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COMMUNITY RESILIENCE TO LANDSLIDES: CASE STUDY OF  
SINDHUPALCHOWK DISTRICT IN NEPAL

**BY**

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**DATE OF SUBMISSION**

**July, 2014**

**DECLARATION**

I declare that this is my original work and it has not been presented for any degree in any other University.

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Signature

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Date

.....4th.July.2014.....

**DECLARATION BY SUPERVISOR**

This project has been submitted for examination with my approval as the University Supervisor.

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Signature

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Date

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## **DEDICATION**

This project paper is dedicated to my loving husband Mr. Rabindra Poudel and my son Prasam Poudel whose constant support and patience throughout the study made me persistent in achieving my goal. Their understanding has been amazing throughout my study period.

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## LIST OF ABBREVIATIONS AND ACRONYMS

<b>CBS</b>	- Central Bureau of Statistics
<b>CDECF</b>	- Community Development and Environment Conservation Forum
<b>CR</b>	- Community Resilience
<b>DDC</b>	- District Development Committee
<b>DDRC</b>	- Developmental Disabilities Resource Center
<b>DPR</b>	- Disaster Preparedness and Response
<b>DRR</b>	- Disaster Risk Reduction
<b>EWS</b>	- Exchange Web Services
<b>FGD</b>	- Focus Group Discussion
<b>GLOF</b>	- Glacial Lake Outburst Floods
<b>HFA</b>	- Hyogo Framework for Action
<b>HIV</b>	- Human Immunodeficiency Virus
<b>AIDS</b>	- Acquired Immune Deficiency Syndrome
<b>ICIMOD</b>	- International Centre for Integrated Mountain Development
<b>ICHARM</b>	- International Centre for Water Hazard and Risk Management
<b>IPCC</b>	- Intergovernmental Panel on Climate Change
<b>ISDR</b>	- International Strategy for Disaster Reduction
<b>LDOFs</b>	- Landslide Dam Outburst Floods
<b>LWF</b>	- Lutheran World Fund
<b>MoHA</b>	- Ministry of Home Affairs

<b>NGOs</b>	- Non Government Organizations
<b>NIP</b>	- Nepal Institute of Peace
<b>NRCS</b>	- Natural Resources Conservation Service
<b>NSDRM</b>	- National Strategy for Disaster Risk Management
<b>PDMP</b>	- Participatory Disaster Management Program
<b>SPSS</b>	- Statistical Package for Social Sciences
<b>UNISDR</b>	- United Nations International Strategy for Disaster Reduction
<b>UNRHCO</b>	- United Nations Resident and Humanitarian Coordinator
<b>VDC</b>	- Village Development Committee
<b>WFP</b>	- World Food Programme

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## ABSTRACT

The broad objective for this study was to find out the extent of community resilience to the landslides in Sindhupalchowk district in the central hilly region of Nepal. The study was guided by the following specific objectives: to determine the potential threats of landslides to the communities living in Sindhupalchowk district, to establish the level of awareness of communities in Sindhupalchowk district on their vulnerability to landslides, to determine the push and pull factors for residing in landslide prone areas and to establish the community resilience strategies to the landslides in the district. Theory of reasoned action and planned behaviour were used to explain the relationship between the study variables.

This study used descriptive research design. It was carried out in Sindhupalchowk District in Nepal. The population for the study was the communities living in the District. The study targeted members of the community and government administration at the local level such as VDC secretaries and NGO staff. Purposive sampling technique was used to sample the area chiefs while simple random sampling technique was used to sample the members of the community in the District. A total of 60 respondents were sampled for the study, out of which 58 responded giving a response rate of 96.7 percent. Similarly, 3 staff from local NGOs and 3 personnel from VDC secretaries participated as the key informants in the study. Questionnaires, interview schedules and observation checklist were used as instruments for data collection. The researcher used questionnaires to collect data from members of the local communities and VDC secretaries while interview schedules to collect data from representatives from NGOs operating in the area. Two focus group discussions were carried out by members of the local communities. Quantitative data was analyzed using descriptive statistics while content analysis technique was used to analyze qualitative data collected using interview schedules. Statistical Package for Social Sciences (SPSS) package was used to analyze the quantitative data.

On the potential threats of landslides include: loss of life, health risks such as injuries during landslide; pollution of water creating scarcity of drinking water, inaccessibility to facilities such as health and school after landslide, loss of property and crops, destruction of roads and soil erosion. On the awareness of the community members on their vulnerability to landslides, the study found that 50 percent of the respondents

indicated that the community was highly vulnerable to landslides, 42 percent of the respondents indicated that they were moderately vulnerable while 8 percent indicated that they were less vulnerable. On the push and pull factors behind residence in landslide prone areas, the study found that 83.3 percent of the respondents indicated that residents cannot afford land in safer areas to a very large extent, 47.2 percent of the respondents indicated ethnic reasons to be a push factor to a very large extent, while 47.2 percent of the respondents indicated that landslide disaster being preventable is a pull factor to a neutral extent. Community resilience strategies included: construction of safer houses, relocating to safe places, planting of trees, construction of fences, use of early warning systems and crop diversification.

The study recommended that the government of Nepal should relocate the affected population to safer areas. The study finally recommended that another study to be done on the ways of improving the lives of communities living in other landslide prone districts which was not the concern of this study.

## CHAPTER ONE: INTRODUCTION

### 1.1 Background

Natural disasters occur and affect people's lives and livelihoods in almost all parts of the world (Samir, 2013). Rao (2012) contends that in the 21<sup>st</sup> Century, natural disasters are becoming more frequent worldwide and are a cause for concern. Earthquakes, floods, tsunami, landslides, droughts, and others cause tens of thousands of deaths, hundreds of thousands of injuries, loss of lives and public property and bringing untold misery to the people (Komoo, 2010). Birkmann (2006) reported that over the past ten years, disasters affected more than 3 billion people, killed over 750,000 people, and cost more than US\$ 600 billion. These are alarming statistics considering that the full impacts of natural disasters are not always documented.

The frequency, duration and intensity of extreme events such as floods, landslides, droughts, heavy rains, hurricanes and typhoons are expected to increase due to global warming (Siddiqui, Bharati, Pant, Gurung, Rakhali & Maharjan, 2012). The Indian Tsunami of 2004, Hurricanes Katrina and Rita in 2005, together with the worldwide evidence of global warming illustrate that communities and people are increasingly becoming more vulnerable to natural hazards (Mayunga, 2007). We have also witnessed large-scale flood disasters in Bangkok, Thailand (2011); Brisbane, Australia (2011); Guangdong, China (2007); New Orleans, USA (2005); Dresden, Germany (2002); and Taipei, Taiwan (2001), among others (Liao, 2011).

Natural disasters are not uniformly distributed. Some populations and geological areas are more vulnerable than others (Phaiju, Bej, Pokharel & Dons, 2010). This is the case of Nepal. Nepal is a mountainous country in between India and China constituting one third of the Himalayan arc that resulted from Indian and Eurasian plate collision (Powell & Conaghan, 1973). The distinct features of Nepal are steep slopes, extreme relief, rugged topography, and high elevation ranging from 60 m to 8848 m above sea level (Duncan et al. 2003). Presence of complex geology, diverse climatic conditions and floral diversity within a small elevation range makes Nepal a unique place of the world. However, these distinct physiography and biogeography, which are the consequence of seismic, tectonic, hydro-logic and geomorphologic processes, have made it vulnerable to natural disaster (Hasegawa et al. 2009, Pokhrel et al. 2009).

The Global Natural Disaster Risk Hotspots analysis report (Dilley et al., 2005) shows that Nepal falls on 11th position on disaster vulnerability in the world and half of its population is under the threat. According to the International Centre for Water Hazard and Risk Management [ICHARM], the most known natural hazards in Nepal are floods, earthquakes, landslides, debris flows, drought, snow avalanches, Glacial Lake Outburst Floods (GLOF), hailstorms, thunderbolts, cold waves, hot waves and epidemics.

Landslides are the most frequent natural disaster in Nepal (Bhandary, Yatabe, Dahal, Hasegawa & Inagaki, 2013). A landslide is the downslope movement of a mass of rock, debris, earth, or soil (Khadka, 2012). The steep slopes, weathered bedrock, and intense monsoonal rainfall of the Nepalese Himalayas create ideal conditions for the landslides (Gabet et al, 2004). In addition, human interventions particularly in terms of road slope cutting, land development and agricultural practices have increased the occurrence of landslides (Bhandary et al, 2013). Apart from the above, the increasing demand for firewood, infrastructure projects and conversion of forest into grazing land and resettlements, has resulted to a decline of forest covered area from 45 percent to 29 percent of the total land area in Nepal (Encyclopaedia of the Nations, 2010). Furthermore, the region's poorly constructed roads are also considered as one of the major reasons for rise in landslides (Petley, et. al., 2007). Additionally, the widespread extraction of boulder from the hills and sand from the riverbeds for the construction purposes intensifies the problem further (International Strategy for Disaster Reduction {ISDR}, 2008).

According to Bhattarai et al. (2002), a total of about 12,000 small- and large-scale landslides occur in Nepal every year. Moreover, professor Petley along with his team of Durham University recorded nearly 400 fatal landslides in Nepal between 1978 and 2005 that caused nearly 2,180 deaths. They also observed a steep rise in the cumulative number of fatal landslides since 2005. The head of the disaster management division in the Home Ministry, Nepal also verified landslides have displaced the maximum number of people in the country (Khadka, 2012). The Nepal Institute of Peace [NIP] (2009) states that landslides results to human casualties, displacement, disruption to business, infrastructure, services, public health, and peoples' general livelihoods. Shrestha et al. (2004), reports that the annual rate of human deaths in landslides stood at over 300.

When disasters are unavoidable, minimizing their consequences is vital (Gurung, 2008). This guided the adoption of Hyogo Framework for Action (HFA). The main goal of HFA was to achieve substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries (United Nations International Strategy for Disaster Reduction {UNISDR}, 2011). The HFA recognizes the linkages between disaster risk reduction and sustainable development (UNISDR 2005). It has five priorities for action: Prioritizing disaster risk reduction by providing high-profile leadership, establishing relevant policies and programs, and allocating resources to implement them: Identifying, assessing and monitoring disaster risks and improving early warning systems: Creating awareness at all levels of society about risk and providing information about how to reduce it: Reducing social, economic and environmental vulnerabilities and those related to land use through improved development planning and post-disaster reconstruction by all sectors: Strengthening disaster preparedness for effective response at all levels (ibid.). The HFA has been already adopted by 168 governments including Nepal (Phaiju, Bej, Pokharel & Dons, 2010).

The Hyogo Framework for Action 2005-2015 has proved a major inspiration in disaster management in Nepal. Nepal developed a Draft National Strategy for Disaster Risk Management (NSDRM) that seeks to reorganize the existing system of disaster reduction and emergency response. The country is also making efforts to improve the legal environment by working to create a new Act to replace the existing Calamity (Relief) Act 1982 (ISDR, 2009). The Tenth National Development Plan (2002-2007) has two separate chapters on disaster management. Chapter 17 emphasizes on the irrigation and water induced disaster preparedness, whereas chapter 22 deals on population, environment and natural disaster management. Similarly, the Three Year Interim Plan (2007/08-2009/10) also has a separate chapter (chapter 26) on natural disaster management. The interim plan emphasizes on policy formulation, strengthening institutional mechanism, Exchange Web Services (EWS), coordinated approach for DRR and linking disaster management with climate change, etc.

Additionally, the Developmental Disabilities Resource Center (DDRC) supports disaster victims by coordinating with various local and international organizations, civil societies and other humanitarian partners. Natural Resources Conservation Service (NRCS) deploys Initial Rapid Assessment Teams observing fatalities,

affected and displaced families and their whereabouts. NRCS, World Vision and Plan-Nepal provide food, non-food relief items and shelter to displaced families. WFP also provides food to the victims. United Nations Resident and Humanitarian Coordinator (UN RCHC) Office updates the news of floods and landslides triggered by monsoon rains and damage across the country (RCHC, 2011).

Following the nationwide and regional meetings for disaster preparedness facilitated by MoHA in 2011, in which a substantial number of government officials, agencies, and security forces committed for response preparedness activities at the district level; District DPR plans were prepared in more than 61 districts across Nepal. As a result, these preparedness and planning exercises have strengthened district level disaster response capacities, ensuring effective, timely and coordinated responses by the relevant authorities and humanitarian partners to the ongoing floods and landslides (ibid.).

Similarly, Participatory Disaster Management Program (PDMP) implemented in 2000 in eight villages of four districts encouraged policymakers to integrate a diverse range of indigenous knowledge in the disaster management initiatives of the country. The project revealed that a record of such knowledge would make the efforts of building disaster management capacity in the communities cost-effective, also sustainable and harmonious to the nature-culture relationship. The Upgrading Disaster Management Capacity in Nepal aims to combine modern knowledge and indigenous knowledge in disaster preparedness and mitigation with the goal of building community capacity in a participatory, sustainable and cost-effective manner (Thapa M.B., et al, 2008).

The hilly region is home to 45 percent of Nepal's population. Over 60 percent of dwellers in this region are considered below the poverty line (Willy L.A. et al., 2008). Predominantly, agriculture is the main source of subsistence, often supplemented by animal husbandry (Degen et al., 2010). Throughout the world, landslides are a major hazard in hilly regions (Fort et al., 2010) including the central hilly region of Nepal. However, research on household resilience and preparedness to deal with landslides in the hilly region is limited. It is against this background that the study seeks to investigate community resilience for landslides in the central hilly region of Nepal.

## **1.2 Problem statement**

Nepal experiences a variety of natural hazards that occur throughout the year. People live with hazards, accepting them as part of life. However, the frequency and intensity of hazards is on the increase (ISDR, 2009). Landslides are the most common and frequent natural hazard, especially in hill and mountain areas. They cause huge damage to property and loss of human life every year. According to Bhattarai et al. (2002), a total of about 12,000 small and large scale landslides occur in Nepal every year. The available data indicate that the annual rate of human deaths in landslides and related disaster events in Nepal still stands at over 300 (Shrestha et al. 2004). One major cause is the country's geomorphologic situation as most of its land is covered with mountains and steep slopes of hills. It is further sandwiched between the giant, active Indian and Himalayan tectonic plates (Petley et. al, 2007). Landslides triggered by earthquakes are natural phenomena; thus, not much can be done to stop them from occurring. On the other hand, the government is also blamed for its inability to cope with disasters both at national and community levels. Nevertheless, the underlying causes of seasonal disaster created by landslides in hilly region of Nepal can be traced all the way from the government's failed land reform policy for resettlement of growing population (Wily L.A. et al., 2008). The increased population in the last five decades was encouraged to resettle in the land that cut off nearly half of the total forest land in the country. Massive deforestation and exploitation of natural resources for biomass fuel, overgrazing, building infrastructure beyond the bearing capacities of the hill slopes (LWF Nepal, 1999) and settlements degraded the hilly surroundings depleting the soil holding capacity of trees. Similarly, improper agricultural and irrigation practice are also the factors for the vulnerability of hilly region to landslides (ibid.). Impact of climate change has further made the locals unable to predict the monsoons in terms of seasons and duration. Their sole livelihood is washed away with the heavy rainfall and floods even losing the top fertile soil, leaving farmers to use the remaining land which is not favourable for cash crops. This contributed frequent occurrences of landslides in the hills and floods in the lowlands (Karkee 2004, Regmi 2008).

Despite national and international efforts to mitigate the effects of landslides, there are number of fatalities in the hilly region of Nepal in every monsoon. Infact, it is increasing every year (Khadka, 2012). People residing in hilly region are paying huge

compensation by losing loved ones and properties in an annual basis due to landslides followed by heavy rainfall (landslides in Nepal, 2010).

Hazards like earthquake, landslide, floods themselves are not disasters themselves. Disaster occurs when a potential hazard strikes the elements at risk to that hazard. Similarly, landslide turns into a disaster when there are presence of people and other elements like animals and properties in fragile condition; which is vulnerable to landslide. Hence, there is a need to observe reasons behind people living in such conditions, degree of their vulnerability, trend of repeating the similar scenario every year and extent of preparedness for the next impact in the hilly region of Nepal.

Due to failure of land reform in the past, people who did not have land were forced to utilize marginal lands (Wily et al., 2008). Because of ineffective implementation of national building codes (Thapa K., 2008), they were allowed to build their shelters in such places. As a result, their shelter, cultivated land and themselves are vulnerable to landslides. Since the impact of landslide effects mostly poorest among poor, planning sector and policy makers seem to ignore them in their landslide preparedness and planning. In addition, given Nepal's complex geophysical structure, it takes extra effort to reach landslide victims, especially in the hilly region the search and rescue activities are usually hampered by availability of rescue equipment (Landslides in Nepal, 2010). As preparation for disaster is more cost effective than recovering from the aftermath of the disaster (GWPC, 2010), empowering the community itself to prepare for and cope with impacts of landslides could be more effective measure to reduce the impact of landslides. Community resilience which is about empowering the community for potential hazards is also the priority 5 of HFA. It makes the community able to anticipate, prepare for, respond to, and recover quickly from impacts of disaster. Awareness is the key in terms of them having accurate information on the phenomenon, the effects it causes, ways and means of reducing vulnerability to the hazard.

Accordingly, this paper investigated community's awareness of landslides, knowledge of its vulnerability to landslides and reason behind residing in landslide prone areas. It also examined community preparedness for the next landslide and existence of government and non-government sectors' assistance towards community resilience from the impact of landslides. From a policy point of view, the research focused on

community's participation and integration of their knowledge in programs/plans to mitigate the effects of landslides.

### **1.3 Research questions**

The following question guided the research:

1. What are the potential threats of landslides to the community?
2. What is the level of awareness of the community on their vulnerability to landslides?
3. What are the push and pull factors for the community to reside in landslide prone areas?
4. What are the resilience measures at the community level to protect themselves?

### **1.4 Study objectives**

#### **1.4.1 General objective**

The broad objective for this study was to assess the extent of community resilience for the landslides in Sindhupalchowk district in the central hilly region of Nepal.

#### **1.4.2 Specific objectives**

1. To determine the potential threats of landslides to the communities living in Sindhupalchowk district
2. To establish the level of awareness of communities in Sindhupalchowk district on their vulnerability to landslides
3. To determine the push and pull factors for residing in landslide prone areas
4. To establish the community resilience strategies to the landslides in the district

## **1.5 Scope and limitation of the study**

In the hills of Nepal, landslides during monsoon season claims more lives than landslides caused by earthquakes or during other seasons which are linked to climate change. For this reason, this research focused on landslides happening during monsoon.

One of the regions that is more prone to landslide is the central hill region. This study focused on Village Development Committees (VDCs) in the Sindhupalchowk district which is located northeast of Kathmandu, the capital of Nepal. The reason for selection of the study area was based on the fact that compared to other places, the area was easily accessible in terms of communication and transportation. By focusing on one district, the researcher was able to save on time and money used during the data collection.

The fact that the focus of this research was on community resilience, the study concentrated only on this aspect of the landslide, i.e., the community's level of awareness and resilience strategies to the landslides.

As preparedness is a relative concept, directly associate to level of awareness of the problem (event or incident); the more one is aware the more one can prepare. For this reason, the study first focused in determining the level of awareness of the community to their vulnerability to landslide. Afterwards the research investigated social, economic and political factors that determine the reasons behind people's decision to reside in a landslide prone area. Thereafter, the research focused on community based landslide management strategies and their effectiveness in reducing the risks associated with and responses to landslides. Additionally, the study sought to find out the landslide resilience strategies employed by the communities in the area of study. The study was also expected to suggest on other resilience and awareness creation strategies which can be adopted in the management of landslides in the district.

## 1.6 Definition of terms

**Community Resilience:** Refers to the ability of a community to survive, to adapt, and to quickly recover when faced increasing levels of disturbances or potential hazards.

**Climate Change:** Refers to the change in climate that persists for decades or longer, arising from human activity (Intergovernmental Panel on Climate Change {IPCC}, 2007). It is now widely accepted that the global climate is changing, principally as a result of burning fossil fuels which in turn contribute to a greenhouse effect. The rise in global temperature is causing changing rainfall patterns, rising sea levels, and more unpredictable weather events.

**Disaster:** Refers to a calamitous event which occurs suddenly causing great loss of life, damage or hardship. Disaster happens when vulnerable people or their valuable properties are hit by forecasted hazard.

**Disaster Management:** Refers to the process of reducing, preparing for, responding to and recovering from potential hazards. Its goals are to reduce or avoid losses from hazards, assure prompt assistance to victims and achieve rapid and effective recovery.

**Deforestation:** Refers to the clearing of forest lands, especially for the purpose of settlement and agriculture purposes. It is seen most of the parts of the world that as human population increases by, forest lands are reduced to fulfil human's needs.

**Governance:** The term governance embraces a whole range of public and private, formal and informal organizations, policies, and processes, operating at local, national and international levels, which impact on different aspects of livelihoods, disaster preparedness or capacity to adapt to future uncertainty.

**Gender:** Refers to socially constructed roles, behaviours and activities of men and women which are deemed appropriate by a particular society. Women's position in society often makes them more vulnerable than men due to less access to resources, under-represented in decision-making processes, lack of time to participate due to gender roles. They bear a heavy social and economic burden: taking responsibility for domestic tasks such as producing and cooking food, fetching water, looking after children and caring for the sick and elderly.

**Hazard:** Refers to the threats to humans and what they value; such as; life, well being, material goods and environment.

**Landslide:** Refers to the down-slope movement of a mass of rock, debris, earth, or soil; occurs mostly on the hill region towards the lowlands. It can be triggered by earthquake, heavy rainfall or other human activities such as; extraction of boulder from the hills and sand from the riverbeds, mining and deforestation.

**Livelihoods:** It comprises the resources (including skills, technologies and organizations) and activities required to make a living and have a good quality of life. The livelihood options available to individuals and households depend on the diversity of resources, skills and technologies they are able to access.

**Marginalized or disadvantaged groups:** Refers to the groups which are often excluded from participating on the basis of age, race, caste, gender, religion or other ethnic grounds. Sometimes people are unable to participate such as the disabled, the aged, the young or the very poor who may have other priorities and cannot prioritize participating in meetings over their immediate needs.

**Risk:** Refers to the combination of probability of occurrence of a potential hazard and the magnitude of the specified consequences. It is the probability that a particular technology or activity will lead to a specified consequence over time and activity unit.

**Vulnerability:** Refers to the long term factors which affect the ability of the victims to respond to events or which make them susceptible to calamities. It can be understood in terms of physical exposure to specific hazards: people are vulnerable to Landslides when they live on the slopes of the hills.

## **CHAPTER TWO: LITERATURE REVIEW AND THEORETICAL FRAMEWORK**

### **2.1 Introduction**

This chapter comprises the review of existing body of information in disaster situation at the international, regional and national levels. The natural disasters are followed by the landslides situation at the various levels, different measures to mitigate and respond from the landslides at the international, regional, national and district levels. Finally the gaps are identified in the efforts from the various levels to mitigate and prepare for the impact of the landslides.

### **2.2 Landslides**

Landslides are defined as the mass movement of rocks, debris or earth along a sliding plane. They are characterised by almost permanent contact between the moving masses and sliding plane (Crozier, 1984). Landslides cause substantial economic, human and environmental losses throughout the world.

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). 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).

Examples of devastating landslides at a global scale include the 1972 Calabria landslide in Italy, the 1970 Hauscaran landslide in Peru (McCall, 1992), the 1966 Aberfan landslide in Wales, and the 1985 Armero landslide in Colombia (Alexander,

1993). It is estimated that in 1998, 180,000 avalanches, landslides, and debris flow in different scales occurred in China, estimated at 3 billion dollars worth of direct economic losses (Huabin et al., 2005).

In Africa, landslides are not new phenomena. They have been reported in Cameroon, Kenya, Uganda, Rwanda, Tanzania, and Ethiopia (Rapp et al., 1972; Inganga et al., 2001; Muwanga et al., 2001; Nyssen et al., 2003; and Knapen et al., 2006). Although the East African highlands are a very heterogeneous region in terms of physiography, geomorphology and rainfall (Knapen et al., 2006), they have a high vulnerability to slope instability in common. The high annual rainfall, high weathering rates, deforestation and slope material with a low shear resistance or high clay content are often considered the main preconditions for landslides (ibid.).

Nepal experiences various geo hazards such as earthquakes, landslides, flood, forest fire, windstorm, avalanche, and epidemics. Landslides are the most common natural hazards affecting people and property (Hasegawa et al. 2009). These are scale dependent ranging from massive failure of single peaks to small slopes failures (Shroder and Bishop 2004).

In Nepal, landslides occur due to combined effects of landslide-inducing and causal factors (Gerrard and Gardner 2002, Ghimire 2011). These landslide activating agents such as rainfall, earthquake and seismic events are also called trigger mechanisms. Susceptibility factors include intrinsic material properties of earth and physical topography such as steep slopes, rugged topography, sparse vegetation cover, fragile geological formations and structurally fragmented rock materials (Wieczorek 1996). In addition to, human activities also aggravate landslide susceptibility due to insufficient attention being given in the land use practices, infrastructure development and over exploitation of natural resources (Petley et al. 2007). Natural factors causing landslides in Nepal are discussed in section 4. A short summary of landslide studies in Nepal is discussed in this section.

In Nepal, landslides have occurred since prehistoric times. Moraines and rock mineral deposits are the evidence of past landslides. For example, the Langtang landslide occurred during the last glacial and inter glacial periods and landslide deposits as moraines and different forms of rock minerals from the same period are found in the

Langtang valley. But records of these prehistoric landslides are scarcely available (Heuberger et al. 1984).

### **2.3 Potential Threats of Landslides to the Community**

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.

The relict large-scale landslides have been causative to debris flows and slides along the highways (Hasegawa et al, 2008). More than 300 people in a highway in Tibet were trapped in 2011 in the monsoon when a landslide blocked a river and formed a barrier lake 150 metres long and 30 metres deep, China's official news agency Xinhua

reported. Krishnabhir which is located 82.5 km west from the capital Kathmandu, used to be a nightmare for the hundreds of thousands of people travelling on the Prithvi highway, the main transport artery of Nepal. Debris flow on the roads caused by the landslides every monsoon blocked the way between 1999 and 2003, disrupting essential supplies connecting to the locals with the towns and neighbouring country. As the heavy rain damage roads and obstruct transport, there are histories of the community people living without access to roads for months. Even the food, fuel and other goods imported from India is blocked for many days due to the debris. Consequently there is shortage of food with hiking prices of essential goods (UNHCR, 2011). Subsistence farmers and their children suffer from food deficit and depletion of nutritious food.

Apart from these, debris flow from the landslides causes the Terai region vulnerable to floods. Floods and landslides are often interrelated in Nepal (ISDR, 2008). Some landslides are triggered by riverbank erosion, and some flash floods are aggravated by landslides in the areas adjoining riverbanks. Both these phenomena occur during the monsoon season. Glacial lake outburst floods are common in the Himalayan region, and are triggered by a wide range of hydrological and seismic factors. Disastrous flash floods usually occur in Nepal when landslides or debris block a river for several hours and the water is then released suddenly, inundating areas downstream. Continuous heavy rainfall may also cause flash floods in many rivers originating in hilly regions. Flash floods may also be caused by an avalanche, snowstorm or cloudburst. Terai region of Nepal, India's northern part bordering Nepal and some parts of Bangladesh suffer from the impact of flash floods and floods every year during monsoons.

Landslide dam outburst floods (LDOFs) can occur when large amounts of material from landslides or debris flows reach a river and temporarily block its flow, creating a reservoir in the upstream reach. As the reservoir level rises from river flow and overtops the dam crest, sudden erosion of the dam can cause an outburst. Overtopping can also be caused by secondary landslides falling into the reservoir. Internal instability of the dam might trigger an outbreak even without overtopping. Such floods scrape out beds and banks, causing heavy damage to riparian areas and huge sedimentation in downstream areas (International Centre for Integrated Mountain Development {ICIMOD}, 2012). The flash flood followed by avalanches of rocks and debris at the source of Seti river in the mountain region claimed 70 lives and swept 2

villages in Kaski district of Nepal in 2012 (Adhikari, 2012). A similar type of flash flood occurred in Larcha, Nepal in July 1996, wiping out 22 houses and killing 54 people in a matter of a few minutes (ICIMOD, 2012).

In addition to causalities, there can be loss of property value, livestock and crops, increasing the vulnerability of the population, reducing their coping and caring capacities. Loss of fertile lands, a sole bread winning means and other properties due to the impact of frequent landslides coupled with lack of alternative jobs in own communities compel the rural poor from the hilly region migrate to the capital and neighbouring countries. Due to lack of education and negligible awareness, they often end up in insecure sectors with no insurance for their rights and minimal basic needs.

#### **2.4 Level of awareness of the Community on their vulnerability to Landslides**

A public awareness campaign is defined as a communication campaign that uses the ‘media, messaging, and an organised set of communication activities to generate specific outcomes in a large number of individuals and in a specific period of time’ (Coffman, 2002: 2). Public awareness and education as elements of disaster risk reduction was first highlighted in the Yokohama Strategy and Plan of Action in 1994 and since then the United Nations International Strategy for Disaster Risk Reduction (ISDR) set it as one of its four (4) key objectives in the Hyogo Framework for Action for 2005-2015 (UNISDR, 2005: 2, 9). Public awareness in conjunction with education, aims to familiarize vulnerable societies with their risks and inform them of the various actions that could be taken to minimise these risks (UNISDR, 2002: 188).

According to Chagutah (2009:116), risk reduction in the South African context where physical and financial mitigating measures are not easily realised due to financial constraints, public awareness may be the most accessible and practical tool of reducing risks in the most vulnerable communities. In order to determine whether these measures are effective, projects should be evaluated and the results integrated into further strategies and planning processes.

The process of evaluation measures the changes that the intended outputs of a project have on the target audience, therefore evaluating the impact and thus the effectiveness of the programme (UNICEF, 2005: 10). Evaluating a project has two main purposes,

namely to use resulting feedback to enhance future projects and to create a framework for answerability for implementing organisations (Twigg & Benson, 2007: 153).

In order to address the issue of risk in a community, their understanding of hazards and how to prevent that from negatively impacting on that community needs to be cultivated and must form an integral part of any Disaster Reduction Strategy. The UNISDR (2002: 340) defines Public Awareness as ‘The processes of informing the general population, increasing their levels of consciousness about risks and how to take action to reduce their exposure to hazards.’ These processes gear towards positive behavioural change that would guide preventative decision making in at-risk communities. It entails the broadcasting of public information through various media instruments such as printing, broadcasting and education programmes (ibid.). Public awareness as an element of risk communication is an invaluable tool in increasing at-risk communities’ capacity.

It is generally accepted that risk communication is a ‘process’, and should not be regarded as individual initiatives but rather as a seamless progression of building risk awareness through ‘hearing, understanding, perceiving, believing, confirming and responding’ to such messages (Blanchard-Boehm, Earl, Wachter & Hanford, 2008:299). Historically, risk communication is divided into two components, namely short term ‘emergency warnings’ and how the public respond to such communications, and secondly long-term ‘pre-emergency’ communications or public awareness measures which integrate the audience’s perceptions into such communications.

Most risk communication research focused mostly on the short-term urgent warnings, but with more consideration given to the workings of vulnerability and capacity of a community and how it affects their ability to respond to emergency situations, the focus of risk communication shifted towards a more long-term public awareness environment (Blanchard-Boehm et al, 2008:299).

The purpose of risk communication or public awareness is fourfold: for authorities to conform to legislative requirements and disseminate hazard information, to advocate and educate communities, to change belief systems, and eventually change risky behaviour using the various combined concepts of the social science theories (Mileti, Mathe, Gori, Greene & Lemersal, 2004:1).

Public awareness campaigns advocate risk communication messages to encourage a group of people to perform certain risk reduction measures by way of giving them information and promoting why these measures are the best means of reducing their specific risks (Aspinwall, 1999: 88). It forms part of the mitigatory function of Disaster Risk Reduction which aims to arm at-risk communities with the necessary knowledge and skills as part of their capacity artillery in the face of a possible disaster incident.

Bird, Gisladdottir and Dominey-Howes (2010: 34, 39) propose five factors that affect one's ability to respond to such an incident namely hazard knowledge, risk perception, implementation of preparedness measures, response behaviour and lastly hazard and risk education. These factors are inter-related and dependent on the social, political and economic context of the at-risk community and must be approached holistically during the planning of any awareness campaign.

Hazard knowledge refers to the personal understanding of hazard information and its specific processes (Paton, 2006:7). The rationale being the better one understands the process of hazards, the better equipped response and preparedness actions are, thereby reducing vulnerability and in so doing also disaster risk (Paton, Smith, Daly & Johnston, 2008:180).

Risk perception or the measure of how exposed individuals feel to a risk, is influenced by one's social, cultural context as well as past experiences of such a risk (Siegrist & Cvetkovich, 2000:719). In order to effectively change risk behaviour, the target audience's risk perception and therefore priority areas must be identified taking into consideration the context of the community's situation (Paton et al, 2001:62).

The third factor, implementing preparedness measures, is vital in empowering the at-risk community. In order for such measures to be accepted and enacted, they need to be stressed and continuously re-iterated to such communities (Bird et al, 2010:39).

Appropriate response behaviour during a disaster incident is directly influenced by the hazard knowledge, as well as the social, cultural and economic context of an individual (Chester, Duncan & Dibben, 2008: 225). Feelings of unconcern, dependence on external response and doubt could all lead to mal adaptive response

behaviour requiring constant corrective guidance in order to substitute into positive adaptive and preparedness behaviour.

The fifth and final factor namely educational campaigns inform the public of their particular risks and how to mitigate, prepare for and respond to them respectively (Paton et al, 2008:180). By formulating such campaigns in such a way to influence risk perception and guide informed decision making, hazard ignorance and therefore the community's risk is reduced (Wisner et al, 2004:332).

Public awareness campaigns address all five aspects of disaster preparedness and response ability elements by highlighting these vital elements and are therefore an essential part of the overall disaster risk management process.

Awareness provides a secure environment and can address the problems faced by residents in the event of landslides. Two examples of how residents knowledge can be used to heighten awareness and develop balanced environment of early precautions are, first to enjoined the spirit of planting greenery, and secondly, be exposed to incidents of a landslide disasters. These and other techniques are among the few indigenous early precautions which can serve as sign to prevent the incidence of landslides. They can be used to alert resident of an impending landslide disaster and to seek ways not to destroy the hilly areas reserves or increase the concrete buildings of maintaining green plants.

## **2.5 Push and Pull Factors in Disaster prone Areas**

This section present literature on some of push and pull factors for the disaster prone areas.

### **2.5.1 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 (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). Lack of awareness and access to information can increase levels of vulnerability (Economic Capacity Building, 2006:18). Disasters can happen because vulnerable people do 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 (Paul, 2005:372,). All this could be symptoms of negative social processes which result in increased social vulnerability.

### **2.5.2 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 (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.

### **2.5.3 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 diseases. 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 (Kynia, et al., 2008:33).

#### **2.5.4 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). 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).

#### **2.5.5 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.

## **2.6 Landslide resilience measures at the Community Level**

Practical Action sees resilience as the ability of a system, community or society to resist, absorb, cope with and recover from shocks and stresses (Pasteur, 2011). A resilient community is one in which people can manage risk and recover from shocks such as floods, droughts and violent conflict. It also means people have the ability to adapt to long term trends such as climate change in a timely and efficient manner without undermining their wellbeing. Resilience is the capacity of a community to organize itself to reduce the impact of disasters by protecting lives, livelihoods, homes, assets, basic services, and infrastructure. Capacities include skills, knowledge, resources, practices and networks.

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.

## **2.7 Theoretical Framework of the Study**

This study used the theory of Reasoned Action and Planned Behaviour.

### **2.7.1 Theory of Reasoned Action**

Theory of Reasoned Action suggests that a person's behaviour is determined by his/her intention to perform the behaviour and that this intention is, in turn, a function of his/her attitude towards the behaviour and his/her subjective norm. The best predictor of behaviour is intention. Intention is the cognitive representation of a person's readiness to perform a given behaviour, and it is considered to be the immediate antecedent of behaviour. This intention is determined by three things: their attitude toward the specific behaviour, their subjective norms and their perceived behavioural control.

The theory of reasoned action by Ajzen and Fishbein (1969)) provides a model that has potential benefits for predicting the intention to perform a behaviour based on an individual's attitude and beliefs. This model was extended to accommodate developments in the variables and the resulting model was named the theory of planned behaviour (Ajzen, 1991).

### **2.7.2 Theory of Planned Behaviour**

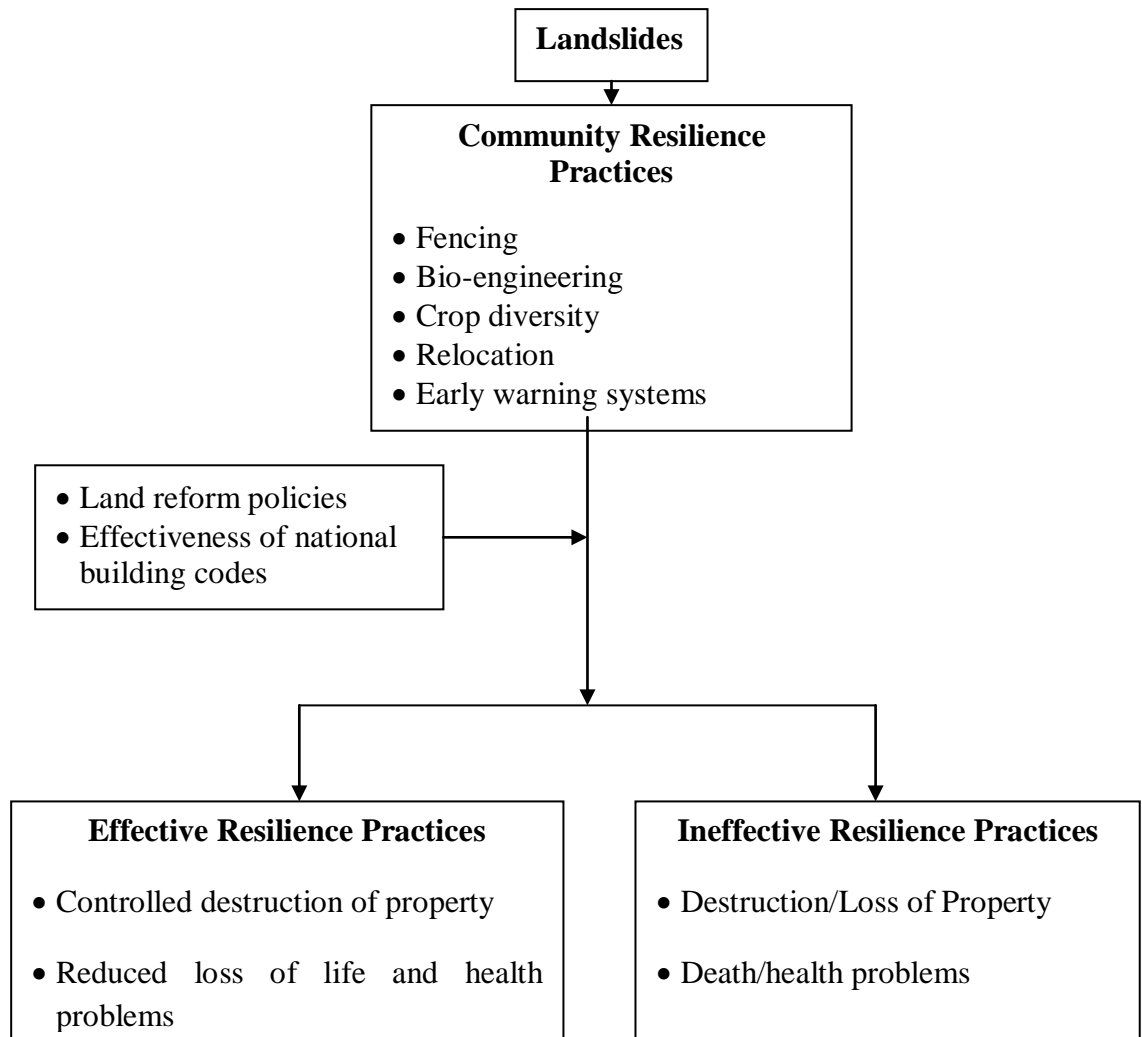
The theory of planned behaviour holds that only specific attitudes towards the behaviour in question can be expected to predict that behaviour. In addition to measuring attitudes towards the behaviour, we also need to measure people's subjective norms and their beliefs about how people they care about view the behaviour in question. To predict someone's intentions, knowing these beliefs can be as important as knowing the person's attitudes.

Both the theory of reasoned action and planned behaviour was used in this study to explain the relationship between the variables of the study. The fact that landslides have destructive effects on the people, those who reside in landslide prone areas continue to live in such areas. The theory of reasoned action was used to explain the reasons behind the occupancy of landslide prone areas besides the effects. The theory was therefore used to explain the push and pull factors for the continuous occupancy of landslide prone areas. The theory of planned behaviour on the other hand was used to explain the community resilience strategies for landslides. Upon realizing the

effects of landslides, the community came up with strategies to minimize the impacts of landslides.

## 2.8 Conceptual Framework

The conceptual framework below presents the relationship between the variables of the study.



**Figure 1: Conceptual Framework**

In the framework above, “landslides” is the independent variable while the effects are the dependent variables. Community practices such as fencing, bioengineering, crop diversity, relocation and early warning systems can be either effective or ineffective depending upon the interventions through land reform practices and national building codes. The effective resilience practices lead to controlled destruction of property, reduced loss of life and health problems where as ineffective resilience practices lead to destruction or loss of property and death or health problems.

## **CHAPTER THREE: METHODOLOGY**

### **3.0 Introduction**

In this chapter, the researcher describes the methods that were used and how the study was conducted. The chapter contains research design, study variables, the study locale, target population, sample size and sampling techniques, research methods, research instruments, piloting, data collection procedure, data analysis plan and ethical issues considerations.

### **3.1 Research Design**

This study used descriptive research design. The design was considered appropriate as it helped the researcher to gather information on community resilience for landslides: Case study of Sindhupalchowk district in Nepal.

### **3.2 Study Area**

Nepal is located on the southern border of Himalayan range in between China and India, where eight of the ten highest peaks of the world are distributed. Nepal occupies an area of 147,181 square kilometre (km) which is divided into three distinct geographic units based on the topography: High mountain (27%), Mid-hills (56%) and Terai (low land) (17%). Nepal has an uneven topography with high relief and complex geology resulted from tectonic processes and active seismicity (Duncan et al. 2003). The topographic elevation of Nepal ranges from 60 metre at sea level in the southern plain to 8848 metre at sea level on Mt. Everest in the north. Approximately 83 percent of the country lies in the mountainous region. Such a sharp topographic variation across a horizontal distance of around 200 km makes it prone to landslide hazard (Caine and Mool 1982, Wagner 1983, Duncan et al. 2003).

Owing to the rugged mountain topography, complex and fragile nature of the geological structures resulting from tectonic movement and the intensive rainfall during every monsoon season, serious landslides have occurred frequently in Nepal. In addition to the importance of these landslides for infrastructures and properties, they have had a marked effect on the lives of local people and been a cause of many socio-economic problems including deforestation and intensive agricultural practices. The rapidly increasing construction of infrastructures, such as roads, irrigation canals

and dams, without due consideration given to natural hazards, is contributing considerably to triggering landslides.

This study was carried out in Sindhupalchowk District in Nepal, which is a part of Bagmati Zone and one of the seventy-five districts of Nepal, with an area of 2,542 square km (981 sq mi). The district's headquarters is in Chautara. In 2006, 336,478 people resided in 79 village development committees, in 2011 there were 287,798 (Nepal National Bureau of Statistics, 2012). There are 79 Village Development Committees (VDCs) in Sindhupalchok District out of which 35 VDCs are highly vulnerable. According to the UN report (2011), 270 families (1600 people) are vulnerable in Sindhupalchok District. There are five local NGOs operating in the region. Sindhupalchowk District had been chosen due to the fact that it is a landslide prone district and also the researcher's familiarity with the area. In support to this, Singleton (1993) states that, the ideal setting is one that is related to the researcher's interest, easily accessible and that which allows the development of immediate rapport.

### **3.3 Target Population**

The population for the study were the communities living in Sindhupalchowk District. The study targeted members of the community, government administration at the local level such as Village Development Committees (VDC) secretaries and members of NGOs.

### **3.4 Sampling Techniques and Sample Size**

Purposive sampling technique was used to sample Village Development Committees (VDCs). This technique was appropriate for sampling the VDCs because only five vulnerable VDCs were targeted by the study. There are 79 Village Development Committees (VDCs) out of which 35 VDCs are highly vulnerable. Out of the 35 highly vulnerable VDCs, 5 VDCs were purposively sampled for the study. Gay (2003) suggested that 10 percent of the accessible population is adequate to serve as a study sample. A Sample of 5VDCs which represents 14 percent of the targeted population was therefore considered representative for the study.

Stratified sampling technique was used to group each of the 5 targeted VDCs according to their names. This sampling technique helped the researcher to ensure that

samples are drawn from each of the targeted VDC. Simple random sampling technique was used to sample members of the local community from each of the targeted VDCs. This sampling technique was deemed appropriate as it gave equal chances to the members of the local communities within each VDC to be sampled for the study. A total of 36 community members were sampled from 3 VDCs (Badegaun, Thakani and Sindhukot) for the structured questionnaire interviews. Additionally, 12 community members from Melamchi VDC and 10 community members from Jyamire VDC were selected to participate in the Focus Group Discussions. A total of 60 members of the local communities from the 5 VDCs were therefore targeted by the study. The study also targeted 5 representatives from the NGOs operating in the region and 5 VDC secretaries. A total of 70 respondents were therefore targeted by the study (constituting 5 VDC secretaries, 60 members of the local communities and 5 representatives from the NGOs operating in the District).

### **3.5 Research Methods**

Triangulation method was used to collect data for the study. This involved the use of different research instruments such as Questionnaires, interview schedules, focus group discussion guide and observation checklist. Primary data was used for the study. The instruments which were used are explained below:

#### **3.5.1 Questionnaire**

The researcher used structured questionnaires to collect data from community members, VDC secretaries and/or Ward members. The questionnaires were divided into different sections whereby each section addressed questions to achieve each of the specific objectives of the study.

#### **3.5.2 Interview Schedules**

The researcher used in-depth interview schedules to collect data from NGOs operating in the District of study. The interview schedule was structured based on the predetermined questions of the study.

### **3.5.3 Observation Schedule**

The observation method was involved directly looking at the effects of landslides and the resilience practices adopted by the local communities. The researcher therefore deemed the method appropriate for the study as it allowed capturing of information that would otherwise not be captured using questionnaires and interview schedules.

### **3.5.4 Focused Group Guide**

The focus group guide was used to collect information from members of the local community. Each of two groups consisted of between 10-12 members. The discussions were conducted on areas such as: community awareness on landslides, the effects of landslides, push and pull factors and community resilience practices.

## **3.6 Piloting of Research Instruments**

The instruments of the study were piloted in the neighbouring VDC named Kartike in the same district which was not studied. The piloting ensured clarity of the final instruments for the actual data collection. The purpose of this pre-testing was to find out any weakness that might be contained in the instruments of the study.

### **3.6.1 Validity**

Opinions from the researcher's supervisor were used to check on the content validity of the instruments.

### **3.6.2 Reliability**

To test on the reliability of the instruments, the researcher used test re-test method. This method involved administering the instruments to the respondents and after some period of time re-administering the same instruments to see the consistency with which the questions are answered. The researcher administered the instruments with the members of the local communities and after a period of two weeks, the instruments were administered with the same respondents again. The instruments were considered reliable because there was consistency of the responses given by the respondents.

### **3.7 Data Collection Procedure**

The researcher obtained a letter from the University of Nairobi allowing her to go to the field. She made appointments with the area chiefs to notify and request for permission to carry out the study in their areas of administration and arrange for the dates for data collection. The researcher administered the instruments with the respondents through the assistance of local research assistants. The research assistants helped in interpreting the questions to the respondents and helped them where necessary to answer the questions appropriately. This ensured achievement of a good return ratio and helped respondents to get a chance to seek clarification on items that proved difficult.

### **3.8 Data Analysis**

Primary data from the field was first edited to eliminate errors made by respondents. Coding was done to translate question responses into specific categories. Coding was expected to organize and reduce research data into manageable summaries. Quantitative data was analyzed using descriptive statistics while content analysis techniques were used to analyze qualitative data collected using interview schedules. Statistical Package for Social Sciences (SPSS) package was used to analyze the quantitative data. Descriptive statistics such as means, standard deviation, frequencies and percentages were used to describe the data. The analyzed data was presented in form of tables, pie-charts and bar-graphs where applicable.

### **3.9 Ethical Considerations**

The researcher had to arrange with the relevant authorities in the targeted VDCs to confirm the dates for data collection and get the consent of the local administration. This was to eliminate the case of surprise entry into administrative areas targeted without prior visit to clarify on the intention of the visit.

The researcher ensured confidentiality of the information given by the respondents. This was done by using the information without mentioning the specific names or VDC from where the data was collected. The researcher made sure of the willingness of participation of the respondents before taking interviews.

## CHAPTER FOUR: DATA ANALYSIS, PRESENTATION AND INTERPRETATION

### 4.0 Introduction

This chapter presents the findings of the study. The purpose of this study was to find out the extent of community resilience for the landslides in Sindhupalchowk district in the central hilly region of Nepal. The section presents the demographic characteristics of the respondents and the findings for the specific objectives of the study. The response rate was as presented in Table 1.

**Table 1 Response Rate**

<b>Categories of Respondents</b>	<b>Expected number of respondents</b>	<b>Actual number of respondents</b>	<b>Percentage of turnout of respondents</b>
Community Members	36	36	100%
Focus group	24	22	91.7%
<b>Total</b>	<b>60</b>	<b>58</b>	<b>96.7%</b>
Key informants	10	6	60%

Out of 60 respondents targeted by the study, a total of 58 members of the communities participated as the respondents giving a response rate of 96.7 percent. Similarly, 3 VDC secretaries and 3 representatives from the NGOs operating in the District participated as the key informants in the study which was 60% of the number targeted by the study.

The questionnaires were administered to 36 local community members (12 each from Badegaun, Thakani and Sindhukot VDCs) who answered the questionnaires while the other 22 local community members were involved into 2 focus group discussions constituting 12 members from Melamchi and 10 members from Jyamire VDCs respectively.

Two VDC secretaries could not be reached as they were preparing for change of office after the general election. Similarly, the researcher could find only 3 NGOs

working on disaster risk reduction. Due to geographic difficulties and lack of fund, the remaining two NGO staff could not be visited at their field based workstations.

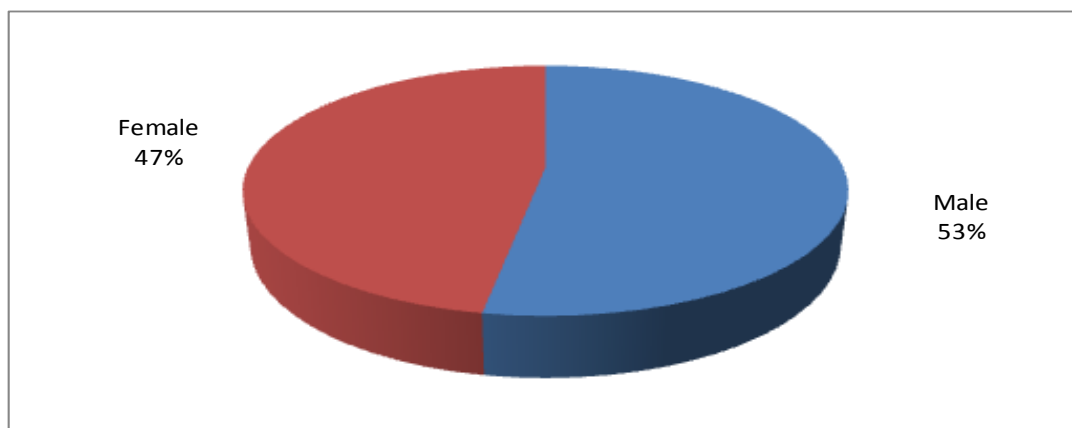
#### **4.1 Socio-demographic characteristics of respondents**

This section presents information on the respondents' gender, age, level of education and source of income. The findings of the study were as presented in the following sub-sections below:

##### **4.1.1 Distribution of the Respondents by Gender**

Gender is an important aspect in any sociological study as it reflects the position of women in the society. Seeking the views of all gender (male and female) on the effects of landslides was therefore important in this study as it reflected the views of both in the society. It will therefore make it easy to prevent and manage the effects of landslides as it affects all the members of the society. Gender of the respondents was noted and recorded accordingly as shown in figure 2 below:

**Figure 2 Distributions of the Respondents by Gender**



The study shows that 53 percent of the respondents were male while 47 percent were female. From the findings of the study, it can be said that the information collected was representative of both gender as both men and women were given a chance to air their views on landslides.

While conducting pilot study in Kartike VDC, only men were present to participate in the study and upon inquiry about women's absence, men revealed that women were

busy doing household chores. Since it was necessary to hear their equal voice, women’s participation was considered important and hence they were convinced to participate in the study in all visited VDCs. In some communities, however; such as; Majhigaun and Thakani, convincing women to take part in the study was quite tough as they consider participating in the research is not so important than doing daily household chores. However, in Melemchi and Jyamire, women were found to be participating readily.

#### 4.1.2 Distribution of the Respondents by Age

Age is an important aspect in this study as it informs the awareness levels among those affected by landslides and at the same time reflects on the experience with landslides. In establishing the respondents’ age, they were asked to indicate their age brackets. The findings of the study are as presented in figure 3 below:

**Figure 3: Distribution of the Respondents by Age**

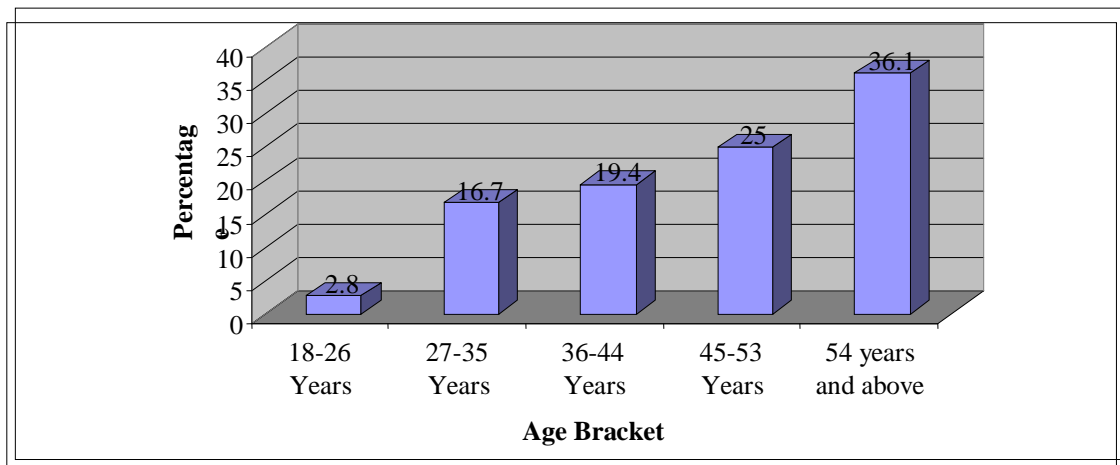


Figure 3 shows that 36.1 percent of the respondents interviewed were 54 years old and above and 25 percent of the respondents were aged between 45-53 years, followed by 19.4 percent who were aged between 36-44 years while, 16.7 percent were aged between 27-35 years.

From the findings of the study, it can be said that most (36.1%) of the respondents interviewed were aged enough and were therefore perceived to have information of landslides in Sindhupalchowk District. The less (2.8%) presence of the younger group

(18-25 years) was that they were in the field; away from home hence, could not participate in the study.

#### 4.1.3 Distribution of the Respondents by Level of Education

The level of education of the respondents is very important in the study as it varies the community members' information on the potential threats of landslides and the level of awareness on their vulnerability to landslides. It also might help in determining the push and pull factors for residing in landslide prone areas and their knowledge in the resilience strategies to the landslides. The education levels of the respondents will therefore reflect the visited communities' level of awareness on their vulnerability and resilience strategies to landslides. The respondents were asked to indicate their level of education ranging from none to middle school. The findings of the study are presented in figure 4 below:

**Figure 4 Distributions of the Respondents by Level of Education**

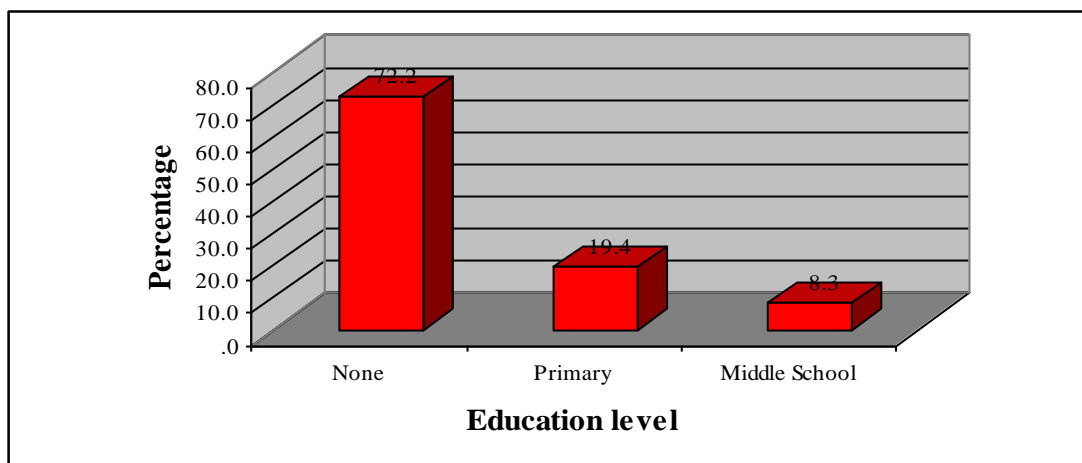


Figure 4 shows that 72.2 percent of the respondents has no formal education while 19.4 percent has primary level of education. The least (8.3%) has middle school level of education. From the findings of the study, it can be said that most of the respondents interviewed were illiterate.

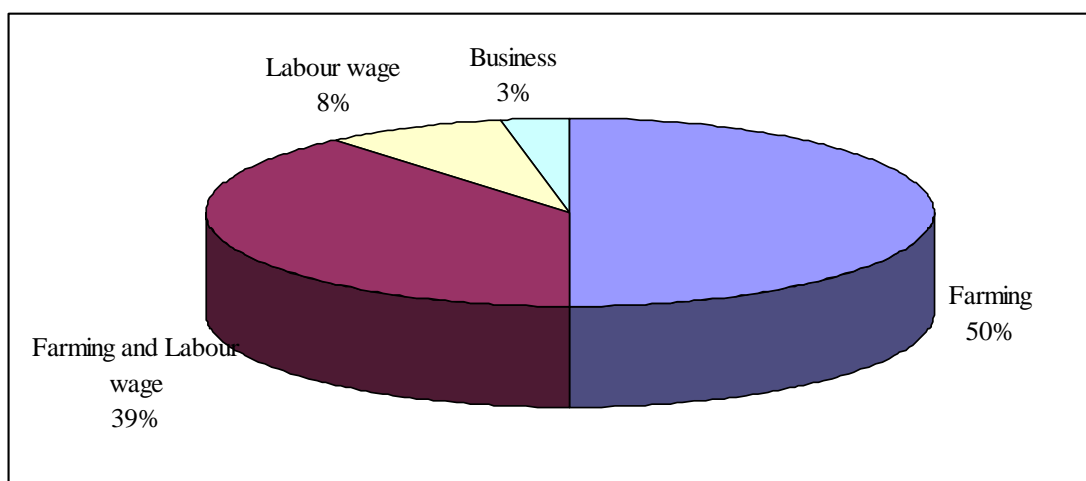
Reason for high illiteracy level in the study can be identified with their Ethnicity as all the respondents from Thakani were Tamang and all respondents in Badegaun were Majhi. Both of these ethnic groups are marginalized groups (Thapa N., 2009) who were deprived development benefits including education.

As the literacy can be linked with the level of awareness, this can be one of the reasons to reside in the landslide prone areas, hence increasing their vulnerability to landslides. This fact was verified by the VDC secretary from Sindhukot: “Since most of the community members are illiterate, they are unaware of handling landslides.”

#### 4.1.4 Source of Income

The level of income of a population is an important factor in preventing the effects of disasters. People may continue staying in disaster prone areas simply because they may not have the adequate resources to enable them to access land on safer grounds. Thus, focusing on the income levels of the respondents will therefore enlighten the effects of landslides on the population. To establish this, the respondents were asked to indicate their source of income and the findings of the study are as presented in Figure 5 below:

**Figure 5 Source of Income**



The figure 5 above shows that half of the respondents interviewed (50%) indicated that their source of income is farming and 39 percent indicated farming and labour wage as their source of income. They work as wage labourers for others when crops are not sufficient to feed themselves and their families. Few respondents (8%) work as labourers only while the remaining 3 percent of the respondents do business for their living. From the findings of the study, it can be said that the majority of the respondents interviewed relied on farming of rice and maize as their main source of

income. The fact of the findings is an indication that those who are living in the landslide prone areas are mostly subsistence farmers with low income.

**The study was guided by the following specific objectives:**

1. To determine the potential threats of landslides to the communities living in Sindhupalchowk district
2. To establish the level of awareness of communities in Sindhupalchowk district on their vulnerability to landslides
3. To determine the push and pull factors for residing in landslide prone areas
4. To establish the community resilience strategies to the landslides in the district

The following sub-sections therefore present the findings of the study as per the objectives of the study:

**4.2 Potential Threats of Landslides to the Communities**

The first objective of the study was to determine the potential threats of landslides to the communities living in Sindhupalchowk district.

**4.2.1 Factors making residence prone to landslide**

To achieve the first objective, the respondents were asked to indicate factors making their residence prone to landslide in their settlements. The factors making their residence prone to landslide were: type of house, location of their area of habitation and land use pattern. The findings of the study are presented in Figure 6 below:

**Figure 6 Factors making residence prone to landslide**

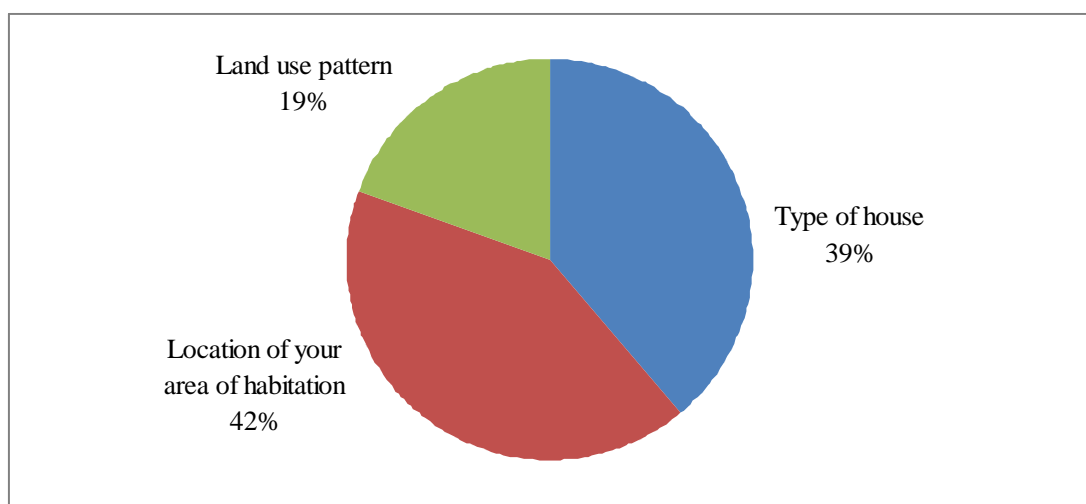


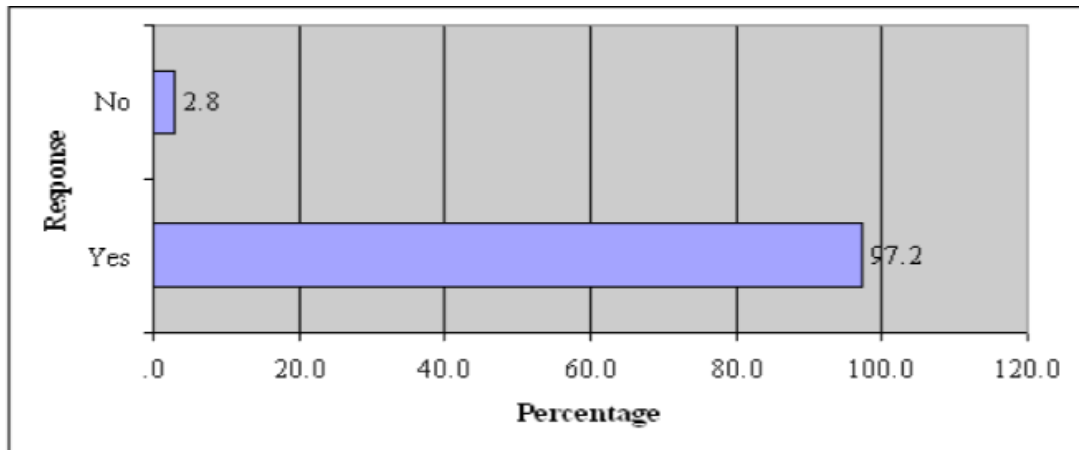
Figure 6 above shows that 42 percent of the respondents indicated that the location of area of habitation makes their residence prone to landslide as most of the respondents' habitations were either on the down slope of the hills (Sindhukot, Melamchi) or next to landslides (Thakani). In Badegaun, since their houses are built near the riverbank of Melamchi River, slippery soil without stones and rocks is making houses prone to landslides. Similarly, 39 percent of the respondents indicated that type of houses makes residence prone to landslides. Those houses are made of mud, stones and wood; unable to withstand landslides. The least (19%) of the respondents indicated that their land use pattern makes residence prone to landslide as their houses are built by cutting the hill where they are residing.

These findings are supported by Committee on Disaster Research in Social Sciences (CDRSS, 2006) which suggests that the vulnerable population occupies hazard prone areas, live and work in less hazard resistant structures within those areas and have lower rates of pre-impact intervention such as mitigation, emergency preparedness and recovery; hence, they are vulnerable to landslides.

#### 4.2.2 Affected population from Landslides

To know the affected population from landslides in the communities, the respondents were asked whether they have ever been affected by landslide in any way. The findings of the study are presented in the following figure 7 below:

**Figure 7 Respondents affected by Landslides**



The Figure 7 above shows that the majority (97.2%) of the respondents indicated that they had been affected by landslide. This verifies with Hasegawa et al (2009) who stated that landslides are the most common natural hazards in Nepal affecting people and property. Few respondents (2.8%) from Badegaun and Thakani revealed that they are no longer affected by landslides since they moved to a safer place.

Landslides were observed in the visited VDCs:



Source: Author

Landslide in Jyamire

A respondent in Jyamire: “We are in the middle of landslides. There was no sign of any landslide when I bought this land few years back. There was heavy rainfall one night. The next day everything was gone. It was astonishing how landslide came and took everything even though water was not so strong. The place has become like this.”



Source: Author

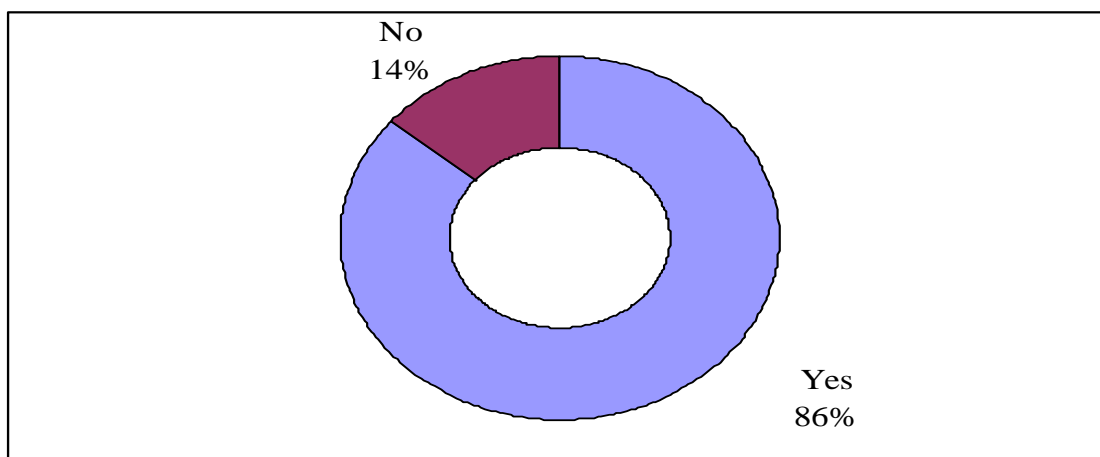
Landslide in Melamchi VDC

“We are suffering from landslides since last 2 years when the road department began digging the hill for road construction.” Villagers from Melamchi VDC

### 4.2.3 Effects of the threats by landslide on settlement (type of structure and location of building)

The respondents were asked whether the threats by landslides affect their settlement in terms of the type of structure and location of the building. The findings of the study were presented in figure 8 below:

**Figure 8 Effects of Landslide on type of houses and settlement**



The study found that 86 percent of the respondents indicated that the threats by landslide affect settlement in terms of the type of structure (houses) and location of the building. In Sindhukot and Badegaun; respondents stated that as the location of their houses are on the slope of hills and are made of bricks/stones and mud, their settlement is affected by the threat of landslide. Their stables, walls of houses, fencing are damaged; crops and field have been either sloped away or degraded as they are mostly covered with debris and fertile soil flows away during rainy seasons. In Badeguan, soil is always wet; it never dries and drifts away under the houses because of increase in flow of stream during rainy seasons. In Thakani, the location of their settlement is closer to landslide, hence; similar effects like damaged houses, crops and degraded land can be seen. In Melamchi VDC, cracked houses were observed as the threat of landslide caused by digging the hill for road construction.

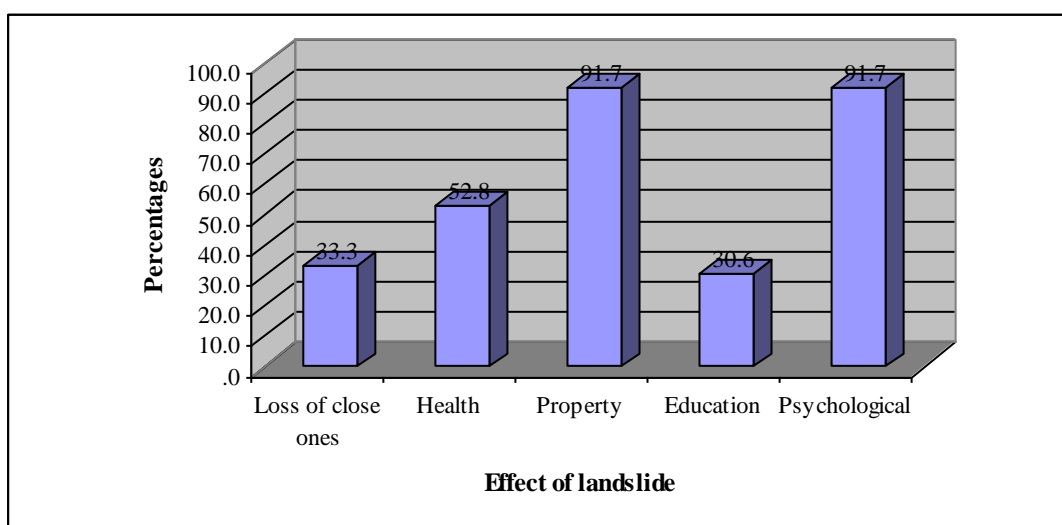
Few respondents (14%) indicated that the threats by landslide do not affect their settlement in terms of the structures and location of the buildings. These respondents were those who said that their houses are not cracked nor anything has drifted away at the present residence. The reason could be that they have moved to the safer places

where they built stronger houses and planted trees on their land to minimize the threats of landslides.

#### 4.2.4 Affected areas on community members

The community members were asked how landslides have affected the communities living in their VDCs. They were requested to choose from the following effects: Loss of close ones, Health, Property (crop, infrastructures), Education (school drop outs) and Psychological effect.

**Figure 9 Types of effects on community members due to Landslides**



#### **Loss of property:**

The findings on figure 8 show that the majority (91.7%) of the respondents indicated that landslides have affected their properties. In all three visited VDCs (Sindhukot, Badegaun and Thakani), fields with crops were either swept away or covered with debris. Fertile soil flows away and land gets dry and degraded due to debris flow during the rainy seasons. Old houses are completely destroyed, stables are damaged and most of the new houses are also cracked. Some houses and lands have drifted downward. Fencings with stones made by the community are also damaged. Some people have moved out from Sindhukot VDC after losing their properties.

In Badeguan, at least a house of each community members was swept away by the landslide occurred in 2010. Crops with 4-5 *Ropanis*<sup>1</sup> land were swept away with debris. The community members had to move to a temporary shelter until they built new houses. Likewise, the landslide which occurred nearly 20 years ago in Thakani swept away the land of 1.5 to 12 *Ropanis* including houses, crops and trees. The community members had to move to another place, labouring on other's land and being dependent on others for their basic needs. As the land is still sinking gradually beneath their residence, they often have to move upward to protect themselves from the effect of the landslide.

An officer from CDECF and the President from NRCS also verified that there is loss of properties equivalent to 2-3 million annually in the district as a result of landslides.

### **Psychological effects:**

Similarly, 91.7 percent of the respondents said that they have been psychologically affected by landslide. In Sindhukot and Thakani, as the habitations are at the peak of the hills, they are always in fear and worry of losing crops, houses being damaged during rainy seasons and there is tension for children falling down and getting injured. As the present habitat is very much in threat, the community members in Thakani are often worried about where to go if they have to move from the current place too. Since everything has been lost in the landslide, there is no hope of good life for some of the respondents in this area. They are worried of their children's future if they also have to suffer like them because of landslides.

“Due to landslides, we lost everything. We had to move to other places 2-3 times in the past. The place where we moved, the locals sued us. It was a tensed moment for us. We are living in someone's house which is also nearby the landslide. As we are not entitled to do farming, we have become wage labours. We wonder of going somewhere to live during rainy seasons when there is threat of landslides. We spend rainy nights by waiting impatiently to turn into days. We might somehow protect our lives, however, it is difficult to struggle and survive on daily basis with such threats.”

*-A respondent in Badegaun*

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<sup>1</sup>Unit of measurement for land in Nepal. 1 *Ropani*= 74 feet\*74 feet

On 9<sup>th</sup> August 2012, more than 100 households' land was swept away by debris flow caused by heavy rainfall. Crops and some 9 *Ropani* land were gone. About 1000 *Ropani* land in total is affected due to landslide. Our land is also sliding downward and soil of our land has degraded. Now we have to go farther to collect fodder. 16 houses are still in threat of landslide. There is possibility of displacement of the whole community. We are not happy because of landslide. - *The FGD members in Jyamire, 2013*

### **Effects on Health:**

Among the respondents, 52.8 percent indicated that landslides have affected their health. Respondents from Sindhukot VDC revealed that they sometimes get injured while walking through debris. They also said that water gets polluted because of soil erosion, hence; there is scarcity of drinking water during the occurrence of landslides. In Badegaun VDC, there were cases of getting sick with dysentery as a result of drinking contaminated water, becoming disabled and getting injured because of landslide.

When landslide occurs, there is no good provision of food and health care; hence the community gets sick resulting in declining health. In Thakani and Sindhukot VDCs, it is difficult to reach hospital during monsoon because of blockage of roads with debris causing further degradation in health. The members of communities also suffer from psychological effects as discussed above, which affect their health.

### **Loss of life:**

When asked if there was loss of life in the communities as the result of landslides, 33.3 percent of the respondents indicated that they had lost their close ones. In Sindhukot VDC, a respondent's husband's brother and sister in law were killed by landslide 16-17 years ago. Officials from CDECF and NRCS also verified that at least 5-6 people die annually in the district as a result of landslides and its effects.

**Effects on Education:**

While 30.6 percent of the respondents indicated that landslides affected their children's education in many ways. In Sindhukot, Thakani and Badegaun, the respondents revealed that sometimes when landslides block the road; it is difficult for children to go to school, thus; they have to stay at home. In Badegaun, the respondents said that when they are affected with landslides, they are unable to prepare meals for their children; hence; sometimes their children do not go to school. Even if they go; sometimes they come back after the registration of their attendance since they starve.

During FGD with members of the local communities of Jyamire and Melamchi on the effects of landslides, the following effects were mentioned: loss of life, health risks such as injuries during landslide; pollution of water creating scarcity of drinking water, inaccessibility to facilities such as health and school after landslide, loss of property and crops, houses, destruction of roads and soil erosion. Other effects included inaccessibility to schools, psychological effects such as fear, insecurity due to the risks of landslides and that during rainy season respondents stay alert at night which disorganizes their lives and activities.

These findings are supported by Shafri (2010) who mentioned that the landslides tend to dislocate objects that they come in contact with, by way of uprooting trees, destroying crops, degrading land, sweeping away houses, and destruction of roads. This also verifies Singh (2010) that they have assumed catastrophic and disastrous proportions causing extensive damage to life and property resulting in great problems and serious challenges development processes to the community members of Sindhupalchowk. The study confirm the statement that landslides result in injuries and death; induce environmental, physical and economic damages that impede the development of poor nations as stated by Jamali & Abdolkhani in 2009.

The devastated effects of landslides in Sindhupalchowk district were observed as shown in the pictures below:



Source: Bibhu

Way to Melamchi VDC: Debris flow and gullies formed by heavy rainfall during the rainy season has affected the communities' properties, health and their children's education.



Source: Author

Men in Sindhupalchowk district removing debris from the landslide affected area that occurred after the monsoon in 2013.

### Landslide affected area in Thakani:



Source: Author

According to programme officer of CDECF and the displaced community, this landslide is the largest one in Sindhupalchowk district. The headmaster revealed that around 20 houses including a huge football ground were swept away gradually by landslide. In this disaster, a family lost as much as 10-12 *Ropani* of land including houses and crops. They are not being compensated even nearly after 20 years.



Source: Tamang

A deserted house in Thakani VDC

After losing all properties, the local communities were forced to move to a new place which is still not safe as landslides are approaching nearer every year.

#### 4.2.5 Causes of Landslides

The respondents were asked to rate the extent of the perceived causes resulting into landslides in their areas. The factors were given as: high rainfall, land use pattern, settlement near the road, riverbank erosion, lack of awareness, type of soil and specify if any other factors. The findings are presented in Table 2 below:

**Table 2 Perceived factors resulting Landslides**

Statement (Factors)	Very large Extent		Large extent		Neutral		Small extent		No extent at all		Total (%)	
	F	%	f	%	F	%	f	%	f	%	F	%
High Rainfall	24	66.7	10	27.8	1	2.8	1	2.8	0	0	36	100
Land use pattern	5	13.9	9	25	12	33.3	5	13.9	5	13.9	36	100
Settlement near the road	2	5.6	5	13.9	0	0	0	0	29	80.6	36	100
Riverbank erosion	6	16.7	6	16.7	3	8.3	0	0	21	58.3	36	100
Lack of awareness	7	19.4	6	16.7	10	27.8	9	25	4	11.1	36	100
Type of soil	13	36.1	10	27.8	9	25	2	5.6	2	5.6	36	100

Table 2 above shows that rainfall (66.7%) is perceived to cause landslides to a very large extent in the areas prone to landslides followed by the type of soil (36.1%). Similarly, high rainfall and type of soil are perceived to cause slides at a large extent (27.8%). Since almost all the respondents (92.5%) rating high rainfall as the highest cause for landslides verifies the statement that landslides mostly occur either during or after the rainy seasons.

Land use pattern is perceived to cause land slide to a small extent (13.9%) while 80.6 percent of the respondents rated that the settlement near the roads is not perceived as a cause for landslides at all since most of the visited villages are not located near the roads. Likewise, 58.3 percent of the respondents indicated that riverbank erosion causes landslides to no extent at all. This can be the fact that among 5 visited VDCs, only Badegaun is located near the riverbank where 50 percent of the respondents from that VDC rated riverbank erosion to very large extent and remaining half (41.7%) of the respondents from the same VDC rated to very large and large extent respectively.

However, 33.3 percent remained neutral in indicating land use pattern as the causal factor for landslide. From the findings of the study, it can be said that high rainfall is the major cause of landslide in Sindhupalchowk district.

In addition to the causal factors mentioned above, human activities also aggravate landslide susceptibility due to insufficient attention being given in to the land use practices, infrastructure development and over exploitation of natural resources (Petley et al. 2007).

The participants from the focus group discussion in Jyamire mentioned that the frequency of landslide has increased since the government quarried land to construct road. The VDC secretary of Jyamire revealed the destruction of a large public forest which was turned into field during the conflict between the contemporary government and the Maoist rebellions. A teacher in the same VDC mentioned that landslides are at their place due to *Bhuchaya*<sup>2</sup>, building houses on the trances of hills and excavation of rocks or stones. It is due to these factors that soil became weak and the drifted rocks covered the path of the stream which made new path swiping away their land.

Hence, from the findings of the study, it can be said that high rainfall, type of soil, lack of awareness, riverbank erosion are the causes of landslide. Similarly, from the focus group discussions, it can be said that quarrying land, rocks and stones; deforestation; degradation of land; building houses without following building codes are the causal factors for increase in landslides in Sindhupalchowk district. This verifies the research done by Gerrard and Gardner 2002, Ghimire 2011 who documented that in Nepal, landslides occur due to combined effects of landslide-inducing and causal factors. These findings are supported by Knapen (2006) who stated that the high annual rainfall, high weathering rates, deforestation and slope material with a low shear resistance or high clay content are often considered the main preconditions for landslides.

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<sup>2</sup>Bhuchaya – degradation of soil

Exploitation of rivers and excavating of sand are some of the man made activities which contribute to occurrence of landslides as were observed through the pictures taken in the various visited villages in Sindhupalchowk district:



Source: Author

Communities in Badegaun are still vulnerable to landslides as exploitation of the river beneath their habitation can be observed.



Source: Author

Local people excavating sand from the River Melamchi

### 4.3 Level of Awareness of Communities in Sindhupalchowk District on their

#### Vulnerability to Landslides

To establish the level of awareness of communities in Sindhupalchowk district on their vulnerability to landslides as the second specific objective, the respondents were asked to indicate to what extent they agree by responding to different statements on their vulnerability to landslides. They were asked to rate to what extent each used strategy is effective in their communities in regard to the creation of awareness among the communities living in Sindhupalchowk district.

#### 4.3.1. Level of understanding about landslides

The respondents were asked to indicate their level of understanding among the following statements: landslides are natural process, disaster happens when lives and properties are exposed to landslides and its effect can be preventable. The findings are presented in Table 3 below:

**Table 3 Level of understanding landslide**

Statement	Strongly Agree		Agree		Neither Agree nor Disagree		Disagree		Not sure/Do not know		Total (%)	
	F	%	F	%	F	%	F	%	F	%	F	%
Landslides are natural process	26	72.2	8	22.2	2	5.6	0	0	0	0	36	100
Disaster happens when lives and properties are exposed to landslides	18	50	18	50	0	0	0	0	0	0	36	100
Its effect can be preventable	3	8.3	5	13.9	7	19.4	18	50	3	8.3	36	100

Table 3 shows that 72.2 percent of the respondents strongly agreed that landslide is natural process. In Thakani and Sindhukot, 83 percent of the respondents strongly agree that landslides are natural process. In Badegaun, 92 percent of the respondents strongly agree and agree respectively that landslides are natural process. In

contradictory, participants from FGD in Melamchi VDC did not agree that landslides are natural processes since they experienced landslide resulting from the construction of the road in their area. Hence, the members of the communities are not knowledgeable about the fact that landslides cannot be always natural but can be the result of combined effects of landslide-inducing and causal factors (Gerrard and Gardner 2002, Ghimire 2011).

The study found that half of the respondents (50 %) strongly agreed and the remaining half (50%) also agreed that disaster happens when lives and properties are exposed to landslides. However, 50 percent of the respondents disagreed that effects of landslides can be preventable. In Thakani, the majority (75%) of the respondents disagreed that it can be preventable. One official (candidates from a political party) during a recent election campaign in the VDC declared that the landslide cannot be prevented in the village. This kind of perception on landslides by the officials can be one of the ways of negatively enforcing their perception on prevention of landslides. The community members who are not aware of the causes leading to landslides could think that landslides cannot be prevented at all.

A respondent in Badegaun: “Eventhough how much we tried to prevent landslide in the past, it is difficult to do so.”

Respondents from Thakani: “No one can stop landslide. Landslide is there since a long time. No one and nothing can prevent it.”

In Badegaun, only 25 percent of the respondents strongly believe that the effect of landslides can be preventable. Their strong beliefs on this can be understood after observing the community, for instance, actively involvement on prevention, response and rehabilitation stages of disaster management by the local NGO (CDECF) under initiative of UNDP and the government.

The pictures below show some of the initiatives taken by the communities with the belief that landslides are preventable to some extent if the community members plant trees, fence the areas and build strong houses:



Planting trees and fencing are the strategies practiced by the community assisted by the government and Department of Soil Conservation in Badegaun VDC.





Source: Author

Community was moved to new places where they built strong houses with the financial assistance from the government and NGO. They have also planted trees and built terraces to minimize the effect of landslides. Such resilience strategies being practiced by the community show the community's belief that landslides are preventable.

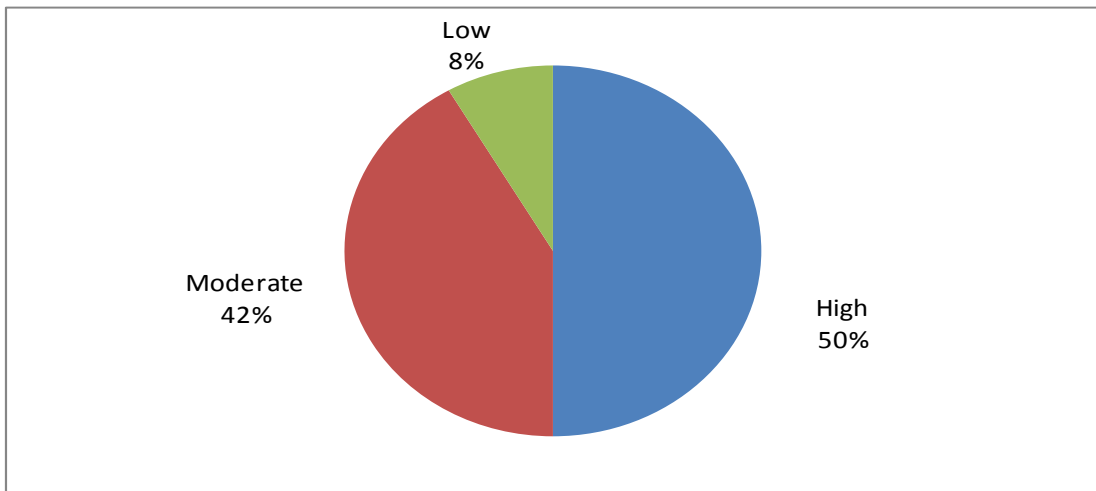
In the interviews with the representatives from the NGOs operating in the area on the understanding of the local communities on landslides, they mentioned that most of the members understood what landslides are since they are normally affected themselves. An officer from CDECF said that the communities know where landslides usually occur or are occurring.

Hazard knowledge refers to the personal understanding of hazard information and its specific processes (Paton, 2006). The rationale being the better one understands the process of hazards, the better equipped response and preparedness actions are, thereby reducing vulnerability and in so doing also disaster risk (Paton, Smith, Daly & Johnston, 2008:180). From the findings of the study it can be said that the respondents are not aware that landslides cannot always be natural processes and it can be prevented; however; they have knowledge on disaster that it happens when lives and properties are exposed to landslides.

#### 4.3.2. Vulnerability of the Community Members to Landslide

The respondents were asked to indicate the rate of vulnerability of the community members to landslide. The findings of the study are as presented in Figure 10 below:

**Figure 10: Vulnerability of the Community Members to Landslide**



The findings on figure 10 show that 50 percent of the respondents indicated that the communities are highly vulnerable to landslides. In Badegaun and Thakani VDCs, 75 percent of the respondents rated that the vulnerability is high in their communities. Furthermore, respondents from Badegaun explained that their community is in danger during rainy season as land with crops and houses slide downward such that they feel all the 21 houses in the village are in threat of landslide if the river beneath cuts the bottom of the hill where they are residing.

The VDC secretary also mentioned that the communities are very vulnerable due to the fact that landslides always occur in these areas especially during the heavy rains. The most affected villages according to the secretaries are those who have settled near the steep land and unstable areas.

## Vulnerability of the Community as observed in Badegaun VDC:



Source: Author

The displaced community is still vulnerable to landslides as the picture above shows the excavation of sand from the river for the development purposes.

The respondents in Thakani stated that they are living above the place where there is the biggest landslide in the district. They believe that wherever they go, will be threatened by landslides. From the headmaster of a primary school it was revealed that those displaced were discriminated to some extent by other members of the communities and were refused to provide them with good land to establish their structures or houses forcing them to move above the landslide affected area which is still a threat to them.

However, 42 percent of the respondents indicated that they are moderately vulnerable while only 8 percent indicated that they are less vulnerable to landslide in their communities. These respondents said that they had moved to other safer places which are not so vulnerable at the moment. From the findings of the study, it can be said that vulnerability of the community members to landslide is high. 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 (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.

#### 4.3.3 Creation of Awareness on Landslides among the Community

Regarding strategies used in the creation of awareness on landslides among the community, the respondents were asked to indicate the extent to which different awareness techniques were adopted. The findings are as presented below in Table 4:

**Table 4 Creation of Awareness on Landslides**

Statement	Very large extent		Large extent		Neutral		Small extent		No Extent at all		Total (%)	
	F	%	F	%	F	%	F	%	F	%	F	%
Raising awareness through group training	5	13.9	7	19.4	2	5.6	12	33.3	10	27.8	36	100
Raising awareness through media	0	0	15	41.7	12	33.3	4	11.1	5	13.9	36	100
Use of informal education	6	16.7	8	22.2	0	0	7	19.4	15	41.7	36	100

The findings on Table 4 show that 55.6 percent of the respondents indicated that use of informal education has been adopted in their communities to a small extent. Out of this population, 80 percent were from Sindhukot where no informal education has been provided regarding disaster management. However, 16.7 percent indicated that use of informal education adopted in the communities to a very large extent and 22.2 percent rated it to a large extent. While, 33.3 percent of the respondents indicated that raising awareness through group training is to a small extent. Majority of respondents from Sindhukot rated raising awareness through group training is to a small extent as

well. Similarly, majority of respondents from Thakani (58.3%) rated as no extent at all since they complained that no training has been provided in raising awareness.

The study also found that 41.7 percent of the respondents indicated that raising awareness through media is to a large extent. The majority from Badegaun falls in this group as they have experience of moving safely to other places before landslide hit them like in the year 2010. The DDC informed them through the media to move out from their landslide prone residences to safer places. Additionally, the respondents from this VDC also revealed that they were given mobile phones to stay updated on landslide related news which helped them to stay in touch with CDECF and prepared them to leave the place when they were asked to do so by the NGO.

Majority (75%) of the respondents from Thakani however rated creation of awareness to no extent at all and the respondents from Sindhukot (91.7%) revealed the reason of staying neutral as most of the community members have no access to TV, radio or newspapers, hence they do not get any awareness messages. The community members from these VDCs therefore think that raising awareness through media cannot be effective in their VDCs.

The UNISDR (2002: 340) defines public awareness as the processes of informing the general population, increasing their levels of consciousness about risks and how to take action to reduce their exposure to hazards. These processes gear towards positive behavioural change that would guide preventative decision making in at-risk communities. It entails the broadcasting of public information through various media instruments such as printing, broadcasting and education programmes (UNISDR, 2002: 340). Public awareness as an element of risk communication is an invaluable tool in increasing at-risk communities' capacity. The study findings therefore reveal that there were no effective awareness activities on landslides in the area of study hence the need to reinforce the same.

#### 4.3.4 Effectiveness of Strategies used in the Creation of Awareness on Landslides among the Community

To find out the effectiveness of strategies used in the creation of awareness on landslides among the community, the respondents were given different statements on the effectiveness of strategies. The findings of the study are as presented in Table 5:

**Table 5 Effectiveness of Strategies used in the Creation of Awareness on Landslides among the Community**

Statement (Strategies)	Very effective		Effective		Less effective		Not Effective		Not Sure/ Don't know		Total (%)	
	F	%	F	%	F	%	F	%	F	%	F	%
Raising awareness through group training	5	13.9	19	52.8	10	27.8	0	0	2	5.6	36	100
Raising awareness through media	1	2.8	16	44.4	11	30.6	2	5.6	6	16.7	36	100
Use of early warning system	2	5.6	10	27.8	12	33.3	1	2.8	11	30.6	36	100

Table 5 shows that 52.8 percent of the community members indicated that raising awareness through group training is effective and 44.4 percent indicated that raising awareness through media is effective. According to the respondents in the visited VDCs, informal and formal group training and media like TV, radio, mobile means of communication are only effective but not very effective in creating awareness among the communities in Sindhupalchowk.

According to 33.3 percent of the respondents, use of early warning system is less effective in the area. From the findings of the study, it can be said that even though different strategies are used in the creation of awareness they are effective except early warning system which is found to be less effective. This applies to respondents from Thakani and Sindhukot who did not receive early warnings from any authorities,

hence they find it not so effective. However, respondents from Badegaun, DDC (District Development Committee) confirmed that they were warned to move to safer place before landslide occurred at the area of their residence. This conflicting information affirms the resistance of the community members in taking action after they are warned of the threats of landslides.

In an interview with the VDC secretaries on the effectiveness of different strategies for creating awareness, they mentioned that the strategies in place were not so effective. For instance, formal training was not so effective due to low literacy levels among the population. They explained that media could have been the best method but it has not been effectively used to relay the information on the landslides. The secretaries further explained that they conduct community meetings to try to educate people on the landslides and commented that the practice had not been so effective due to difficulties in community members relating to each other particularly those who occupy landslide prone areas.

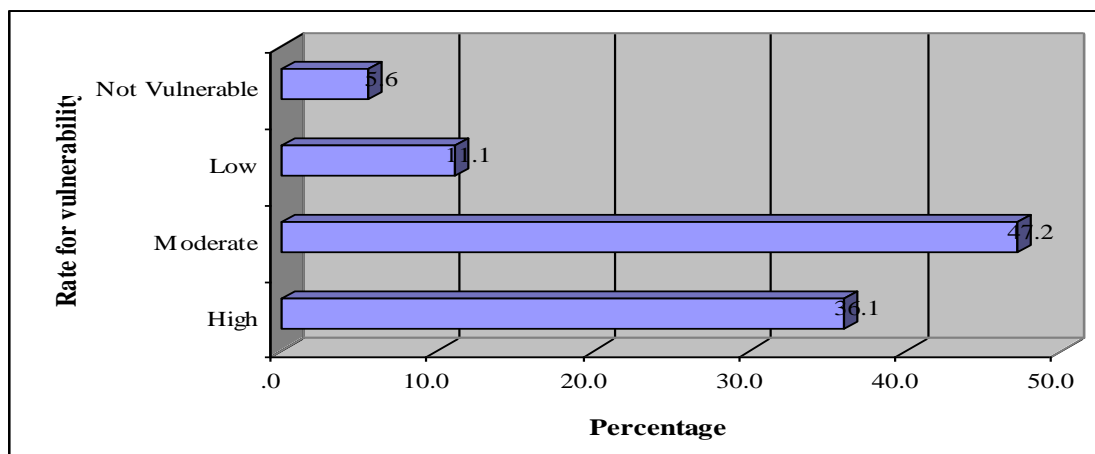
#### **4.4 Push and Pull factors for Residing in Landslide prone Areas**

To determine the push and pull factors for residing in landslide prone areas, respondents were asked the questions like how do they rate their place of residence towards vulnerability to landslides; if their area is vulnerable, have they considered moving away to look for better places for residing; to indicate the extent to which each of the factors given has led to the occupancy of landslide prone areas and what are the other reasons behind occupancy of landslide prone areas by the members of the local communities.

##### **4.4.1. Vulnerability of the Places of Residence to Landslide**

Vulnerability of residence areas was rated by asking the community members to indicate the rate the vulnerability from high to not vulnerable. Below are the findings of the study presented in Figure 11:

**Figure 11: Vulnerability of the Places of Residence to Landslide**



The findings on Figure 11 above show that 47.2 percent of the respondents indicated that their place of residence is moderately vulnerable. Among this group, 83 percent of the respondents from Sindhukot stated that life becomes difficult during rainy seasons and landslide is not so destructive during other seasons.

In addition, 36.1 percent of the respondents indicated that their places of residence are highly vulnerable to landslides. The respondents from Thakani mentioned that there is possibility of the whole habitat sinking since landslide is occurring closer to their present habitation. In Badegaun, the community members' houses are on the slope of the hill bottom which is gradually being cut by the river (stream) and houses are slowly sliding down and land is drifting apart. However, 5.6 percent of the total respondents indicated that they are not vulnerable at all such as respondents from Sindhukot stated that landslide in their community is not a major disaster and there is less threat during rainy seasons as they have moved to a safer place of residences, hence, they are not so vulnerable.

From the findings of the study, it can be said that most of the places of residences by the local communities are generally vulnerable. This information was supported by the Program officer from CDECF (Community Disaster Preparedness and Response Plan) working in Sindhupalchowk district, who mentioned that the district is highly vulnerable to landslides.

#### 4.4.2. Movement to other Safe Places

Community members were asked to indicate if they consider moving away to look for better places for residing. The findings of the study are as presented in Figure 12 below:

**Figure 12 Respondents' Willingness to move to Safer Places**

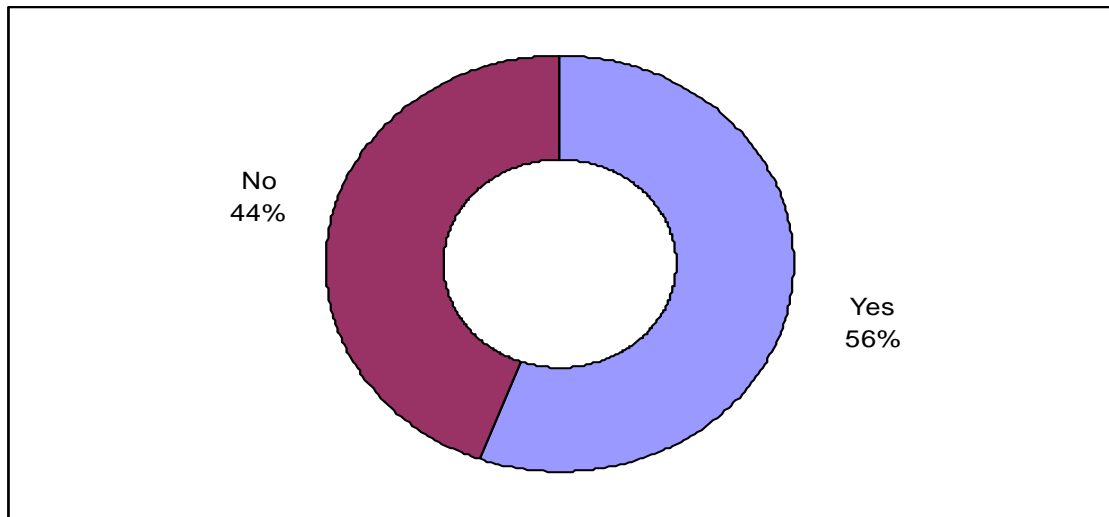


Figure 12 shows that 56 percent of the respondents indicated that they would consider moving away to look for better places for residence, while 44 percent indicated that they would not consider moving away to look for better residence. When they were asked to briefly explain their answers, they said that the one they currently have is the only property they have and no one wants to buy their land. Some community members were too old to migrate and some could not afford to buy another piece of land due to lack of finances.

These findings are supported by Cutter (2003:244) and Wisner, et al. (2004) that 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.

Some landslide affected victims in Thakani VDC have moved to safer place, however they are unable to build strong houses due to financial constraints.



Source: Author

Displaced people by landslide in Thakani

#### 4.4.3 Push and Pull factors behind Residence in Landslide prone areas

To test on the push and pull factors behind residence in landslide prone areas, the respondents were given different statements. The findings of the study are as presented in Table 6 below:

**Table 6 Extent to which Push and Pull factors has led to the Occupancy of Landslide prone Areas**

Statements/ Factors	Very large Extent		Large extent		Neutral		Small extent		No extent at all		Total (%)	
	F	%	F	%	F	%	F	%	F	%	F	%
Residents cannot afford land in safer areas	30	83.3	5	13.9	1	2.8	0	0	0	0	36	100
Ethnic reasons/Ancstral Land	17	47.2	10	27.8	4	11.1	3	8.3	2	5.6	36	100
Landslide disaster is preventable	0	0	3	8.3	17	47.2	3	8.3	13	36.1	36	100

The findings on Table 6 above show that 83.3 percent of the respondents indicated that they cannot afford land in safer areas to a very large extent. The respondents from all visited VDCs revealed that even though they want to move, they cannot afford to buy property in the safer places as safer land has proved to be very expensive.

“No one buys this land at reasonable price which will not be enough for us to buy property in safer place. We are poor with extended families. It is better to live here with difficulties than begging on the streets elsewhere. Since we do not have other possessions, we are safeguarding our properties as we are living here.” – Respondents in Sindhukot

“My children including me are disabled. We’ve been living here for a long time. I cannot struggle elsewhere. Everyone wants to live in a good place with good facilities. Even if we want to move, who will buy our land? How can I take such a big family anywhere else, how will I support them? Neither we can farm nor work as labourers. If only our children are raised well, it will be better. They may go somewhere later, but we will not go anywhere.” –A disabled respondent from Sindhukot

In Thakani, respondents quoted that they can move if land is provided. They have already moved to the present habitat which is a public land. However, landslide has also reached near that place and there is no other land to move from their current residence.

Respondents from Badegaun said that they have already moved to safer place (community forest) which is not a threat for landslide at the moment. Their little remaining fertile land is close to a river and they are aware that their shelter is still in threat due to regular riverbank erosion during and after rainy season every year. They can move elsewhere only if both shelter and food are provided to them.

These findings are supported by Anderson (2011) that 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. The poor are more vulnerable than economically better off sectors of the society (Benson & Clay, 2004:5).

**Ethnic reasons:**

When the respondents were asked to rate the factors behind residing in landslide prone areas, 47.2 percent indicated ethnic reasons to be a push factor to a very large extent and 27.8 percent rated the reasons to a large extent. Ethnic factors can be traced through the history of Nepal, when members of the communities occupied marginalized areas which were prone to landslides.

The respondents from Thakani and Sindhukot said that they were safeguarding their properties and moving away means that they still do not have the rights to their ancestral land. They are afraid that others (including the government and elites) will seize their land if they move away from that place. This fear of the members of the communities can be understood by the history of Nepal's land reform system (Wiley et al., 2008) which seized their ancestral land after they were categorized as low and impure castes by the National law of 1854. Hence, they became tenants on their own land and new development benefits were deprived to these indigenous people (Tamang Samaj UK, 2013, S.Majhi, 2014). These experiences by the communities lead to fear of losing their ancestral land if they are to respond to threats of landslides and decide to move to safer areas.

Officials from CDECF mentioned that *Majhi* community in Badegaun does not want to move from their ancestral land which is on the slope of a hill near the riverbank. Since they are fishermen, they cannot leave the riverside. The respondents were found to be quoting:

“Since we are Majhi (fishermen), we have to live nearby a river. We need stream/river to do rituals when we die. Rivers/streams used to be our sole livelihoods since our 12 generations. At present as well, the fertile land is yielding good crops for us. Different authorities assured us that we can live in this place. We just hope that landslide may not occur here again, besides, no land is available in the safer place.”

This verifies Majhi S., 2014, who stated that from the dawn of time, Majhi ethnic group had a special relationship with the rivers of Nepal. Their main traditional occupation was boat building and river transportation services. However, due to new development activities country wide, their traditional livelihood has been sized with the construction of modern bridges. In addition, they are deprived of education, land rights and other development benefits based on their ethnic values (Thapa N., 2009). As a result, most of Majhi ethnic groups are below the poverty line to afford land to safer places; hence, they are pushed to live in such areas.

Hence, ethnicity is also one of the major factors in pushing the members of the communities in the landslide prone areas.

### **Landslide disaster is preventable:**

On the belief that landslide disaster is preventable, 47.2 percent remained neutral and 36.1 percent rated their belief to the statement as no extent at all. Among them, the respondents from Sindhukot (83.3%) and Thakani (83.3%) were the most who rated the statement as no extent at all. The respondents from these VDCs said that they do not take any measures to prevent landslide as they believe that it cannot be prevented. Their belief can be related to the absence of such organizations working on disaster prevention in the VDCs in contrast to the presence of CDECF, Department of soil Conservation and other organizations clustered only in Badegaun where the respondents (50%) were found to be rating landslide disaster as preventable to large and small extent.

The majority of the respondents not believing landslide disasters as preventable verifies the fact that despite their belief, they do not have any choice other than choosing the place to live in landslide prone areas.

Other reasons behind living in such areas were found as:

Respondents from Sindhukot revealed that they have been living at their place for a long time; there is harmony in their society which cannot be found anywhere and cannot be built in their lifetime again. Hence, it is difficult for them to leave the place.

In Thakani, landslide victims were found to be discriminated by non- landslide affected communities by not allowing them to live nearby; hence, they are forced to live in landslide prone areas.

In an interview with the VDC chiefs on the reasons behind the occupancy of the area besides their vulnerability, following reasons were given: lack of finance to buy another land, limited assistance from the government, their residence was their ancestral land and that they do not have any other place to go. The CDECF staff also said that the communities are living in such areas due to their poor economic condition as they cannot afford to buy good land at other places.

#### **4.5 Community Resilience Strategies to the Landslides in the District**

To establish the community resilience strategies to the landslides in the district, the community members were asked questions on what the government is doing to ensure safety of people living in their administrative areas in terms of mitigation, preparedness, response, rehabilitation and any other. They were also asked about what the community is doing in their attempt to reduce the impact of landslides in their area and to indicate the extent to which each of the strategies has been adopted by members of their community to control landslides as well as how effective are the resilience strategies.

##### **4.5.1 Attempts to reduce the Impacts of Landslides**

Community members were asked to state their attempts to reduce the impacts of landslide. The following strategies were mentioned: using witchdoctor, planting trees, fencing and building stronger houses, government placing wall at the bottom of the hill, building temporary shelters and moving to safer areas.

##### **4.5.2 Extent to which landslide resilience strategies have been adopted**

To test on the extent to which landslide resilience strategies have been adopted, community members were given different statements on land resilience strategies. The findings of the study are as presented in Table 7:

**Table 7 Extent to which landslide resilience strategies have been adopted**

Statement	Very large Extent		Large extent		Neutral		Small extent		No extent at all		Total (%)	
	F	%	F	%	F	%	F	%	F	%	F	%
Constructing safer houses	1	2.8	5	13.9	1	2.8	15	41.7	14	38.9	36	100
Fencing	2	5.6	4	11.1	10	27.8	12	33.3	8	22.2	36	100
Crop diversification	0	0	2	5.6	6	16.7	0	0	28	77.8	36	100
Planting trees	3	8.3	12	33.3	5	13.9	6	16.7	10	27.8	36	100
Moving away to safer place	7	19.4	13	36.1	9	25	6	16.7	1	2.8	36	100
Use of early warning system	3	8.3	8	22.2	8	22.2	2	5.6	15	41.7	36	100

**Constructing safer houses:**

Table 7 shows that 41.7 percent of the respondents indicated that constructing safer houses had been adopted to a small extent. In Badegaun, stronger houses are built with the help of the government which provided financial and technical (ceiling) support. Furthermore, the residents are trained to build strong houses. However, in Thakani and Sindhukot, the landslide victims are not assisted in any way to build stronger houses resulting in construction of weaker houses.

**Fencing:**

The findings also show that 11.1 percent of the respondents indicated that fencing had been adopted to a large extent. In Sindhukot and Badegaun, fencing with stones and trees has been found to be effective. The frequency of landslides has been decreased since the community members built fence around their residence.

However in Thakani district, community members do not believe anything can prevent landslides as the landslide is there from a long time and biggest in the district, fencing could not be seen in the VDC.

#### **Crop diversification:**

The study revealed that 16.7 percent of the respondents indicated that crop diversification had been adopted to a neutral extent. Only in Badegaun VDC, the respondents said the crop diversification has been adopted to large extent as per the advises from the Soil-Conservation department and CDECF. The respondents revealed that soil erosion has decreased since this strategy has been adopted in their community.

#### **Planting Trees:**

The findings show that 33.3 percent of the respondents indicated that planting trees had been adopted to a large extent. In Sindhukot, the community members have planted trees around their area. In Badeguan, Soil-Conservation department provided plants (trees) and gave training; hence, trees and shrubs are planted around their residence. Since then soil erosion has been decreased.

#### **Moving away to safer place:**

Some respondents (36.1%) mentioned that they have adopted moving away to safer place to a larger extent. In Sindhukot, the community members move to temporary shelter and return after landslide stops. In Badegaun also, the vulnerable community moved to safer place in 2010 when landslide hit their community and lived in a temporary shelter until the effect of landslide got minimized. In Thakani too, there is a primary school at the foothill where the community members are advised to use in case of threat of landslide.

#### **Use of early warning system:**

The findings also show that 22.2 percent of the respondents indicated that use of early warning system had been adopted to a large extent. In Badegaun, community members were saved after the government decided to move them from the previous

place as landslide was approaching. In Thakani, no one was hurt during landslide which occurred about 20 years ago as the community members decided to leave the place after observing the extent of soil erosion.

In an FGD with the members of the community on the resilience strategies to landslides, they mentioned the following: planting trees, moving away to safe places and seeking help from the government.

“Our 15 houses were destroyed. We lived in a makeshift house (hut) until another was built. It took 4-5 months to build a better house. – DilBahadur Majhi, Badegaun

From the findings of the study it can be said that moving to safer place is the most common used strategy to landslide resilience. This verifies the study done by Practical Action, which stated that Community Resilience is the capacity of a community to organize itself to reduce the impact of disasters. From the capacities of the communities that are mentioned above and the strategies practiced, it can be said that the members of the visited communities are resilient to landslide to some extent.

#### **4.5.3 Effectiveness of landslide resilience strategies**

To assess the effectiveness of landslide resilience strategies, the community members were given different statements to rate the effectiveness of the existing used strategies. The findings of the study are as presented below in Table 8:

**Table 8 Effectiveness of landslide resilience strategies**

Statement	Very Effective		Effective		Less effective		Not effective		Not sure		Total (%)	
	F	%	F	%	F	%	F	%	F	%	F	%
Constructing safer houses	4	11.1	13	36.1	1	2.8	13	36.1	5	13.9	36	100
Fencing	2	5.6	14	38.9	9	25	4	11.1	7	19.4	36	100
Crop diversification	1	2.8	3	8.3	4	11.1	10	27.8	18	50	36	100
Planting trees	7	19.4	10	27.8	7	19.4	6	16.7	6	16.7	36	100
Moving away to safer place	6	16.7	17	47.2	10	27.8	1	2.8	2	5.6	36	100
Use of early warning system	1	2.8	13	36.1	11	30.6	0	0	11	30.6	36	100

The findings on Table 8 show that 47.2 percent of the respondents indicated that moving away to safer place is perceived to be effective strategy. This can be linked with the respondents' level of understanding landslides where the majority (72.2%, Table 3) strongly agreed that landslides are natural processes and 8.3 percent (refer Table 3) strongly disagreed that its effect can be preventable. Regarding fencing, 38.9 percent of the respondents indicated that fencing is an effective strategy for resilience to landslides. The community members of all 3 visited VDCs desired that the government provided necessary resources for strong fencing.

Additionally, 36.1 percent of the respondents indicated that the use of early warning system and construction of safer houses are effective strategies respectively. In Badeguan, the respondents believe that their loss is less because of DDC which warned them prior to the occurrence of landslide and in Thakani too some adults observed the pattern of soil erosion and decided to leave the place hence, no one was hurt. However, despite their experience in the past, some of the respondents believe that only moving away from the landslide prone areas is safer.

Furthermore, 19.4 percent of the respondents indicated planting trees to be a very effective strategy. In Badegaun, majority of respondents (83.3%) indicated planting trees are effective to some extent (very effective, effective and less effective) as they have planted trees around their houses given by Soil Conservation Authority who also informed the community members the importance of planting trees. However, the respondents from Thakani and Jyamire do not consider planting trees to prevent landslide as they experienced trees being swept away by landslides in the past.

Community Quotes from Sindhukot:

“If fencing is done properly with stones in many places, soil erosion can be prevented. But the government has to assist us by providing preventing means. We have done fencing with stones and reforestation. But that is not enough.”

“Appropriate fencing and planting trees can be done only with the involvement of advanced technicians and trainers. They should not only provide training, but should involve in the processes as well. This can prevent the effect of landslides.”

From the findings it can be said that moving to a safer place is an effective resilient strategy to minimize or avoid the effect of landslides. NGOs personnel from CDECF and Nepal Red Cross Society (NRCS) also agreed that planting trees and moving to safer place during landslide threat are seen as effective methods which the local communities have adopted in the district.

Observations made on the ways to the communities showed that constructing terraces, building houses away from the steep slopes and planting trees around their residences as different strategies being adopted to minimize the effects of landslides as shown in the pictures below:



Source: Tamang

Researcher, the headmaster and a villager observing the terraces as landslide resilience strategy practiced by the community in Thakani VDC



Source: Author

Newly replaced houses in Majhigaun where community has planted trees, diverted crops. They were compensated by Nepal government to build new houses after landslide destroyed their previous habitation in 2011.

## **CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS**

### **5.0 Introduction**

The purpose of this study was to find out the extent of community resilience for the landslides in Sindhupalchowk district in the central hilly region of Nepal. The study was guided by the following objectives: to determine the potential threats of landslides to the communities living in Sindhupalchowk district, to establish the level of awareness of communities in Sindhupalchowk district on their vulnerability to landslides, to determine the push and pull factors for residing in landslide prone areas and to establish the community resilience strategies to the landslides in the district.

### **5.1 Summary of the Findings of the Study**

This section presents the summary of the findings of the study according to the objectives.

In determining the potential threat of landslides to the communities living in Sindhupalchowk district, the study found that most (41.7%) of the respondents indicated that the location of area of habitation makes residence prone to landslide, 38.9 percent of the respondents indicated type of house makes residence prone to landslide, while 19.4 percent of the respondents indicated land use pattern makes residence prone to landslide. Regarding the effect of landslide, the study found that 91.7 percent of the respondents of the respondents indicated that landslides affected their property and also had psychological effect on them respectively, 52.8 percent of the respondents indicated that landslides affected their health, 33.3 percent of the respondents indicated that they had lost their loved ones, while 30.6 percent of the respondents indicated that landslides affected their children's education.

Other effects of landslides included: loss of life, health risks such as injuries during landslide; pollution of water creating scarcity of drinking water, inaccessibility to facilities such as health and school after landslide, loss of property and crops, destruction of roads and soil erosion. Others were inaccessibility to schools, psychological effects such as fear, insecurity due to the risks of landslides, and during

rainy season respondents staying alert at night which disorganizes their lives and activities.

On the awareness of the community members on their vulnerability to landslides, the study found that 50 percent of the respondents indicated that the community was highly vulnerable to landslides, 42 percent of the respondents indicated that they were moderately vulnerable while 8 percent indicated that they were less vulnerable. Regarding strategies used in the creation of awareness on landslides among the community, the study found that 55.6 percent of the respondents indicated that use of early warning system strategies is to a small extent. The study also found that 41.7 percent of the respondents indicated that raising awareness through media is to a large extent. While, 33.3 percent of the respondents indicated that raising awareness through group training is to a small extent.

On the effectiveness of the strategies used in the creation of awareness, the study found that 52.8 percent of the community members indicated that raising awareness through group training is effective, 44.4 percent of the respondents indicated that raising awareness through media is effective, while 33.3 percent of the respondents indicated that use of early warning system is less effective.

On the push and pull factors behind residence in landslide prone areas, the study found that 83.3 percent of the respondents indicated that residents cannot afford land in safer areas to a very large extent, 47.2 percent of the respondents indicated that ethnic reasons to be a push factor to a very large extent, while 47.2 percent of the respondents indicated that landslide disaster being preventable is a pull factor to a neutral extent. Other reasons behind the occupancy of the area besides their vulnerability included: lack of finance to buy another land, limited assistance from the government, their residence was their ancestral land and that they do not have any other place to go.

On the community resilience to landslides, the study found that 41.7 percent of the respondents indicated that constructing safer houses had been adopted to a small extent, 36.1 percent of the respondents indicated that moving away to safer place had been adopted to a large extent, 33.3 percent of the respondents indicated that planting trees had been adopted to a large extent, 22.2 percent of the respondents indicated that

use of early warning system had been adopted to a large extent, 16.7 percent of the respondents indicated that crop diversification had been adopted to a neutral extent, while 11.1 percent of the respondents indicated that fencing had been adopted to a large extent.

## **5.2 Conclusions**

From the findings of the study, it can be concluded that there is potential threat of landslides to the communities living in Sindhupalchowk district as evidenced by loss of life, health risks such as injuries during landslide; pollution of water creating scarcity of drinking water, inaccessibility to facilities such as health and school after landslide, loss of property and crops, destruction of roads and soil erosion.

It can also be concluded that there is limited awareness among communities in Sindhupalchowk district on their vulnerability to landslides. This is due to limited and ineffective creation of awareness.

The study further concludes that there are push and pull factors behind residence in landslide prone areas such as lack of finances to buy land in safer areas, ethnic reasons and the belief that landslide disaster is not preventable.

The study finally concludes that the resilience strategies to the landslides in the district includes construction of safer houses, relocating to safe places, planting of trees, construction of fences, use of early warning systems and crop diversification.

## **5.3 Recommendations**

The following recommendations are made based on the study findings:

- The landslide victims should be assisted in protecting their remaining assets by building stronger houses, fencing their degrading land and planting trees to minimize the vulnerability to landslide to the communities. The relevant sector should both provide necessary materials and train the communities to make their surroundings resilient to landslides.
- Creation of awareness – Government and other humanitarian assistance bodies like NGOs should be more actively involved in the creation of awareness among

the communities living in landslide prone areas. Awareness should be created to alert the occupants of landslide prone areas on their vulnerability, effects of landslides, landslide mitigation strategies and disaster preparedness.

- The government should introduce strict building codes to discourage construction houses on landslide prone areas. This should also be aimed at evaluating the existing structure to take the necessary action and resilience strategies to avoid future effects.
- The study finally recommends that the government should regulate quarrying activities especially those carried out along the road and disaster prone areas. This will reduce the action of human activities which is believed to enhance occurrence of landslide disasters in landslide prone areas.

#### **5.4 Recommendations for Further Research**

This study was carried out in Sindhupalchowk district in the central hilly region of Nepal. The researcher therefore recommends that another study should be done in other districts on the ways of improving the lives of communities living in other landslide prone Districts which was not the concern of this study.

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## APPENDICES

### APPENDIX I: QUESTIONNAIRE FOR VDC SECRETARIES

Greetings!

My name is Manita Sharma. I am a post graduate student pursuing a **Masters of Arts Degree in Advanced Disaster Management** at the University of Nairobi. I am required to submit a project on **“Community Resilience to Landslides: Case Study of Sindhupalchowk District in Nepal”** as a part of my research work assessment. To achieve this, you have been selected to participate in the study. Hence, I kindly request you to fill the attached questionnaire to generate data required for this study. This information will be used purely for academic purposes and will be treated in confidence and will not be used for publicity. Your name will be mentioned in the report. Your assistance and cooperation will be highly appreciated.

Thank you in advance!

#### SECTION A: BACKGROUND INFORMATION

1. Village Development Committees (VDCs): \_\_\_\_\_

2. Ward Number: \_\_\_\_\_

3. Gender :                      Male [  ]                      Female [  ]

4. Age: \_\_\_\_\_

5. Highest academic qualification: \_\_\_\_\_

6. Occupation: \_\_\_\_\_

7. Position at work: \_\_\_\_\_

8. How long have you been at this post? \_\_\_\_\_

#### SECTION B: POTENTIAL THREATS OF LANDSLIDES TO THE COMMUNITIES LIVING IN SINDHUPALCHOWK DISTRICT

9. Have you ever been affected by landslides?

Yes [  ]                      No [  ]

If yes, how did it affect you? \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

10. Do the threats by landslides affect the settlement of members of the local communities in terms of the type of structure and location of the building?

Yes [ ] No [ ]

Explain your answer: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

11. How have landslides affected the communities living in your VDC?

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

12. The following are some of the perceived causes of landslides. Please indicate the extent to which each of the factors has resulted into landslides in your area?

	Very large extent	Large extent	Neutral	Small extent	No extent at all
Heavy Rainfall					
Land use pattern					
Settlement near the road					
Riverbank erosion					
Lack of awareness					
Type of soil					
Any other (specify)					

**SECTION C: LEVEL OF AWARENESS OF COMMUNITIES IN SINDHUPALCHOWK DISTRICT ON THEIR VULNERABILITY TO LANDSLIDES**

11. How do you rate the vulnerability of the community members to landslides?

High  moderate

Low  Not vulnerable at all

Explain your answer: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

12. What kind of knowledge does the community have on handling landslides?

Mitigation: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Preparedness: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Response: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Rehabilitation: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Any other: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

13. The following are some of the strategies used in the creation of awareness on landslides among the community. Please indicate the extent which each of the following strategies has been used in your area:

<b>Strategies</b>	Very large extent	Large extent	Neutral	Small extent	No extent at all
Raising awareness through group training					
Raising awareness through media					
Raising awareness through extension officers					
Any other (specify)					

14. How effective are the strategies mentioned below in the creation of awareness among the communities living in Sindhupalchowk district?

<b>Strategies</b>	Very effective	Effective	Less effective	Not effective	Not sure/do not know
Raising awareness through training					
Raising awareness through media					
Raising awareness through extension officers					
Any other (specify)					

15. Please indicate the kind of information disseminated by which of the authorities mentioned below:

Authorities/Activities	Hazard knowledge	Mitigation measures	Preparedness measures	Appropriate response	Other (specify)
NGOs					
Community Organization					
Government					
Media {Radio, TV, Newspapers, Others (specify)}					
Any other (specify)					

**SECTION D: PUSH AND PULL FACTORS FOR RESIDING IN LANDSLIDE PRONE AREAS**

15. Do you consider your place of residence vulnerable to landslides?

Yes            [ ]            No            [ ]

Explain your answer:

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16. If your area is vulnerable, have you considered moving away to look for better places for residence            Yes            [ ]            No            [ ]

Explain your answer: \_\_\_\_\_

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17. The following are some of the push and pull factors behind residence in landslide prone areas. Please indicate the extent to which each of the factors has led to the occupancy of landslide prone areas?

	Very large extent	Large extent	Neutral	Small extent	No extent at all
Residents cannot afford land in safer areas					
Ancestral land					
Landslide disaster is preventable					
Any other (specify)					

18. What are other reasons behind occupancy of landslide prone areas by the members of the local communities? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**SECTION E: COMMUNITY RESILIENCE STRATEGIES TO THE LANDSLIDES IN THE DISTRICT**

19. What is the government doing in their attempt to ensure safety of people living in your administrative area in terms of the following?

Mitigation: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Preparedness: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Response: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Rehabilitation: \_\_\_\_\_

\_\_\_\_\_

Any other: \_\_\_\_\_

\_\_\_\_\_

20. What is the community doing in their attempt to reduce the impacts of landslides in your area?

\_\_\_\_\_

\_\_\_\_\_

21. The following are some of the landslide resilience strategies. Please indicate the extent to which each of the strategies has been adopted by members of your community to control landslides.

Strategies/Extent	Very large extent	Large extent	Neutral	Small extent	No extent at all
Constructing safer houses					
Fencing					
Crop diversification					
Planting trees					
Moving to safer place during the landslide threat					
Use of early warning system					
Any other (specify)					

22. How effective are the resilience strategies mentioned below?

Strategies/Effectiveness	Very effective	Effective	Less effective	Not effective	Not sure/ Do not know
Constructing safer houses					
Fencing					
Crop diversification					
Planting trees					
Moving to safer place during the landslide threat					
Use of early warning system					
Any other (specify)					

23. What would you recommend to be done to control the effects of landslides on the communities living in Sindhupalchowk district? \_\_\_\_\_

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*Thank you for your time and cooperation*

## APPENDIX II: QUESTIONNAIRE FOR COMMUNITY MEMBERS

Greetings!

My name is Manita Sharma. I am a post graduate student pursuing a **Masters of Arts degree in Advanced Disaster Management** at the University of Nairobi. I am required to submit a project on “**Community Resilience to Landslides: Case Study of Sindhupalchowk District in Nepal**”; as a part of my research work assessment. To achieve this, you have been selected to participate in the study. Hence, I kindly request you to reply the following questions as you acknowledge as a member of this community. Your valuable answers would be used to generate data required for this study. This information will be used purely for academic purposes and will be treated in confidence and will not be used for publicity. Your name will not be mentioned in the report. Your assistance and cooperation will be highly appreciated.

Thank you in advance!

### SECTION A: BACKGROUND INFORMATION

1. Name of the Village development Committees (VDCs): \_\_\_\_\_
2. Ward No: \_\_\_\_\_
3. Gender :            Male [  ]            Female [  ]
4. Age: [  ] 18–25    [  ] 26 – 35    [  ] 36 -45    [  ] 46 – 55    [  ] 56 – above
5. Education level:    [  ] None            [  ] primary            [  ] middle school  
                                 [  ] high school        [  ] SLC passed        [  ] college
6. Occupation/Source of income: \_\_\_\_\_

### SECTION B: POTENTIAL THREATS OF LANDSLIDES TO THE COMMUNITIES LIVING IN SINDHUPALCHOWK DISTRICT

7. What makes your residence prone to landslides?  
[  ] Type of house  
[  ] Location of your area of habitation  
[  ] Land use pattern

Any other (Specify)

Please explain your answer:

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8. Have you ever been affected by landslides? Yes  No

If yes, how did it affect you? \_\_\_\_\_

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9. Does the threats by landslides affect your settlement in terms the type of structure and location of the building? Yes  No

Explain your answer: \_\_\_\_\_

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10. How have landslides affected the communities living in your VDC?

Loss of close ones: \_\_\_\_\_

Health: \_\_\_\_\_

Property (crop, infrastructures): \_\_\_\_\_

Education (school drop outs): \_\_\_\_\_

Psychological effect: \_\_\_\_\_

Any other (Specify): \_\_\_\_\_

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11. The following are some of the perceived causes of landslides. Please indicate the extent to which each of the factors has resulted into landslides in your area

<b>Causes/Extent</b>	Very large extent	Large extent	Neutral	Small extent	No extent at all
High Rainfall					
Land use pattern					
Settlement near the road					
Riverbank erosion					
Lack of awareness					
Type of soil					
Any other (specify)					

**SECTION C: LEVEL OF AWARENESS OF COMMUNITIES IN SINDHUPALCHOWK DISTRICT ON THEIR VULNERABILITY TO LANDSLIDES**

12. Please indicate the level of your understanding landslides:

<b>Your understanding:</b>	<b>Strongly Agree</b>	<b>Agree</b>	<b>Neutral</b>	<b>Disagree</b>	<b>Not sure/ Do not know</b>
Landslides are natural process					
Disaster happens when lives and properties are exposed to landslides					
Its effect can be preventable					

13. How do you rate the vulnerability of the community members to landslides?

High  moderate   
 Low  Not vulnerable at all

Explain your answer: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

15. The following are some the strategies used in the creation of awareness on landslides among the community. Please indicate the extent which each of the strategies has been used in your area?

	Very large extent	Large extent	Neutral	Small extent	No extent at all
Raising awareness through training					
Raising awareness through media					
Use of early warning system					
Any other (specify)					

16. How effective are the strategies mentioned above in the creation of awareness among the communities living in Sindhupalchowk District?

<b>Strategies</b>	<b>Very effective</b>	<b>Effective</b>	<b>Less effective</b>	<b>Not effective</b>	<b>Not sure/ Do not know</b>
Raising awareness through training					
Raising awareness through media					
Use of early warning system					
Any other (specify)					

**SECTION D: PUSH AND PULL FACTORS FOR RESIDING IN LANDSLIDE PRONE AREAS**

17. How do you rate your place of residence for vulnerability to landslides?

High  moderate

Low  Not vulnerable at all

Explain your answer: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

18. If your area is vulnerable, have you considered moving away to look for better places for residence?      Yes       No

Explain your answer: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

19. The following are some of the push and pull factors behind residence in landslide prone areas. Please indicate the extent to which each of the factors has led to the occupancy of landslide prone areas?

<b>Push and Pull factors</b>	<b>Very large extent</b>	<b>Large extent</b>	<b>Neutral</b>	<b>Small extent</b>	<b>No extent at all</b>
Residents cannot afford land in safer areas					
Ethnic reasons					
Landslide disaster is preventable					
Any other (specify)					

20. What are other reasons behind occupancy of landslide prone areas by the members of the local communities? \_\_\_\_\_

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**SECTION E: COMMUNITY RESILIENCE STRATEGIES TO THE LANDSLIDES IN THE DISTRICT**

21. What are you doing in your attempt to reduce the impacts of landslides in your area? \_\_\_\_\_

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22. The following are some of the landslide resilience strategies. Please indicate the extent to which each of the strategies has been adopted by your community to control the impact of landslides.

<b>Strategies</b>	<b>Very large extent</b>	<b>Large extent</b>	<b>Neutral</b>	<b>Small extent</b>	<b>No extent at all</b>
Constructing safer houses					
Fencing					
Crop diversification					
Planting trees					
Moving away to safer place					
Use of early warning system					
Any other (specify)					

23. How effective are the resilience strategies mentioned above?

<b>Strategies</b>	<b>Very effective</b>	<b>Effective</b>	<b>Less effective</b>	<b>Not effective</b>	<b>Not sure/ Do not know</b>
Constructing safer houses					
Fencing					
Crop diversification					
Planting trees					
Moving to safer place during the landslide threat					
Use of early warning system					
Any other (specify)					

24. What would you recommend to be done to control the effects of landslides on the communities living in Sindhupalchowk district? \_\_\_\_\_

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*Thank you for your time and cooperation*

**APPENDIX III: INTERVIEW SCHEDULES FOR REPRESENTATIVES  
FROM NGOS OPERATING IN THE AREA**

Greetings!

My name is Manita Sharma. I am a post graduate student pursuing a **Masters of Arts degree in Advanced Disaster Management** at the University of Nairobi. I am required to submit a project on **“Community Resilience to Landslides: Case Study of Sindhupalchowk District in Nepal”**; as a part of my research work assessment. To achieve this, you have been selected to participate in the study. Hence, I kindly request you to fill the attached questionnaire to generate data required for this study. This information will be used purely for academic purposes and will be treated in confidence and will not be used for publicity. Your assistance and cooperation will be highly appreciated.

Thank you in advance!

1. Name (optional): \_\_\_\_\_

2. Position in the NGO: \_\_\_\_\_

3. For how long has the NGO been operating in this area? \_\_\_\_\_

4. What are the effects of landslides in Sindhupalchowk district?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

5. How aware are the community members on their vulnerability to landslides?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

6. What could be the reasons behind living in landslide prone areas in the district? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

7. What are the landslide resilience strategies adapted by members of the local communities?

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8. How effective are the resilience strategies used by the local communities?

<b>Strategies</b>	<b>Very effective</b>	<b>Effective</b>	<b>Less effective</b>	<b>Not effective</b>	<b>Not sure/ Do not know</b>
Constructing safer houses					
Fencing					
Crop diversification					
Planting trees					
Moving to safer place during the landslide threat					
Use of early warning system					
Any other (specify)					

9. What activities related to community resilience to landslide you are involved in the district? \_\_\_\_\_

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10. Which agencies you are coordinating with to ensure safety of people living in the district as far as landslides are concerned?

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11. In which area you are collaborating with the/se agencies?

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12. What are some of the obstacles in the efforts to strengthen community resilience by your organization? Please explain:

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13. What else would you recommend to be done to control the effects of landslides on the communities living in Sindhupalchowk district? \_\_\_\_\_

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*Thank you for your time and cooperation*

## APPENDIX IV: FGD FOR MEMBERS OF THE LOCAL COMMUNITIES

Greetings!

My name is Manita Sharma. I am a post graduate student pursuing a **Masters of Arts degree in Advanced Disaster Management** at the University of Nairobi. I am required to submit as part of my research work assessment, a project on “**Community Resilience to Landslides: Case Study of Sindhupalchowk District in Nepal**”. To achieve this, you have been selected to participate in the study. Hence, I kindly request you to fill the attached questionnaire to generate data required for this study. This information will be used purely for academic purposes and will be treated in confidence and will not be used for publicity. Your name will not be mentioned in the report. Your assistance and cooperation will be highly appreciated.

Thank you in advance!

1. What do you know about landslides? Please explain:
2. How has it affected you over the years? Please explain:
3. Would you consider your community in Sindhupalchowk district to be aware of the landslides and its effects? Explain:
4. What are the reasons behind living in such landslide prone areas?
5. What kind of methods do you use to reduce the effects of landslides in your community?
6. How effective are these methods?
7. What would you recommend to be done to control the effects of landslides on the communities living in Sindhupalchowk district? Please explain:

*Thank you for your time and cooperation*

## APPENDIX V: OBSERVATION SCHEDULE

	<b>Observation item</b>	<b>Status</b>	<b>Comment</b>
<b>1.</b>	<b>Potential threats of landslides:</b> <ul style="list-style-type: none"> <li>• Pattern of settlement</li> <li>• Type of houses</li> </ul>		
<b>2.</b>	<b>Awareness of the communities</b> <ul style="list-style-type: none"> <li>• Settlement</li> <li>• Observable</li> </ul>		
<b>3.</b>	<b>Resilience Practices</b> <ul style="list-style-type: none"> <li>• Settlement</li> <li>• Fencing</li> <li>• Planting of trees</li> </ul>		

