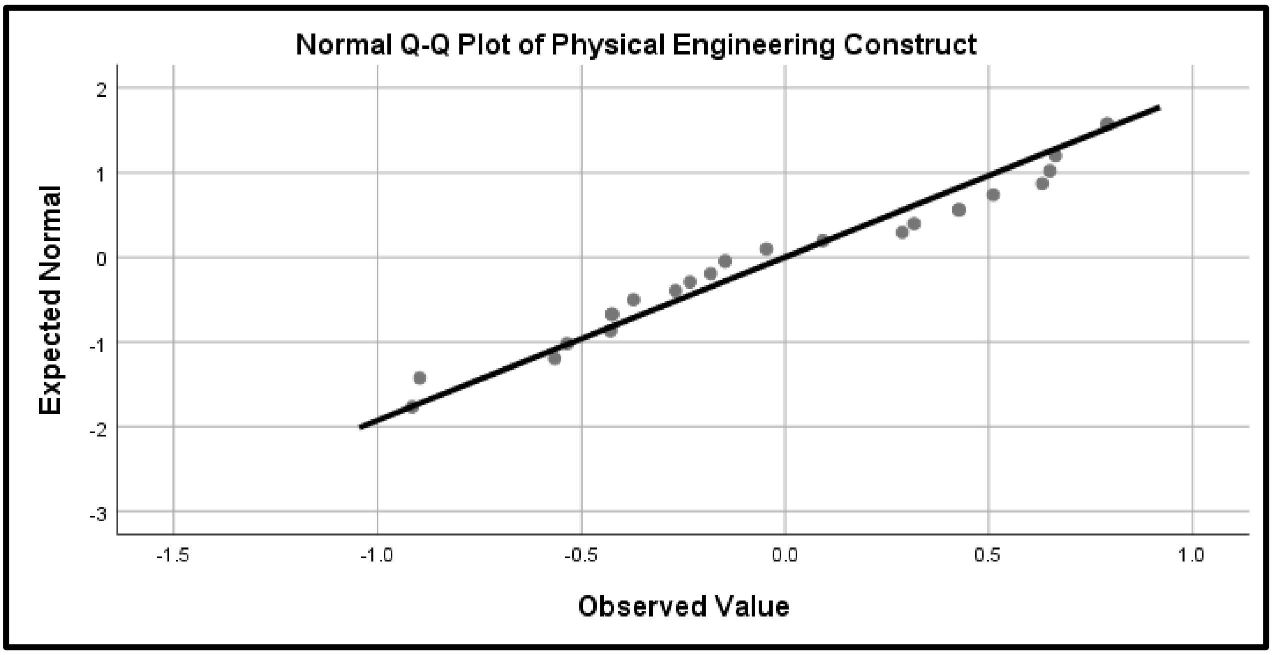
Source: Author's Construct field work (2019)

Appendice 6: Q-Q plot showing individual study constructs for Socio Economic variables.



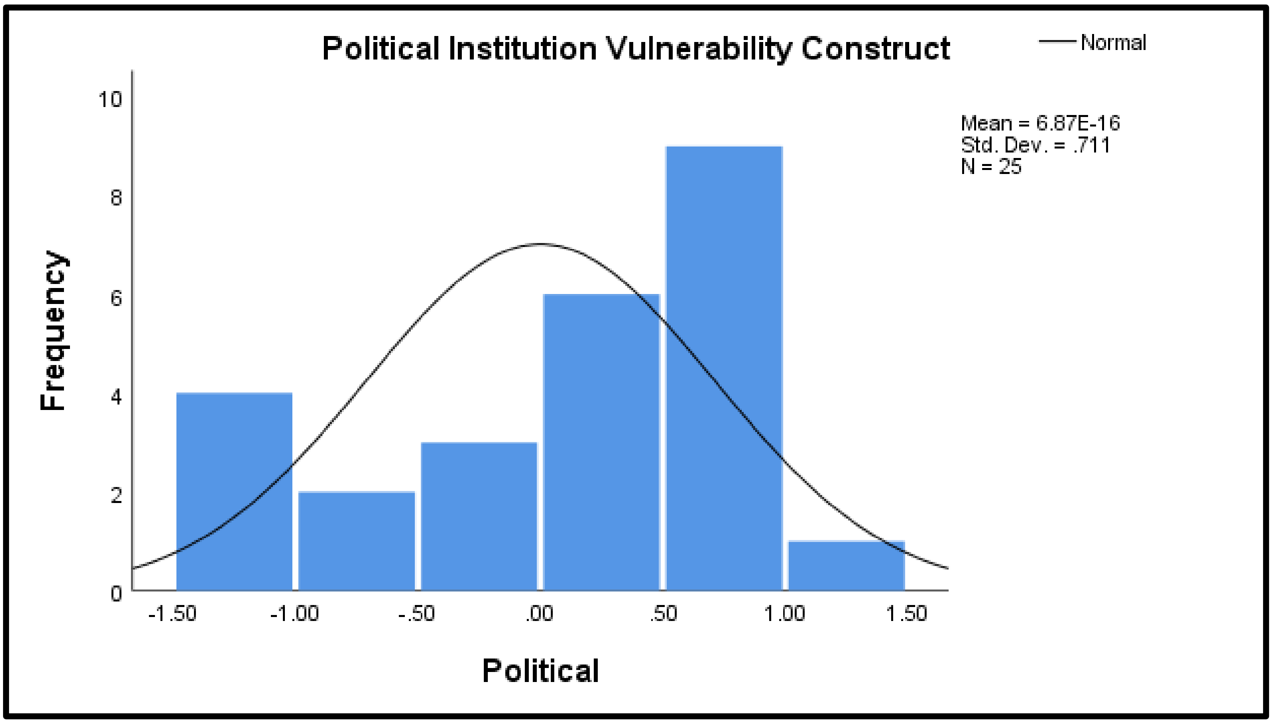
Source: Author's Construct field work (2019)

Appendice 7: Histogram graph for Physical Engineering variables



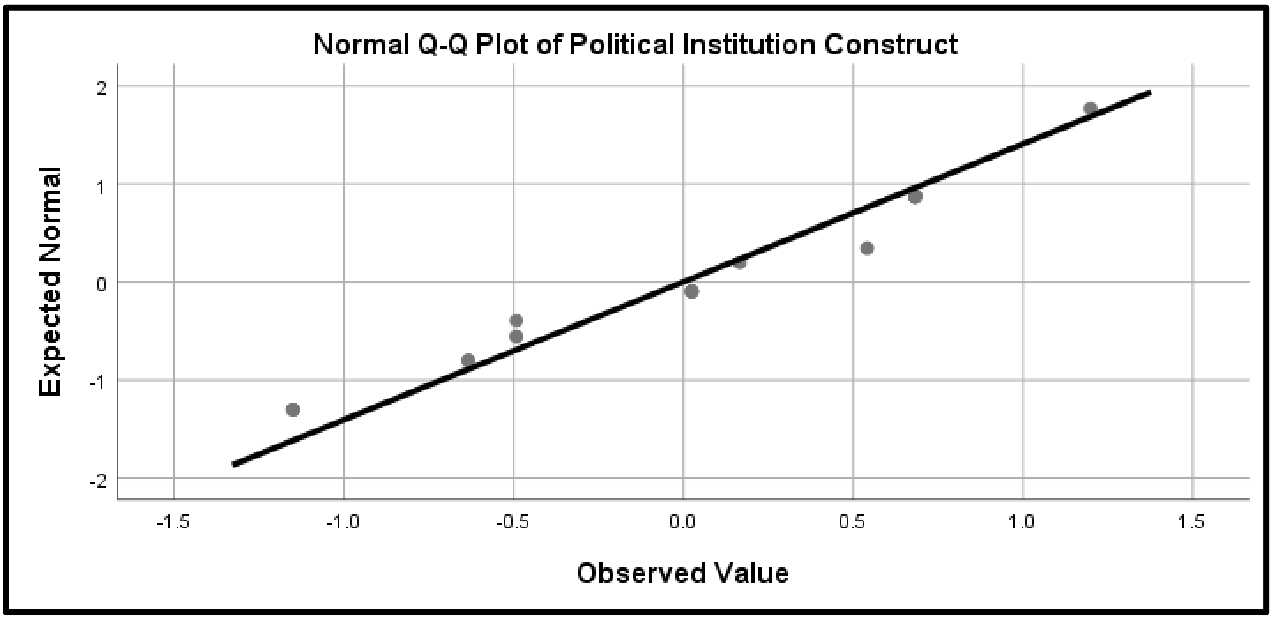
Source: Author's Construct field work (2019)

Appendice 8: Q-Q plot showing individual study constructs for Physical Engineering variables



Source: Author's Construct field work (2019)

Appendice 9: Histogram graph for Political Institution variables



Source: Author's Construct field work (2019)

Appendice 10: Q-Q plot showing individual study constructs for Political Institution variables

ANNEXURE 2: Observational Checklist

ECOLOGICAL/ENVIRONMENTAL ATTRIBUTES

Villages	Level of Waste management	How well are the Drainage systems functioning	Level of degradation	Effectiveness of Land use planning policy	Topography	LEGEND
	1= Very Poor 5= Very good	1= Very Poor 5= Very good	1= Very high 5= Very low	1= Very Poor 5= Very good	1= Very Poor 5= Very good	1= Very Poor 5= Very good
V1						
V2						
V3						
V4						
V5						
V6						
V7						
V8						
V9						
V10						
V11						
V12						
V13						
V14						
V15						
V16						
V17						
V18						
V19						
V20						
V21						
V22						
V23						
V24						

V25						

Appendice 11: Ecological/environmental attributes

PHYSICAL ENGINEERING

Villages	Housing Typology	Construction Material	Land Tenure	Road Connectivity (Permeability)	Distance of Structures from the flood line	Presence of evacuation route	Legend
	1= Very Poor 5= Very good	1= Very Poor 5= Very good	1= Very Poor 5= Very good	1= Very Poor 5= Very good	1= Very Poor 5= Very good	1= Very Poor 5= Very good	
V1							1= Very Poor 5= Very good
V2							
V3							
V4							
V5							
V6							
V7							
V8							
V9							
V10							
V11							
V12							
V13							
V14							
V15							
V16							
V17							
V18							
V19							

V20							
V21							
V22							
V23							
V24							
V25							

Appendice 12: Physical/engineering attributes

SOCIO-ECONOMIC

Villages	GPS coordinates	Population/ population density	Community participation	Level of Disaster relief received last floods	Total number of people injured in the previous flood	Combined statistics of people drowning and or dying in the previous flood	Level of Preparedness	Presence of evacuation route	Legend
		1= Very Low 2= Very high	1= Very Poor 5= Very High	1= Very Poor 5= Very High	1= Very Poor 5= Very High	1= Very Poor 5= Very High	1= Very Poor 5= Very High	1= Very Poor 5= Very High	
V1									1= Very Poor 5= Very High
V2									
V3									
V4									
V5									
V6									
V7									
V8									
V9									
V10									
V11									
V12									
V13									
V14									
V15									

V16									
V17									
V18									
V19									
V20									
V21									
V22									
V23									
V24									
V25									

Appendice 13: Socio Economic attributes

POLITICAL/INSTITUTIONAL FACTORS

Villages	Extent of Municipal Preparedness	Strength of Collaboration between the surrounding communities with traditional leadership	Strength of Collaboration between the surrounding communities with municipality	Strength of Collaboration between the surrounding communities with Other stake holders (NGO)	Effectiveness of the municipal early warning system in the previous flood	Level of response by municipality during floods	Level of awareness by the traditional leadership	Level of community awareness	Legend
	1= Very Poor 5= Very High	1= Very Poor 5= Very High	1= Very Poor 5= Very High	1= Very Poor 5= Very High	1= Very Poor 5= Very High	1= Very Poor 5= Very High	1= Very Poor 5= Very High	1= Very Poor 5= Very High	
V1									1= Very Poor 5= Very High
V2									
V3									
V4									
V5									
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V23									
V24									
V25									

Appendice 14: Political Institution attributes.

UNIVERSITY OF VENDA

SCHOOL OF ENVIRONMENTAL SCIENCES

DEPARTMENT OF URBAN AND REGIONAL PLANNING

This is a "preliminary" questionnaire for Municipal officials

I am undertaking a research study entitled, "***Investigating prospects of integrating spatial planning with disaster risk reduction: A case of Greater Tzaneen Municipality***. This study will being conducted because it is a requirement to complete a Master's Degree in Urban and Regional Planning. I humbly requested, for your objective assistance by completing this questionnaire. Your responses will be solely used for academic purposes only and information collected will be treated with utmost confidentiality.

Researcher : **Tladi Mazwi Thapelo**

Student No : **11617673**

Supervisor : **Prof P Bikam**

Co-Supervisor : **Mr T Gondo**

ADMINISTRATIVE INFORMATION

Date : ....

Questionnaire no : ....

CONTACT INFORMATION

a. Name : …………………………………………………….........

b. Contact no. :…………………………………………………………

Demographic Information and socio-economic characteristics

1. Sex

Male		Female	
	1		2

2. Age

10-15		15-25	25-30		30-45		45-60		60 & above	
	1			2		3		4		5

5. Education qualification

Degree		Diploma		Certificate		Grade 10 or 11		Grade 8		Other (Specify	
	1		2		3		4		5		6

6. Which of the following factors contributes to flooding?

Please indicate your answers using the following 5-point scale where

1= Very strong 2= Strong 3= Moderate **4**= Not effective **5** =Not necessary

		1	2	3	4	5
1	Availability of funds					
2	Lack of personal with skills					
3	Poor public participation					
4	Insufficient strategies					
5	Poor planning					

7. Which of the following do you think have great impact on disasters?

Please indicate your answers using the following 5-point scale where

1= Extremely Unlikely (EU) 2= Unlikely (U) 3= Neutral (N) 4= Likely (L) 5= Extremely Likely (EL)

	Vulnerability attributes	**1**	**2**	**3**	**4**	**5**
1	Political/Institutional					
2	Socio-Economic					
3	Ecological/Environmental					
4	Physical/Engineering					

8. Which of the following spatial planning attributes have positive impact in reducing disasters?

Please indicate your answers using the following 5-point scale where

1= Very strong 2= Strong 3= Moderate 4= Not effective 5 = Not necessary

	Spatial planning attributes	**1**	**2**	**3**	**4**	**5**
1	Integration					
2	Greenfield sites					
3	Urban re-development					
4	Land use planning					
5	Development control / building standards					

9. What type of flooding do you usually experience in your area?

Please indicate your answers using the following 5-point scale where

1= Every time 2= Sometimes 3= Not really 4= Don't know the difference 5= Never

	Different type of floods	**1**	**2**	**3**	**4**	**5**
1	River floods					
2	Urban floods					
3	Flash floods					
4	Costal floods					
5	Areal floods					

15. Does the Municipality invite you in planning for disaster management?

1= Always 2= Never 3= Sometimes 4= Not sure

		1	2	3	4	5
1	Public participation					
2	Community empowerment					
3	Evacuation during rainy seasons					
4	Provision of services during floods					
5	Development of flood prevention strategies					

Appendice 15: Research Questioner

Appendice 16: Turnitin Report

Appendice 17: Letter from the English editor