# LANDSLIDE HAZARDS: HOUSEHOLD VULNERABILITY, RESILIENCE AND COPING IN BUDUDA DISTRICT, EASTERN UGANDA.

**By**

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# DECLARATION

I, John Juventine Ekotu, No. 2009094331, hereby declare that this dissertation is a product of my own independent work and has not previously been submitted for the award of a similar or related degree in any other university. All sources of information used have been correctly referenced, and any other assistance rendered has been fully acknowledged.

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Author: …….. Date: ….....……

JOHN JUVENTINE EKOTU

# ABSTRACT

*Landslides are among the most widespread geological hazards that threaten human lives worldwide, most especially on the mountainous regions of the world. On 1 March 2010, a devastating debris flow occurred in Nametsi village, Bukalasi Sub County, Bududa district in Eastern Uganda. The landslide event caused significant damage to farmland, crops, and livestock; claimed over 400 human lives and displaced an estimated 5,000 people. The high death toll and damage suffered by households from this landslide suggested high level vulnerability, absence of resilience and coping mechanisms. This study focuses on the assessment of household landslide hazard vulnerabilities and vulnerable elements in Bududa. It addresses the household awareness of landslide hazards, landslide early warning, mitigation, resilience and coping strategies that have been employed by households in the area over time. This was a qualitative study with a cross sectional approach. It was found out that in Bududa, children were the most vulnerable to landslide hazards followed by the elderly persons. Lack of awareness of landslide hazards, location of their homes on steep slopes and inability to run away quickly from the threat contributed to their vulnerability although most households in Bududa have places for evacuation in case of landslide occurrence. Meanwhile it was established that most people were able to cope with landslide hazards through prayers to God, the presence of many families around, talking to friends, support from nongovernment organizations and government. Assistance from relatives, use of personal savings and migration to other areas within relieved the impact. However it has been suggested that vulnerabilities in the area could be reduced through afforestation, proper sitting of houses, restricting settlement and agricultural activities such as cultivation and grazing on the danger prone areas. Community participation in the management of natural resources, public awareness campaigns and outreach programmes are recommended. The relocation of settlements programme that was fronted by the government requires further investigation to be carried out especially in terms of willingness to relocate to safer places. Also more work needs to be done in the area to change production systems, improving household income levels, landslide hazard mapping, assessment, development of predictive models, early warning and slope monitoring mechanisms.*

# DEDICATION

To the Lord God Almighty, who by His grace has seen me through my academic journey to this level, the glory returns to Him.

My Uncle, Okello William Ocen, my parents John Ekotu and Bridget Atim Ekotu

Thank you for inspiring me always to strive higher, being supportive and exemplary to me. May the Lord reward you

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# ACROYNYMS

| | |
|---|---|
| BDLG | Bududa District Local Government |
| CBO | Community Based Organizations |
| CDRSS | Committee on Disaster Research in the Social Sciences |
| CRED | Centre for Research on the Epidemiology of Disasters |
| DFID | Department for International Development |
| DRDP | Department of Relief and Disaster Preparedness |
| ECB | Economic Capacity Building |
| ECLAC | Economic Commission for Latin America and the Caribbean |
| LG | Local Government |
| NEMA | National Environmental Management Authority |
| NGO | Non Government Organization |
| OPM | Office of the Prime Minister |
| PAR | Pressure and Release Model |
| PEAP | Poverty Eradication Action Plan |
| UN | United Nations |
| UN-ISDR | United Nations International Strategy for Disaster Reduction |
| UNRA | Uganda National Road Authority |
| URC | Uganda Red Cross |
| USGS | United States Geological Survey |

# Chapter One
# Introduction

## 1.1 Background

Landslides are among the most widespread geological hazards that threaten lives and property globally, most especially on the mountainous regions of the world (Huabin, *et al.,* 2005:548; Jamali & Abdolkhani, 2009:25,). In general, the term is used to describe a wide range of land forms and processes involving the movement of soil and rock down slope under the influence of gravity (Reed, 1992:39). They occur as one of the many natural phenomena and are an integral part of the geological or geomorphologic cycle of landform development through sequential activity of slopes in any elevated region and especially in young fold mountain chains (Singh, 2010:120). They form part of the processes that shape the surface of the earth. However, when they threaten mankind, then they present a hazard situation (Shafri, *et al.,* 2010:59). In recent times, the occurrences of landslides have increased both in frequency and intensity resulting from a combination of several attributes including geological, morphometric, climatic and anthropogenetic that directly or indirectly cause slope instability (Singh, 2010:119).

Landslides tend to dislocate objects that they come in contact with, by way of uprooting trees, destroying utility lines such as telephone, gas, electricity and sewage, tossing vehicles off the roadways, destruction of roads, railways and bridges (Shafri, *et al.,* 2010:59). They have assumed catastrophic and disastrous proportions causing extensive damage to life and property resulting in great problems and serious challenges to man and his development processes (Singh, 2010:120). Landslides result in injuries and death, induce environmental, physical and economic damages that impede the development of wealthy as well as poor nations and regions the world over (Jamali & Abdolkhani, 2009:25).

According to the International Federation of Red Cross and Red Crescent Societies disaster report (2006:72), it is estimated that in 2005 landslide hazards accounted for about 100,000 deaths worldwide affecting 161 million people, and a total cost of about 160 billion United States dollars lost. Lacasse & Nadim (2009:32), however, observe that the trend of fatalities due to natural hazards over the past 100 years shows that the increase in the known numbers of death

is due to the increase in the exposed population and the increased dissemination of information, not an increase in the frequency or severity of natural hazards.

According to the World Bank report (Dilley, *et al.,* 2005:11), the profile of landslide exposure worldwide is presented with the following dimensions; land area of the globe exposed to landslides is 3.7 million square kilometres, with an exposed population of 300 million, an equivalence of five per cent of the total world population. The land area identified as high risk zone is 820,000 square kilometres and the population living in high risk areas is estimated at 66 million people. The report further points out that the Americas (North, Central and South) and China in general have borne the highest number of fatalities from landslide hazards.

## 1.2 Landslide Hazards in Uganda

According to the Committee on Disaster Research in the Social Sciences (CDRSS) (2004:33), a landslide hazard is described as the potential for occurrence of a damaging landslide within a given area. Such damage could include loss of life or injury, property damage, social and economic disruption, or environmental degradation. Uganda has experienced a wide range of disasters that have affected the country such as displacement of persons as a result of civil strife, famine as a result of drought, earthquakes, disease epidemics, livestock and crop disease, flooding, technological accidents as a result of inadequate safety procedures and landslides resulting from heavy rains and injudicious environmental management (Office of the Prime Minister (OPM), 2005:2). Landslides, however, have become common phenomena in Uganda especially on the mountainous areas of the Southwest and Eastern sides where they have caused extensive damage to property, environment and loss of lives (Office of the Prime Minister (OPM), 2005:2; Kitutu, *et al*., 2009:611).

Kizza (2011:1) notes that the African continent was not much affected by landslides or mudslides in the early days until recently when they have become common. Kitutu, *et al.,* (2009:611) observe that in 2002, landslides in Bududa killed three people and injured six. In 2007 they struck Wanale in Mbale district destroying homes and crops of ten families. Over 133 people previously lost their lives due to landslides, the highest number being in 1970 when 60 people were killed in Bulucheke Sub County and Bushenyi district in south western Uganda. Between 1997 and 1999, 48 people were killed as a result of landslides with over 15,000 left in displacement after their homes had been destroyed (Kitutu, *et al*., 2009:611). This increase in

occurrences has been attributed to the global warming phenomena resulting in high precipitation, and poor environmental management practices.

### 1.2.1 Landslides in Bududa

Landslides have occurred in Bududa since the 1900s. It is now becoming clear that these disasters are on the increase as the population increases. Landslides in the Mount Elgon areas and mostly in Bududa, seem to have occurred in the past with little intervention and study. According to Chenery (1960) in the major soil surveys done in the country the soils of Bulucheke or the Bududa series in the areas around Mount Elgon were mentioned to be under risk of soil slips. He reported the presence of cracks in the soils and further mentioned recent scars of landslips in that year. Bududa District has been affected by landslides some of which are reported and others not. People mostly report landslides where there is loss of life and many are never reported (NEMA, 2010:3).

Kitutu, *et al.* (2009:611), observe that Bududa has increasingly experienced catastrophic landslides over the past few decades. In 2002, landslides in Bududa killed three people and injured six. In 2007 they struck Wanale in Mbale district destroying homes and crops of ten families. On 1 March 2010, another landslide disaster triggered by intense precipitation, which resulted to slope failure occurred in the mountainous district of Bududa on the slopes of Mount Elgon, in Eastern Uganda. To be precise, the area affected is located on geographical coordinates $0^0$ 54' 48" North and $34^0$ 19' 51" East (Figure 22), at an elevation of about 1800 meters above sea level (Kitutu, *et al.,* 2010:8). The landslides swept through three villages of Nametsi, Kubehwo and Namangasa in Nametsi parish of Bukalasi sub-county destroying homes, markets, schools and a health clinic killing about 350 people. A total of 106 bodies were recovered by the rescue teams, and over 250 victims remained missing and were believed to have been buried under the rubble (Uganda Red Cross, 2010:1). This is arguably one of the worst landslide disasters to hit the region and the country as a whole in recent times, prompting the government to declare a state of emergency.

Altogether 516 people have been reported to have been killed by landslides in Bududa since 1933. Thus, in 1933, 25 people were killed when celebrating a harvest; in 1964, 18 people died; In 1970, about 60 people were killed in one event when celebrating a circumcision ritual; in 1997, 48 people were killed and 10,000 displaced; while in 2010 over 400 people were killed with over 5,000 left in displacement by landslides (NEMA, 2010:5).

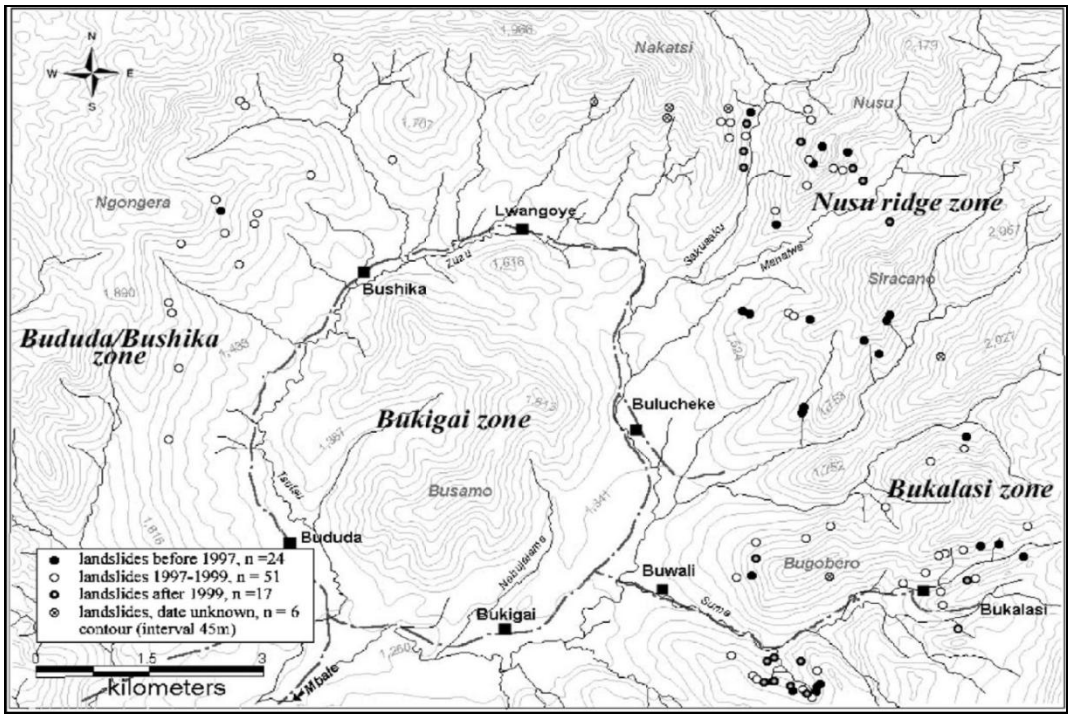



**Figure 1:** Locations where landslide occurred, 1970-1999 shown by dots. Bukalasi and Nusu zones have the highest number of landslides ever and areas of high risk.

**Source:** NEMA report (2010:4)

### 1.2.2 Causes of landslides in Bududa

The activity of land sliding in East Africa, including Bududa ,is generally influenced by heavy rainfall, steep slopes, slope shape and high clay content in the soil (Knapen, *et al.,* 2006:151). Other factors that play a role in triggering landslides in this area according to Knapen, *et al.,* (2006:151) are the swelling properties of clay and the rate at which water infiltrate into the clay at depth. According to the report by NEMA (2010:13), it is observed that during intense rain showers in Bududa, the roads, small footpaths, plot boundaries and runoff ditches concentrate large volumes of runoff water, and direct this to restricted infiltration zones or hollows. In the Bududa/Bushika zone, these linear features are numerous and cracks develop upon drying in the swell–shrink soils. As these cracks form a by-pass mechanism for rapid infiltration, over-saturation of the zone above the shear plane may occur with subsequent slope failure. Sidle, *et al.* (1985), however, observes that other soil properties such as the size of the particles and

pore distribution influence slope stability. These will in turn influence the rate of water movement and the capacity of the soil to hold water. The 2010 landslides were triggered by rains which lasted for three day (See Figure 2).

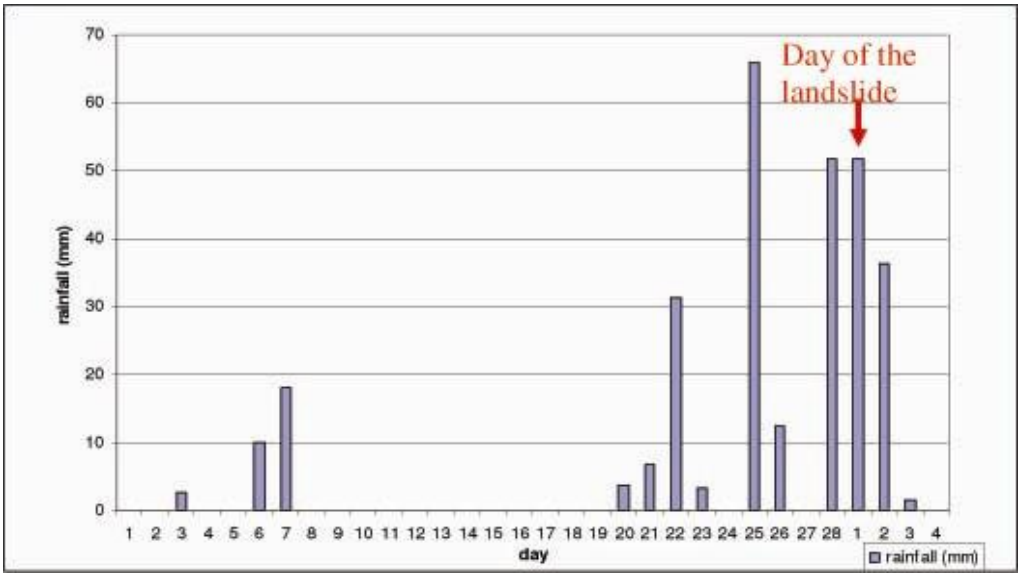



**Figure 2:** Daily rainfall for Bududa in millimetres (MM) for the months of February and part of March 2010.

**Source:** Department of Meteorology**.**

However in Bududa district, over years the occurrence of landslides have also been associated with community's beliefs in myths and superstition related to some mysterious animals (Kitutu, *et al.*, 2009:618). On the influence of soil properties, Kitutu, *et al.,* (2009:618) observe that landslide occurrences in Bududa district are mainly conditioned by topography and wet tropical climate. They observe that the soil type has no influence on landslide occurrence, but soil texture seem to be significant. In the western zone of Bududa, landslides are due to soil horizon stratification that favours water stagnation in the lower horizon and are only confined to areas that experience water stagnation. While in the eastern zone, landslide occurrences are dependent on a number of factors which include soil texture, depth to the bed rock, land use and shape of the slope.

Undercutting of slopes in Bududa for construction of houses and roads removes the lateral support of the slope leading to slope failure (Figure 3). Although slope undercutting mostly decreases hill slope stability without actually initiating movement, in Bulucheke, for example in

2007, the excavation for house building was directly responsible for triggering slope failure and creep phenomena that caused landslides. Two young girls were killed in this house in 2007 (NEMA, 2010:13).


**Figure 3:** Landslide caused by undercutting of the slope for house construction
**Source:** NEMA report (2010:13)

The recent landslides have in most cases been associated with population growth resulting in increased urbanisation. The most explosive growth has been in developing countries resulting where urban population has tripled in the last 30 years (Haigh & Amaratunga, 2010:12). The expansion of settlements is increasing the impact of natural disasters both in the developed and developing countries (Guzzetti, 2003; Renschler, *et al.,* 2010:15,). Degradation of slopes through soil loss due to landslides in Bududa District, which lies in eastern Uganda is a problem with fatalities, environmental consequences and food shortages envisaged in the future. Farmlands and infrastructure such as bridges and roads are destroyed. These landslides displace about 11,000,000m3 of soil and debris into river channels and wetlands downstream (Figure 4 below).

According to the National State of Environment Reports for Uganda for the years 2000 through to 2007, it is pointed out that land is becoming increasingly scarce as the country's population

increases at a high rate. The population growth rate for Uganda in the 2002 census stands at 3.4% per year. The mountainous districts of Kabale, Mbale, Manafwa, Bududa and Sironko are ranked areas with high population density, and the consequences are serious land pressure leading to land degradation. People are forced to exploit steep slopes for settlement and agriculture causing land degradation which in the end leads to increased landslides in extreme cases. In addition, a big percentage of the population depends on agriculture for a living. The loss of soils leaves the areas bare and non-productive, which creates more pressure on land, which is already a scarce commodity in some of these areas (NEMA, 2010:3).

**Figure 4:** Half length of the March 2010 Bududa landslide pictured from the opposite hill.
**Source:** National Environmental Management Authority (NEMA) report, (2010:6)

This particular site suffered from a landslide in 1997 and four people were killed. A huge boulder from that landslide rolled down, narrowly missed the Health Centre built by Care International, but was completely swept away in the current debris flow. It was reported that this site again suffered from small landslides early this year with no damage. This could have been early warning signs for an impending major slope failure.

Deforestation is considered one of the main preparatory factors for landslides in most East African highlands (Inganga, & Ucakuwun, 2001:95; Nyssen, *et al.,* 2003:203; Kitutu *et al.,* 2004:349). Bududa has been deforested since the 1930s although spatial and temporal

information is lacking. Undoubtedly, the forest stretched much further eastwards, prohibiting slope failure on the steep slopes with shallow soils in the Bukalasi and Nusu ridge zone. Stability analysis shows that deforestation decreases the safety factor, which is a measure of the slope stability, through root decay by 30% to 60% on these slopes. Another indication of the importance of a forest cover in prohibiting mass movements in the area, is the absence of landslides under forest on slopes with similar topographic and soil properties as in the Bukalasi and Nusu zone where landslides do occur.

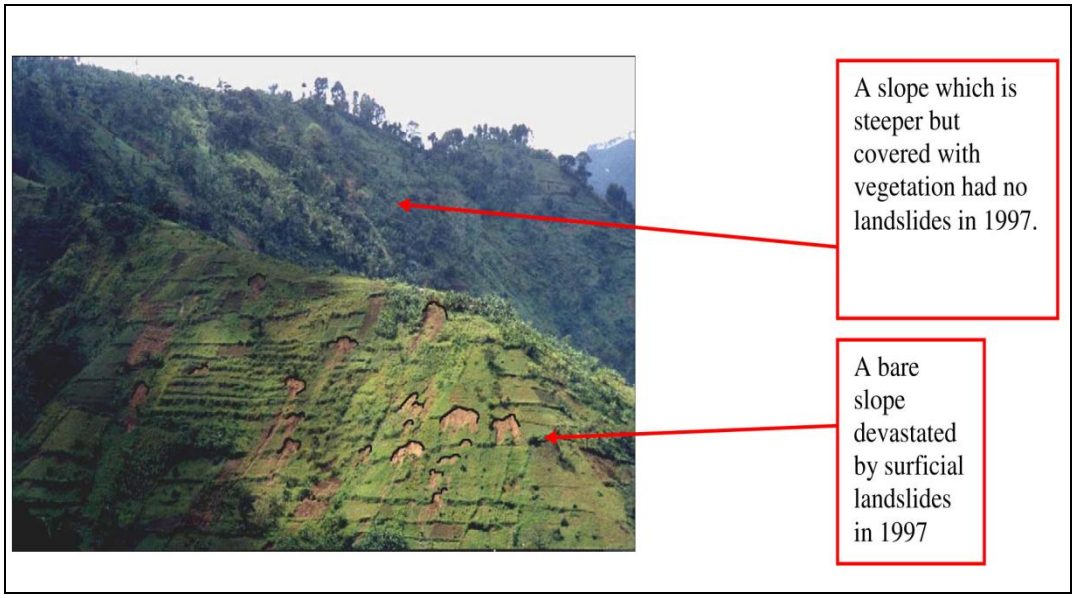
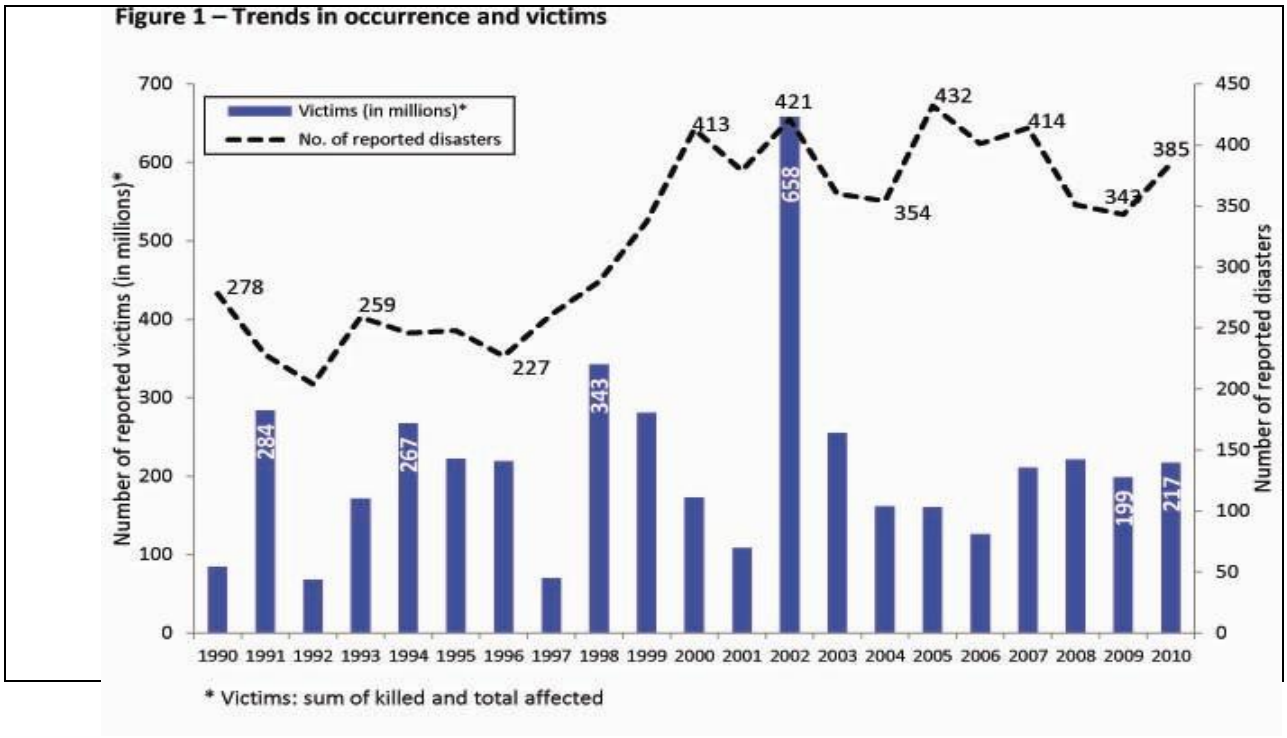



**Figure 5:** Importance of vegetation in preventing landslides

**Source:** NEMA report (2010:14)

## 1.3 Trends in Occurrence of Landslide Disasters and Victims

According to Guha-Sapir, *et al.,* (2010:1) in 2010, the number of reported disasters approximated the annual average disaster occurrence during 2000 to 2009, that is, 387. The number of victims increased from 198.7 million in 2009 to 217.3 million in 2010, but remained below the annual average number of victims of 227.5 million during 2000 to 2009. Economic damages of US$ 47.6 billion from natural disasters in 2010 were over 2.5 times higher than in 2009, and increased by 25.3% compared to the annual average for the period 2000-2009 with a total US$ 98.9 billion (Figure 6).




· **Figure 6:** Trends in occurrences of disasters between 1990 to 2010.

**Source:** Guha-Sapir, *et al.,* (2010:1).

They further observe that, the regional distribution of disaster occurrences in 2010 resembled the annual average distribution of the last decade. Asia accounted for more than a third of the number of all reported disasters, 34.8%. The Americas had a 25.2% share of global disaster occurrence, Europe and Africa both took nearly a fifth of disaster occurrence, that is, 18.2% and 17.9% respectively while Oceania 3.9%. Although Europe saw the biggest increase in disaster occurrence and Asia had the largest decrease, with fewer victims and damages compared to the last decade's annual averages, the continent still took the largest share of disaster occurrence and victims in 2010 (Guha-Sapir, *et al.,* 2010:1).

However, according to the CRED The number of victims from hydrological disasters, that is, Flood and Mass Movements, in 2010 was the highest in a decade, and increased by 98.9% compared to the yearly average of the last decade. They caused 87.0% of the global reported number of victims in 2010. Hydrological disasters were responsible for 92.9% of disaster victims in the Asian continent alone, the highest share since the 1980s. These resulted from extensive floods and landslides following heavy monsoonal rains in Southern China causing 134.0 million

victims globally with more than one third of the damages, that is, 37.9% (Guha-Sapir, *et al.,* 2010:1).

## 1.4 Statement of the Problem

Landslides are among the most widespread geological hazards that threaten lives and cause destruction of property globally (World Disaster Report, 2006:11). They continuously result in human suffering, environmental degradation, property damage and destruction of infrastructure. Located on the densely populated slopes of Mount Elgon, Bududa has experienced increased occurrence of landslides since the beginning of the twentieth century (Ole, 2001:1).The latest and most devastating landslide to occur was in 2010 which left over 350 people dead and made thousands homeless. Yuri and Shannon, (2010:1) report that mapping of the slope area above the adjacent village of Murwerwe revealed a newly developed crack between 0.5-2.0m high, 25m long and 9m wide at the apex (Figure 7). The apex of the crack is located at 2,076 meters, at the same elevation as the apex of the fatal March 1, 2010 Nametsi landslide. The distance between the two is approximately 300 meters along the convex slope which is completely covered with crop fields.

They further report that at the bottom of the scarp, a newly developed crack, 10-15 centimetres wide is visible at a distance of at least 100 meters away. By overlaying field survey data and elevation model from ASTER GDEM data they found that the apex of the scarp is in the upper-middle part of the concave slope which is a common location in many landslides. Considering the very high slopes of up to 60 degrees in the area, the location of the scarp signifies a critical situation where excess rainfall could trigger another massive landslide. The households in the area remain vulnerable and susceptible to landslide hazards. Therefore a research study was required to determine household landslide hazard vulnerabilities, resilience and coping mechanisms in the area and appropriate mitigation measures that can be devised to minimise further occurrences and impacts, in case landslides occurred. It was also essential to study how people in this area perceive landslides and cope with them.

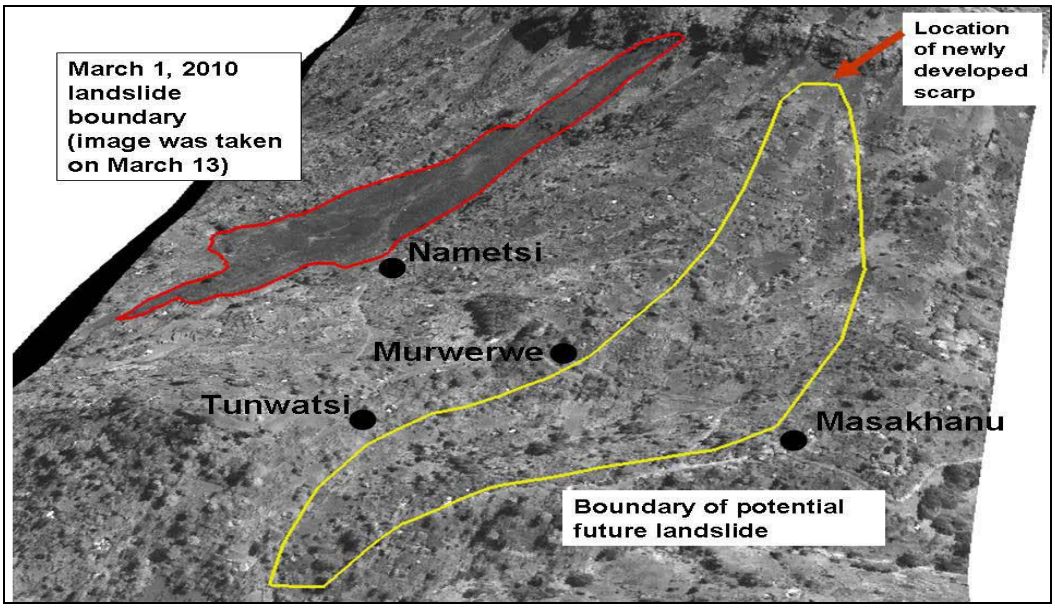



**Figure 7:** Location of March 2010 landslide and boundary of potential future landslide identified from elevation data and field survey (by newly developing scarp).
**Source:** Gorokhorich, & Doocy, (2010:1).

## 1.5 Objectives of the Study

### 1.5.1 Main Objective

The vulnerability of individuals, communities and the environment is a major factor in exposure to disaster causing hazards which limits resilience, but these hazards do not affect everybody in the same way (Cutter, *et al.,* 2003:243). The poor and socially disadvantaged groups are the most exposed and suffer the greatest impact from disasters (Wisner, *et al*., 2004:12). Yet these fragile people groups are most often not given priority in disaster prevention strategies despite quite clearly being the most vulnerable. Understanding vulnerability factors, populations coping mechanisms with landslides, how they perceive risk and their priorities are first and key steps toward developing more effective rural development and landslide risk management programmes (Anderso,n *et al*., 2011:591). Therefore the main objective of this study was to assess household vulnerabilities, resilience and the coping mechanisms to landslides in Bududa district, Eastern Uganda.

The study aimed at recommending landslide mitigation measures against vulnerability factors which, if implemented, would reduce the vulnerability of individuals, households and

communities to landslide hazards by increasing their resilience capacity to shocks. These measures would take into consideration the already existing coping mechanisms, related traditional knowledge and people's beliefs surrounding the occurrence of landslides.

### 1.5.2 Specific Objectives

The specific objectives of the study were to:

(1) To assess household vulnerability factors and risk elements in Bududa.

(2) To evaluate the level of household awareness on landslide hazards.

(3) To examine the landslide hazard early warning, monitoring and mitigation mechanisms.

(4) To assess the capacity of households to cope with landslides and future shocks in Bududa.

## 1.6 Study Area

The study was conducted in Bududa district, Eastern Uganda (Figure 8), Bukalasi sub-county. The district of Bududa was systematically selected by the researcher because it has had a long history of landslide activity in Uganda and besides, it is the most recently affected area. The sub-county selected, falls under the hazard prone area where populations have been affected by landslide hazards. This provided a better study population and was able to generate a better opinion on the assessment conducted. Bududa is one of the districts located on the slopes of Mount Elgon in Eastern Uganda and has increasingly experienced catastrophic landslides. During the El Niño rains of 1997, landslides killed 48 people and displaced thousands in this area. In 2004 over 15,000 people were displaced and made homeless by landslides (Kitutu, *et al.,* 2009:611). Besides displacement of people, landslides in the area cause loss of income for farmers, damage to roads and bridges which further constrains the delivery of service and development initiatives in the district (NEMA, 2010:3).

## 1.7 Characteristics of the Study Area

### 1.7.1 Location

Bududa district lies at the foot of the South-Western slopes of the Mount Elgon volcano in Eastern Uganda. It is geographically bound by latitude 2° 49' N and 2° 55' N, longitude 34° 15' E and 34° 34' E (Figure 22). The district comprises one county, seven sub-counties and one

town council. The district was named after its chief town Bududa. It was initially part of Manafwa District as Manjiya County, but it was made a district in 2006. It is bordered by Manafwa District to the south, Sironko District to the north, Mbale District to the west, and the Republic of Kenya to the east. Bududa District headquarters are located approximately 23km by road southeast of Mbale, the largest city in the sub-region (NEMA, 2010:1).

### 1.7.2 Geological Setting

Geologically, the Bududa region consists of soil types conditioned by topography and tropical climate namely Nitisols, Cambisols, Lixisols, Ferralsols, Leptosols, Gleysols, and Acrisols (Kitutu, *et al.,* 2009:611). The geology consists of fenitised basement rocks and in the central part of Bukigai, a pre-Elgon alkaline volcanic structure, the Butiriku carbonatite complex stands out (NEMA, 2010:2). The soils in the western side of Bududa are predominantly clay and have the same texture down the profile. The soils on steep slopes areas are deep and very porous in the top 100 centimetres of clay loams or clays. They have very little or no laterite with very little horizon differentiation below the top 20 - 25 centimetres apart from slight changes in firmness. On the carbonatite dome in the Bukigai area, the soils are clay-rich with more than 30 pe rcent clay. They are uniformly coloured down the profile with less than 20 per cent change in clay content. The sand and silt contents decreases down the profile. The soils have a redder hue in the top horizons and from 40 to 140 centimetres depth they have shiny ped faces (Figure 23) (Kitutu, *et al.,* 2009:614).

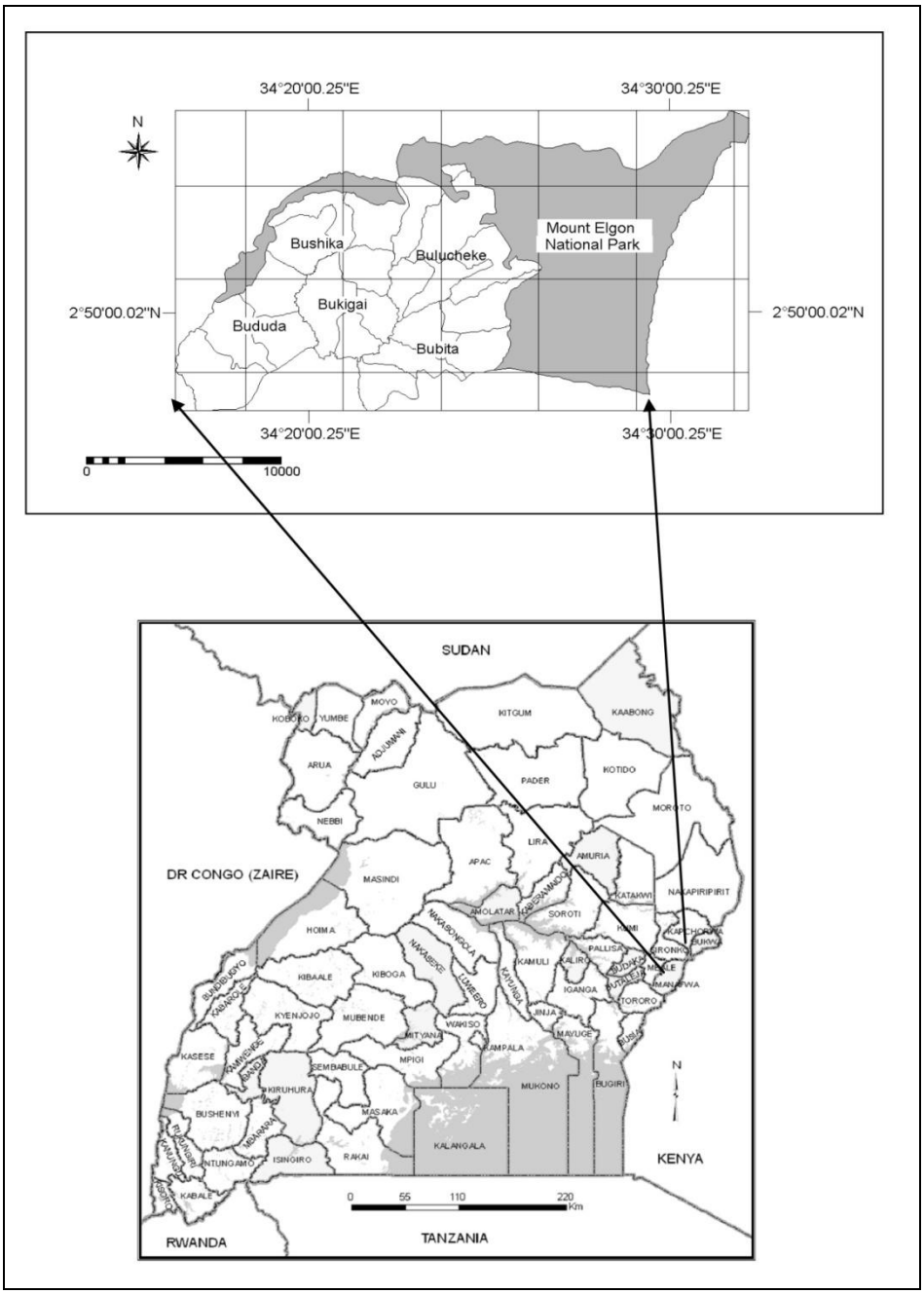



**Figure 8:** The location of Bududa district in Uganda

**Source**: Kitutu *et al.,* 2010:9

**Figure 9:** Soils in Bududa Nametsi sub-county, photograph taken during the field study.

### 1.7.3 Topography and Vegetation

Bududa district lies on the slopes of Mount Elgon in Eastern Uganda. It has a unique topography characterized by stand-alone volcanic cones, interlocking spurs, v-shaped valleys indicating river incisions, cliffs and ridges, both gently undulating and rugged with bamboo forest (Figure 24). The altitude varies significantly from 1250 to 2850 meters (5,900 ft) above sea level (Atuyambe, *et al.,* 2011:3). Kitutu, *et al*. (2009) observes that Mount Elgon forest and National Park cover approximately forty per cent of the district.

**Figure 10:** Part of the Nametsi area with interlocking spurs and funnel-like valleys. Photograph taken during field study at Nametsi.

### 1.7.4 Climate and Hydrology

The Mount Elgon's ecosystem plays a bigger role in determining the climate patterns in eastern, central and northern Uganda and western Kenya. The temperatures on the slopes of Mount Elgon are normally very low because of the high elevation. The study area, which is at an altitude that ranges from 1250 to 2850 meters above sea level, has relatively low temperatures. The mean maximum monthly temperature ranges from 21.20C to 23.50 $^{0}$C. The area experiences two distinct wet seasons separated by dry periods during the months of December to February and July (NEMA 2010:2). The precipitation usually peaks in May and October and it is largely influenced by the high altitude of 1250-2850m and an average of 1,800 m (5,900ft) above sea level (Kitutu, *et al.,* 2011:8).

Every slope experiences gravitational activity induced by shear stress which increases with slope height, inclination and unit weight of materials forming the slope. Expansion, contractions and freezing actions on the slope may contribute to increased shear stresses particularly in the surface. Under normal circumstances, the shear stress along the slope is in equilibrium with the shear resistance, however, it can be modified and influenced by external factors such as increase in the load on the slope from construction activity, increased pore pressure due to

intense rainfall, exceptional precipitation and water saturation on the soil; weakening of the soil and rock layers leading to reduced cohesion for example by mining, excavation, deforestation, and this may result to land sliding (Singh, 2010:120, Uniyal, 2010:364). Triggers that are known to cause or reactivate landslides on hilly places include heavy rainfall or snowmelt, earthquake shaking, erosion, and human activities (Nicoll, 2010:134).

### 1.7.5 Human and Economic Activities

Agriculture is the most important activity being carried out in the area with a majority of the people living practising subsistence farming. The fertile volcanic soils and the abundant rainfall of average 1,500 millimetres per year ensure ample yields of both cash and food crops. The main crops grown in the area include coffee, beans, bananas, cabbage, tomatoes, onions, carrots and other green vegetables. Coffee is grown as a cash crop and mainly on small scale. The people in Bududa also keep animals such as goats, cattle, pigs and chicken (Figure 25). Other activities in Bududa include small-scale and medium-scale businesses such as retail shops, food kiosks, restaurants, bars, and transportation. These activities provide the only and yet infrequent income to the owners

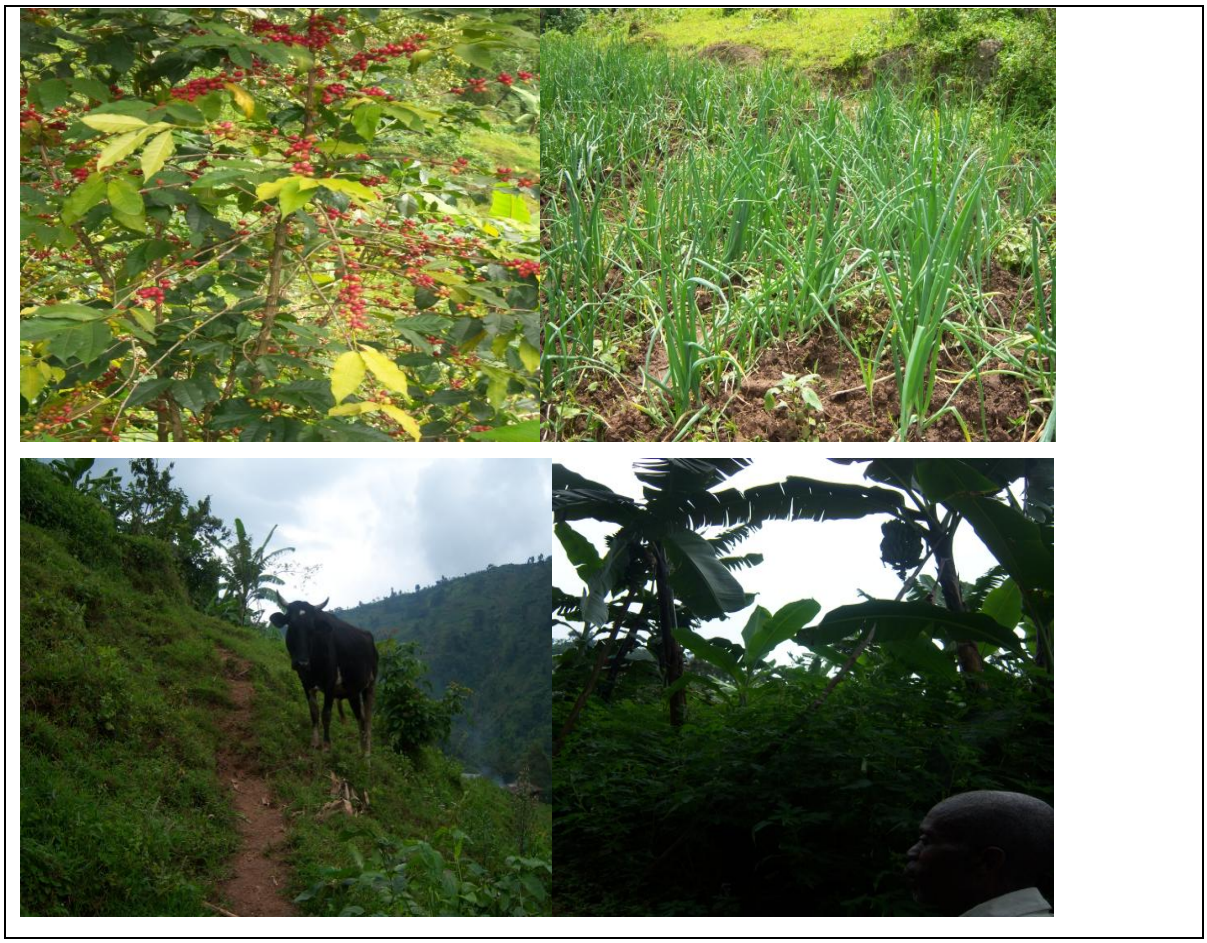


**Figure 11:** Coffee plantations, vegetables, banana plantation and cattle grazing on the slopes in bududa, nametsi sub-county. Photographs taken during the field study.

### 1.7.6 Population and Administration

In 2006, the district population was estimated at about 146,000, with a total of 73,861 females and 74,468 males, placing the ratio at approximately 1:1 respectively (Atuyambe, *et al.,* 2011:3). According to the Uganda Population and Housing Census Report, the population of Bududa is steadily growing at a rate of 3.8% per annum (Uganda Bureau of Statistics, 2002:17). According to Kitutu, *et al.* (2011:10) Bududa District is densely populated with about 952 persons living per square kilometre. This seems to imply that the greatly increasing population is responsible for the high rates of deforestation on the slopes of Mount Elgon in search for settlement and agricultural land. Administratively, Bududa is largely a rural district with nine urban growth centres which also serve as lower local governments. There is one town council that is Bududa Town Council and eight sub-counties which include: Bududa, Bukalasi, Bukibokolo, Bukigai, Bulucheke, Bumasheti, Bumayoka, and Bushika. (Bududa District Local Government, 2010).

## 1.8 Significance of the Study

The slopes of Mount Elgon have since the early twentieth century experienced increased occurrence of landslides (Kitutu, *et al*., 2009:611). In Bududa district, the landslides have caused loss of lives, destruction of property and displacement of thousands of people into relocation camps. The conditions in these camps are characterised by dependence on foreign aid, poor shelter, lack of safe water, clothing, domestic utensils, and breakdown in education system and food production. At the macro level, economic growth, balance of payment and public spending are all affected. The funds targeted for development are reallocated to finance efforts to resettle the affected populations jeopardising the long term national development goals, as a result, the commitment to pursue productive livelihood through poverty reduction have been continually frustrated. Therefore the study is significant in a number of ways.

The study provides an assessment of landslide household vulnerability factors, resilience and coping mechanisms in Bududa. This will inform the national government, nongovernment organizations (NGOs) and the United Nations (UN) agencies involved in emergency response, on formulation of appropriate landslide disaster management and response strategies.

The study has generated information which may be used in the decision-making process to mitigate landslide occurrences. Various government departments and agencies could make use of the information, thereby being in a position to develop landslide control measures. For example, the Department of Relief and Disaster Preparedness (DRDP) could use the information in preparing landslide disaster management plans, which could reduce or avoid losses from landslides by ensuring prompt assistance to the victims, and achieve rapid and effective recovery. The information may help in the development of an early warning system for landslide hazards. The Uganda National Roads Authority (UNRA) could use the information in planning the road system on the unstable slopes of Mount Elgon in eastern Uganda. The Department of Lands and Physical Planning could use the information to determine and recommend best sites for human settlements and agricultural activity on the landslide prone slopes.

The study could assist individuals, households and communities in the affected areas to understand better the vulnerability of their physical environments, the danger-prone areas and risks posed by landslides to their communities. The study provides information on how human

activities have contributed to instability of the slopes. This, in the long run, should help the local people to appreciate the problem, and be more willing to rehabilitate the unstable hill slopes or relocate from the danger-prone areas.

The information generated is of value to various stakeholders working in the affected areas on the rehabilitation of individuals, households, community and the physical environment in Bududa, especially the local government (LG), the government agencies like National Environmental Management Authority (NEMA) and the NonGovernmental Organizations (NGOs). These may use the information to rehabilitate the hill slopes, catchment areas resulting to better environmental protection and management practices in the area. It would also aid the development of plans to mitigate the impact of landslide hazards, assess the coping mechanisms and provide recommendations for the mitigation of landslide vulnerability factors in Bududa and other prone regions.

Finally, the information generated by this study is of academic value. Not much is known about landslides in Uganda. Most research studies make reference to international landslides instead of the local case studies. This study will enable the interested and affected parties to appreciate the extent of the problem in their own geographical setting.

## 1.9 Justification of the Study

Different hazards have continued to strike different parts of the world at an increasing rate. Their effects on the victims are, however, similar although the magnitude may vary. In Africa, the poor, who happen to be the majority, are the most vulnerable in any kind of disaster and in the same way such disasters have become a powerful downward trigger to poverty, because the few assets are continually destroyed and funds meant for development activities are diverted to finance recovery while the investment infrastructure and services get wiped away. Bududa, Eastern Uganda has been a victim of landslide hazards for long, and have resulted in massive destruction, loss of lives and displacement of the populations who are left with no productive livelihood activities.

Landslides have continued to claim human lives, damage property, and infrastructure in the study area. The continued susceptibility of this area to landslide hazards puts human life, property and the environment in great danger. There was therefore a need to examine the

causes of vulnerability of households to landslides in order to formulate an informed basis for preventing further loss and destruction of both lives and property. Through the identification of vulnerabilities, resilience and coping strategies in the area, the study forms part of the basis for landslide hazard management for Bududa district.

This study provides recommendations that would benefit the government of Uganda in its commitment to reduce levels of household vulnerabilities to landslides in the mountainous areas of Bududa and other landslide prone regions in the country. The study contributes towards the commitment to alleviate suffering of the vulnerable groups such as children, women, disabled and the elderly by way of providing ideas to improve their resilience, mitigation, coping mechanisms and recovery from landslide. This supports the achievement of poverty eradication action plan (PEAP) objectives, currently being implemented by the government of Uganda. The study informs individuals, households, opinion leaders, the local and international community involved in disaster management on household vulnerability reduction and other emergency activities for landslide prone areas in Uganda and elsewhere in the World.

This study is the first attempt to provide an assessment of household vulnerabilities, resilience and coping with landslide hazards in Eastern Uganda. In that regard therefore the research is an important step towards bringing together the local understanding of landslide vulnerability, capacity, and adaptive strategies that have been used by different generations that have inhabited this area. This is important because it would create better understanding of the different relationships between the physical environment, humans, and the occurrence of landslides.

## 1.10 Scope of the Study

This study was conducted in Bududa district, Eastern Uganda. Bududa district has one county with seven sub-counties. The study covered Bubiita and Bumayoka sub-counties. These were strategically selected by the researcher because they are in these sub counties where Bukalasi parish with the villages of Nametsi, Kubehwo and Namangasi that were affected by the latest landslide hazard, are located. This means they have the largest number of households that have been affected by landslide hazards over time and therefore provided a sufficient study population who have had an encounter with the landslides. The study carried out an assessment on the household vulnerability factors, resilience and coping strategies to deal with

landslide and future shocks. The assessment covers the landslides that have occurred within the past five years; January 2006 to December 2010.

## 1.11 Conclusion

Chapter one provides background information to the study and describes the problem, objectives and significance of the study. Chapter two provides a review of the literature on landslide hazards, definitions, causes, mechanisms and impacts of landslides. It also provides literature on theories and models that have been used to explain the concepts of vulnerability, resilience and coping with disasters. These concepts provide the basis for explanation of household vulnerability, resilience and coping in Bududa. Chapter three describes the methodology used in executing this study including the design of the study, sampling techniques, data collection and analysis. Chapter four provides findings from the field survey derived from the analysis of data. Chapter five is the synthesis of the findings. It explains the factors behind household vulnerability, coping and house hold resilience mechanisms. The chapter also provides the hazard mitigation mechanisms that would increase household resilience. Chapter six is composed of the major conclusions from the study, recommendations and highlights areas for further study.

# Chapter Two
# Literature Review

## 2.1 Background

The chapter examines the existing related literature in the area of landslide hazards, vulnerability factors to landslides, resilience and coping mechanisms. It explores what other research studies have discovered with particular interest in understanding the concepts of vulnerability, resilience, coping with current and future shocks in the landslide hazard prone areas. The chapter points out the characteristics and provides insight into the different conceptual models used for assessing each of them.

Landslides are one of the most widespread geological hazards on earth, responsible for a considerable loss of property, economic dislocation, environmental degradation, damage on the infrastructure, loss of cultural and natural heritage and most often human injury and death (Sassa, 2005:136;, Uzielli, *et al.,* 2008:251;Jamali & Abdolkhali, 2009:25). The term landslides according to Huabin, *et al.,* (2005:548) describes a wide range of processes responsible for the downward and outward movement of slope forming material composed of rock, soil, artificial fills or a combination of all these  down a slope. They are part of the mass movement processes or dynamic forces which constantly generate irregularities on the earth's surface in the form of varying relief and major landforms (Jamali & Abdolkhali, 2009:25).

In recent years, landslides have occurred most often, and they have impacted more victims globally especially in the mountainous areas with steep topographies adjacent to human settlements and infrastructure such as towns, roads, bridges and utilities (Chen, *et al.,* 2008:89, Kamp, *et al.,* 2008:631, Moayedi *et al.,* 2011:116). At the global level, some examples of the most devastating landslides recorded include the 1972 Calabria landslide in Italy, Hauscaran landslide of 1970 in Peru (McCall, 1992), the Aberfan landslide of 1966 in Wales, and the 1985 Armero landslide in Colombia (Alexander, 1993). Huabin, *et al.,* (2005:548) estimate that in the year 1998 alone, 180,000 avalanches, landslides, and debris flow of different scales occurred in China, causing estimated direct economic losses worth 3 billion dollars.

Landslides can be triggered by a variety of stimulus such as intense rainfall, earthquake shaking, water level change, storm waves or rapid stream erosion that results in rapid increase in shear stress or decrease in shear stress of slope forming material (Guzzetti, 2003:1, Alcantara-Ayala, 2004:19). Singh (2010:120), points out that the shear stress along any slope under normal conditions is in equilibrium with the resistance of the slope. However, this can be influenced and modified by external and internal factors, and once the shear stress along the slope exceeds the shear resistance, landslides and other forms of mass wasting phenomena are triggered along the most vulnerable surface and the slope is modified to new values of equilibrium. Although landslides are primarily associated with steep slopes or mountainous regions, they can also occur in areas of generally low relief. This takes the form of cut and fill failures, river bluff failures, lateral spreading landslides, collapse of mine waste piles and other slope failures associated with quarries and open pit mines (Zerube & Mencel, 1982:324).

According to Larsen and Simon (1993:14), the areas where meteorological events, for instance hurricanes, typhoons and cyclones are recurrent, the occurrence of landslides is more frequent with a more devastating impact. In 1989, for example more than 400 landslides were triggered by hurricane Hugo in Puerto Rico and in 1996 typhoon Herb produced 1,300 landslides in Taiwan (Lin & Jeng 2000:192). In 1998, hurricane Mitch in Central America triggered a mud flow produced in volcano Casita in Nicaraga which buried two towns causing a death toll of about 2,000 people (Kerle & de Vries, 2001:53). In the North of Venezuela, thousands of mass movements occurred in 1999 resulting from extraordinary rainfall which produced devastating and big volumes of deposit; this has been considered as one of the largest rainfall induced landslide worldwide recorded in history (Wieczorek, *et al.,* 2001:4).

Besides, Dai *et, al.* (2002:65), argue that as development expands into unstable hill slope areas because of increasing population and urbanization, human activities such as deforestation, excavation of slopes for road construction, and building sites have become important triggers for landslides. The landslides caused by human activity as Kjekstad and Highland (2009:580) put it, include those that result from construction of highways, logging roads, clearing land for crops, mine and quarrying, and other activities that alter the drainage patterns, causes change in the vegetation regimes, alter the grade of the slopes, covers extensive areas concrete paving and excavation of large tracts of land, all of which result to change in the morphology of the landscape.

Dorren (2003:71), however, indicates that human activities leading to decreased stability of hill slopes are still minor compared with geological factors, but are of great importance locally, such as undercutting of slopes during quarrying or excavation for infrastructure. He concludes in his study that a combination of topographical, geological and climatological factors is responsible for the occurrence of landslides. Huppert and Sparks (2006:1878), on the other hand, urge that the major causes of increasing landslide catastrophes is directly related to human activities resulting from population growth and urbanization, environmental degradation, land use change caused by human activities which make communities much more vulnerable to natural hazards.

## 2.2 Impact of Landslide Hazard

Disasters cause severe impact with potentially serious consequences on the affected countries or regions (Benson & Clay, 2004:11). These impacts are varied and may be categorized as physical, social, psychological, demographic, economic and political impacts (Committee on disaster research in social sciences (CDRSS), (2006:76). Kjekstad and Highland (2009:573,) however, note that the impact of landslide hazards is greatly varied and difficult to assess at any level, mainly because landslide hazard assessment is often merged with other associated disasters such as earthquakes, flooding and other meteorological events, which most often act as triggers of landslides. The 1970 Huascaran disaster in Peru, for example which killed more than 20,000 people is often referred to as an earthquake disaster because the landslide was triggered by an earthquake, yet the destruction and casualties were directly caused by a high velocity debris avalanche (Schuster & Highland, 2001:1).

Landslide hazards have caused large numbers of casualties and huge economic losses especially in the mountainous regions of the world (Kjekstad & Highland, 2009:574). Globally, landslide hazards cause billions of dollars in damages and thousands of deaths and injuries. Japan leads other nations in landslide severity with projected direct and indirect losses of four billion dollars annually (Popescu & Sasahara, 2009:610). The United States of America, Italy and Canada follow with the cost of damage ranging from one to two billion dollars and between 25 to 50 deaths annually (National disaster education coalition, 1999:93). Landslide hazards are also common in developing countries where their economic losses sometimes equal or exceed the gross domestic product (GDP) (Sassa, *et al*., 2005:135).

Petley (2008:1) reports that in terms of the occurrence of landslide fatalities in the year 2007 by nation, the most seriously affected country was China with 695 landslide-induced deaths, followed by Indonesia (465), India (352), Nepal (168), Bangladesh (150) and Vietnam (130). In terms of trigger, 89.6% of worldwide fatalities were a result of landslides caused by intense and prolonged precipitation. Other triggering processes were construction involving mostly undercutting of slopes, (3.4% of deaths), mining and quarrying (1.8% of deaths) and earthquakes (0.7% of deaths). No cause was identified for 3.4% of all landslides.

### 2.2.1 Physical impact

The physical impact of landslides includes the damage to the built environment, and can be classified as affecting residential, commercial, industrial, infrastructure or community service sector (CDRSS, 2006:76). It also includes casualties, that is, deaths and injuries resulting from landslide disaster (Lindell & Prater, 2003:177). Schuster and Highland (2001:2) note that in the twentieth century, death and injuries due to landslide hazards was exacerbated by highly growing population settlements in the landslide prone areas. This trend has continued and as Kjekstad and Highland (2009:574) observe, the perceived rise in landslide casualties is more a function of increased vulnerability of the population as a result of growing urbanization, uncontrolled land use, increased forest clearance and crop growing other than an actual increase in the intensity or frequency of the hazards. The Uganda Minister of State for relief, disaster preparedness and management, Honourable Ecweru, (2011:11) observed that the many natural disaster being experienced at national, regional and global level including the Bududa and Bulambuli landslides were a result of several years of environmental degradation caused by massive tree cutting, clearance of vegetation and wetlands, poor agricultural practices, settlement on steep slopes, first growing population and climate change.

Landslide hazards cause damage to structures and their content (CDRSS, 2006:76), which usually results from the physical damage or destruction of property. It could be that the damage to the contents results from collapsing structures. A significant structural impact of landslides to affected community is the destruction of household dwellings (Lindell & Prater, 2003:177). This is particularly significant in the case of low income households, which tend to be headed disproportionately by females and racial or ethnic minorities (Wisner, 2004:111). Coupled with high social vulnerability perspective, such households are more likely to experience great damage of their homes because of their location in areas of high hazard exposure (Cutter, *et al.,* 2003:243). They are also most affected because they occupy structures which were built

according to older architecture with less stringent building code, low quality construction materials and methods used, and are less well maintained (Bates & Peacock, 1992:135).

### 2.2.2 Social impact

In general, the social impact of disaster can take the form of psychological, demographic, economic or political in nature resulting directly from the physical impact and can be seen immediately or can arise indirectly and develop over shorter to longer periods of chronological and social time frame (Lindell & Prater, 2003:176; CDRSS, 2006:78). The psychological impacts of landslide hazards may include a wide range of psychological responses such as fatigue, gastrointestinal upset, cognitive signs such as confusion, impaired concentration and attention deficit (Bolin, 1985:3-28; Gerrity & Flynn, 1997:102). It also includes emotional signs such as anxiety, depression and grief. Behavioural effects such as sleep and appetite disorder, ritualistic behaviour and substance abuse. As CDRSS (2006:78) notes, in the event of a disaster, few victims may require psychiatric diagnosis, most benefit from crisis counselling orientation especially if the normal social support network of friends, relatives, neighbours and co-workers remain largely intact. A few segments that may require attention and active outreach include children, frail elderly, and people with pre-existing mental illness, racial and ethnic minorities and families of those who have died in the disaster.

Emergency workers may also need special attention because they often work long hours without rest, have witnessed horrific sights and are members of organizations in which discussion of emotional issues may be regarded as a sign of weakness (Rubin, 1991:224). The above negative psychological impacts of disaster generally disrupt the social functioning of a very small portion of the disaster victims in a population. Victims instead, engage in adaptive problem focused coping activities to save their own lives and those of close associates (Drabek, 1986). Pro-social behaviours may include donating material aid and a decreased incident of antisocial behaviours such as crime (Siegel, *et al.*, 1999:289). In other cases people engage in altruistic behaviour that risks their own lives to save others (Tierney, *et al.,* 2001:80).

### 2.2.3 Economic impact

Economic impacts of any disaster can be divided into direct and indirect costs affecting the private and public properties (ECLAC, 2003:10; Committee on Disaster Research in the Social Sciences, 2006:80). The property damage caused by disaster impact creates losses in asset

values that can be measured by the cost of repair and replacement (National Research Council, 1999:8). The direct costs of landslide disasters include the cost of repair, replacement, rebuilding or maintenance resulting from damage to property or installation within the boundaries of the responsible landslide (Schuster & Highland, 2001:1). All the other costs are indirect, and as outlined by Kjekstad and Highland (2009:575) they include:

1. Loss of industrial, agricultural, forest productivity and tourist revenue as a result of damage to land, facilities and interruption of transportation system.

2. Reduction in real estate value in areas under threat by landslides.

3. Loss of tax revenue on properties devalued as a result of landslides.

4. Measures that are required to be taken to prevent or mitigate additional landslide damage.

5. Adverse effects on water quality in streams and irrigation facilities outside the landslides.

6. Loss of human or animal productivity because of injury, death, or psychological trauma Secondary physical effects resulting from landslide-caused flooding for which losses are both direct and indirect.

### 2.2.4 Political impact

According to the Committee on Disaster Research in the Social Sciences (2006:83), disasters can cause social activism resulting into political disruption especially during the seemingly interminable period of disaster recovery. Lindell and Prater (2003:180),argue that disaster victims may experience a decrease in the quality of life associated with poor housing because there are inadequate number of housing units and a delay in movement from temporary shelter to permanent housing. The site characteristics may cause problems because temporary shelter and housing oftentime is far from work, school, shopping and preferred neighbourhood. Conditions on allocation of shelter may be a problem mainly because recovery agencies may impose financial terms, reporting requirements and outside inspection (CDRSS, 2006:83). These complaints may cause political impact by mobilizing victim groups that have a shared identity such as age, ethnicity or a history of past activism (Tierney, *et al.,* 2001:82). According to CDRSS (2006:83), attempts to change the prevailing patterns of government may arise when individuals sharing a grievance about the handling of recovery process seek to redress that

grievance through collective action. Dynes (1994:156) observes that the typology of organizations and existing community groups with different political agenda may expand their membership to increase their strength, whereas community groups without a political agenda may expand their domain to include disaster-related grievances. While Tierney, *et al,* (2001:82) further urge that new groups, such as activist groups may emerge to influence the local state or federal government legislators to take action that they support, and to terminate action that they disprove. Such community groups may also pressure government to provide additional resources for recovering from disaster impact; oppose candidate re-election or seek to recall some politicians from office (Lindell & Prater, 2003:180).

### 2.2.5 Demographic impact

The demographic impact of a disaster according to Smith *et al,* (2001) can be assessed by adopting the demographic balancing equation stated as:

$$<P_a - P_b = B - D + IM - OM>$$

Where:

**$P_a$** – is the population size after the disaster

**$P_b$** – is the population size before the disaster

**B** – Number of births

**D** – Number of deaths

**IM** – is the number of immigrants

**OM** – is the number of emigrants (Smith *et al.,* 2001)

In this case the magnitude of the disaster impact, $P_a - P_b$ is computed for the population of a specific geographical area and two specific points in time. CDRSS (2006:80), however, indicate that there is limited research on the demographic impact of disasters thus suggesting that they have negligible demographic impacts. However, Lecomte and Gahangen (1998:98) note that over 50,000 people migrated out from south Dade County in the aftermath of hurricane Andrew. In many cases though, this emigration was temporary, but in cases where housing reconstruction had been delayed indefinitely it resulted to emergence of “ghost towns” (Comerio, 1997:168). Other potential causes of population emigration are psychological effects

such as belief that the likelihood of disaster recurrence is unacceptably high; economic effects like the loss of jobs or community services; and political effects like increased neighbourhood or community conflict; all these could produce significant demographic impacts at neighbourhood level (CDRSS, 2006:80).

In the case of Bududa landslides, the government of Uganda has considered relocating people to safer areas in fear of more landslides occurring. Edyegu (2010:1) reports that the Office of the Prime Minister (OPM) has so far relocated over 1,300 people to Kiryandongo of over 8,000 people displaced by landslides. The exercise, however, is facing steep resistance from the victims who still value the fertile agricultural land in Bududa, fear to lose their cultural attachment and are uncertain about the new place.

## 2.3 Impact of the Bududa Landslides

### 2.3.1 Deaths and injuries

One of the major consequences of the landslide in Bududa has been the loss of lives. According to the NEMA report, between 1933 and 2010 landslides in Bududa have killed over 516 people (NEMA, 2010:5). Meanwhile several others sustained injuries. The 2010 Bududa landslides alone, killed over 400 people and left thousands homeless. Most of those who died constituted the energetic age group in the parish. They had been very helpful in farm production and transportation of goods on foot to and from Bukalasi Trading Centre since the road to Nametsi parish is not accessible by any other form of transport.

### 2.3.2 Outbreak of disease

The landslide destroyed sanitation facilities such as latrines, and also caused heavy flooding. These resulted in water contamination and some water sources were completely covered by the rubble. According to a study by Atuyambe, *et al.* (2011:11), it was reported that there were inadequate health facilities such as latrines and limited access to safe water. These they concluded left the communities vulnerable to the outbreak of such as malaria, dysentery, cholera, and diarrhoea. Besides, those who sustained injuries from the landslides started to develop tetanus because community members did not have first aid skills to help them. That worsened the already bad conditions especially in the displacement camps attracting the urgent attention of the World Health Organization.

### 2.3.3 Destruction of infrastructure

The landslide which occurred in Nametsi Parish had serious impact on infrastructure in the area. The only health centre in the area with all its contents was completely buried including health personnel was destroyed. According to NEMA report (NEMA, 2011), Nametsi Health Centre III that had been constructed by Compassion International was buried in the rubble by mudslides. That left Bukalasi Health Centre III located three kilometers away,as the nearest facility and Bududa Hospital located 15 kilometers away. The nurses who were on duty at the health centre at the time of the landslide were buried along with it, contributing to loss of skilled manpower. The road network was also covered and rendered impassable by huge stones. Shops, food kiosks, and homes were destroyed and buried by the rubble.

### 2.3.4 Destruction of businesses and personal property

The entire trading centre in Nametsi Village was buried by the rubble from the landslide. Consequently many people lost their businesses, which initially served as their main sources of income and livelihood. Community members who once owned kiosks, shops and other forms of businesses at the trading centre lost them all. Personal property such as stored food and other household items were destroyed and households left homeless.

### 2.3.5 Destruction of farms, farmland and livestock

Landslides destroyed farmland, farm crops and livestock as they got covered with rubble comprised of huge stones. That resulted in food shortages and increased food prices. The community members in the affected parish feared that because of the landslide, there were threats of famine in future. Agriculture was one of the main economic activities and source of livelihood for people in Bududa. Therefore a reduction in the harvest as a result of destruction of farmland could greatly affect the returns for farmers as well as the quality of their life. Many community members also lost their livestock like cattle, goats, pigs and chickens which were all buried by the landslide. The livestock was always sold by households to solve their financial problems such as medical care. Given that agriculture is the mainstay for households around the Mount Elgon region, the destruction of farms and farmland by landslides places people in this region at the risk of famine. Mutuna, (2010:1) reported that landslides had displaced more than 300 people in Kisinga sub county in Kasese district of Western Uganda. No death or injuries were realized, but numerous fields of crops and livestock were destroyed by falling mud. He further stated that over 340 acres of coffee plantations were destroyed by landslides in

Bulambuli in 2011. It was estimated that coffee production went down by 40 metric tonnes resulting in a predicted 10% decline in output for the years 2011/2012. This equally translates to loss in foreign exchange earnings for the country.

### 2.3.6 Displacements and relocation

Because of destruction of homes and houses, many people who were affected by landslides in Bududa became displaced and were temporarily hosted by relatives and neighbours. Atuyambe, *et al.,* (2011:2) observe that the landslides in Bududa had killed over 400 people and left over 5,000 homeless and displaced. The displaced population was temporarily relocated to a camp in Bulucheke sub-county head quarters, seven kilometres from the site of the disaster. According to their assessment Atuyambe, *et al.* (2011:11) conclude that displaced community members in the camps were experiencing harsh living conditions due to continued rain and mud. There was inadequate access to safe water in the camp. Most people were therefore vulnerable to water-related diseases since they used river and unprotected spring water, which was potentially unsafe.

## 2.4 Types of Landslides

Landslide is a term used to cover a wide range of gravity dominated processes that transport earth materials down slope (Msilimba & Holmes, 2005:200). The displacement takes the form of one or more of the three mechanisms: flowing, falling, and sliding (McCall, 1992) which produce a wide range of slope failures in terms of form and behaviour. In some cases, the displacement is achieved in a single, short-lived movement (Gondwe & Govati, 1991) while in other circumstances the movement is gradual, cyclic or pulsed in nature. The displaced materials can create irregular terrain of scars, ridges, humps, hollows (Alexander, 1993) and channel with varied sizes. The various kinds of landslides therefore can be differentiated by the type of material involved, and the mode of movement which may take the form of falling, toppling, sliding, spreading or flowing (United States Geological Survey, 2004:1).

### 2.4.1 Rock Slides

This type of mass wasting or landslide occurs where there is a distinct zone of weakness that separates the slide material from more stable underlying material. Slides are the down slope movements of rock and soil along a slip surface characterised by almost permanent contact

between the moving mass and the slide surface (Bryant, 1991; Alexander, 1993). The most common sub-divisions include *translational* and *rotational* slides. Translational slides are relatively flat or planar movements along surfaces with generally pre-existing slide planes that are activated during the slide event.

While rotational slides are described as having curved surface ruptures, and produce slumps by backward slippage (Alexander, 1993; Smith, 1996). Some rotational slides are multiple regressive phenomena and are termed roto-translation (Alexander, 1993). When the slope is almost horizontal the debris spreads over a wider area; hence, the term lateral spread. Rotational landslides have been observed in Northern Malawi due to deep weathering of the basement (Msilimba & Holmes, 2005:211). They are also common type of landslides experienced on the slopes of Mount Elgon in Uganda (Knapen, *et al*., 2006:157).

### 2.4.2 Rock Falls

Falls are described as free movements of rock material down steep slopes, with no permanent contact of the moving material to the slope surface (Alexander, 1993). Bryant (1991), classifies the movement as turbulent and the reach of the rock fall is in close relation to the angle of internal friction of the moving material, and is defined by the energy line. Falls are common in Zomba Mountain Area of Southern Malawi (Msilimba & Holmes, 2005:211).

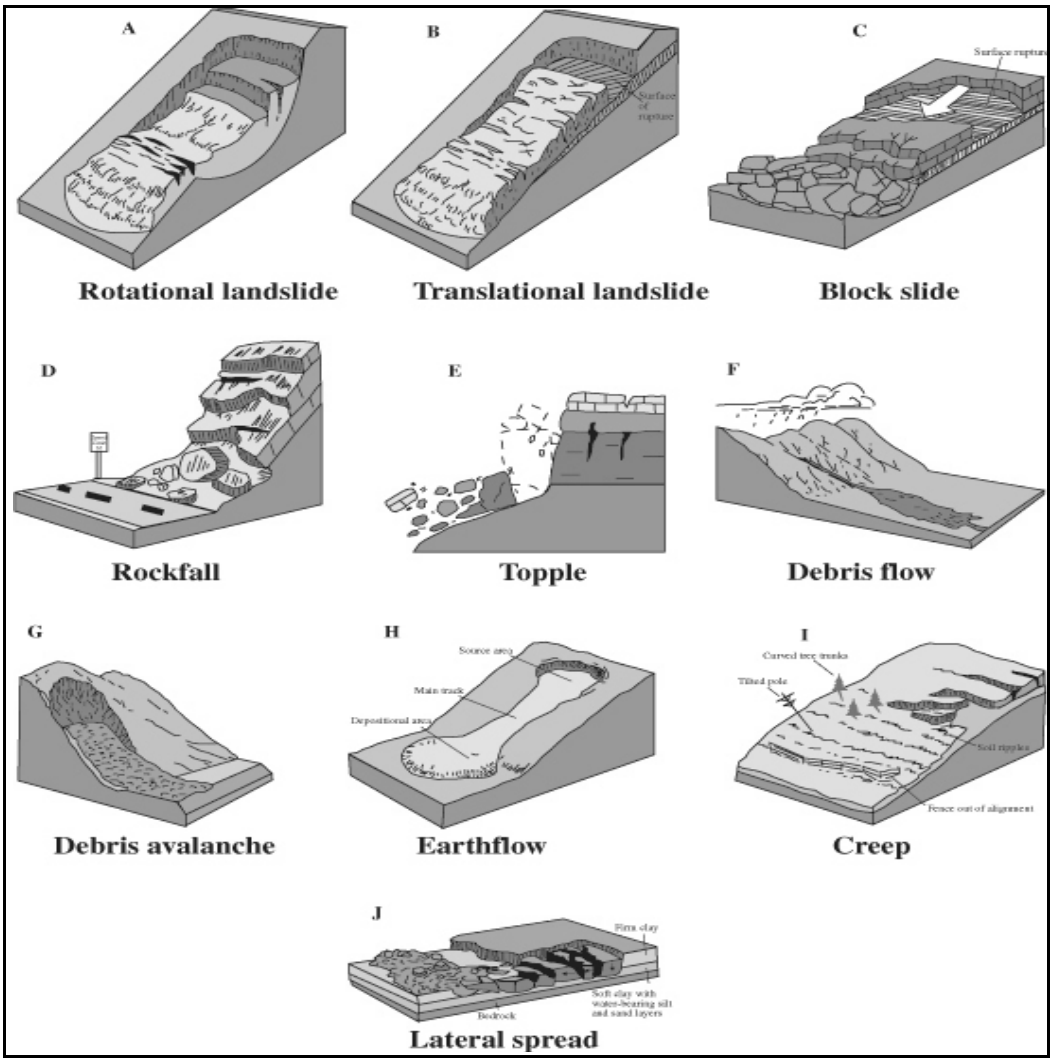



**Figure 12:** Schematic representation of landslide types

**Source:** http://pubs.usgs.gov/fs/2004/3072/images/Fig3grouping-2LG.jpg

### 2.4.3 Topples

Topples are the outward rotation or inward buckling and basal collapse of angular blocks or rock columns that become detached from cliffs (Alexander, 1993). These are usually defined by the intersection of joints or other fractures, and the stability of their base is often disturbed by erosion (Ludman & Koch, 1982). Sometimes toppling is influenced by the presence of water or ice in the crack mass, but the major factor behind them is the gravity exerted by the weight of material upslope. According to Msilimba and Holmes (2005:187), Topples commonly occurred on the slopes of Nyambilo Hills in Southern Malawi.

### 2.4.4 Soil creeping

Soil creeping is a slow, superficial and predominantly seasonal form of land sliding (Alexander, 1993). However, many of the other forms of landslides can undergo creeping, and gradually do serious damage. Soil creeping was observed in Vunguvungu/Banga catchments in Northern Malawi (Msilimba & Holmes, 2005:215).

### 2.4.5 Earth or mud Flows

A flow is a spatially continuous movement in which the surface of shear are short lived, closely spaced and usually not pressured. Flows are down slope movements of viscous masses composed of fluidized soil and other materials. In a flow, the structure of the material changes into quasi – fluid (Bryant, 1991), and the most common type of flow landslide is the debris flow (Corominas, *et al.,* 1996:65). Debris flows are one the most dangerous type of landslide because they often extend far from their sources, moves rapidly and their depositional areas often include inhabited sites. The 1991 Phalombe Landslide (Msilimba & Holmes 2005:199), in Southern Malawi, and the 2010 Bududa landslide in Uganda (Kitutu, *et al.*, 2011:9) are typical examples of debris flows and they are associated with extensive damage to property and life. Other categories of flows include: solifluction, mudflows, and debris avalanches (USGS, 2004).

**TABLE 1: CLASSIFICATION OF LANDSLIDE TYPES**

| Type of landslide | Character or nature of movement | Subdivision | Speed and type of movement |
|---|---|---|---|
| **Falls** | Particles fall from cliff and accumulate at base. | Rock falls | Extremely rapid, develops in rocks. |
| | | Soil fall | Extremely rapid, develops in sediments |
| **Slides** | Masses of rock or sediments slide down slope along planer Surface. | Rock slide (Translational) | Rapid to very rapid sliding of rock mass along a rectilinear or inclined surface |
| | | Slump (Rotational) | Extremely slow to moderate sliding of sediment rocks mass along a curved surface |
| **Flows** | Displaced mass flows as plastic or viscous Liquid. | Solifluction | Very slow to slow movement of saturated regolith as lobate grows |
| | | Mudflow | Very slow to rapid movement of fine grained particles with 30% water. |
| | | Debris flow | Very rapid flow of debris; commonly started as a slump in the upslope area |
| | | Debris avalanche | Extremely rapid flow; fall and sliding rock debris |
| **Creeping** | Regolith soil and rock. | | Extremely slow superficial deposit and the influence of gravity; predominantly seasonal |
| **Complex** | Combination of two or more principle types of movements. | | |

**Source:** adapted and modified from Smith, (2001)

## 2.5 The Landslide Hazards

A hazard, natural or human can be defined as an event, a phenomenon, human activity or agency which has the potential to cause harm, property damage, social and economic disruption or environmental degradation (Living with Risk, 2002:24; O'Hare & Rivas, 2005:240; Baas, *et al.,* 2008:10).

They may include latent conditions that may represent future threats and have different origins. Hazards are characterised by their different locations, intensity and probability; and their potential may be because of its unexpected arrival, extreme nature in terms of its intensity or its duration (Living with Risk, 2002:24). Where communities have evolved, they are able to handle changes in hazard events, which fall within the expected range and accommodate them; this is called the coping range of a society or community. Landslides become hazards when they have an impact on the society or environment because of their extreme nature in timing and scale which may fall beyond the coping range of the affected community rendering it vulnerable (O'Hare & Rivas, 2005:240).

Because of population explosion, urban expansion and changes in the climate patterns, the economic and social costs of landslide hazards will continue to rise, implying increased demand for improved protection against landslides (Jamali & Abdolkhali, 2009:25).

### 2.5.1 Types of hazards

Hazards can broadly be classified as natural or human made. On the basis of origin, hazards can be single, sequential or combined and each hazard is uniquely characterised by its location, intensity and probability of occurrence (Living with Risk, 2002:24). Natural hazards are those that have their origin in natural process over which people have little or no control. These are further categorised as geological, hydrological or biological.

**TABLE 2: CLASSIFICATION OF HAZARDS**

| HAZARD ORIGIN | EXAMPLE / HAZARD TYPE |
|---|---|
| **Geological hazards** | Earthquakes Tsunami or Tidal wave Mass earth movement such as landslides, rockslides, subsidence, surface collapse, geological fault activity. |
| **Hydro meteorological hazards** | Floods, debris and mudflows, storm surges, thunderstorms, hailstorms, rain and wind storms, blizzards and other severe storms, drought, desertification, bush and wild fires, heat waves, sand and dust storms, permafrost, snow avalanches. |
| **Biological hazards** | Outbreaks of epidemic diseases Plant or animal contagions Extensive infestations. |

**Source:** Adapted and modified from Emergency Capacity Building, (2006:15)

## 2.6 Landslide Occurrences and Trigger Factors

There is no single cause of landslides because different conditions usually interact to make the rock or soil susceptible to land sliding (Kitutu, *et al.,* 2009:611). A number of factors affecting the stability directly or indirectly and responsible for the occurrence of landslides broadly include lithology, structure, soil depth, soil texture, geomorphology, slope morphology, slope dip, slope aspect, slope magnitude, weathering, land use and cover, and anthropogenic activities (Singh, 2010:410). The stability of a slope depends on a combined effect of these factors (Pande, *et al.,* 2009:411).

Uniyal (2010:356) observes that Uttarakhand state in India is an extremely vulnerable area to natural disasters, and has suffered from multiple hazards such as earthquakes, landslides, cloudbursts and flash floods. The susceptibility of these areas to landslide hazards is due to its fragile geology, active tectonics, high relief, critical slope and intensive high rainfall. Besides that, the formation of the Himalayas is attributed to the continent-continent collision between India and Asia (Thakur, 2004:1556). This has produced a seismically active segment of the Indian sub-continent and occurrences of landslides are common in such geo-dynamically sensitive belts.

According to Singh (2009:283), slope failures are common in the Himalaya Mountains due to undercutting of slopes by fluvial erosion, shaking during earthquakes and heavy monsoon rainfall leading to saturation and erosion of slopes. Besides, it is also noted by Uniyal, (2010:359) that the unprecedented exploitation of the Himalaya by man's activity combined with its complex geology, physiographic and climate attributes are the trigger factors to a variety of landslides, and mass wasting phenomena in the area. This means that the cumulative effects of the natural factors coupled with anthropogenic activities are a cause of the potential landslides. The high frequency of occurrence in and around human habitation in hilly areas demonstrates that anthropogenic activities in the fragile terrain have contributed to accelerated natural processes and advanced the occurrence of landslides (Uniyal & Prasad, 2006:822). The overall implication is that the increasing settlement, infrastructure facilities and the environment are all prone to risk from landslides hazards.

While evaluating the landslide hazard problem in Hanuman Chatti area in India, Pande, *et al.* (2009:416) concluded in their findings that the major factors that influence slope stability are

lithology, structure, soil depth, soil texture, geomorphology, slope morphology, slope dip, slope aspect, slope magnitude, weathering, land use, land cover and anthropogenic activities. Their study groups landslide hazard prone areas into five classes, that is, very high, high, moderate, low and very low hazard zones. The areas classified as very high hazard zones are those prone to landslide activity at any time and such areas were characterised of steep to very steep slopes, high weathering, high dissection and denudation processes, torrential nature of streams and accelerated anthropogenic activities destabilising the slope. They also observe that the rock formations in such areas as being folded, faulted, fractured and displaced at many places.

O'Hare and Rivas, (2005:240) in their study, observed that the distribution of landslide hazards in the city of La Paz, Bolivia is complex in time and space. They point out that the landslides within the city are influenced by geographical variations in the slope gradient, the nature of the overlying surface deposits and drainage density patterns. In their mapping of the landslide hazards, they conclude that most landslide prone locations coincide with the most mobile surface deposits on higher and steeper slopes. They, however, agree that landslide hazards are triggered when material becomes saturated with moisture from rain, stream water, water seepage from high surrounding water tables and domestic sources.

According to Chan (1998:18), the impact caused by high economic growth rates have resulted in disturbance and change in the physical natural system. The modifications on the hydrological cycles due to desertification, urbanisation, development on hill slopes and other human land use activities have given rise to increased risk of landslide hazards. He observes that the recent occurrence of tragic landslide consequences in Malaysia such as the collapse of the Highland Towers in 1993 which claimed 49 lives, the Genting Highland landslide tragedy in 1995 which killed 20 people and injured 23 others, the 60 landslides in Sepang in 1995 are all a result of environmental degradation following human miscalculation and mismanagement of the forces of nature. On that basis therefore, it can be urged that landslide hazards and disasters occur, because humans choose to occupy hazard zones, mismanage hazards, overdevelop land and deplete natural resources at the rate which the capacity of the natural system cannot cope with and adapt to.

## 2.7 The Concept of Vulnerability

The concept of vulnerability has been interpreted by researchers in many different ways (Levine, 2004:396). According to Tuner, *et al.* (2003:8075), vulnerability refers to the degree to which a system, subsystem or system component is likely to experience harm due to exposure to a hazard either a perturbation or stressor. Households and communities may be exposed to different forms of vulnerability that may include weather related shocks, and natural calamities pests and disease, economic shocks, civil strife, environmental stress, and so forth. In the area of disaster management, a broadly accepted version (Cannon, 2000:1) of explanation is provided by Wisner, *et al.* (2004:11) who argue that vulnerability defines the characteristics of individuals or communities in terms of their capacity to anticipate, cope with, resist and recover from the impact of a hazard. It is therefore, the vulnerability of the community that determines its residents' susceptibility to loss and harm in the event of hazard impact.

Their argument is that, the risk of disaster is a function of the hazard and the vulnerability context including the resilience of items under threat, these therefore means vulnerability denotes the degree to which communities, households, individuals or geographical locations are likely to be affected by a disaster when a hazardous event occurs (Wisner, *et al.,* 2004:11). They propose an approach to vulnerability that takes into account the social, economic, and political environment of disasters. The analytical model that they provide, the Pressure and Release (PAR) model, examines the evolution of unsafe conditions, specifically dynamic pressures such as urbanization and environmental degradation, and the origin of their causes and background explained by the political economy. This model incorporates the temporal dimension, the disruption, not just of the lives and property but also of livelihoods, and the difficulty of rebuilding again in the future (Wisner, *et al*, 2004:50).

Wisner, *et al.* (2004:50) further presents that the concept of vulnerability involves varying magnitudes; some groups of people or households are more prone to damage, loss and suffering more than others. The more vulnerable groups are those that find it hardest to reconstruct their livelihoods following a disaster which in turn makes them more vulnerable to the effects of subsequent hazard events. The key factors behind the varying magnitude of different hazard impacts is determined by the differences in wealth, occupation, ethnicity, gender disabilities and health status, age, immigration status, the nature and extent of social networks. A disaster occurs when a significant number of vulnerable people experience a

hazard and suffer severe damage or disruption of their livelihood system in such a way that recovery is unlikely without external assistance (Wisner, *et al.,* 2004:55).

## 2.8 Vulnerability Factors

Vulnerability relates to the potential and future jeopardy with the implication or likelihood that some kind of crisis may occur that will damage one's health, life or the property and resources on which health and life depends (Tanislas, *et al.,* 2009:133; Anderson, *et al.,* 2011:597). Communities living in hazard prone areas may be made susceptible to negative impacts of the hazards by conditions determined by physical factors, weak social organizations, limited economic opportunities, political processes and other factors within the local environment (Economic Capacity Building, 2006:16). According to Cannon (2000:8), vulnerability is critically linked to the likely severity of a given hazard impacting on people's livelihoods, and this is primarily determined by the social, physical, economic, environmental and political factors, which increase the susceptibility of a community to the impact of hazards (UN-ISDR, 2004:24).

These factors determine the level of resilience of people's livelihoods and ability to prepare and withstand hazards. The same factors, as McEntire (2011:299) observes, are part of daily life and are relevant to the ability of individuals, groups or communities to withstand unforeseen circumstances like natural hazards. Disasters are a result of hazards impacting on vulnerable conditions of people and their livelihoods. Therefore if people can be made less vulnerable then a hazard may still occur, but not produce a disaster (Wisner, *et al.,* 2004:55). This apparently indicates that reducing disaster is possible not only by modifying the hazard conditions, but also by reducing vulnerabilities. The basic determinants of vulnerability are: -

### 2.8.1 Social vulnerability

Social vulnerability is a multidimensional concept that can be used to identify those characteristics and experiences of communities and individuals that enable them to respond to and recover from hazards (Levine, 2004:396). According to Wisner, *et al*, (2004:22), social vulnerability relates to the characteristics identifiable with persons or the groups that lack the capacity to anticipate, cope with, resist and recover from the impact of a hazard. Such a vulnerable population segment, according to CDRSS (2006:73), occupy hazard prone zones, live and work in less hazard resistant structures within those zones, have lower rates of pre-impact intervention such as mitigation, emergency preparedness and recovery. They have lower

rates of post impact emergency and disaster recovery response. Therefore as Lindell and Prater (2003:176) observes, they are more likely to experience casualties, property damage, psychological, demographic, economic or political impacts as direct, indirect or informational effects (CDRSS:2006:73).

Although Cutter, *et al.* (2003:243) agrees that social vulnerability is most often portrayed using the individual characteristics of people such as age, race, health, income, type of dwelling unit and employment status, Wisner, *et al.* (2004:11) and Mallick, *et al.* (2011:228), further point out that social vulnerability is partially the product of social inequalities, which includes those social factors that influence or determine the susceptibility of various groups to harm and that also govern their ability to respond. It also includes place inequalities, that is, the characteristics of communities and the built environment, such as the level of urbanization, growth rates, and economic vitality, which add to the social vulnerability of places (Cutter, *et al.,* and 2003:243).

The social science community, however, agrees that some of the major factors that influence social vulnerability to hazards include: lack of access to resources such as information, knowledge, and technology; limited access to political power and representation; social capital, including social networks and connections; beliefs and customs; building stock and age; frail and physically limited individuals; and type and density of infrastructure and lifelines (Putnam, 1995:66; Tierney, *et al.,* 2001; Cutter, 2003:244; Wisner, *et al*., 2004:22). Other characteristics identify special needs populations that lack the normal social safety nets necessary in disaster recovery, such as the physically or mentally challenged, immigrants, the homeless, transients, and seasonal tourists. The quality of human settlements (housing type and construction, infrastructure, and lifelines) and the built environment are also important in understanding social vulnerability, especially as these characteristics influence potential economic losses, injuries, and fatalities from natural hazards.

Social factors are linked to the level of wellbeing of individuals, households or communities. It considers aspects such as the level of education and literacy, peace and security, access the basic human rights, systems of governance, social equity, positive traditional values, knowledge structures, customs and ideological beliefs and overall organizational system (Wisner, *et al.,* 2004:56; Philo, 2005:442). Lack of awareness and access to information can increase levels of vulnerability (Economic Capacity Building, 2006:18). Disasters can happen because vulnerable people did not know how to heed to warnings, get out of harm or proactive measures.

Some groups of people are more vulnerable than others; the more vulnerable categories include those less privileged in class and cast structures, ethnic minorities, the very old and other disadvantaged marginalised segments of the population. Women, because of their role in the house are more vulnerable in times of disaster (Wisner, *et al.*, 2004:11).

The social factors of vulnerability may be characterised by increased criminal activity, higher incidence of HIV/AIDS, higher rates of children dropping out of school, declining age of prison population, declining public health, deteriorating public infrastructure and migration of skilled professionals (Wisner, *et al.*, 2004:15; Paul, 2005:372,). All this could be symptoms of negative social processes which result in increased social vulnerability.

### 2.8.2 Physical vulnerability

Physical factors encompass the aspects of location and susceptibilities of the built environment. Physical vulnerability is the susceptibility of individuals, households and communities to the physical environment in which they find themselves (Kynia, *et al.,* 2008:4). It relates to aspects such as access to suitable land, land use planning, housing design, building standards, materials used for building houses, accessibility to emergency services. It also entails remotely located settlements, lack of access to service infrastructure and information (Wisner, *et al.,* 2004:56; McEntire *et al.,* 2010:58). Physical vulnerability therefore implies exposure to hazards, living in harmful ways or being in the wrong place at the wrong time.

### 2.8.3 Economic vulnerability

The economic status of nations, communities, households and individuals greatly influence their level of vulnerability. This relates proportionately to higher losses in case of a disaster and lower capacity to recover (Anderson, *et al.,* 2011:596). The poor are more vulnerable than economically better off sectors of the society (Benson & Clay, 2004:5).

The economic factors of vulnerability include levels of reserves, debt, and degree of access to credit and loans as well as insurance. Equally, inadequate access to critical and basic social economic infrastructure such as communication networks, utilities and supplies, and transportation facilities increase people's exposure to risk (Wisner, *et al.,* and 2004:55). Lack of access to basic services such as water, forces people to use unsafe sources for cooking and drinking placing them at risk of epidemics and disease. Alternatively, the absence of electricity or other sources of power will force people to cut down trees for firewood which in turn lead to

environmental degradation hence increasing exposure to flooding and other hazards (Marulanda, *et al.*, 2010:553).

Economic status has influence on people's ability to cope and recover from adverse effects. The rich section of the population may survive the impact of a hazard without suffering any adverse effects or are able to recover quickly (Wisner, *et al.,* 2004:55). The poor on the other hand, are forced to build temporarily in crowded, unsafe dwellings in dangerous locations. Vulnerability is not poverty, but the poor tend to be more vulnerable (Galli & Guzzetti, 2007:650; Kynia, *et al.*, 2008:33).

### 2.8.4 Environmental vulnerability

Ecological factors that influence many disasters are either caused or aggravated by environmental degradation. The creation of drought conditions, for example is a natural phenomenon, but this may be exacerbated by poor cropping patterns, overgrazing, stripping of top soil, poor conservation methods, and depletion of both surface and subsurface water supplies and unchecked urbanization (Nathan, 2008:340, Eeckhaut, *et al.,* 2010:348). The key aspects of environmental vulnerability include the extent of natural resource depletion, state of resource degradation, loss of resilience of the ecological system, loss of biodiversity, exposure to toxic and hazardous pollutants (Wisner, *et al.,* 2004:56).

### 2.8.5 Political vulnerability

Political factors entail a set of deep rooted social economic elements which include denial of human rights, lack of access to power structures, education and employment opportunities, land tenure system, resources, basic service and information (Wisner, *et al.,* 2004:55). All these create and maintain extreme levels of susceptibility to the impact of hazards.

## 2.9 Conceptual Frameworks of Vulnerability

Vulnerability has been defined by different scholars and researchers to encompass different concepts and methods of measurement (Birkmann, 2006:11). These different approaches according to Bogardi and Birkmann (2004:76), show that it is not clear what vulnerability stands for, resulting in various analytical concepts and models that attempt to systemise it. The different concepts and models are essential to the development of methods for measuring and identifying relevant indicators of vulnerability (Downing, 2004:19). Following are different

conceptual frameworks such as the PAR by Wisner, double structure of vulnerability by Bohle, the livelihood framework and the UN-EHS frameworks.

### 2.9.1 The Pressure and Release (PAR) Model

The pressure and release (PAR) model views disaster as the intersection of two major forces, that is those generating vulnerability on the one hand and the natural hazard event on the other. The PAR model approach underlines how disasters occur when natural hazards affect vulnerable people (Wisner, *et al*., 2004:49). The conceptual framework stresses the fact that vulnerability and the development of a potential disaster can be viewed as a process involving increasing pressure on the one hand, and the opportunities to relieve the pressure on the other. The approach is based on the commonly used equation:

***Risk = Hazard x Vulnerability***

This framework defines vulnerability within three progressive levels that is, the root causes, dynamic pressures and unsafe conditions (Figure 9). The root causes can be, for instance, economic, demographic and political processes, which determine the access to and distribution of power and a range of resources. These root causes are also closely linked with the question of good governance, such as the nature of the control exercised by the police and military and the distribution of power in a society (Wisner, *et al*., 2004:50). The dynamic pressure on the other hand encompasses all processes and activities that transform and channel the effects of root causes into unsafe conditions; such may include epidemic diseases, rapid urbanisation and violent conflicts (Wisner, *et al*., 2004:54). The dynamic pressure, however, should not be considered as negative pressure *per se* (Wisner, *et al.,* 2004:50). Root causes finally lead to unsafe conditions, which are a third column of the PAR model approach. Unsafe conditions are specific forms in which human vulnerability is revealed and expressed in a temporal and spatial dimension. These conditions may include lack of effective protection against diseases, living in hazardous locations, or having entitlements that are prone to rapid and severe disruption (Wisner, *et al*., 2004:52).,They further point out that unsafe conditions are dependent upon the initial level of well being and how these level varies between regions, micro-regions, households and individuals (Wisner, *et al,* 2004:55).

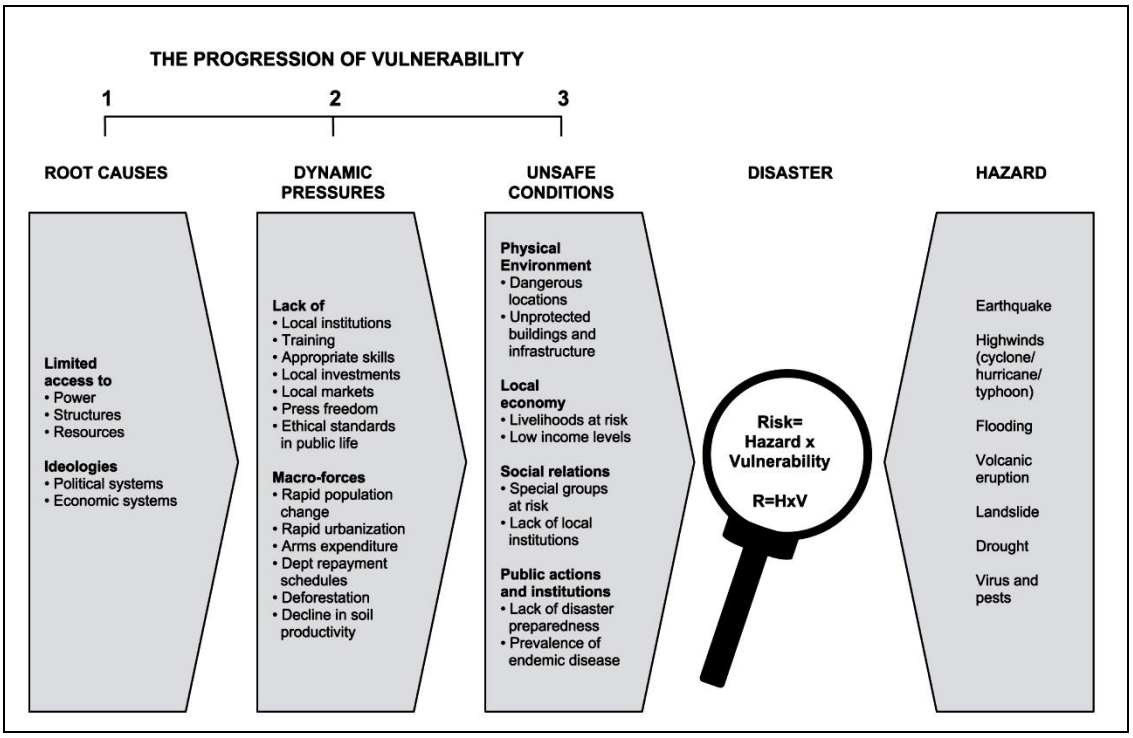



**Figure 13:** The pressure and release (PAR) model

**Source:** Wisner, *et al*., 2004:51

The separation of root causes, dynamic pressures and unsafe conditions highlight the author's view that measuring vulnerability should go beyond the identification of vulnerability, but it should address underlying driving forces and root causes in order to be able to explain why people are vulnerable

### 2.9.2 Sustainable livelihood (SL) framework

The key elements of this framework are the five livelihood assets or capitals, that is, human, natural, financial, social and physical capital. The vulnerability situation is viewed as shocks, trends, seasonality, and the influence of transforming structures for the livelihood strategies and their outcomes. The sustainable livelihood framework involves two major terms, sustainability and livelihoods. Livelihoods are viewed as the means of gaining a living, encompassing livelihood capabilities, tangible and intangible assets. Within the livelihood framework, the term sustainability is often linked to the ability to cope with and recover from stresses and shocks as well as to maintain the natural resource base (Chambers & Conway, 1992; DFID, 1999).

The framework (Figure 10) lays emphasis on the transforming structures in the governmental system or private sector and respective processes such as laws and culture that influence the vulnerability context, and determine both the access to, and major influences on livelihood assets of people. The approach underlines the necessity of empowering local marginalized groups in order to reduce vulnerability effectively (DFID, 1999; Schmidt, 2005). A central objective of the framework is to provide a method that views people and communities on the basis of their daily needs, instead of implementing ready-made or general interventions and solutions, without considering the various capabilities that the poor people may propose (De Haan & Zoomers, 2005:28).

The framework links with the various categories used in the disaster risk community such as hazard, exposed and at risk elements, driving forces or root causes, likely outcomes and responses. The various shocks comprise hazard components while the five livelihood assets could represent elements that are exposed and susceptible. The transforming structures and processes in other frameworks are seen as the root causes, dynamic pressures or driving forces as in the case with the PAR model. The livelihood strategies and outcomes can be viewed as a mixture of intervention and response elements. However, the understanding of vulnerability in the sustainable livelihood approach is very broad, also encompassing the hazard sphere (Baas, *et al.,* 2008:9).

The sustainable livelihood framework can be used to provide an insight and analysis to identify which type of households are likely to be particularly vulnerable to the impact of hazards. This framework is developed based on the analysis of the interrelationship between shocks, vulnerabilities, households' bundles of assets and coping mechanisms. The framework puts households and their livelihoods at the centre of analysis assuming that they are contentiously influenced by potential threats of shocks and disaster (Baas, *et al.,* 2008:9).

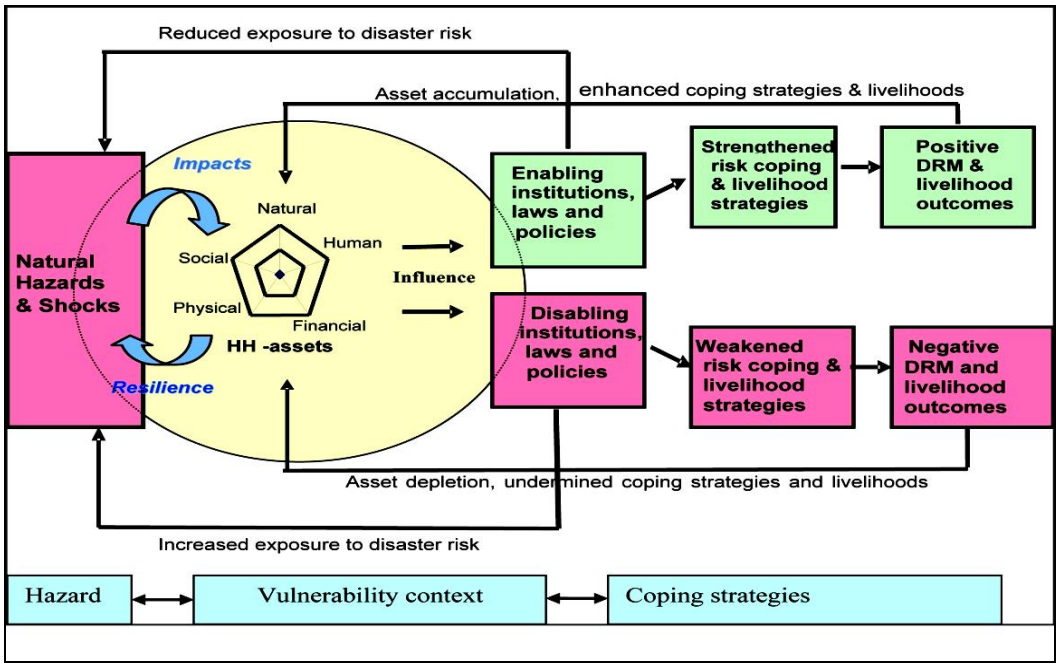



**Figure 14:** Sustainable livelihood framework

**Source:** Baas, *et al.,* 2008:11

According to this framework (Figure 10), vulnerabilities of different kinds form the core part of the overall context within which development takes place. They contend that the stock of assets owned by households, social groups, communities and institutions ultimately determine the ability of those households, social groups and communities to cope with disaster before, during and after their occurrence (Baas, *et al.,* 2008:10). The sustainable livelihood framework represents a cause – effect model for understanding the situation faced by poor households basing on the relationship between household assets, the vulnerability context and institutional processes which shape their lives.

The proponents of the framework also urge that, whereas some hazards may affect members of the community to a similar degree, households with greater assets may have the means to adopt more effective coping mechanisms that can prevent a hazard turning into a disaster. The framework puts focus on how effective community and higher level institutions can cushion the effect of a disaster on poor households by mobilising both community and outside action for the benefit of the most vulnerable (Baas, *et al.,* 2008:10).

In terms of household resilience, the sustainable livelihood perspective urges that households with a large stock of assets (livelihood) will be more resilient to hazards than the relatively less

asset households. The stock of assets could be drawn by households in the form of reserves to purchase food, restock or to enable educated households to migrate temporarily for employment in other areas (Baas, *et al.,* 2008:10). Although resilience is not the central concept within the framework, resilient individuals or communities could be considered to be those with a sustainable livelihood (Fitzgerald & Fitzgerald, 2005:16).

### 2.9.3 The BBC Framework

The term ‘‘BBC’’ is connected to the conceptual work done by Bogardi and Birkmann (2004) and Cardona (2001), which provides a basis for this framework. It grew from three different discussions seeking to link vulnerability, human security and sustainable development (Bogardi & Birkmann 2004); develop a holistic approach to disaster risk assessment (Cardona, 2001); and expand the debate on developing causal frameworks for measuring environmental degradation in the context of sustainable development.

According to this framework, various vulnerabilities are addressed on the basis of social, economic and environmental context. The framework stresses that vulnerability analysis goes beyond the estimation of the deficiencies and the assessment of the disasters in the past. It emphasises the necessity to view vulnerability within a processes focusing simultaneously on vulnerability, coping capacities and potential intervention tools to reduce vulnerabilities. It views vulnerability in terms of the susceptibility and the degree of exposure of elements at risk as well as their coping mechanisms (Birkmann, 2006:1).

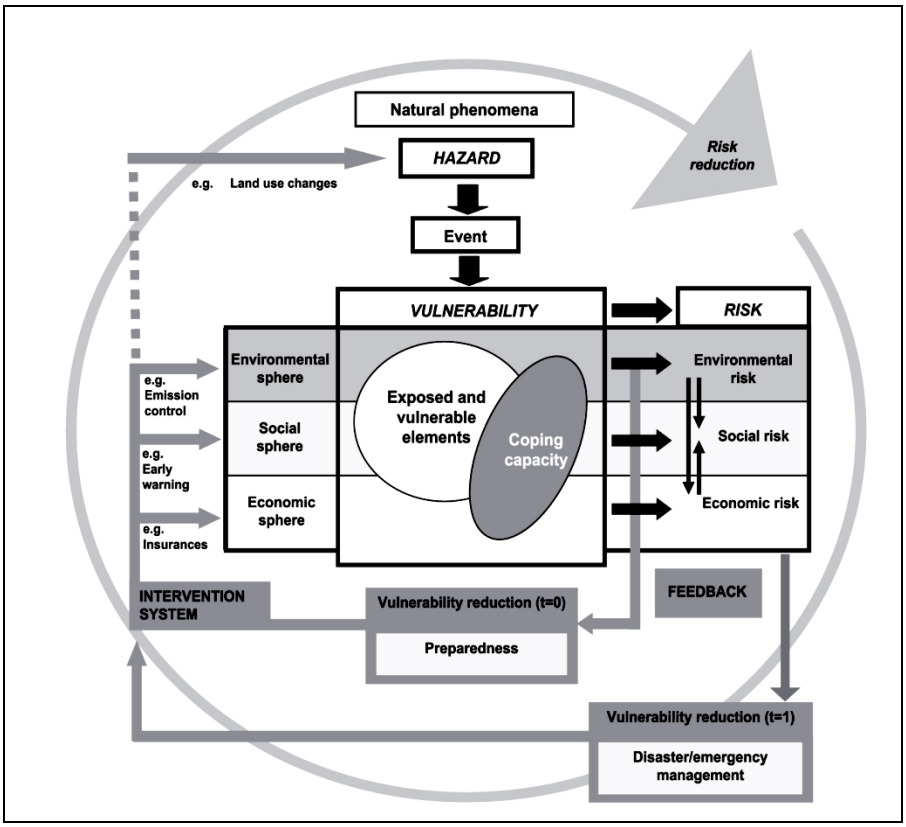



**Figure 15:** The BBC conceptual framework.

**Source:** Birkmann 2004:35

The BBC framework through the linkages between sustainable development and vulnerability underlines the necessity to give due consideration to the environment on which human conditions depend. The concept promotes a problem-solving perspective by analysing possible losses and deficiencies of the various elements at risk, the coping mechanisms and the potential interventions measures. The development of vulnerability indicators and the assessment of vulnerability should address both susceptibility and exposure of different elements at risk on the basis of social, economic and environmental spheres. Besides it should also identify and assess coping capacities and the potential intervention tools (Birkmann, 2004:2).

### 2.9.4 The access to resources and coping model

The access model deals with the amount of access that people have to the capabilities, assets and livelihood opportunities that will enable them to reduce their vulnerabilities, and avoid

disasters (Wisner, *et al.,* 2004:88). The framework puts focus on the way unsafe conditions arise in relation to the economic and political processes that allocate assets, income and other resources in the society. It explains the relationship between natural events and the social processes that generate unsafe conditions. The model aids in explaining the complex and varied sets of social and environmental events together with the long processes associated with a disaster (Wisner, *et al,* 2004:88). It points out that there are generally shared characteristics in the way vulnerability is generated, how the trigger events and the unfolding of disaster have its impact. At the micro level it explains the establishment and trajectory of vulnerability and its variations between individuals and households. It deals with the impact of a disaster as it unfolds, the role and agency of people involved, how they are impacted, how they cope, develop recovery strategies, and interact with other actors (Wisner, *et al*., 2004:88).

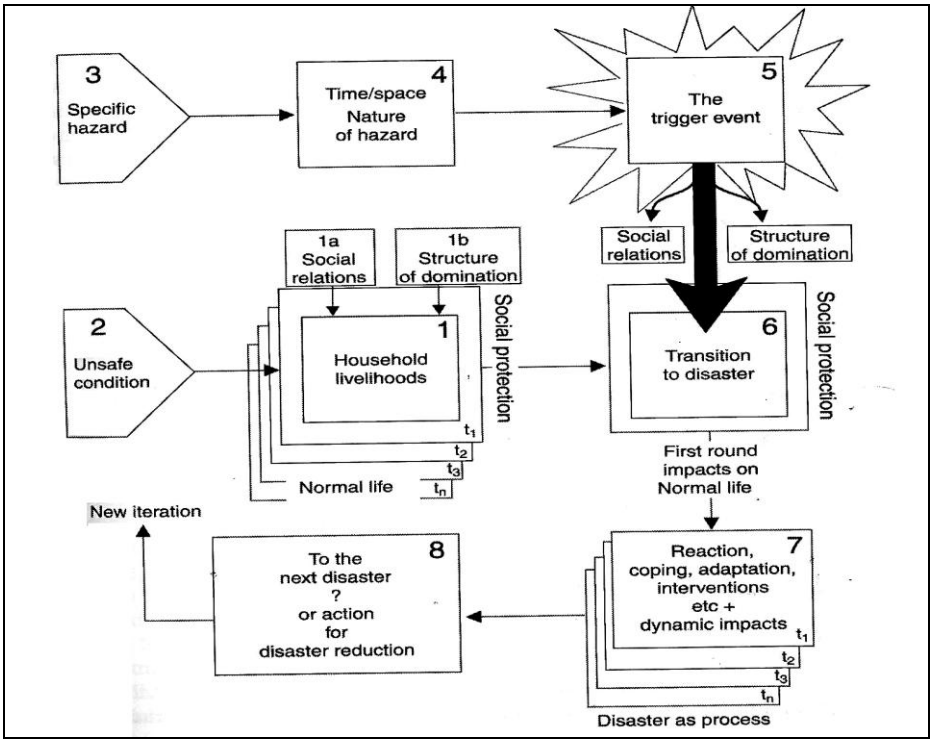



**Figure 16:** The Access to resources and coping model

**Source:** Wisner, *et al*., 2004:89

The access model involves the ability of an individual, family, group or a community to use available resources to secure livelihood in normal pre-disaster times and their ability to adapt to

new and threatening situations. At the household level, each individual has an initial state of well-being defined by physical abilities to withstand shocks, prolonged periods of stress and deprivation specific to a particular disaster of hazard. The access to resources may include land, livestock, reserves of food, specialised knowledge and skills, which can be used to avert the impact the hazards (Wisner, *et al.,* 2004:94).

### 2.9.5 Bohle's conceptual framework for vulnerability analysis

According to Bohle (2001:118), vulnerability is seen as having an external and an internal side. The internal side, that is, coping, relates to the capacity to anticipate, cope with, resist and recover from the impact of a hazard, while the external side involves exposure to risks and shocks. In social sciences the distinction between the exposure to external threats and the ability to cope with them is often used to underline the double structure of vulnerability (Van Dillen, 2004). Based on the social geography perspective and the intensive famine research carried out by Bohle (2001:119), the double structure model underlines the fact that vulnerability is a result of interaction between exposure to external stressors and the coping capacity of the affected household, group or society. The framework defines and identifies vulnerability as a potentially detrimental social response to external events and changes such as environmental change. The Bohle's conceptual framework (Figure 13) describes exposure to hazards and shocks as a key component of vulnerability itself.

Viewed in this way, the term exposure goes beyond mere spatial exposure; it also encompasses features related to the entitlement theory and human ecology perspective. Within the debate of social vulnerability the term exposure also deals with social and institutional features, meaning processes that increase defencelessness and lead to greater danger, such as exclusion from social networks. These alter the exposure of a person or a household to risk (Cannon, *et al*., 2003).

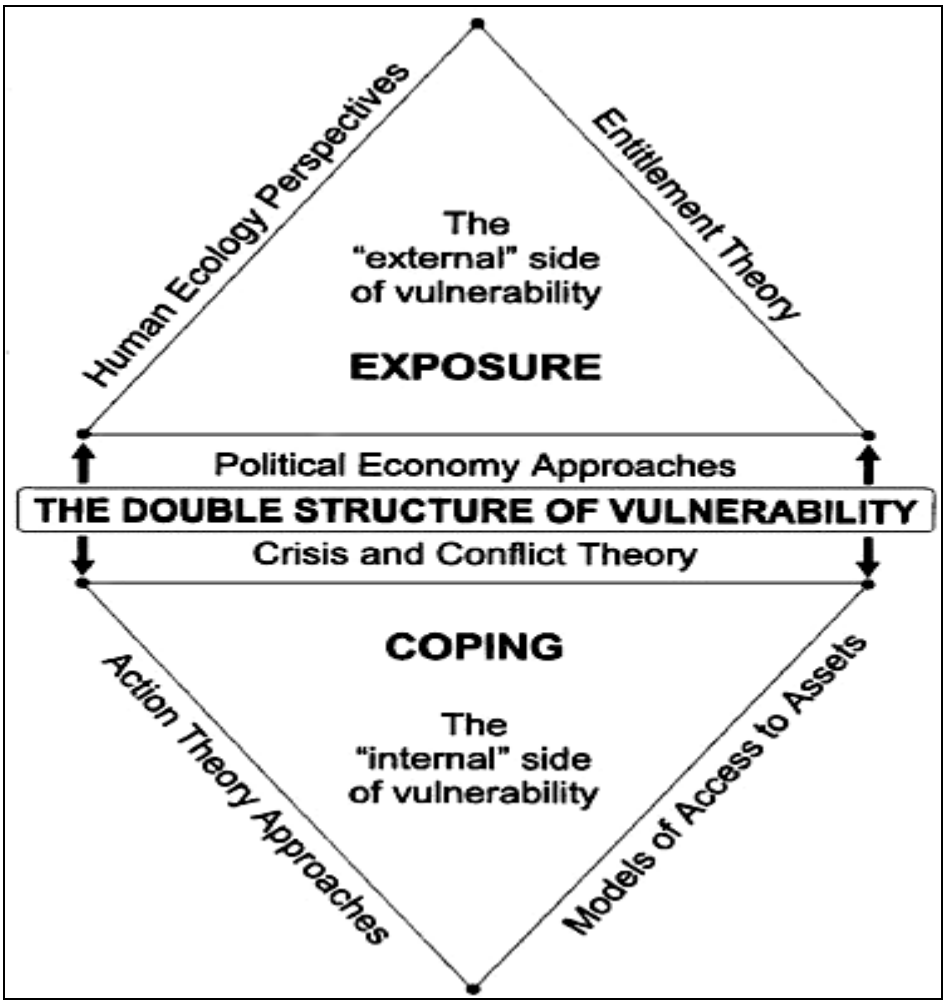



**Figure 17:** Bohle's conceptual framework for vulnerability analysis.

**Source:** Bohle, 2001.

However, the conceptual framework of the double structure indicates that vulnerability cannot adequately be characterised without simultaneously considering coping and response capacity, defined here as the internal side of vulnerability.

### 2.9.6 The International Strategy for Disaster Reduction (ISDR) framework for disaster risk reduction

According to the UN/ISDR framework, vulnerability is viewed as a key factor determining risk. They argue that vulnerability can be classified into social, economic, physical and environmental components (see Figure 14). The vulnerability assessment process is understood as a tool and a requirement for effective risk assessment (UN/ISDR, 2004:14–15). Although the framework

provides an important overview of different phases to be taken into account in disaster risk reduction, such as vulnerability analysis, hazard analysis, risk assessment, early warning and response, it does not indicate how reducing vulnerability can also reduce risk. It only places vulnerability outside the risk response and preparedness framework, making it difficult to understand the necessity of reducing risk through vulnerability reduction and hazard mitigation.

According to this conceptual framework risk and vulnerability cannot be reduced directly (Birkmann, 2006). The arrows from vulnerability and hazards only point out into the direction of the risk analysis while the opportunity to reduce the vulnerabilities themselves is not explicitly shown. The framework underlines the fact that early warning, preparedness and response could reduce the disaster impact, even though a link between the risk factors and the application of risk reduction measures is not included. Moreover, the conceptual framework does not give an answer as to whether exposure should be seen as a feature of the hazard or of the vulnerabilities.

On the UN/ISDR report, Living with Risk (UN/ISDR, 2004:16), physical vulnerability is seen as the susceptibility of location. This may be interpreted as a sign that physical vulnerability encompasses spatial exposure (UN/ISDR, 2004:42). The report further differentiates between coping capacity and capacity. Capacity is understood as all the strengths and resources available within a community, society or organization that can reduce risk, while coping capacity is the way in which people or organizations use available resources and abilities to face adverse consequences of a disaster (UN/ISDR 2004:16). This indicates that there is a need for one to consider the fact that potentially available capacities and applied capacities are different with regard to disaster risk reduction.

Additionally, the UN/ISDR conceptual framework places vulnerability and the disaster risk reduction elements within a framework called the ‘‘sustainable development context’’ (Figure 14). This is meant to underline the necessity of linking risk reduction and sustainable development, which means risk reduction strategies, should promote sustainable development by making the best use of connections among social, economic and environmental goals to reduce risk (UN/ISDR, 2004:18). Birkmann (2006), however, points out that although it is important to link risk reduction with sustainable development, the perception that risk reduction is similar to and compatible with sustainable development is inadequate. In practice, vulnerability reduction and sustainable development are confronted with deeply rooted social,

economic and environmental conflicts, which cannot be wished away through a simple balancing exercise (Birkmann, 2006).

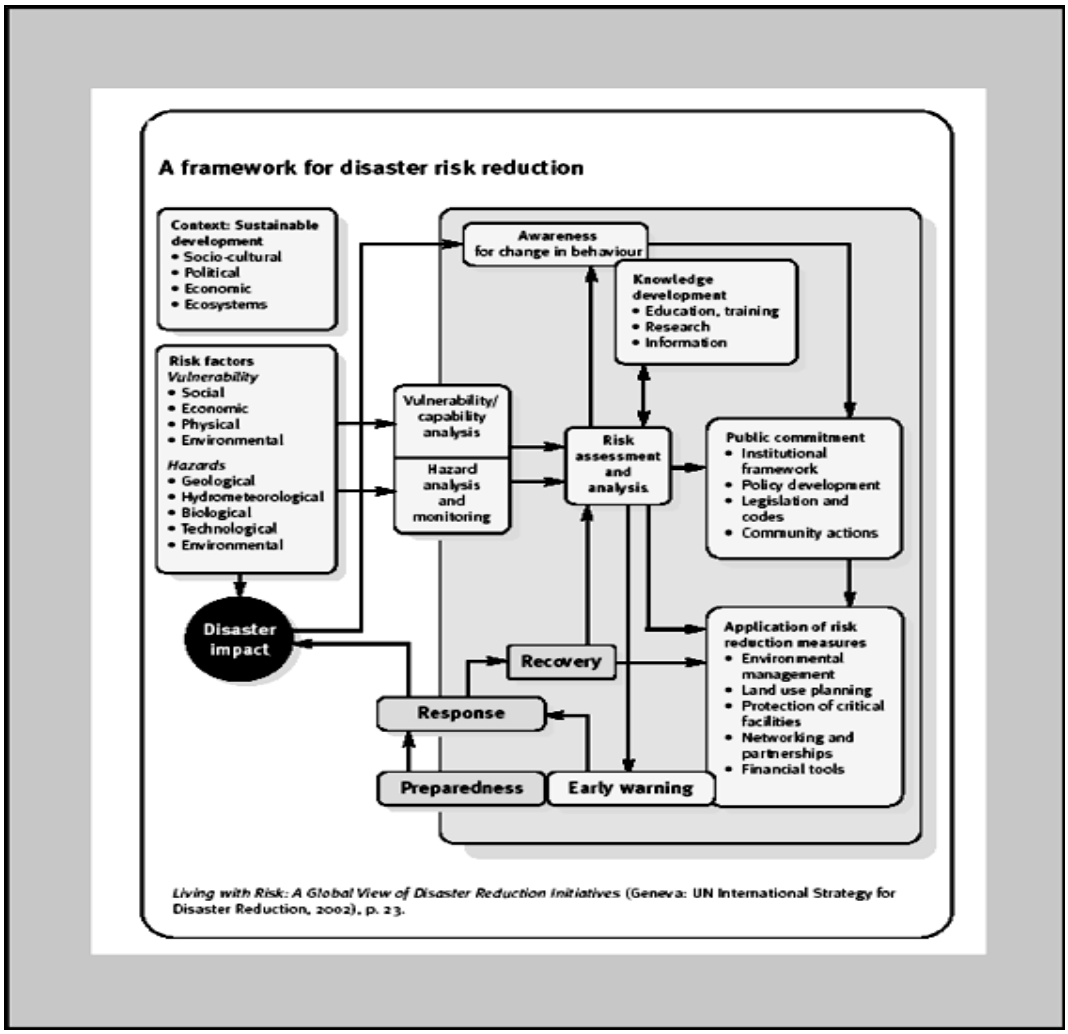



**Figure 18:** The International Strategy for Disaster Reduction (ISDR) framework for disaster risk reduction.

**Source:** UN/ISDR, 2002:23.

### 2.9.7 The onion framework

This was developed by the UNU-EHS. The onion framework defines vulnerability with regard to different hazard impacts in relation to the economic and social spheres. The impact of a disaster and the resultant vulnerability are illustrated using the example of floods. The framework provides a distinction between a reality axis and an opportunity axis. The reality axis shows that

a flood event could affect the economic sphere and cause flood damage, while if the impact of the flood caused huge additional disruption in the social sphere, a disaster would occur (Figure 15). The model shows that, economic assets can be replaced, but the disruption of the inner social sphere of a society would result in to long term injuries and losses, which in this model are primarily associated with vulnerability. Different capacities exist within the centre of the social sphere (C1–C3), which means that whether a flood event becomes a disaster or not depends almost as much on the preparedness and coping capacity of the affected society other than on the nature of the flood event itself (Bogardi & Birkmann, 2004:76). While C1 shows the fact that although the social sphere is affected, there still exist adequate coping capacities. An impact of the flood event on the inner circle of the social sphere C3, however, would imply that social capacities are totally inadequate to deal with the flood event, thus leading to the occurrence of a disaster (Bogardi & Birkmann, 2004:75).

The onion vulnerability framework (Figure 15) relates the terms, risk and vulnerability, to potential losses and damages caused in the three different spheres. The model emphasizes that vulnerability deals with different loss categories, such as economic and social losses. This means it stresses the fact that if a community or a person's losses go beyond economic losses, for example extending to loss of confidence and trust, the flood event has reached the intangible assets. This implies a serious disruption of the functioning of the society to the point that vulnerability becomes evident.

According to this framework, the more comprehensive concept of social vulnerability should incorporate the monetary dimension that is the likelihood of economic harm as well as intangibles like confidence, trust and fear as potential consequences of the flood. Furthermore, the onion framework shows potential response activities related to the different spheres. Finally, one has to remark that the onion framework does not account for environmental vulnerability. It defines the environment primarily as the event sphere. The aspect of exposure is also not specifically incorporated (Birkmann, 2006).

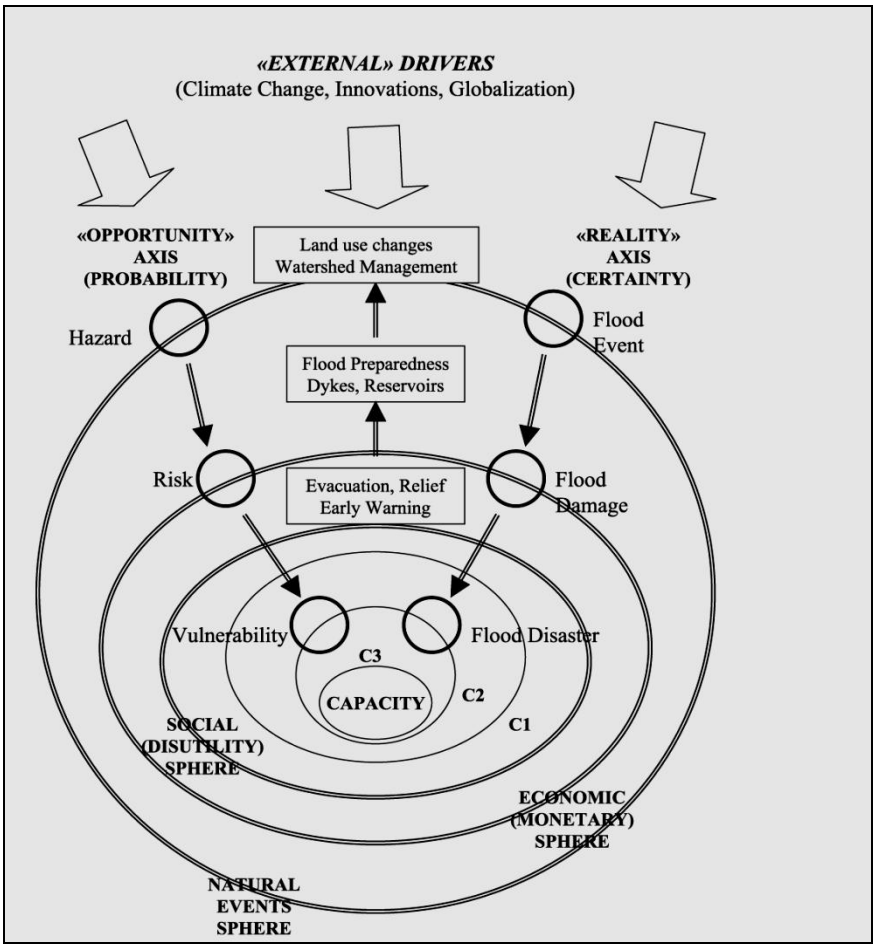



**Figure 19:** The onion vulnerability framework.

**Source:** Bogardi/Birkmann, 2004:78.

### 2.9.8 Vulnerability in the global environmental change community

This conceptual framework was developed by Turner, *et al.* (2003:8077), and is considered as being a representative of the global environmental change community. Their definition and analytical framework of vulnerability includes exposure, sensitivity and resilience. According to this model, vulnerability is viewed in the context of a joint human environmental system (Turner, *et al*., 2003:8075; Kasperson, 2005:14). This conceptual framework defines exposure, coping response, impact response and adaptation response explicitly as parts of vulnerability (Figure 16). The framework also takes into account the interaction of the multiple interacting perturbations, stressors and stresses (Turner, *et al*., 2003:8075). This framework further examines vulnerability within the broader and closely linked human environment context (Turner, *et al*., 2003:8076; Kasperson, 2005:14) and takes into account the concept of

adaptation, which is seen as an element that increases resilience. Birkmann (2006), however, points out that the model leaves out some questions unanswered such as whether the distinction between drivers and consequences in the feedback-loop system is appropriate.

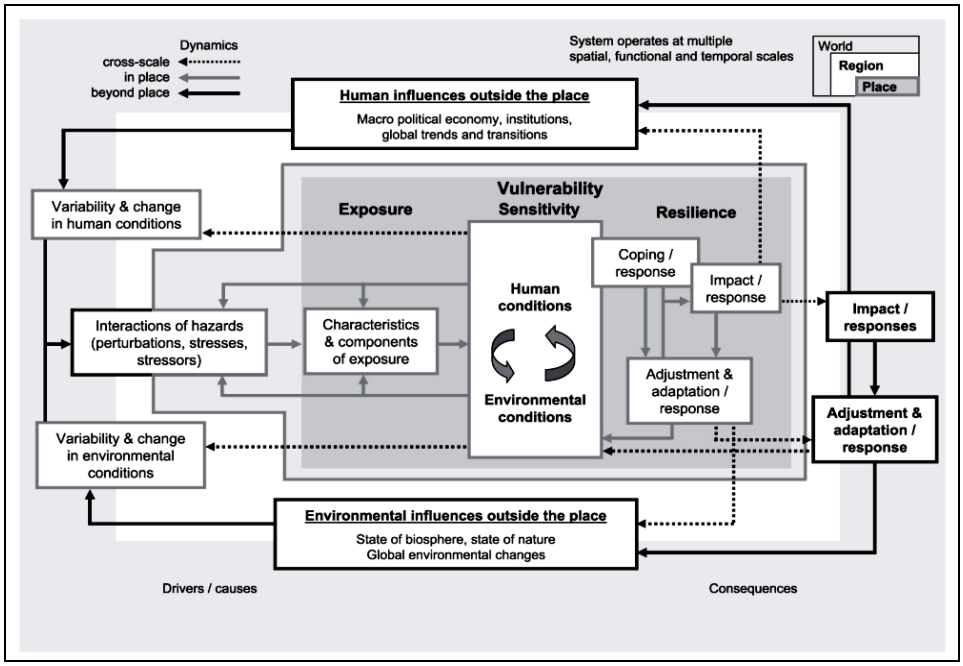



**Figure 20:** Vulnerability in the global environmental change community framework.

**Source:** Turner *et al.,* 2003:8076.

### 2.9.9 A holistic approach to risk and vulnerability assessment

The conceptual framework for a holistic approach to evaluating disaster risk is attributed to the work of Cardona and his developments with Barbat in 2000. In their first concept, vulnerability is seen to consist of exposed elements that take into account several aspects of vulnerability characterized by three vulnerability factors which include:

1. Physical exposure and susceptibility, which is designated as hard risk and viewed as being hazard dependent.
2. Fragility of the socio-economic system, which is viewed as soft risk and being non hazard dependent.
3. Lack of resilience to cope and recover, which is also defined as soft risk and being non hazard dependent (Cardona, *et al.,* 2003).

According to this framework vulnerability conditions depend on the exposure and susceptibility of physical elements in hazard-prone areas on the one hand, and on the other, the socio-economic fragility as well as on the lack of social resilience and abilities to cope. These factors provide a measure of the direct as well as indirect and intangible impacts of hazard events. The framework emphasizes the fact that indicators should measure vulnerability from a comprehensive and multidisciplinary perspective. They should capture conditions for the direct physical impacts that is, exposure and susceptibility; as well as for indirect and at times intangible impacts, socio-economic fragility and lack of resilience of potential hazard events. Therefore the approach defines exposure and susceptibility as necessary conditions for the existence of physical risk (hard risk). The likelihood of experiencing negative impacts, as a result of the socio-economic fragilities and inability to cope adequately are also vulnerability conditions, which are understood as soft risk (Barkmann, 2006).

This framework suggests a broader understanding of vulnerability, encompassing exposure, susceptibility and lack of resilience. The consequences of the interaction of the hazardous events and vulnerabilities are defined as risks from which a feedback loop starts: it encompasses a control and an actuation system that represent risk management organization, corrective and prospective interventions. The feedback loop starts after the risk has become evident (Cardona, *et al.,* 2003).

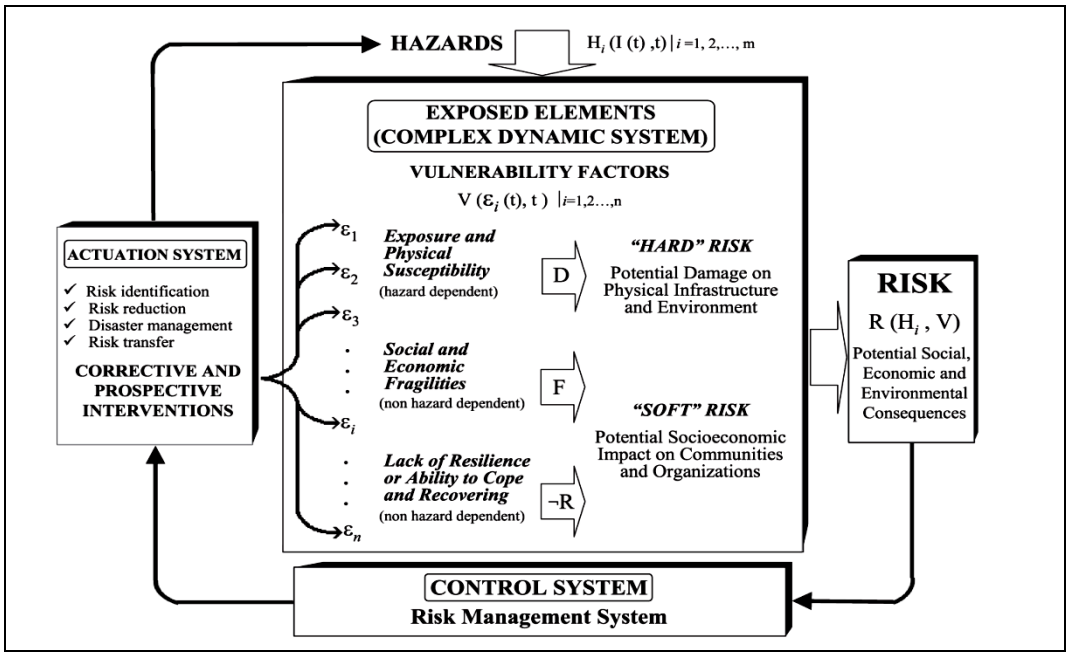



**Figure 21:** Theoretical framework and model for holistic approach to disaster risk assessment and management.

**Source:** Cardona & Barbat, 2000.

## 2.9 Resilience to Hazards

The concept of resilience has been widely used across many disciplines in the social and biomedical sciences (Almedom, 2008:5). Originally developed as an ecological concept (Holling, 1973:174), resilience is being used increasingly in the field of human – environment interactions, including disaster management and vulnerability reduction of natural hazards (López-Marrero & Tschakert, 2011:229). Generally, resilience implies both the ability to adjust to normal or anticipated levels of stress and to adapt to sudden shocks and extra ordinary demands (Galadon, *et al.,* 2008:21). Within the context of natural hazards, resilience emphasizes the multiple ways a system can respond to hazard occurrence, including its ability to absorb hazard impacts, to learn from, adapt to and recover from them, and to reorganize after impacts (López-Marrero & Tschakert, 2011:229). In other words, a resilient system is able to absorb hazard impacts without changing its fundamental functions, at the same time, it is able to renew, reorganize and adapt when hazard impacts are significant. Renschler, *et al.* (2010:1), note that hazard resilience covers both pre-event measures that seek to prevent hazards

related damage and losses while post event strategies are designed to cope with and minimise disaster impacts.

According to Holling (1973:17), resilience determines the persistence of relationships within a system, and is a measure of the ability of these systems to absorb change of state variable, driving variables, and parameters, and still persist. He observes that resilience goes beyond recovery to advocate anticipation and preparedness in the face of natural hazards. Therefore, linkages and collaborations between community members and emergency managers need to be more effectively developed. As defined by the UN-ISDR (2002:24), resilience refers to the capacity of a system, community or society to resist or to change in order that it may obtain an acceptable level in functioning and structure. Tumwine and Almedom (2008:1) view resilience as a multi-dimensional construct referring to the capacity of individuals, families, communities, systems and institutions to anticipate withstand and engage with catastrophic events actively making meaning with the goal of maintaining normal functioning without fundamental loss of identity. At an individual level, human resilience is a normal and common response to adversity while at family and community levels the capacity to anticipate withstand and maintain normal functioning following a disaster is mediated by right type, timing and level of social support of which international humanitarian assistance is one form (Almedom, 2008:7).

Disaster resilience according to Bruneau, *et al.* (2003:18), is the ability of social units such as organizations and communities to mitigate hazards, contain the effect of disaster and carry out necessary activities in ways that minimise social disruption while also mitigating the effects of future disasters. They further urge that, if the critical services and capital of a community are not resilient in the face of severe economic and natural disturbance, the result will likely be a disaster and serious impairment of livelihoods (Bruneau, *et al.,* 2003:18).

Resilience to hazards emphasizes building human capacity to improve the anticipation of, preparation for and mitigation of such hazard (Kaplan, 1999, López-Marrero & Tschakert, 2011:230). Enhancing community resilience has been identified as a central element of disaster management, risk reduction and efforts to reduce vulnerability (Adger, 2005:349). The main aim here is to identify ways in which exposed communities can better anticipate, mitigate, prepare for and cope with the occurrence of present and future hazard events. This means that resilience encourages managing hazards instead of merely controlling them. Renschler, *et al.* (2010:4), remark that disaster resilient communities have a hallmark of strength, flexibility and the ability to cope with, and overcome extreme challenges. Such communities, they observe,

are characterised by reduced failure probability, that is, reduced likelihood of damage and failure of critical infrastructure systems and components, reduced sequence of failure in terms of injuries, lives lost, damage, negative economic and social impacts. Resilient communities equally, have reduced time of recovery, that is, the time required to restore a specific system or set of systems back to normal or pre-disaster level of functioning (Renschler, *et al.,* 2010:5). Disaster resilience therefore requires established standard measures to state resilience, define its dimensions and measure improvements in resilience.

Glandon, *et al.* (2008:24) in their study on resilience in the post Katrina disaster observed that resilience is more than just the absence of post traumatic stress disorder (PTSD), but its wide spread and in the wake of a disaster its widely driven by the instinct of adaptation. They applied the "sense of coherence" (SOC-13) concept and its corresponding scales to measure resilience in a post disaster setting. Their findings show that long-term displacement has a deleterious effect on human resilience, which suggest that home is an important asset in building resilience with adversity because it is the core of individual, families and community's rootedness. They recognise in their study that grass root organizations that promote coherence play a very important role in building and promoting community resilience.

According to Chandra, *et al.* (2011:3), community resilience or the sustained ability of a community to withstand and recover from adversity has become a key policy issue which is embraced at federal, state and local levels. They observe that it is increasingly recognised that resilience is critical to a community's ability to reduce long recovery periods after an emergency. They identified what they have called key components of community resilience that affect both pre-event vulnerability to disaster and adaptive capacity to recover. These include the physical and psychological health of the population, social and economic well-being, individual, family and community knowledge and attributes regarding self resilience and self help; effective risk communication; level of social integration of government and nongovernmental organizations in planning, response and recovery; and the social connectedness of community members (Keim, 2008:514).

In their study Chandra, *et al*. (2011:4) identified eight levers which have been built on the core components, and these are then expanded into an applied framework for building community resilience. They include wellness and access which contribute to the development of the social and economic well-being of a community; education; which can be used to provide effective risk communication; while engagement and self sufficiency are needed to build social

connectedness. Partnership on the other hand helps engage governmental and nongovernmental organizations, while quality and efficiency are ongoing levers that cut across all levers and core components of community resilience (Chandra, *et al*., 2011:4).

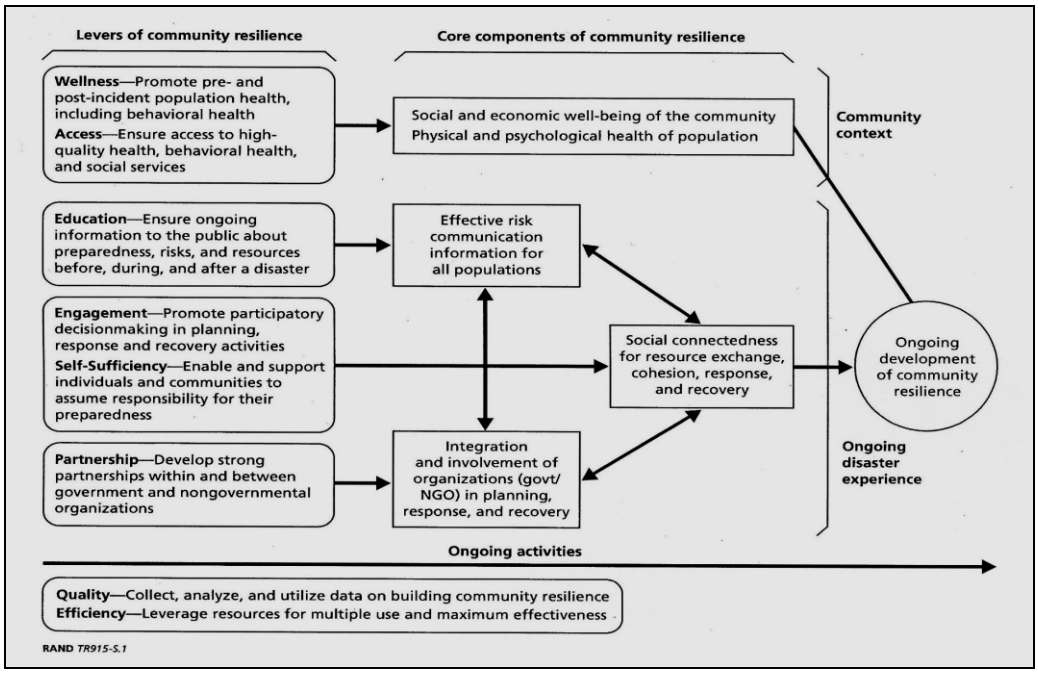



**Figure 22:** Levers and components of community resilience
**Source:** Chandra, *et al*., 2011:4

Figure 18 above shows that as activities related to levers strengthen each of the components of community resilience, the community moves closer to achieving resilience shown in the circle because developing resilience is an interactive and ongoing process (Chandra, *et al.,* 2011:10).

Based on the work of Folke, *et al.* (2002:439), on resilience of social-ecological systems, Berkes (2007:289) points out different elements that support community resilience to hazards. These elements are interrelated and they include; learning to live in hazardous, changing and uncertain environments; that is, the process of adaptation. Adaptation according to Smit and Wandel (2006:285), refers to the actions a system undertakes to better cope with, adjust to or manage hazards. They further explain that these actions are attained through social memory, the lessons that have been learned from past disasters, from accumulated experience and hazard knowledge, and from reorganization after prior disturbance events, which could include outside assistance.

Using all kinds of knowledge for learning and adaption, this reflects the process of social learning, which is key to enhancing adaptive capacity and hence resilience. They define social learning in their study as learning to develop common knowledge, awareness and skills by engaging multiple participants, sharing diverse perspectives, thinking and acting together. This according to Surjan and Shaw (2009:419), involves identifying existing knowledge for example what to adapt to, hazard characteristics, tested strategies and management options for different stakeholders and bringing this knowledge together to allow for the identification of gaps in information. This also allows for a common understanding of processes that promote social learning. Social learning therefore involves refining existing knowledge and generating new knowledge, which can then be used to guide planning for future actions toward hazard mitigation and preparedness (López-Marrero & Tschakert, 2011:244).

Nurturing diversity and flexibility according to Berkes (2007:289), includes diversifying components such as knowledge, practices, management options, institutions, stakeholders and world views, and being flexible in the use of strategies that allow for adapting, preparing, mitigating and recovering from hazards (Berkes, 2007:289). They argue that diversity and flexibility of management options increases the opportunities to cope with natural hazards. While on the other hand, management strategies that rely on only a few options can erode resilience by constraining the mechanisms for creative adaptive responses (Folke, *et al.*, 2002:348). According to Adger, *et al.* (2005), diversity is important as it helps to maintain, support and encourage social learning and adaptation through the inclusion of different stakeholders, knowledge and experience. Besides, it provides the starting point for new options and opportunities needed in the renewal and reorganizing phases of resilience (Adger, *et al.,* 2005).

Creating opportunities for self-organization with emphasis put on to build and enhance networks both horizontal and vertical, partnerships and collaborations (Berkes, 2007:290). Buckle, *et al.* (2000) stresses that knowledge sharing, diverse experiences, skills and resources as well as common goals are all crucial elements that allow systems to reorganize, particularly after hazard impacts. These various factors according to Allen (2006), can be translated into strategies and projects that aim at making systems better prepared to face future natural hazards, and also help to speed up their recovery after hazard occurrence. The social capital including bonds of trust, reciprocal relationships and collective actions in this case is a key source of resilience upon which partnerships and collaboration depend (Adger, *et al.,* 2005).

Networks, partnerships and collaborations of stakeholders and institutions operating at different levels also promote social learning, foster diversity and create opportunities for recovery, renewal and reorganization (López-Marrero & Tschakert, 2011). Self organization according to the authors can occur within the system or it can be promoted by external components and it involves flexible decision making and management during times of crisis.

## 2.10 Conceptual Frameworks for Resilience

### 2.10.1 The MCEER framework

According to the MCEER framework (Figure 19), developed by Bruneau, *et al.* (2003:19), resilience to hazards can be expressed on the basis of the time varying measure of the quality of the community infrastructure. This framework advocates that the quality of the infrastructure can range from 0% to 100% where 100% means no degradation in the service, and 0% means no service is available.

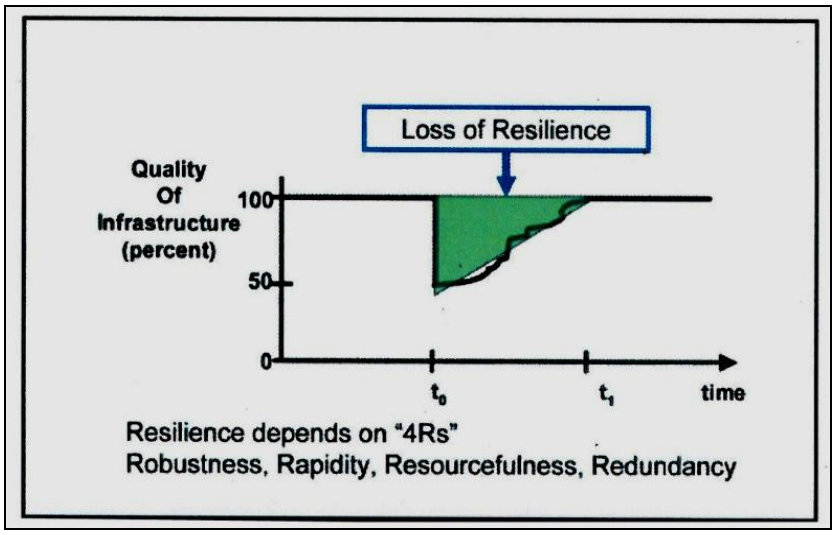



**Figure 23:** The MCEER resilience framework
**Source:** Bruneau, *et al.,* 2003:19.

If the infrastructure is subjected to a hazard at time, $t_{0,}$ it could result in damage on the infrastructure such that the quality is reduced say from 100% to 50% as shown above. The argument raised here is that the restoration of the infrastructure is expected to occur over time, that is, $t_{1,}$ when it is completely repaired and returns to 100%. In this framework, the loss of

resilience with respect to exposure to specific hazards can be measured by the size of the expected degradation in quality over time. The MCEER further defines the resilience of both physical and social systems based on the following properties:

*Robustness*; this refers to the ability of the elements, systems and other units of analysis to withstand a given level of stress without suffering degradation or loss of function.

*Redundancy*; refers to the extent to which elements, systems or other units of analysis exist that are substitutable, that is, capable of satisfying functional requirements in the event of disruption, degradation or loss of function.

*Resourcefulness;* refers to the capacity to identify problems, establish priorities and mobilise resources when conditions exist that threaten to disrupt some elements, systems or other units of analysis.

*Resourcefulness;* can further be conceptualised as consisting of the ability to apply material and human resources to meet established priorities and achieve goals.

*Rapidity;* refers to the capacity to meet priorities and achieve goals in a timely manner in order to contain losses and avoid future disruptions (Bruneau, *et al.,* 2003:19).

The MCEER's framework also includes dimensions of resilience which can be used to help quantify measures of resilience for various types of physical and organizational systems. These include:

*Technical*; the ability of a physical system including interconnected components to perform to acceptable levels when subject to a disaster,

*Organizational;* the capacity of organizations especially those managing critical facilities and disaster related functions to make decisions and take action that contribute to resilience.

*Social;* these consist of measures specifically designed to lessen the extent to which disaster stricken communities and governmental jurisdictions suffer negative consequences due to loss of critical services resulting from disaster (Bruneau, *et al.,* 2003:19).

MCEER framework observes that the performance of technical and organizational systems impact a community's social and economic systems in times of disaster. The loss in electric power for example as a technical element will negatively affect the way of life of the community

(social) and business (economic). Resilience objective of technical and organizational dimension should result in specific tasks that improve performance in each of these dimensions thereby lessening the negative impacts to the communities (Bruneau, *et al.,* 2003:19).

### 2.10.2 Community Resilience Index (CRI)

Renschler, *et al.* (2010:6) define a resilient community as one that does not experience serious degradation in critical services when an extreme event occurs and in the event of a degradation or failure of certain services, recovers to a similar or batter level of service within a reasonable amount of time. They front the development of an integrated community resilience index that will enable the development of geospatial and temporal decision support software tools to help planners and key decision makers and stakeholders to assess and enhance resilience of their communities. The resilience index requires quantifying the status, exposure and recovery of physical, economic, social-cultural and ecological capital for a specific target community.

They develop a resilience framework that provides a methodology to assess the recovery of vegetative biomass after an extreme event, and they use these to derive a computer simulation model of community disaster resilience. This model makes use of the information on the expected biomass production as a measure for ecosystem wellness and incorporates it into the simulation of recovery dynamics of social-economic agents such as households and businesses, neighbourhoods and communities following a disaster. The result of their study indicate that the variable nature of the recovery of ecological capital after an extreme event can potentially impact the recovery of certain business that rely heavily on ecosystem services such as agriculture, forestry, fisheries and tourism (Renschler, *et al.,* 2010:6).

Mampare and Bouwer (2006:445) undertook a study to indentify resilient and non resilient middle adolescents in formerly black only, urban schools in South Africa. They urge that resilience means having a disposition to identify and utilise personal capacities, competencies (strength) and assets in a specific context when faced with perceived adverse situation. This implies that the interaction between the individual and the context leads to behaviour that elicits sustained constructive outcomes that may include continuous learning and flexibly negotiating the situation. Resilient individuals are considered to have a hardy personality and are likely to employ adaptive strategies and not maladaptive responses like denial. Such individuals according to Mampare and Bouwer (2006:445), have been found to be characterised by internal locus of control with a sense of purpose, challenge, commitment, responsibility and

independence. They are assertive and posses problem-solving abilities. A proactive, achievement oriented nature with the ability to plan and have aspirations, they are able to construe their experience positively and constructively, have a positive self concept, sense of coherence, autonomy, spirituality, emotional stability, physical well-being and cognitive competencies (Mampare & Bouwer, 2006:445).

In his resilience framework (Figure 20), Kumpfer (1999:185) undertakes to review resilience forces within multiple environmental risk factors and the internal resilience factors of the individual. The model begins with the stress factor or a challenge that signifies the disruption in the individual's stable life or environment and at the same time sets in motion the process of resilience reintegration to re-establish the disrupted stable individual life or environment. In this case the stress factor marks the beginning of the resilience process, and the process ends with an outcome which may constitute either resilience reintegration or maladaptive reintegration.

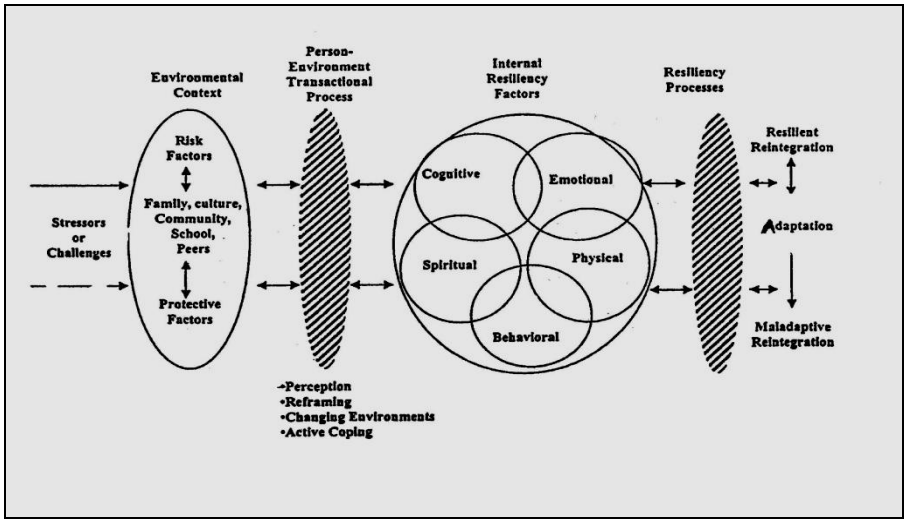



**Figure 24:** Resilience framework
**Source:** Karol Kumpfer, (1999:185).

### 2.10.3 The Resilience Progression Model

According to Boyd and Eckert (2002:9), individuals and environmental protective factors contribute the type of reintegration that individuals will experience helping them overcome adversity, and experience healthy reintegration after exposure to challenges and stressors.

They developed a resilience process model to illustrate the resilience and non resilience processes and outcomes occurring after adversity.

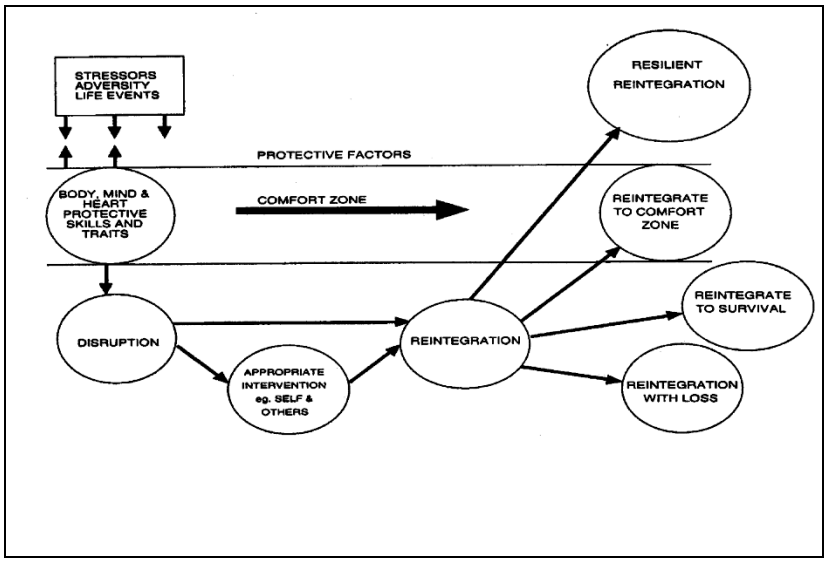



**Figure 25:** The resilience progression model.

**Source:** Boyd & Eckert, 2002:9.

According to this model, Figure 21, the internal and external protective factors sometimes balance the stressors and enable the individual to experience stable and predictable life in a comfort zone. The resilience process model assumes every individual to have developed protective factors which include learnt characteristics or strategies from the previous coping with stressors in order to maintain development and adaptation in the comfort zone. The comfortable state of resilience is the most preferred state where everything seems normal and healthy development is ongoing (Mampare & Bouwer, 2006:445). Disorganization occurs when the available protective factors are not able to balance the stressor resulting in disruption, chaos, and turbulence in the life or development of the individual. This requires the necessary

intervention from the individual and social systems to help the individual to bounce back and regain the comfort zone hence the reintegration process that helps to restore the crisis, re-establish and preserve the comfort zone.

Besides the comfort zone reintegration, the other option according to this model is to view resilience as a state of growth or advancement that surpasses the comfort zone. Boyd and Eckert (2002:9) explain that at such a point, the individual becomes greater than previously. Reintegration with loss is a state that is inclined to be dysfunctional with individuals perceiving themselves as victims of unfortunate circumstances which may be manifest, for example by way of succumbing to drug or alcohol abuse, suicide attempts and displaying loss of self-worth or the capacity to cope. Some individuals fail to recover fully from the stressor, and this leads to a life of emptiness with loss of hope and enthusiasm, assuming negativism and employing unhealthy and antisocial coping strategies. Such individuals have reintegrated into states of survival and reintegration with loss (Boyd & Eckert, 2002:9). They are the non-resilient individuals who require interventions such as care and support, life skill training, pro-social bonding, opportunities, meaningful participation, clear structures and expectations to help them exit the below comfort zone. Non resilience can be equated to the downward spiral from which the individual may never recover.

## 2.11 The Concept of Coping

The concept of coping reflects the increased recognition of people's ability to face climate-related and other natural hazards (Gaillard, 2010:220). It refers to the resources and assets people possess to resist, cope with and recover from disaster shocks that they experience (Davis, *et al.,* 2004). According to Kuban and MacKenzie-Carey (2001), the concept also encompasses the ability to either use and access needed resources. Therefore it goes beyond the sole availability of these resources. Meanwhile, Gaillard (2010:220) points out that, coping capacities are often rooted in resources which are endogenous to the community and depend on traditional knowledge, indigenous skills, technologies and solidarity networks. The ways in which capacities are mobilized in times of crisis reflect coping strategies. The United Nations International Strategy for Disaster Reduction (UNISDR) (2002), on the other hand defines coping strategies as the manner in which people and organizations use existing resources to achieve various beneficial ends during unusual, abnormal and adverse conditions of a disaster phenomenon or process.

Alam (2006:3) observes that coping, adaptation and adjustment are three similar ideas used to explain how individual and a community react to an exceptional situation as a result of disasters.

It entails a set of actions, mechanism, strategy and initiatives that are used by an individual or a community to view, act or behave towards the situation. Wisner, *et al*. (2004:113) describe coping as a manner in which people act within the limits of existing resources and range of expectations to achieve various ends. This implies that coping is a means by which people or organizations use available resources and abilities to face adverse consequences that could lead to a disaster. Coping according to Khandker (2007:172) generally involves managing resources, both in normal times as well as during crises or adverse conditions.

It is the ability of people, organizations and systems using available skills and resources to face and manage adverse conditions, emergencies or disasters (UN-ISDR, 2002:24). It involves no more than managing resources, but usually implies how it is done in unusual, abnormal and adverse situations (Brahmi & Poumphone, 2002:39). This means, coping includes defence mechanisms, active ways of solving problems and methods for handling stress. In the face of adverse circumstances, coping may be seen as a series of adaptive strategies to preserve needs as high up the hierarchy as possible in the face of threat. The major aim behind the objective of coping is the survival of the individual in the short term (Wisner, *et al.*, 2004:113).

Cohen and Sebstad, (2005:432) observe that coping mechanisms are adaptive strategies in the face of adverse circumstances. People collectively or individually often adopt certain actions to cope with abnormal situations which can be in several forms such as:

1. *Physically;* by changing the physical environment for example comfortable shelters.
2. *Behaviourally and habitually;* by way of changing food habits.
3. *Physiologically and emotionally;* by male for example taking care of children, women taking role considered as men's such as alcoholism and drug abuse.
4. *Livelihoods;* finding new sources earning, distress selling.
5. *Values and dignity;* people may change their affiliation, take up new roles or work generally considered as less dignified, giving legitimacy to action considered as illegal before the occurrence of disaster.
6. *Organizationally;* this is associated with groups that play a role in mobilizing for external assistance (Cohen & Sebstad, 2005:433; Alam, 2006:3).

They, however, conclude that the way one copes with hazard situations is very much related to their culture, history, knowledge system, power dynamics or governance of a particular geographical of political unit. Wisner, *et al.* (2004:114) on the other hand, observe that local coping strategies for managing disasters are often transmitted from generation to generation within communities and households. This is based on the assumption that disasters follow a familiar pattern; therefore people's earlier actions are the reasonable guide for similar events.

## 2.12 Mechanisms for coping with disaster

Disasters have always occurred and have impacted individual lives, communities, societies and households. This calls for mobilization of resources at various levels to cope with such impact (Wisner, *et al.,* 2004:115). Douglas (2006:77) observes that when people know an event may occur in the future because it has happened in the past, they often set up ways of coping. Coping strategies are a set of measures taken by the communities for obtaining resources in times of adversity and disaster. According to Brahmi and Poumphone (2002:39), they are based on experience, social structures, resources and their capabilities to combine them. They are often transmitted from generation to generation within communities or households and they depend on the assumption that the event will follow a familiar pattern, and that people's action will be a reasonable guide for similar events (Brahmi & Poumphone, 2002:40; Wisner, *et al.,* 2004:115). Coping strategies for adverse events, which are perceived to have precedents consist of actions before, during and after an event (Khandker, 2007:172, 173). Wisner, *et al*. (2004:115) identify different types of coping strategies which could be applicable to individuals, households and communities; these include:

1. *Preventative strategies:* at the individual and small group level means people making choices so that they will not be affected by an event, such as avoiding dangerous places at certain times or choosing safe residential locations.

2. *Impact minimising strategies:* these are strategies to minimise loss and to facilitate recovery in the event of a loss. This is generally referred to as 'mitigation' in disaster literature, but 'adaptation' in climate change literature. Very simply, this should imply improving access to a minimum level of food, shelter and physical security so that people will be less vulnerable in case a disaster or climatic event does happen.

3. *Building up stores of food and saleable assets:* storing of food may be more common in rural areas, but urbanites living in a cash-based economy may use similar strategies such as keeping items of value that can be sold if needed.

4. *Diversifying income sources:* in cities this may mean illegal or quasi-legal work, such as street-hawking, waste recycling, or even looting and pilfering in areas that have been affected by a disaster. Having more than one, or sometimes several, income earners in the family also allows for diversification. If families have contributed to savings groups, this can offer a form of income during hard times.

5. *Development of social support networks:* this is the ability to call on the resources of others during difficult times. The social structures that form the basis of community and family life play a key role in determining the individual and collective levels of vulnerability (Cutter, *et al*, 2003:243).

Networks can be within the household, between extended family members living near or afar, within neighbourhoods, and with wider groups who have a shared identity such as religious, geographic or commercial. Assistance can come in many forms such as financial help, emotional support, shelter in time of need, or physical helping of any kind (Dougall, *et al*., 2001:225). According to a study by Birkmann, *et al*., 2006) they report that, when the tsunami hit the Uited States, it was primarily neighbours (55 per cent), friends (10 per cent) and other family members and relatives (18 per cent) who helped the affected people before the authorities could provide aid and rescue support. Dougall *et al,* (2001:225) points out that social support networks helps disaster victims to overcome distress and long-term intrusions. They have been linked consistently with less self-reported distress, lower heart rate and blood pressure, lower catecholamine levels, better immune functioning, the use of more adaptive coping strategies, such as problem-focused coping, and less use of maladaptive coping strategies, such as avoidance.

## 2.13 Post event coping strategies

Post event coping strategies may include the substitution of lower quality and wild food for more expensive staples; these can be followed by calling on resources from others that can be obtained without threatening future security through reciprocal social interactions and avoidance of usurious interest rates (Wisner, *et al.,* 2004:116). They also argue that other sources of

household income apart from the dominant ones may be tapped such as wage labour, petty commodity production, and sale of easily disposable items that do not undermine future productive capacity may also be done to cope with the tragedy. They point out that the stress that requires coping may build up over a longer period of time. This allows for succession of strategies for adaptation in (Wisner, *et al.* 2004:116). Households may be force to get loans from money lenders and sell important assets such as agricultural implements and livestock when all the preceding strategies have failed to curd the situation. Households may also migrate to roadsides, towns and possible sources of survival (Wisner, *et al.,* 2004:116).

### 2.13.1 Culture of coping with hazards

Bankoff, (2007:26) observes that communities that are subjected to different kinds of hazards and threats develop different cultures of coping. Such changes can be found in their historical records and may include changes in design and construction of buildings, change in agricultural systems, constant relocation of settlements and the frequency of migrations. The design of homes and buildings in the Philippines for example has been greatly influenced by the seismic and meteorological hazards. The use of simple palm and bamboo huts offer a good example as they are easily rebuilt when damaged and are less likely to injure people during storm or earthquake.

### 2.13.2 Relocating settlements

The survivors of a community may opt to relocate their settlements to safer areas removed from the perceived source of danger. This is a coping strategy. Following the Katrina hurricane disaster in the United States of America, many families in the New Orleans who had been affected left the city and moved temporarily to leave with relatives elsewhere in the country. Bankoff, (2007:27) also observes that the people of central Luzon in the Philippines abandoned their beach side settlement in 1756 and moved to a location further inland as a result of devastating destruction caused by the eruption of Taal volcano in 1754 and the impact of the floods that had hit the lower part of their town. In 1991, following the eruption of Mount Pinatubo, the second largest volcanic event of the twentieth century, seven cubic kilometres of pyroclastic material devastated the surrounding areas causing between 900 to 1000 hazard related deaths and displacing nearly 1.2 million people as communities were forced to relocate to safer places (Bankoff, 2007:27). These kinds of migrations and relocations can be regarded as coping practices to prevent the same set of circumstances from reoccurring.

### 2.13.3 Emotional and psychological adaptation

The frequency and magnitude of hazard exposure may lead the affected communities to identify various ways of coping emotionally and psychologically. Communities that have been exposed to hazards have developed expression that help them cope such “leave it to fate”. At the same time expressions of courage, daring and a sense of finely calculated assessment of the odds coupled with elements faith in the effectiveness of prayer and intercession may be adopted to define protection (Bankoff, 2007:28). Following the eruption of Mount Pinatubo, many local people resorted to both Christian prayer and shamanistic rituals to strengthen their village’s defence and protect themselves from the flow of larvae. Glandon, *et al,* (2008:24) on their study of resilience on post Katrina New Orleans also report that respondents often mentioned the people, institutions and beliefs that helped them to cope. The most commonly mentioned source of strength and support were religion, church or faith in God.

### 2.13.4 Support for one another

Communities that are subjected to hazards tend to respond by way of helping one another, sharing shelter and food with those who have lost livelihood completely. (Bankoff, 2007:28) observes that one of the core coping mechanism among the Pilipino people is the practice they call *bayannihan,* this is translated to mean “toiling on another’s behalf and assuming another’s burdens”. The meaning behind the concept has the connotation of shared identity and common association expressing the sense of shared community, that is, neighbourhood which guarantees support for members especially during times of personal travail or common hardship. In the United States, after the hurricane Katrina storm many affected people confessed they were relieved when they found out their relatives and friends were safe and they appreciated having them around to share resources or simply commiserate (Glandon, *et al.,* 2008:24)

### 2.13.5 Community mobilization

Is another coping strategy that provides for self generated community action in times of disaster. In the early days there were formal and informal associations at the local level committed to individuals and extra-familial welfare (Bankoff, 2007:29). The religious associated functioned alongside or overlapped the village based mutual aid organizations in which the notion of reciprocity and assistance were common place. In the late nineteenth and early twentieth centuries, there were developments of some of these into rural credit associations, farmers

organizations and corporative societies, these and other manifestations of civil societies like Parents Teachers Association (PTA) and unions share much in common with the contemporary nongovernmental organizations (NGO's) (Bankoff, 2007:29).

### 2.13.6 Personal resources

Where communities are self reliant, they depend on their own resources to deal with hazards that confront them (Glandon *et al.*, 2008:25), while the most vulnerable especially the poor who poses little in form of resources tend to mobilise themselves and practice mutual reliance. Following the 1990 Baguio earthquake disaster, households and neighbourhoods immediately responded by sharing food, shelter and transport by way of sharing kitchens, providing shelter to the homeless and pooling available vehicles to facilitate transportation (Bankoff, 2007:29).

### 2.13.7 Use of social networks

The degree of interdependence, the need for corporation and construction of strong social networks are important coping mechanisms in communities faced by continual environmental uncertainty (Glandon *et al.*, 2008:25). During hurricane Katrina disaster in New Orleans USA, grass root organizations are reported to have played a very important role in building and promoting coping for the community. They helped the worst affected local communities recover from the disaster regardless of their individual membership (Glandon *et al*, 2008:25).

## 2.14 Coping Strategies for Landslide Hazards

The interaction of the human beings and the natural world exert influence on the natural environment resulting to persistent hazards or threats and disasters. Although the natural social sciences depict disasters as abnormal occurrences, hazard prone communities usually come to accept hazards and disasters as a common phenomenon in life (Bankoff, 2007:26). These has guides them to develop a number of adaptive strategies to enable cope with disasters. The coping mechanisms adopted by individuals, households or communities are based on the assumption that what has happened in the past is likely to repeat itself following a familiar pattern (Wisner et al., (2004:116).

## 2.15 Conclusion

The chapter has provided an overview of landslide hazards, classification of landslides, causes, trigger factors and the impact of landslides. The literature also explores the concept of vulnerability, resilience and coping in relation to landslide hazards. The models that have developed by different authors to explain these concepts have been examined. The purpose for this is to provide a basis to explain household vulnerability, resilience and coping with landslide hazards. In the next chapter the methodology for executing the study is presented.

# Chapter Three
# Research Methodology

## 3.1 Study Design

This chapter describes the techniques that were employed in the course of executing this study to the point of arriving at conclusions that have been made from the raw data. It describes the methods used in data collection, tools and sources of data. It explains issues of sample selection, data management and analysis. The chapter provides a full description of the study area and also highlights the limitations to the study.

This study employed qualitative design and it applied a cross sectional approach. This was a better design in conducting an assessment of a phenomenon, and has enabled the researcher get the real overall picture of what is on the ground. It enabled the researcher to interact with a cross section of the affected population, opinion leaders in the area, and the humanitarian agencies involved in emergency activities. The approach incorporates the opinion of the people, which provides the best design in assessing vulnerabilities, resilience and coping mechanisms in the area.

## 3.2 Study Population

The research studied a cross section of households and opinion leaders in Nametsi sub-county, Bududa district, Bududa County. The households were of interest in this study because they were the ones directly affected by the landslides hazards and whose livelihood was being disrupted. The opinion leaders, on the other hand, were considered for the purpose of providing a balanced assessment on the vulnerability factors, resilience and coping mechanisms in the disaster prone areas. The opinion leaders constituted the key informants who were interviewed during data collection.

## 3.3 Sample Size

The study collected data for a period of fourteen days from a cross section of 261 households constituted from Bukalasi sub-county in the villages of Nametsi, Kubewo, Namubele, Murwerwe,

Maskanu and Tunwasi. The household heads interviewed were selected from the five different villages. In the selected villages, interviews with key informants consisting of opinion leaders were conducted. A sample size of 261 was considered adequate enough to provide ample data that could be used to generate reliable, valid and generalizable results. These would provide valid inferences representative of the population in Bududa. The sample size was also considered on the basis that it would produce adequate information to explain significant relationships, differences or interrelationships in the variables under consideration (Bartlett, *et al.,* 2001:43).

## 3.4 Sampling Method

The sub-county of Bukalasi was strategically selected because of its location. The sample parishes and villages from the two sub-counties were selected on the basis of their strategic location and having experienced landslide hazards in 2010. The households interviewed in each village were selected on the basis of purposive sampling technique. This allowed the researcher to select the most appropriate sample of households to be interviewed. The researcher asked the previous interviewee to provide details and contact of another potential two to three households that could be interviewed. A list of those suggested was made and they were contacted to fix an appointment for interviews. The same method was used in selecting opinion leaders who were interviewed as key informants.

## 3.5 Research Tools

The study used structural questionnaires, personal observation and key informant discussions in the data collection process. The questionnaires for the household interviews were composed of closed ended questions, a sample attached as Appendix A. The key informants interviewed were constituted from the local opinion leaders. The key informant interview method was useful because it provided an opportunity for open expression of opinions and gave the researcher an opportunity to probe more on the issues being raised during the discussions. The key informant's interview guide is attached as Appendix B. The use of observation techniques enabled the researcher to gather information on multiple variables in a small population and geographical area.

## 3.6 Data Collection

The qualitative methods used in data collection comprised household interviews, key Informant (KI) interviews and observations. A sample of the questionnaire that was used for household interviews is attached (Appendix A). Qualitative data was collected by way of administering questionnaires directly to the household heads, and taking notes during both observations and key informant discussions. The household heads interviewed were selected purposefully. Interviewees were asked to recommend two to three possible respondents and their contacts; these were contacted to make appointments for the interviews. Observation checklist was constructed and systematic observations were made in the villages with the help of a checklist. They focused on household vulnerability factors, land use, human activities, location of settlements, landslide resilience and mitigation related activities in the area. Interactive interviews were held with 25 key informants (KIs) consisting of opinion leaders from the six villages. The interview guide is attached as Appendix B. These were selected purposefully, using the local knowledge of the subject and geographical area. The researcher identified some key informants that were thought would be relevant. They were later asked to recommend two to three possible respondents and their contacts. The collected data was cleaned to help identify gaps that were immediately completed and the data captured in the computer on a daily basis.

## 3.7 Data Management and Quality Assurance

The data collected was cleaned and coded according to the criteria developed by the researcher. The coding process was then followed by data capture using Epi Info. The data was transferred to the statistical package for social sciences (SPSS) for analysis to be performed. To ensure quality, research assistants were recruited and trained for one day on how to administer the questionnaires and collect quality qualitative data. They were familiar with the study area and fluent in the local language (Lumasaba) and English. The questionnaires were pre-tested and edited where necessary to cover identified gaps. Meetings were also held with research assistants on a daily basis to counter any challenges that were met during the data collection process. During data collection, supervision was done continuously, and the researcher himself was in the field.

## 3.8 Ethical Considerations

In consideration of the research ethics and code of conduct, this study was subjected to the institutional review by the Uganda National Council for Science and Technology who gave its due approval (Appendix B). Permission to carry out the study was dully granted by the Office of the President (Appendix C). Besides, in the process of collecting data, the purpose of the study was explained to the respondents verbally, and their consent to participate was obtained. The respondents were informed that participation was voluntary, confidential, without any risk and that they could choose not to participate or withdraw their participation at any time during the interview.

## 3.9 Conclusion

The chapter has described the methodology used in this study. The characteristics of the study area have been presented to help bring better understanding of the physical environment where landslides occur. The next chapter presents analysis and findings derived from the data.

# Chapter Four
# Presentation of Study Findings

## 4.1 Introduction

This chapter focuses on analysis and presentation of results of the data gathered from the household survey carried out in Bududa district, Bududa County, Bukalasi sub-county in the villages of Tunwatsi, Nametsi, Masakhanu, Murwerwe and Kubehwo. The results presented in this chapter have been arranged in sections which include; the analysis of social demographic aspects of the respondents, this includes gender, age groups, duration of stay, educational attainment, income levels, ownership of housing structure, people's awareness of landslide occurrences, impact of landslides on household, vulnerable groups, perceived causes of vulnerability; household coping strategies; mechanisms for reducing the impact of landslides; training on land slide management and mechanisms for managing sudden shocks and stress caused by landslides. Relationships between variables were tested using cross tabulation methods.

## 4.2 Socio-Demographic Characteristics of Households

The total sample comprised of 261 respondents who were household heads. The social demographic features of households are as shown in (Table 3). The majority of the respondents were male (71.65%) while females constituted 28.35%. Most of the respondents were aged between 25 and 39 years (34.87%). The level of education was assessed because it was an important factor in understanding household vulnerability to disasters. The majority of the respondents (65.38%) attained only primary education as their highest level with 15.38% having no schooling at all. 15.00% had secondary level education and only 11 respondents, represented by 4.23% had attained tertiary level of education. The majority of the households 112; that is 42.91% had between four to six members, 20.77% had between one to three members, while 93 households, a representative of 36.40% of the total households had seven or more members.

**TABLE 3: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF HOUSEHOLDS**

| Variable | Frequency (n=261) | Percentage (%) | Cum. Freq |
|---|---|---|---|
| **Sex of household head** | | | |
| Male | 187 | 71.65 | 71.65 |
| Female | 74 | 28.35 | 100.00 |
| **Age group of household head** | | | |
| Less or equal to 18 | 2 | 0.77 | 0.77 |
| 18 – 24 | 38 | 14.56 | 15.33 |
| 25 - 39 | 91 | 34.87 | 50.19 |
| 40 – 49 | 54 | 20.69 | 70.88 |
| 50 - 59 | 43 | 16.48 | 87.36 |
| 60+ | 33 | 12.64 | 100.00 |
| **Education Levels** | | | |
| No formal education | 40 | 15.38 | 15.38 |
| Primary | 170 | 65.38 | 80.77 |
| Secondary | 39 | 15.00 | 95.77 |
| Tertiary | 11 | 4.23 | 100.00 |
| **Household size** | | | |
| 1 - 3 | 54 | 20.77 | 20.77 |
| 4 - 6 | 112 | 42.91 | 63.68 |
| ≥7 | 95 | 36.40 | 100.00 |

### 4.2.1 Ownership, type of dwelling and duration of stay

Out of the 261 respondents, nine represented by 3.46% had lived in the area for a duration of less than one year, while 8.46% and 16.92% of the respondents had lived in the area for a period of between one to five years and 6 - 15 years respectively. The majority of the respondents 71.26% had lived in the study area for more than 15 years. The type of dwelling was important in assessing household vulnerability to landslides and household resilience and coping. The majority of the households interviewed (68.58%) lived in informal buildings; that is, grass thatched roof with wood and wattle walls (Figure 26). Of the households, 11.88% lived in semi formal buildings; that is, wood and wattle walls with iron sheet roof; while 19.62% lived in formal kinds of buildings. In terms of ownership, only 1.15% lived in rented houses while 98.85% were living in their own houses. The majority of households therefore lived in the type of houses that make them susceptible to landslides and the impact of high precipitation in the area.

**Figure 22:** A kind of informal buildings in Bukalasi, Photograph taken during field study.

**TABLE 4: OWNERSHIP, TYPE OF DWELLING AND DURATION OF STAY**

| Variable | Frequency (n=261) | Percentage (%) | Cum. Freq |
|---|---|---|---|
| **Ownership of housing structure** | | | |
| Own house | 258 | 98.85 | 98.85 |
| Rented house | 3 | 1.15 | 100.00 |
| **Type of dwelling** | | | |
| Informal building | 179 | 68.58 | 68.58 |
| Semi formal | 31 | 11.88 | 80.46 |
| Formal building | 51 | 19.62 | 100.00 |
| **Duration of stay** | | | |
| Less or equal to 1 year | 9 | 3.46 | 3.46 |
| 1 – 5 years | 22 | 8.46 | 11.92 |
| 6 – 15 years | 44 | 16.92 | 28.85 |
| ≥15 | 186 | 71.26 | 100.00 |

### 4.2.2 Economic Status of Respondents

The economic status of households is important as a factor in the increased occurrence, vulnerability and reduced resilience in the face on natural disasters. The majority of household heads interviewed (56.32%), were self-employed in the informal sector, which included activities like brewing, charcoal burning and other forms of wage based informal activities like provision of manual agricultural labour. Others, 35.00% did not have any form of employment, 7.31% were formally self-employed, that is formal businesses such as shop, while only1.54% had a formal form of employment, that is, earning a formal monthly income in the form of a salary. The levels of income were low; the majority of the respondents (69.57%) earned between Uganda Shillings (UGX) 5,000 – 300,000 per annum (an equivalent of $ 117.64 per annum). 21.92% of households had an income of more than Uganda Shillings 500,000 (an equivalent of $ 196.07 per annum), while a total of 24 households represented by 9.19% did not have any source of income (Table 5) below.

**TABLE 5: TOTAL ANNUAL HOUSEHOLD INCOME**

| Variable | Frequency (n=261) | Percentage (%) |
|---|---|---|
| None | 24 | 9.19 |
| 5,000 – 10,000 | 26 | 10.00 |
| 10,001 – 50,000 | 16 | 6.15 |
| 50,001 – 100,000 | 43 | 16.54 |
| 100,001 – 300,000 | 42 | 16.15 |
| 300,001 – 300,001 | 53 | 20.38 |
| ≥500,001 | 57 | 21.92 |
| **Total** | **261** | **100.00** |

## 4.3 Awareness and Impact of the 2010 Landslides

According to the key informants that were interviewed in the field, the occurrence of landslides in the area took the residents by surprise because it was a natural phenomenon. The majority of the respondents, 91.51% were aware of the 2010 landslide occurrence, while only 7.75% said they were not aware. In terms of the effect of landslides, 59.39% of the respondents had been affected by the landslides, and 40.61% said they had not been affected. A majority of the households (95.38%) said they did not have any prior warning about the impending threat of

landslides, while 4.62% said they had warnings about the threat of landslides as indicated by Table 6.

**TABLE 6: AWARENESS AND IMPACT OF THE 2010 LANDSLIDE**

| Variable | Frequency (n=261) | Percentage (%) | Cum. Freq |
|---|---|---|---|
| **Awareness of the 2010 landslide** | | | |
| Yes | 241 | 91.51 | 91.51 |
| No | 20 | 7.75 | 100.00 |
| **Affected household** | | | |
| Yes | 155 | 59.39 | 59.39 |
| No | 106 | 40.61 | 100.00 |
| **Warning about landslide** | | | |
| Yes | 12 | 4.62 | 4.62 |
| No | 248 | 95.38 | 100.00 |

### 4.3.1 Source of information

Regarding the different media for passing information on landslide threat, 2.68% of the total respondents said they received information through the area local council (LC) meeting, 3.45% said they received warnings about landslides by word of mouth while, 0.38% of the total respondents reported that they had received information by radio and traditional ways. No one received information by means of television, posters, the internet, news papers (Table 7). That can be partly explained by the remote location of the area. One key informant explained that they were susceptible to landslides because they lived in “no man’s land” which could only be reached on foot.

**TABLE 7: SOURCE OF INFORMATION FOR HOUSEHOLDS**

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| **Through television** | | | |
| Yes | 0 | 0.00 | 0.00 |
| No | 261 | 100.00 | 100.00 |
| **Through radio:** | | | |
| Yes | 1 | 0.38 | 0.38 |
| No | 260 | 99.62 | 100.00 |
| **Word of mouth** | | | |
| Yes | 9 | 3.45 | 3.45 |
| No | 252 | 96.55 | 100.00 |
| **Posters put up** | | | |
| Yes | 0 | 0.00 | 0.00 |
| No | 261 | 100.00 | 100.00 |
| **On internet** | | | |
| Yes | 0 | 0.00 | 0.00 |
| No | 261 | 100.00 | 100.00 |
| **Newspapers** | | | |
| Yes | 0 | 0.00 | 0.00 |
| No | 261 | 99.62 | 100.00 |
| **Traditional ways** | | | |
| Yes | 1 | 0.38 | 0.38 |
| No | 260 | 99.62 | 100.00 |
| **Local council (LC) meetings** | | | |
| Yes | 7 | 2.68 | 2.68 |
| No | 254 | 97.32 | 100.00 |

## 4.4 Household Vulnerability to Landslides in Bududa

### 4.4.1 Most affected by landslides in Bududa

The majority of the respondents, 64.62% said that children were the most affected by landslides followed by the elderly persons, 21.15%. The effect on women was represented by 9.62%, disabled persons 3.46% while others which included traders and visitors constituted 2.30% of the total sample interviewed (Table 8). Most key informants interviewed emphasized that children were greatly affected because they were returning from school and being a rainy day, they had taken shelter at the nearby health centre which unfortunately got completely buried by rubbles form the landslides which caught them unawares because it happened suddenly.

**TABLE 8: MOST AFFECTED HOUSEHOLD MEMBERS**

| Variable | Frequency (n=261) | Percentage (%) | Cum. Freq |
|---|---|---|---|
| **Children** | | | |
| Yes | 169 | 64.62 | 64.62 |
| No | 92 | 35.38 | 100.00 |
| **Elderly people** | | | |
| Yes | 55 | 21.07 | 21.07 |
| No | 206 | 78.93 | 100.00 |
| **Disabled persons** | | | |
| Yes | 9 | 3.46 | 3.46 |
| No | 252 | 96.54 | 100.00 |
| **Women** | | | |
| Yes | 25 | 9.62 | 9.62 |
| No | 236 | 90.38 | 100.00 |
| **Others (Traders)** | | | |
| Yes | 3 | 1.15 | 1.15 |
| No | 257 | 98.85 | 100.00 |
| **Others (Visitors)** | | | |
| Yes | 3 | 1.15 | 1.15 |
| No | 258 | 98.85 | 100.00 |

### 4.4.2 Factors contributing to landslide vulnerability

Analysis of factors responsible for household vulnerability to landslides was centred in the lack of information. A large number of respondents, 86.59% believed that those who were affected by landslides were caught unawares (Table 6). Other factors equally contributing to the vulnerability of households were: 59.77% of the respondents interviewed indicated that households were vulnerable because of their location on steep slopes; 48.66% of the respondents attributed vulnerability to inability of those affected to run away when the landslides hit, which mainly applied to the elderly persons, children and the disabled; 26.82% on the other hand, indicated that vulnerable households were those with many people living under one roof. The other factors that contributed to household vulnerability included high population, (18.77%); poor housing structures, (9.58%); not knowing where to run when landslides struck, (4.21%). Those who had moved out of the house for business were also vulnerable to landslides.

## 4.5 Coping with Landslides

### 4.5.1 Availability and type of evacuation area

The majority of respondents interviewed (73.18%) said they had places where they ran for safety in case of landslides; 26.82%, however, did not have any evacuation areas (Table 9). The places for evacuation for most people were the public schools (44.44%); this was followed by neighbours' homes as indicated by 36.02% of the respondents. A small number of respondents represented by 4.21% said their evacuation area was the public and private buildings, while only 0.38% said they evacuated to church buildings (Table 10).

**TABLE 9: AVAILABILITY OF EVACUATION AREA FOR HOUSEHOLDS**

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| Yes | 191 | 73.18 | 73.18 |
| No | 70 | 26.82 | 100.00 |

**TABLE 10: FACTORS FOR VULNERABILITY TO LANDSLIDES**

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| **Were not aware** | | | |
| Yes | 226 | 86.59 | 86.59 |
| No | 35 | 13.41 | 100.00 |
| **Location of their homes** | | | |
| Yes | 156 | 59.77 | 59.77 |
| No | 105 | 40.23 | 100.00 |
| **Weak to run away** | | | |
| Yes | 127 | 48.66 | 48.66 |
| No | 134 | 51.34 | 100.00 |
| **Their number is big** | | | |
| Yes | 49 | 18.77 | 18.77 |
| No | 212 | 81.23 | 100.00 |
| **Live in poor houses** | | | |
| Yes | 25 | 9.58 | 9.58 |
| No | 236 | 90.42 | 100.00 |
| **Did not understand announcements** | | | |
| Yes | 2 | 0.77 | 0.77 |
| No | 259 | 99.23 | 100.00 |

*continued*

| Variable | Frequency (n=261) | Percentage (100% | Cum. Freq |
|---|---|---|---|
| **Many people live in one house** | | | |
| Yes | 70 | 26.82 | 26.82 |
| No | 191 | 73.18 | 100.00 |
| **Did not know where to run** | | | |
| Yes | 11 | 4.21 | 4.21 |
| No | 250 | 95.79 | 100.00 |
| **Gone out of home for business** | | | |
| Yes | 3 | 1.15 | 1.15 |
| No | 258 | 98.85 | 100.00 |
| **Were in a social centre** | | | |
| Yes | 21 | 8.05 | 8.05 |
| No | 240 | 91.95 | 100.00 |

### 4.4.2 Household landslide coping mechanisms

When natural disasters occur they affect the sources of livelihood for individuals, households and communities in many different ways. The affected people are forced to devise strategies to survive in such areas. The various coping mechanism adopted to cope with landslides in Bududa are presented in Table 12.

**TABLE 11: TYPES OF EVACUATION AREAS AVAILABLE**

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| **Public school building** | | | |
| Yes | 116 | 44.44 | 44.44 |
| No | 145 | 55.56 | 100.00 |
| **Neighbours' homes** | | | |
| Yes | 94 | 36.02 | 36.02 |
| No | 167 | 63.98 | 100.00 |
| **Public building** | | | |
| Yes | 11 | 4.21 | 4.21 |
| No | 250 | 95.79 | 100.00 |
| **Church building** | | | |
| Yes | 1 | 108 | 41.38 |
| No | 153 | 58.62 | 100.00 |
| **Private building** | | | |
| Yes | 11 | 4.21 | 4.21 |
| No | 250 | 95.79 | 100.00 |

A majority of the respondents, 67.05% of the total sample, indicated prayers to God the main way they cope with the impact of landslides. This argument was repeated by the key informants interviewed who said there was need to relocate, since their destiny was in the hands of God. Talking and settling with friends (42.91% and 38.70%) respectively were also indicated by respondents as important in helping them cope with landslides. A key informant explained that they go to a drinking joint to meet friends, talk, drink and forget the threat of landslides. There were 27.57% and 25.29% of the people who considered the non government organizations and government support as important in helping them cope with the impact of landslides. Of them 25.67% said they managed to cope by relocating to other places, while 50.19% said the presence of other families around provided company that helped them to cope. It also emerged from the key informants that the presence of many houses around provided consolation especially to those who lost a relative, shared food with those whose food was destroyed and they housed those who lost their buildings. Few households (0.38%) thought that the design of the buildings was important when coping with landslides. That was reflected by a small number (19.62%) of those living in formal buildings, and low levels of income prohibited people from considering better designed houses to resist the impact of landslides.

**TABLE 12: HOUSEHOLD LANDSLIDE COPING MECHANISMS**

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| **Many families around** | | | |
| Yes | 131 | 50.19 | 50.19 |
| No | 130 | 49.81 | 100.00 |
| **Government support** | | | |
| Yes | 66 | 25.29 | 25.29 |
| No | 195 | 74.71 | 100.00 |
| **NGO support** | | | |
| Yes | 72 | 27.59 | 27.59 |
| No | 189 | 72.41 | 100.00 |
| **Have a job** | | | |
| Yes | 3 | 1.15 | 1.15 |
| No | 258 | 98.85 | 100.00 |
| **Talking to friends** | | | |
| Yes | 112 | 42.91 | 42.91 |
| No | 149 | 57.09 | 100.00 |

*continued*

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| **Prayers to God** | | | |
| Yes | 175 | 67.05 | 67.05 |
| No | 86 | 32.95 | 100.00 |
| **Settlement with friends** | | | |
| Yes | 101 | 38.70 | 38.70 |
| No | 160 | 61.30 | 100.00 |
| **Counselling from NGOs and government** | | | |
| Yes | 41 | 15.71 | 15.71 |
| No | 220 | 84.29 | 100.00 |
| **Design of buildings** | | | |
| Yes | 1 | 0.38 | 0.38 |
| No | 260 | 99.62 | 100.00 |
| **Relocation to other places** | | | |
| Yes | 67 | 25.67 | 25.67 |
| No | 194 | 74.33 | 100.00 |

### 4.4.3 Ways households reduce the impact of landslides

The measures households undertake to reduce the impact of landslides are aimed at mitigating landslides. Table 13 shows the household response to the different mitigation measures. Of the total respondents interviewed, 49.04% indicated that the support from the non government organizations had helped most in reducing the impact of landslides. Of them (47.51%) said they managed to reduce the impact of landslides by migrating to other areas. The key informants interviewed, however, argued that most people in Bududa were not interested in being relocated to other places as government proposed, but rather preferred temporary migrations within the area.

External assistance from government and relatives represented by 42.15% and 42.53% respondents respectively, was the other important way households in Bududa used to reduce the impact of landslides. The assistance was mainly in the form of relief items distributed to the affected households. Of the households, 16.09% said they had managed to reduce the impact of landslides through mitigation actions. These according to the key informants interviewed mainly included tree planting and replanting in the case of areas where forests had been destroyed for agriculture. Of the total respondents, 20.69% said they used personal savings while 6.90% said they reduced landslide impact by borrowing money. According to the key informants, most people in the area borrowed from relatives and friends because they feared to

engage with financial institutions like banks. Others did not have the collateral security required by such institutions. Sale of assets, 8.81% searched for new employment, 7.66% stopped schooling of children, and 3.45% asked children to work for money and 1.15% constituted other ways households used to reduce the impact of landslides (Table 13).

## 4.5 Household Landslide Hazard Resilience

### 4.5.1 Training on landslide hazards and kind of information received

In terms of training on landslide hazard management before the occurrence of the 2010 landslides in Bududa, 80.84% of the total respondents said they had never received any training, while only 19.16% had some training on landslide management (Table 14). Of those who had some training, 14.94% indicated the main kind of information they received, was on how to identify areas which were highly prone to landslide occurrences. Other types of information from the training included warning and alert signals (10.73%), evacuation routes and sites, (5.75%) and identification of hazards (4.60%).

**TABLE 13: WAYS HOUSEHOLDS ARE REDUCING LANDSLIDE IMPACT**

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| **Borrow money** | | | |
| Yes | 18 | 6.90 | 6.90 |
| No | 243 | 93.10 | 100.00 |
| **Mitigation actions** | | | |
| Yes | 42 | 16.09 | 16.09 |
| No | 219 | 83.91 | 100.00 |
| **Assistance from government** | | | |
| Yes | 110 | 42.15 | 42.15 |
| No | 151 | 57.85 | 100.00 |
| **Assistance from NGOS** | | | |
| Yes | 128 | 49.04 | 49.04 |
| No | 133 | 50.96 | 100.00 |
| **Use personal savings** | | | |
| Yes | 54 | 20.69 | 20.69 |
| No | 207 | 79.31 | 100.00 |
| **Assistance from relatives** | | | |
| Yes | 111 | 42.53 | 42.53 |
| No | 150 | 57.47 | 100.00 |

*Continued*

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| **Sale of assets** | | | |
| Yes | 23 | 8.81 | 8.81 |
| No | 238 | 91.19 | 100.00 |
| **Migrate to other areas** | | | |
| Yes | 124 | 47.51 | 47.51 |
| No | 137 | 52.49 | 100.00 |
| **Look for new employment** | | | |
| Yes | 20 | 7.66 | 7.66 |
| No | 241 | 92.34 | 100.00 |
| **Stop schooling of children** | | | |
| Yes | 9 | 3.45 | 3.45 |
| No | 252 | 96.55 | 100.00 |
| **Ask children to work for money** | | | |
| Yes | 3 | 1.15 | 1.15 |
| No | 258 | 98.85 | 100.00 |

**TABLE 14: TRAINING ON LANDSLIDE MANAGEMENT BEFORE 2010**

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| Yes | 50 | 19.16 | 19.16 |
| No | 211 | 80.84 | 100.00 |

**TABLE 15: KIND OF INFORMATION RECEIVED FROM THE TRAINING**

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| **Warning and alert signals** | | | |
| Yes | 28 | 10.73 | 10.73 |
| No | 233 | 89.27 | 100.00 |
| **Evacuation routes and sites** | | | |
| Yes | 15 | 5.75 | 5.75 |
| No | 246 | 94.25 | 100.00 |
| **Identification of hazards** | | | |
| Yes | 12 | 4.60 | 4.60 |
| No | 249 | 95.40 | 100.00 |
| **Identification of risky areas** | | | |
| Yes | 39 | 14.94 | 14.94 |
| No | 222 | 85.06 | 100.00 |

### 4.5.2 Resilience strategies in Bududa

Resilience entails the ability of individual households, families, communities or systems to anticipate and withstand catastrophic events and maintain normal functioning without losing fundamental identity (Tumwine & Almedom, 2008:1). The various resilience strategies used to manage sudden shocks may include actions such as support from family members and friends, counselling, etcetera. In Bududa, respondents interviewed showed that different actions were undertaken to manage such sudden shocks and stress resulting from landslides (Table 16).

A total of 59.77% of the respondents indicated that they received support from friends; 49.81% said they received support from family members, while 26.05% indicated that they were able to withstand the impact of the landslides through support from organizations such as the non government and community based organizations. Some, 26.44%, indicated counselling to have helped them, with 11.49% saying the teachings they had received before were helpful in managing sudden shocks and stress. A few, 3.45% indicated that talking to God helped them, while 2.30% of the respondents said working on the farm provided them with the necessary relief and 1.15% indicated that they were able to cope by drinking alcohol. According to the key informants, alcohol was taken as a source of courage to those who consumed it. They believed it helped one to sleep and forget about the threat of landslides.

**TABLE 16 : WAYS HOUSEHOLDS MANAGE SUDDEN SHOCKS**

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| **Support from friends** | | | |
| Yes | 156 | 59.77 | 59.77 |
| No | 105 | 40.23 | 100.00 |
| **Support from family** | | | |
| Yes | 130 | 49.81 | 49.81 |
| No | 131 | 50.19 | 100.00 |
| **Community organizations NGOs and CBOs** | | | |
| Yes | 68 | 26.05 | 26.05 |
| No | 193 | 73.95 | 100.00 |
| **Teachings provided** | | | |
| Yes | 30 | 11.49 | 11.49 |
| No | 231 | 88.51 | 100.00 |
| **Counselling** | | | |
| Yes | 69 | 26.44 | 26.44 |
| No | 192 | 73.56 | 100.00 |

*Continued*

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| **Drinking alcohol** | | | |
| Yes | 3 | 1.15 | 1.15 |
| No | 258 | 98.85 | 100.00 |
| **Working on the farm** | | | |
| Yes | 6 | 2.30 | 2.30 |
| No | 255 | 97.70 | 100.00 |
| **Talking to God** | | | |
| Yes | 9 | 3.45 | 3.45 |
| No | 252 | 96.55 | 100.00 |

## 4.6 Role of Government and NGOS

The question of what role the government and NGOs should play to control landslides was asked to determine what households perceived as their responsibility. The results of the responses gathered are shown in Table 17. The majority, 72.41% of the total respondents interviewed indicated that government and non government organizations should provide seedlings for afforestation, while 54.02% of the total respondents urged that government and NGOs should relocate settlement to safer areas. Up to 51.72% believed that government and the NGOs should play a key role in conducting the landslide hazard awareness campaign; while 10.34% of the total respondents proposed that the government and NGOs should introduce a village housing scheme, which according to the key informants, would provide locals with houses built to the standards that would withstand landslide hazards.

The implication therefore was that people were willing to carryout afforestation and re-afforestation of the areas where forests had been destroyed for settlement and agriculture. A key informant observed that the area where the most devastating landslides occurred 2010 was part of a forest reserve gazetted by government, but because of increased population, poverty and low education levels, the forests had been destroyed and replaced by crops especially vegetables which could no longer hold the soils together. Forests are a source of fuel for cooking, charcoal burning which provided a source of income to households in the area, poles and timber for construction.

## 4.7 Measures by Households to Control Landslides

The steps being taken by households to control landslides are important in the mitigation of landslide impact. Table 18 shows measures undertaken as provided by the respondents. Up to 88.12% of the total respondents interviewed indicated carrying out afforestation programmes as an important step towards controlling landslides. Of the respondents, 52.87% indicated avoiding cultivation on steep slopes, while relocating settlements was preferred by 36.40% of the total respondents interviewed. Others,11.49% indicated introduction of a proper building code; 3.07% pointed to building strong house foundations and those who indicated 'other' urged that putting trust in God would provide total control of the landslide phenomena.

Some of the key informants interviewed agree with this strategy and explained that landslides were an act of God that man could not control. Some of the people who died in the landslides were in a church building praying as they trusted God to avert the threat. Key informants also pointed out that most people who had been relocated by government to Kiryandongo had returned emphasizing that landslides were an act of God and could occur anywhere at any time.

**TABLE 17: EXPECTED ROLE BY GOVERNMENT AND NON GOVERNMENT ORGANIZATIONS**

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| **Seedlings for a forestation** | | | |
| Yes | 189 | 72.41 | 72.41 |
| No | 72 | 27.59 | 100.00 |
| **Conduct awareness campaign** | | | |
| Yes | 135 | 51.72 | 51.72 |
| No | 126 | 48.28 | 100.00 |
| **Provide building standards** | | | |
| Yes | 34 | 13.03 | 13.03 |
| No | 227 | 86.97 | 100.00 |
| **Relocate settlement to safer area** | | | |
| Yes | 141 | 54.02 | 54.02 |
| No | 120 | 45.98 | 100.00 |
| **Village housing scheme** | | | |
| Yes | 27 | 10.34 | 10.34 |
| No | 234 | 89.66 | 100.00 |

**TABLE 18: MEASURES BEING TAKEN BY HOUSEHOLDS TO CONTROL LANDSLIDES**

| Variable | Frequency (n=261) | Percentage (100%) | Cum. Freq |
|---|---|---|---|
| **Plant trees** | | | |
| Yes | 230 | 88.12 | 88.12 |
| No | 31 | 11.88 | 100.00 |
| **Avoid cultivation on steep slopes** | | | |
| Yes | 138 | 52.87 | 52.87 |
| No | 123 | 47.13 | 100.00 |
| **Relocate people** | | | |
| Yes | 95 | 36.40 | 36.40 |
| No | 166 | 63.60 | 100.00 |
| **Proper building code** | | | |
| Yes | 30 | 11.49 | 11.49 |
| No | 231 | 88.51 | 100.00 |
| **Build strong house foundation** | | | |
| Yes | 8 | 3.07 | 3.07 |
| No | 253 | 96.93 | 100.00 |
| **Others (Put trust in God)** | | | |
| Yes | 4 | 1.55 | 1.55 |
| No | 254 | 98.45 | 100.00 |

## 4.8 Conclusion

The chapter presented results of the data analysis based on the household survey, observations and key informant interviews carried out. The section discussed the socio demographic characteristics of households, economic status and awareness of landslides. Regarding vulnerabilities, children were found to be the most vulnerable followed by elderly persons. The main reasons for lack of awareness or information on landslide hazards were discussed. Most households relied on assistance from NGOs and government to cope while their major strength to adapt to the impact of landslides was derived from the presence of many families around who provided company, counsel and other forms of support.

# Chapter Five
# Vulnerabilities, resilience and mitigation measures

## 5.1 Household Vulnerability to Landslides

The purpose of this chapter is to discuss factors that have contributed to household vulnerabilities to landslides in Bududa. The other issues that are discussed include household awareness on landslides, warning, monitoring and mitigation mechanisms used by households in Bududa. The chapter also discusses the capacity of households to cope, and how they deal with shocks resulting from landslide threats.

The factors responsible for household vulnerability in any disaster situation have been discussed in section 2.7. The section has also provided the different theoretical frameworks to explain vulnerability such as the PAR model, Bohle conceptual framework etcetera. The factors considered in here therefore are on the basis of the pressure and release (PAR) model and these include location of settlements, income levels of households, special groups at risk, unprotected buildings and government policy among others.

### 5.1.1 Location of Settlements

The location of settlements in Bududa led to increased household vulnerability to landslide hazards. As observed during the field study, most of the settlements were located on steep slope areas which are more susceptible to failure. The most affected area is located on the rugged topography composed of interlocking spurs and steep slopes (Section 4.5, Figure 24). The high population in the area attracted by the fertile agricultural soils and high rainfall has resulted in increased pressure on land and other resources causing instability on the slopes. The settlement activities such as cultivation, use of organic fertilizers, slope cutting for construction of houses, animal husbandry and clearance of forests have resulted in destruction of vegetation reducing the soil binding mechanisms. Knapen, *et al.* (2006:149) observed that the effect of settlement on slopes of Mount Elgon in Uganda had increased the load on the deeply weathered basements thereby altering the balance of forces operating on the slope.

### 5.1.2 Income levels of households

The social economic status of households is an important factor in assessing their vulnerabilities to disasters (Wisner, *et al.* 2004:12). Analysing the economic and demographic characteristics of households in Bududa showed that only 4.23% of the total respondents interviewed were receiving a monthly payment, and the majority were poor with 14.23% having completely no source of income (Table 5). The analysis shows that educational levels of households in Bududa are low; only 4.23% of the total respondents attained tertiary level education while the majority, 65.38% of the total respondents attained only primary education (Table 3).

Therefore the low levels of education attained coupled with the low incomes have resulted in poor agricultural practices and over exploitation of the natural resources, such as forests causing degradation to the fragile slopes. The inappropriate agricultural practices on the steep slopes in Bududa can be attributed to the low levels of education. A large proportion of the households depend on informal business activities like charcoal burning, which has resulted in destruction of forests. These activities all led to increased likelihood of slope failures and therefore increased vulnerability of households to landslide hazards. Alcantara-Ayala (2002) observed that economic factors in developing countries played a significant role in increasing vulnerabilities of rural communities to landslides.

### 5.1.3 Unprotected buildings and settlements

Households in Bududa were rendered vulnerable to landslide hazards because of the nature of their dwellings and patterns of settlement. Analysis of types of dwelling in the study area showed that 68.58% of the respondents interviewed lived in informal buildings. Those were constructed using local materials mainly wood and wattle walls with grass thatched roofs (Figure 26). These kinds of buildings were weak and could not withstand any force from land sliding; on the other hand the location of settlements was equally dangerous. Most of the homes were built on steep slopes where soils were cut to provide a flat foundation (Figure 3 & 26). After such cutting had, no reinforcement walls were built to provide protection, strength and guard against the soil behind collapsing. That put the settlement at high risk from landslide hazards.

### 5.1.4 Special groups at risk

The analysis of most affected household members (Table 8) shows that 64.62% of those affected by landslides in 2010 were children below the age of eighteen years of age. This was followed by the elderly persons above the age sixty years old who comprised 21.07% of the

total respondents interviewed. The social characteristics of household members such as age, gender, health status and disabilities (Wisner, *et al.,* 2004:11) are important factors that increase vulnerability to landslides hazards. In Bududa the young children were more vulnerable because of their high population; they were too weak to run, were found at home and did not get any information or warning about the threat of landslides. It was the same with elderly persons. The children were also more vulnerable in this particular case, because they were returning from school and being a rainy day, they had taken shelter in the nearby health centre which was buried under the rabble of the landslide.

### 5.1.5 Lack of disaster preparedness

Disaster preparedness is an important factor to avoid death in the event a disaster occurring. Advanced preparation, training and planning will facilitate the evacuation processes. Analysis of the landslide awareness in Bududa shows that 91.51% of the total respondents interviewed were aware of the 2010 landslides in Bududa (Table 6). But on the other hand, only 4.62% of the total respondents interviewed said they had received warnings about the threat of an impending landslide (Table 6). After the landslide had occurred, communities, rescue teams from both private and government sector, including the military who were involved in rescue, did not have equipment to use. Most of them were seen using hand and small hoes. This was further worsened by the remote location of the place on the steep slopes of Mount Elgon without road access to facilitate delivery of rescue equipment and emergency relief. The lack of preparedness therefore hampered the rescue efforts; as illustrated by the absence of neighbourhood based organizations to mobilise rescue labour, absence of effective risk communication systems about landslides, and the lack of local personnel to carryout evaluation and rescue activities. These left households in Bududa vulnerable to the impact of landslides.

### 5.1.6 Government policy

After the occurrence of landslides in 2010, the government of Uganda declared a state of emergency in the area. The president issued instructions for the people to relocate to safer areas. The relocation ground was identified at Kiryandongo. The process of relocation, however, faced a lot of resistance from the local people who claimed that government wanted to remove them and take over their ancestral land. Some of those who had been relocated returned claiming that no alternative sources of livelihood were provided in Kiryandongo. There was need to provide motivation, incentives and adequate awareness before house were relocated. The

government should also identify and provide alternative sources of livelihood in Bududa, otherwise settlements and cultivation on steep slopes, cultivation and deforestation would continue thereby increasing household vulnerability to slope failures.

The government needs to enact and enforce laws and bylaws that will prohibit activities such as settlement on steep slopes of a certain degree. Such laws should also ensure protection of forests and game reserves. The failure to enforce such laws and allowing households to continue settlement on fragile slopes aggravates the problem of landslide hazards. Relocation of settlements is the most appropriate solution to the problem. However, this requires strong political will, awareness, motivation and provision of attractive incentives. If the government remains silent, settlement on slopes will continue with its degradation impact resulting in increased household vulnerability to landslide hazards.

## 5.2 Household Awareness of Landslides

The majority of the household heads interviewed in Bududa had either no schooling or only primary schooling implying they were illiterate or semi literate. The total respondents interviewed (91.51%), were aware of the 2010 landslide and others. One of the key informants interviewed showed the researcher a boulder that he claimed rolled some years back as a result of a landslide, which shows they were aware of the past landslides. The households were also aware from experience that environmental degradation and heavy precipitation were the major trigger factors for landslides.

The households were able to demonstrate their awareness and relate environmental degradation activities which increased the occurrence of landslides. The increase in population in Bududa resulted in increased settlement on the steep slopes and massive deforestation which left the slopes bare and susceptible to land sliding. Such awareness was important in generation of coping mechanisms and innovations that could be applied to mitigate landslide hazards. Such awareness showed that households were aware of their environment and the kind of changes taking place in it. Households were asked about their expectations regarding the role of government and NGOs in controlling landslides. A majority responded that they should provide seedlings for afforestation. That implied that communities were aware of the role of trees in controlling landslides. Besides that, communities were aware of controlling

landslides. This kind of knowledge is important in the formulation of accepted measures to mitigate and reduce household vulnerability to landslides.

## 5.3 Warning about Landslides

The main cause of landslides in Bududa indentified by households was high precipitation resulting from heavy rain and cultivation on steep slopes. Early warning systems could reduce damage to property and minimise losses of lives. As shown in Table 6, 95.38% of the total respondents interviewed did not get any information or warning about an impending landslide threat. Those who had the information received it by word of mouth, which was a rather slow method for relying information relating to a disaster. Given the nature of the terrain in Bududa that mode of communication was very ineffective. There was no early warning systems in place to detect the threat of landslides early enough and to relay the information properly.

## 5.4 Household Resilience and Coping Mechanisms

A growing body of evidence suggests that most adults exposed to potentially traumatic events are resilient. Resilience is a dynamic, evolving process of positive attitudes and effective strategies (Jensen, *et al.,* 2008:722). Almeldom and Tumwine (2008:3) observe that people, despite formal and informal institutions that govern their lives and livelihoods, actively learn from events and experiences including complex emergencies as and when they struggle to adapt and reorganize with the goal of maintaining normal functioning. The main sources of household resilience were entrenched in the way they perceived disasters as well as how they responded to them. After the landslide disaster, the key sources of resilience and according to the response in Bukalasi Sub County, included the following:

### 5.4.1 Social networking

Social networks and unity present, provided affected households a source of strength to deal with the impact of disaster situations. Basic emotional support would normally be provided through existing social networks. In many cases, family, friends and neighbours offered a helping hand and a listening ear to survivors and their families in order for them to cope with their loss and grief (Christensen, 2008:39). Pratt (2002) reveals that Kenyans in drought situations operated through social networks. They came together, prayed and prepared themselves psychologically and physically. In Bududa, social networks included prayer groups,

burial groups and local saving groups. These groups provided moral, financial and material support services to those who were affected by the landslide disaster, for example they temporarily accommodated those who were displaced, provided counselling, shelter, food and clothing for them. That helped many of the landslide victims to cope with life. It is important to note that these social networks are built on the basis of knowledge, beliefs, and moral principles of the community.

### 5.4.2 Prayer

Some of the affected households understood that the landslide disaster was the making of God and God was well aware of it. Some saw it as an act of punishment by God, but they urged that such occurrence still had to be turned to the same God as a source of strength. Community members and households turned to God and sought to know why he permitted such an occurrence. They prayed to him for strength, repented of their sins and changed their ways of life. They also implored him not to permit such phenomena again. They felt that God had responded to their prayers, they received hope and strength to move on with life despite the challenges they still had to face. The evidence of deriving strength from prayers is not only limited to households in Bududa who suffered landslides. Jensen, *et al.* (2008:726) observes that spirituality is a reflection of deep philosophical questions, and prayer is the way to gain perspective because it is very important and it helps. According to Dekens (2007:27,) Kenyan communities used prayers during drought situations and this involved other actions which enabled community members to come together and prepare physically and mentally. Mooney (2010:1) points out that the main response and source of disaster resilience for households in Haiti were prayer.

### 5.4.3 Relocation of settlements

Some of the households in Bududa accepted the fact to be relocated and resettled in other places. They felt that moving to live in a newer place could enable them to forget the bad memories from the landslide disaster. Such new places provided household members with new sources of strengths, opportunities and outlook on life. All these are mechanisms for coping which facilitate psychological healing.

### 5.4.4 Psychosocial support

This is a process of facilitating resilience within individuals, families and communities. It involves respecting individuals and communities' independence, dignity and coping mechanisms (Dougall, *et al.,* 2001:224). Psychosocial support promotes the restoration of social cohesion and infrastructure. It advocates the use of community-based approach to promoting resilience and strengthening coping mechanisms within individuals, families and the wider community (Bonanno, *et al.,* 2007:673). Some examples of community-based psychosocial support activities that are seen to be effective at times of crises include: Supporting the return to school, work, normal daily routines, play and recreational activities, school-based programmes, children and youth clubs, religious and cultural ceremonies, community sensitization to increase awareness on psychological reactions to critical events, drama, art, cultural activities, livelihood oriented activities and life-skills training, supporting families to function and supporting those who support others.

The households in Bukalasi Sub County proposed that the government should reopen the schools that were closed to enable their children to return to school. They also proposed rebuilding of the health centre that was destroyed by the landslides in 2010. One of the key informants interviewed, revealed that they were holding "Bull fight" games every week as a way of providing recreation to the community. These he claimed helped them forget the landslide experience and carry on.

### 5.4.5 Accessing government and nongovernment aid

During a crisis such as landslides, access to support from government and nongovernment organizations is clearly a coping mechanism for households. In the case of Bududa, 26.05% of the household heads interviewed indicated that they were able to withstand the impact of landslides through support from organizations such as the nongovernment and community based organizations. Glandon, *et al.* (2008:25) in their study of household resilience in post Katrina, point out that participants who continue to be displaced mentioned grassroots organizations as having played a very important role in building and promoting community resilience. It is important to note that most of such organizations work to extend their original mission in order to help the worst affected local communities and households recover from the disaster regardless of individual memberships with them. The households in Bududa mainly

mentioned the role of the Red Cross Society of Uganda and the government as having helped them manage the impact suffered from the landslides.

## 5.5 Mitigation Measures

The purpose of presenting the suggested mitigation measures is to reduce vulnerability and exposure to landslide hazards. Following are some of the mitigation measures that can be used to mitigate landslides and reduce household vulnerability in Bududa.

### 5.5.1 Slope rehabilitation and afforestation

The study observes that extensive deforestation on the steep slopes in Bududa for the purpose of settlement and agriculture has contributed to increased landslide activity in the area. Tree planting may help stabilise the slope through increased evaporative losses associated with tall and deep rooted trees. A careful selection of tree species for planting should be carried out. This can be achieved if done in conjunction with the National Forestry Authority (NFA).

### 5.5.2 Limiting activities in the hazard prone areas

The government needs to control human activities that contribute to slope instability in the landslide hazard prone areas. Cultivation on steep slopes can be controlled, completely banned or be permitted depending on the crop to be grown and other husbandry practices to be followed. The agricultural extension workers at the district and sub county level need to intensify awareness campaigns on appropriate land use and husbandry practices.

### 5.5.3 Community participation on development of mitigation measures

For the landslide measures to be effective and acceptable, the affected communities should be involved in their formulation. This is important because such measures will be implemented in the affected communities and the affected households will be the implementers. The forest reserve at Nametsi has been destroyed by communities for agricultural purpose; this could be partly because they are not part of the management of the reserve. If the government through the NFA can involve the local people through collaboration, their participation in protecting the resource would be greater, which in turn increases their resilience to hazards, hence reduced vulnerability.

### 5.5.4 Public awareness campaign

Household vulnerability to landslide hazards can be reduced through public awareness campaigns and outreach on the causes, contributing factors and mitigation techniques. Most people in Bududa are aware that landslides are triggered by heavy precipitation coupled with bare steep slopes that have been cleared for agricultural production. But they cannot stop this because households need food and the population continues to grow. Clear understanding needs to be created on production systems, and measures to control population explosion must be advocated such as family planning; this will go a long way to support attempts to mitigate landslides. Public awareness campaigns can be done by extension workers, NGO groups, church leaders, district environmental and agricultural officers. Such programmes as landslide hazard safety, community risk reduction training, and media campaigns on landslide hazard risk area can be used to achieve this.

### 5.5.5 Government participation

After the landslide of 2010 in Bududa, the response from government was described as slow and constrained regarding the availability of resources and equipment. The government through the line ministry of disaster preparedness and refugees should develop a disaster preparedness policy and plans on how to respond to disasters promptly. This can be achieved by funding research by individuals and institutions on slope stability problems. The government should develop policies on implementation of landslide hazard mitigation measures and land use planning. This should be incorporated into the emergency operation plan.

Households in Bududa live in temporary informal shelters which are vulnerable to landslide hazards. The government should develop and enforce building codes and standards so that houses are built to withstand landslide hazards. A village housing scheme being implemented in Kiryandongo is meant to act as a motivator for relocation to safer grounds. Given the high levels of household vulnerability still in Bududa, and the need to conserve the natural environment, forests and the game reserve, government should promote relocation of settlements. A process of consultation, trust building and provision of incentives can help achieve this. The danger of settlement on hazard prone areas also needs to be properly explained to gain willingness to move.

### 5.5.6 Early warning and monitoring systems

The Bududa landslides as noted earlier on, were triggered by high precipitation. An early warning system if developed and established could warn people in advance. This could reduce damage to property, minimise loss of lives and provide timely information to all stakeholders involved in management. Meanwhile monitoring of landslide activity over a wide area could be important for the purpose of mapping landslide hazards and landslide risk assessment.

## 5.6 Conclusion

The chapter has highlighted the causes of household vulnerability to landslide hazards in Bududa. The threat of landslide hazards continues looming in Bududa because currently there is little or no effort in place to reduce landslide hazards and damage. The relocation programme by government is facing resistance from households and it is yet to be concluded. The government is yet to commission studies and projects that will carry out mapping of landslide prone areas in Bududa, and improve on funding allocated to emergency management and response. An effective landslide mitigation programme is important because it addresses emergency management response and may assist in the reduction of landslide impact in the long run.

# Chapter Six
# Conclusions and recommendations

## 6.1 Conclusions

This chapter presents conclusions, recommendations and areas for further study based on the discussion of results presented in Chapters 4 and 5. This study was conducted in the district of Bududa, eastern Uganda, in the sub county of Bukalasi. The study covered the villages of Nametsi, Kubewo, Nambele, Murwerwe, Masakanu and Tunwasi. The main objective of the study was to assess household vulnerabilities, resilience and coping mechanisms to landslides in Bududa district, Eastern Uganda; evaluate the level of household awareness on landslide hazards, examine the landslide hazard early warning, monitoring and mitigation mechanisms and to assess the capacity of households to cope with landslides, future shocks and to propose landslide hazard mitigation measures in Bududa.

The study established that landslides in Bududa caused loss of lives and injuries to the people. In 2010, for example at Nametsi village, over 300 people lost their lives when their houses got buried under rabble by landslides. This was the highest death toll ever experienced as compared to the previous landslides in the area. The landslides caused economic losses in the affected areas through destruction of crops in the field and storage; destruction of farmland, houses and killing domestic animals.

The data analysis results suggested that landslides in Bududa occurred as a result of heavy precipitation. The type of mass movement that was experienced was a debris flow. This occurs when masses of poorly sorted sediments, agitated and saturated with water move down slope. They occur suddenly and can submerge an area in a matter of minutes.

The destruction of forest cover in the area for settlement, cultivation, settlement on steep slopes and increased rainfall are the major contributing factors to slope instability in Bududa resulting in landslides.

Household vulnerability to landslides in Bududa was mostly caused by lack of awareness, location of homes and settlements on steep slopes, low levels of income with no steady monthly

income for households and reliance on informal forms of employment that increased their vulnerability to slope failures.

Household production systems were also found to contribute to landslide occurrences in Bududa. In Nametsi, for example cultivation on steep slopes, destruction of vegetation through cutting of trees for charcoal burning and wood for cooking fuel. Grazing of animals such as goats and cattle were observed as some of the factors that led to increased pressure on the steep slopes. The failed relocation of communities as proposed by government and the difficulty in accessing the area hampered delivery of emergency assistance and rescue equipment. That increased vulnerability of the victims.

## 6.2 Resilience and Coping

The study indicated that the low level of income for households, absence of effective communication medium and lack of landslide mapping by government contributed to household vulnerability to landslides in Bududa. These also resulted in reduced household resilience to disasters. Household coping strategies were discussed by the study; they included presence of many families around to provide the counsel, talking to friends, prayers to God, settling with friends, drinking alcohol and support from non government organizations and government.

Ever since the landslides occurred in Bududa in March 2010, no rehabilitation had been undertaken; the health centre that was buried under rubble has not been rebuilt. This increases vulnerability of households and risk of another landslide occurring, especially where the slopes have remained bare. Households are, however, aware of what needs to be done, although the local initiative is lacking. The households believe that the government and the non government organizations should provide seedlings for afforestation, introduce village housing schemes and carry out awareness campaigns on the causes and dangers of landslides.

## 6.3 Suggested Areas for Further Study

This section presents suggested areas for further research. The recommended suggestions have been formulated in light of the limitations of the study.

After the occurrence of the 2010 landslides, the government immediately ordered relocation of all the people living in the landslide prone areas. The communities in Bududa, however, found

this as forced eviction from the Mount Elgon national park and many resisted relocation. A detailed survey needs to be carried out to assess household willingness to move to safer grounds. The survey should also address issues relating to incentive packages, which could motivate people to move to Kiryandongo.

As observed in this study, there has been increased frequency in the occurrence of landslides in Bududa as a result of high and prolonged precipitation, which is an indication of climate change. It is important therefore to assess the impact of climate change on the occurrence of landslides.

The study recommends further study to be carried out in other parts of Uganda that have experienced landsides such as Bulambuli, Manafa, Kapchorwa and the slopes of Mount Ruwenzori in the west, to provide a comparative basis for future studies. The studies will also generate information that will form a basis for land mapping and assessment. It is also suggested that a study be carried out to address the gender implications of landslides, traditional knowledge and perceptions of local people on the occurrence of landslides.

## 6.4 Limitations of the Study

This study was an attempt to assess factors for household vulnerabilities, resilience and coping mechanisms with landslide hazards in Bududa. The research work was, however, affected by limited funding. It was difficult to expand the area of assessment beyond one sub-county, carry out field experiments and modelling. As a developing nation, Uganda still lacks the technical capacity and financial resources to facilitate research work.

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## APPENDIX A

## QUESTIONNAIRE FOR HOUSEHOLD INTERVIEW

Questionnaire No. /__/___/__/__ Date: /__/__// /__/__/ /2011

Interview ID: /___/___/ Name: _____

**Location:**

Sub-county _____ Parish/Village_____ HHNo:/___/___/___/

**Introduction:**

I am a student at the University of Free State, South Africa pursuing a Masters in Disaster Management. I am collecting data for a research study in Bududa District. The study focuses on assessing household landslide vulnerability, resilience and coping in the area. I would like to ask you some questions about your family. The interview takes about 20 minutes to complete and the data that you provide is for academic purpose and it will be kept strictly confidential. This is voluntary, you can refuse to answer to some of the questions but I hope you will accept as your views are very important. Do you have any questions? May we begin? (Please tick in the box or write on the space provided).

**Demographic Data**

1. Gender of household head

1) Male ☐

2) Female ☐

2. Age group of household head

| | | |
|---|---|---|
| 1) | Below 18 | ☐ |
| 2) | 18-24 | ☐ |
| 3) | 25-39 | ☐ |
| 4) | 40-49 | ☐ |
| 5) | 50-59 | ☐ |
| 6) | 60+ | ☐ |

3. Employment status of household head

| | | |
|---|---|---|
| 1) | Not employed | ☐ |
| 2) | Self employed (Informal) | ☐ |
| 3) | Self employed (Formal) | ☐ |
| 4) | Formal employment | ☐ |
| 5) | Others | ☐ |

Specify …….....

4. Education Status: highest level of education attained

| | | |
|---|---|---|
| 1) | No schooling | ☐ |
| 2) | Primary schooling | ☐ |
| 3) | Secondary Schooling | ☐ |
| 4) | Tertiary education | ☐ |

**Social-Economic Variables**

5. Type of dwelling for the household

   1) Informal Building (e.g. Tapeline, grass walls, plastic) ☐
   2) Informal Building (e.g. Wood and wattle walls, grass thatched roof) ☐
   3) Formal Building (e.g. Brick walls, tiles/iron sheet roof) ☐
   4) Others ☐

   Specify ……

6. Household size;

   1) 1-3 ☐
   2) 4-6 ☐
   3) 7& above ☐

7. How long have you lived in this place?

   1) Less than one year ☐
   2) 1-5years ☐
   3) 6-15years ☐
   4) 15+ ☐

8. Ownership status of the housing structure

   1) Own house ☐
   2) Rented house ☐
   3) Others ☐

   Specify ……

9. What are the current sources of income for the household head?

1) No income ☐
2) Formal business (e.g. Shop) ☐
3) From working relatives ☐
4) Monthly Salary (formal) ☐
5) Wages (from informal work) ☐
6) Government pension ☐
7) Informal business (e.g. brewing, charcoal) ☐
8) Others ☐

Specify ……

10. Total household income per annum (Uganda Shillings)

1) None ☐
2) 5,000 - 10,000 ☐
3) 10,001 - 50,000 ☐
4) 50,001 - 100,000 ☐
5) 100,001 - 300,000 ☐
6) 300,001 - 500,000 ☐
7) Above 500,000 ☐

**Landslide Awareness**

11. Are you aware of the 2010 Bududa landslides?

1) Yes ☐

2) No ☐

12. Was your household affected by the landslides?

1) Yes ☐

2) No ☐

13. If yes, how were you affected?

**Tick all That apply**

1) Lost a household member ☐

2) Lost all the crops ☐

3) Houses got destroyed ☐

4) All domestic animals got killed ☐

5) Roads got blocked ☐

6) All stored food got destroyed ☐

7) Others ☐

Specify ……

14. Was there any information/Announcement/warming about the threat of landslides?

1) Yes ☐

2) No ☐

15. If yes, how was the information passed (which media)?

**(Tick all that apply)**

1) TV ☐
2) Radio ☐
3) Word of mouth ☐
4) Posters were hanged ☐
5) On Internet ☐
6) Newspapers ☐
7) Traditional way (e.g. Beating drums, alarm) ☐
8) LC 1 Meetings ☐
9) Others ☐

Specify ……

**<u>Household Vulnerability</u>**

16 Who were the most affected by landslides? **(Rank 3 in the order 1-3 with 1 being most affected and 3 least affected)**

1) Children ☐
2) Elderly ☐
3) Disabled people ☐
4) Women ☐
5) Others ☐

Specify……

17. Why were they the most affected?

**(Tick all That apply)**

1) They were not aware ☐
2) Location of their homes ☐
3) Weak to run away ☐
4) Their number is big ☐
5) Live in poor hour ☐
6) They did not understand announcement/language ☐
7) Many people live in the same house ☐
8) Others ☐

Specify……

18. What visible environmental activities have led to increased risk of landslides?

**(Tick all that apply)**

1) Deforestation ☐
2) Quarrying of stones ☐
3) Dam building ☐
4) Road construction ☐
5) Settlement on steep slopes ☐
6) Increased rainfall ☐
7) Increased population ☐
8) Land fragmentation ☐
9) Others ☐

Specify ……

**Household Coping**

19. Is there a safe area where you escape or run to?

1) Yes ☐

2) No ☐

20. If Yes, where is that area?

1) Public school building ☐

2) Neighbors or relatives ☐

3) Public building/municipal hail ☐

4) Church building ☐

5) Private building ☐

6) Others ☐

Specify ……

21. In the past 5 years have you and your household evacuated when there are landslides or other natural disasters?

1) Yes ☐

2) No ☐

22. What methods do you use to reduce the effect of landslide disasters to your household when they occur?

1) Borrow money (from friends, relatives, bank, money lenders) ☐

| | | | |
|---|---|---|---|
| | 2) | Mitigation actions (strengthening housing structure against landslides) | ☐ |
| **(Tick all** | 3) | Assistance from government | ☐ |
| **that apply)** | 4) | Assistance from NGOs | ☐ |
| | 5) | Use old personal savings | ☐ |
| | 6) | Assistance from relatives | ☐ |
| | 7) | Sale or mortgage assets | ☐ |
| | 8) | Migrate temporarily to other areas | ☐ |
| | 9) | Seek new employment opportunities | ☐ |
| | 10) | Stopped schooling of children | ☐ |
| | 11) | Asked children to work for money/food | ☐ |
| | 12) | Others | ☐ |

Specify …….

23. After the landslides in 2010, how have you managed to stay here without fear?

| | | | |
|---|---|---|---|
| | 1) | Many families around/neighbors | ☐ |
| | 2) | Government support | ☐ |
| **(Tick all** | 3) | NGO support | ☐ |
| **That apply)** | 4) | I have got a job | ☐ |
| | 5) | Talking with friends | ☐ |
| | 6) | Prayers to God I religious support | ☐ |
| | 7) | Settlement with friends | ☐ |
| | 8) | Counseling from NGOs and government | ☐ |
| | 9) | Design of buildings where we live | ☐ |

10) Relocation to other places ☐

11) Others ☐

Specify ……

**Household Resilience**

24. Did you attend any training on landslides management before the 2010 landslides occurred?

1) Yes ☐

2) No ☐

25. If Yes, what information did you receive during the training/workshop?

**(Tick all that apply)**

1) Warning I alert signals ☐

2) Evacuation routes and sites ☐

3) Identification of hazards ☐

4) Identification of risky areas in the community ☐

5) Others ☐

Specify ……

26. Was the information you received useful during the landslide in 2010 and after?

1) Yes ☐

2) No ☐

27. Who provided the information / training?

1) Central government ☐
2) Local government/district ☐
3) NGOs and CBOs ☐
4) Volunteer groups ☐
5) Others ☐

Specify ……

28. What ways do you use to manage sudden shocks and stress caused by landslides?

1) Social support from friends ☐
2) Support from family members ☐
3) Community organizations (NGOs, CBOs) ☐
4) Education/teachings provided ☐
5) Counseling ☐
6) Others ☐

Specify……..

29. What do you think the government or NGOs should do to control landslides?

1) Provide seedlings for afforestation program ☐
2) Conduct awareness campaign on causes and dangers of landslides ☐
3) Provide building standards ☐
4) Relocate settlement to safe areas ☐

5) Introduce village house scheme ☐

6) Others ☐

Specify: ……

30. What steps are you taking to control landslides?

1) Planting trees (afforestation) ☐

2) Avoiding cultivation on steep slopes ☐

3) Relocating of settlements ☐

4) Following proper building code ☐

5) Building strong house foundation ☐

6) Others ☐

Specify …….

**THE END**

## APPENDIX B

## KEY INFORMANTS (KI) INTERVIEW GUIDE

1. What do you think are the causes of landslides? Why?

2. How do you usually deal with landslide occurrences and the effects?

3. In which areas of life have landslides affected you?

4. How were you affected?

5. Why do you think your community was more affected than any other communities?

6. Were you able to tell that landslides would occur?

7. How did you know?

8. Who helped you to know?

9. Is there any way you are being prepared to deal with hazards

10. Who is preparing you?

11. Which relief organizations assisted you to deal with landslides?

12. Do you think relief organizations are important during disaster situations?

13. How and when do they usually help during landslides?

14. Do they ever seek your ideas before, during and after helping in disaster situations?

15. How do they usually do this?

16. Does the district have a disaster management committee?

# APPENDIX C

# APPROVAL BY THE UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

**Uganda National Council for Science and Technology**

*(Established by Act of Parliament of the Republic of Uganda)*

UNCST

**Our Ref: SS 2651** **November 3, 2011**

Mr. John Juventine Ekotu
P.O Box 10730
KAMPALA

Dear Mr. Ekotu,

**RE: RESEARCH PROJECT, "THE LANDSLIDE HAZARDS: HOUSEHOLD VULNERABILITY, RESILIENCE AND COPING IN BUDUDA DISTRICT, EASTERN UGANDA"**

This is to inform you that the Uganda National Council for Science and Technology (UNCST) approved the above research proposal on **October 13, 2011.** The approval will expire on **October 13, 2012.** If it is necessary to continue with the research beyond the expiry date, a request for continuation should be made in writing to the Executive Secretary, UNCST.

Any problems of a serious nature related to the execution of your research project should be brought to the attention of the UNCST, and any changes to the research protocol should not be implemented without UNCST's approval except when necessary to eliminate apparent immediate hazards to the research participant(s).

This letter also serves as proof of UNCST approval and as a reminder for you to submit to UNCST timely progress reports and a final report on completion of the research project.

Yours sincerely,

Leah Nawegulo
for: Executive Secretary
**UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY**

*LOCATION/CORRESPONDENCE*

*Plot 6 Kimera Road, Ntinda*
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**EMAIL: info@uncst.go.ug**
**WEBSITE: http://www.uncst.go.ug**

# APPENDIX D

# APPROVAL BY OFFICE OF THE PRESIDENT

THE REPUBLIC OF UGANDA

## OFFICE OF THE PRESIDENT

PARLIAMENT BUILDING P.O.BOX 7168 KAMPALA, TELEPHONES: 254881/6, / 343934, 343926, 343943, 233717, 344026, 230048, FAX: 235459/256143
Email: secretary@op.go.ug, Website: www. Officeofthepresident.go.ug

**ADM 154/212/01**

November 10, 2011

The Resident District Commissioner
Bududa District

This is to introduce to you **Mr. Ekotu John Juventine** a Researcher who will be carrying out a research entitled **"Household vulnerability, resilience and coping in Bududa District, Eastern Uganda"** for a period of **01 (one) year** in your district.

He has undergone the necessary clearance to carry out the said project.

Please render him the necessary assistance.

By copy of this letter **Mr. Ekotu John Juventine** is requested to report to the Resident District Commissioner of the above district before proceeding with the Research.

Alenga Rose
**FOR: SECRETARY, OFFICE OF THE PRESIDENT**

Copy to: Mr. Ekotu John Juventine