

"PEOPLE'S PERCEPTION ON CLIMATE CHANGE AND AGRICULTURE"

A CASE STUDY OF LIMBA VDC, PANCHTHAR DISTRICT, NEPAL

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LETTER OF RECOMMENDATION

This is to certify that the thesis submitted by Jhima Subbaentitled "People's perception on climate change and agriculture" a case study of Limba VDC, Panchthar District has been prepared under my supervision in the partial fulfillment of the requirements for the degree of Master of Arts in Geography. I recommend this thesis to the evaluation committee for examination.

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APPROVAL LETTER

The present thesis submitted by Miss. Jhima Subba entitled "**PEOPLE'S PERCEPTION ON CLIMATE CHANGE AND AGRICULTURE**" IN LIMBA VDC PANCHTHAR DISTRICT, has been accepted in partial fulfillment of the requirements for **Master's Degree** of the Faculty of Humanities and Social Sciences in Geography.

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ABSTRACT

This study was carried out in Limba VDC of Panchthar District. The objective of this study was to find out the perception and impact of climate change, agriculture, and livelihood of local people and effective adaptation mechanism to cope with climatic induced disasters. Signals of climate change impact are already visible in vegetation, hydrology, and rising temperature affecting normal plant productivity and ecosystem services in Limba VDC. Local people whose livelihood is based on the state of natural resources are hard hit when such changes occur. Since the livelihood of the people is fewer divers than that of migrant settlers, it is important to understand the level of climate impact on livelihoods of the local community, without which it will be difficult to plan support program in order to enhance their resilience towards the impact of climate change.

This study is conducted people's climate change perception of the Limba VDC of Panchthar District of the Eastern region of Nepal, and recommended some adaptation measures. The study analyzed temperature and precipitation records of last 2 decades (1989-2013) and people's perception of the observed variation in climate that has affected ecosystem services. The study focused on people's perception of observed variation in climate change that has affected ecosystem services analyzed temperature and precipitation records of last 2 decades (1989-2013). The study attempted to research most effective measures adopted by local community to natural hazards such as flood, landslide, and drought disasters. The study bare that all over temperature in the area is rising, but precipitation is decreasing. The temperature increase is in parity with the observed temperature trends in Nepal, however, the precipitation trend show high fluctuation with increased rainfall amounts and decreased rainy days. Heavy rainfall events have become pronounced since last Years. Local peoples have experienced increasing drought in recent years. Drought has increased disaster risks in the study area. There is no significant evidence their resilience so that they can withstand the threats of droughts such as increase in insects and pests, and change in time of crop harvest etc. the study concluded that the extreme weather events have increased the vulnerability of agriculture based livelihoods of Local peoples that merits immediate attention to enable them to adapt to the emerging threat. Recommendations have been made to enhance their adaptive capacity of Local peoples.

Key words: Climate change, Local people, livelihood, drought, ecosystem. Adaptation.

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LIST OF ABBREVIATION AND ACRONYMS

CBS	:	Central Bureau of Statistics
CC	:	Climate Change
°C	:	Degree centigrade
et al.,	:	All, alias (Latin Word), and other
FDG	:	Focus Group Discussion
GLO	:	Glacial Lake Outburst Floods
GDP	:	Gross Domestic Product
GF	:	Government Forest
GIS	:	Geographical Information System
ICIMOD	:	International Centre for Intergrated Mountain Development
IPCC	:	Inter-Governmental Panel for Climate Change
IWMI	:	International Water Management Institute
INGO	:	International Non-Government Organization
KIS	:	Key Informant Survey
LDC	:	Least Developed Country
NAPA	:	National Adaptation Plan of Action
NPC	:	National Planning Commission
PF	:	Private Forest
Ppt	:	Precipitation

CHAPTER-I

INTRODUCTION

1.4 Background

Climate Change is gradually becoming a major concern to humankind but most of the people, who are most vulnerable, are not aware of the real consequences of the global warming. It is recognized as a major threat to the communities in the rural areas who are more dependent on the natural resources. Especially in developing countries, the impacts are more severe, but also those living in high-risk areas in developed countries are greatly impacted. Temperature in Nepal is increasing at a high rate in recent years similar to the phenomenon observed globally. Nepal is a mountainous country consisting of the three ecological regions running north to South: Mountain, Hills, and Tarai. According to the CBS (2012) about 17.9% i.e. 2.5 million hectares of the total land area of country is arable for agriculture. Nepal is an agricultural country and is richly capable with many agricultural crops and plants. The variation in temporal, altitudinal, topographical aspects has made agricultural diversity possible in Nepal (Shrestha, 2007). Agriculture is the mainstay of Nepalese economy and around 74% of Nepal's population is engaged in agriculture (CBS, 2012) of subsistence nature which provides food and livelihood security to a substantial section of the Nepalese population accounting 40% of GDP (Gurunget *al.*, 2010). Nepal's agriculture is largely rain fed and its contribution to the GDP and food security is dependent on the characteristics of the monsoon rain. Any extent of change in climatic variables therefore directly affects agriculture performance. However, change in climatic variability and uncertainty has been posing increasing threats on agriculture.

Climate change is the dominant environmental issues of our time and the single greatest challenge. Climate change refers to the variation in the earth's global climate or in regional climates over time. Climate change impacts are the consequences of natural and human systems. It has been universally accepted fact that world climate is changing more rapidly at present than any time period in the past putting greater threats to all the well-being of human as well (i.e. from year 1850). This rate of increase of temperature has not been evidenced before that in the earth's history (Hardy, 2003). This change is challenging both the developing and developed world According to IPCC (2007) the global average temperature rise is 0.74°C in the last 100 years (1906 to 2005) and 0.13°C per decade in the last 50 years (1956 to 2005).

The impacts of climate change have been witnessed in different regions globally with rise in sea level change in precipitation pattern vegetation shift in higher altitude and retreat of glaciers. It is predicted that climate change will cause the extreme climatic events and increase drought, flood and soil degradation there will be decline in agriculture productivity subsequently affecting food security (IPCC, 2007).

Nepal has diverse geo- physical and climatic conditions within short distances, and thus the impact of climate change varies from place to place and from region to region. Being mountain topography, the temperature is rather increasing at high rate in higher altitudes. Warming seems to be consistent and continuous after mid-1970s. Between 1977 and 1994, average warming in annual temperature was 0.06°C per year (Shrestha et al., 1999), with more pronounced increase in the higher altitude regions of Middle Mountain and the high Himalaya while the warming is significantly lower in the Terai and Siwalik regions. Furthermore, warming in the winter is more pronounced as compared to other seasons. The maximum temperature is increasing faster than precipitation in places below 1500m elevation, while the trend is decreasing above 1500m (Baidya et al., 2008). There are decreasing numbers of rainy days but higher intensity rainfall events are increasing. According to a recent study, Nepal's temperature is rising by 0.41°C per decade (Shrestha et al., 2000).

The impacts of these changes are more damaging to livelihoods of those who depend on forest, land, and biodiversity for food shelter, and income. Poor people whose livelihoods are nature based, have experienced adverse impacts of climate change and struggling to cope with it. IPCC Third Assessment Report (TAR) states that the communities who live in marginal lands and whose livelihoods are highly dependent on natural resources are among the most vulnerable to climate change (NAPA, 2009).

"Perception" is the process by which we receive information or stimuli from our environment and transform it into psychological awareness. It is interesting to see that people infer about a certain situation or phenomenon differently using the same or different sets of information (Ban and Hawkins 2000).

The strong dependence of the local communities on the natural environments makes them particularly sensitive to the effects of climate change. To sustain life in unforgiving conditions, each people are in hilly areas in general and in particular of Limba VDC have different ways to deal with the negative effects due to climate change.

1.2 Statement of the problem

There are very few studies about the effects and likely impacts of climate change in Nepal. Scientific evaluations are yet to be carried out to understand the types and degrees of impacts on specific geographical region and development sector. Activities related to climate modeling and assessing the ongoing effects and likely impact of climate change in natural resources, and including water resources and other economic sectors from the mountain and hill regions to the plains and the south have not been carried out due to inadequate human and financial resources and lack of appropriate equipment. Nepal has low adaptive capacity to respond to the variability occurs due to climate change. Moreover, the assessment and predictions of climate change are mostly based on literature review and some scattered information, which were not so reliable. Still, the country is severely threatened by the likely impacts of climate change especially affecting local people, livelihood of farming communities. Nowadays climate change is globally concerned issues. No one is separate from it because directly or indirectly it affects our life. Studies show that developing countries are more vulnerable to climate change than the developed countries. The country like ours is more vulnerable to climate change. Climate change has been already happening across the country with changing point of impacts. Proof of its impact is visible in vegetation, in hydrology, and rising temperature affecting the normal productivity and availability of ecosystem services. Rainfalls in the hill and Mahabharata have been erratic with floods, landslides, and droughts.

The analysis of the long-term hydrological, metrological data from the historical and rainfall data has exposed that the climate in the hilly region is changing faster than the global average. Through this paper, I want to know its changing and its impact on indigenous people adaptation and agricultural based on temperature and precipitation. Changes in climatic-zones result in different cropping patterns and farming systems in Nepal. Climatic parameters have the potential impact to alter the ecological distribution of agriculture crops. If the expansion of climatic zones occurs rapidly due to temperature rise, extinction of biodiversity –might be severe (Malla,2008). Because of such consequences, it is important to understand the effects at local level. Because the hilly regions are more sensitive to climatic change in agricultural practices are more noticeable. For formulating plan to adapt to climate impacts, the knowledge of local people's community about climate change and strategies that take at individual and community level to respond to different types of stresses should be known in

the first place. The study is aimed at understanding adaptation strategies that peoples of the study village take to offset impacts of climate change in agriculture sector.

A single study showing people's perception and adaptation strategies to climate change at micro level is a perceived gap in Nepal. The study has significance to add some knowledge base to field of climate change showing possible pathways to account extent of local people's perception and adaptation strategies. This study attempts to answer the following related questions in particular:

- What is climate change?
- What kinds of impacts have they perceived from climate change?
- What are the direct impacts on human due to climate change?

1.3 Objectives of the study

The general objective of this research is to study the climatic trends and changes in impact of climate change on agricultural farming system and livelihood in hills of Panchthar District and to paper the adaptation measures adopted by the local people. The specific objectives are as follow:

- To assess the change in climatic parameters using available hydrological and metrological data of Panchthar District.
- To analyze the impacts of climate change on agriculture.
- To explore strategies that people can adapt to changing agriculture.

1.4 Rational of the study

Peoples have lived in the respective places for centuries adapting to the local climate. Local people of Nepal are of the oldest inhabitants of hill region in the country. They have been using their knowledge and skills to and maintain the resources and to cope with the natural calamities. Changing the local knowledge developed over centuries may not help to address rapidly emerging challenges. They will need time to get familiar to new context. Their local knowledge and skill they have learnt from their ancestors to tackle the changes are limited to the regular phenomenon. Adapting to climate change has been a primary concern of development. However, how local people would adapt to the emerging problem cannot be assessed unless we have a clear understanding of the situation.

Climate change is global but its impact is always at local level and hence local level case studies are vital for both policy formulation and adaptation and combine local peoples knowledge on present day is most challenging issue. Tarai and mountain regions people are more susceptible to climate change impact and vulnerability. In this context the knowledge generation about community vulnerability due to climate change and agriculture great significance.

The observed trend of change in temperature, rainfall pattern, and increase in extreme climatic events has incurred loss of agricultural yield, property, and lives. Such extreme climatic events hamper people's adaptive capacity and challenge their resilience. Different adaptation measures have been adopted in different parts of the world to cope with climate change impacts. Such measures can be introduced in Nepal as well; however, various local factors such as physical, socio- economic, institutional factors will have to be considered to achieve desirable outcome of the measures. The vulnerability assessment will help to assess these local factors. Then based on the assessment at local level different adaptation measures can be introduced with modification if necessary.

1.5 Scope and Limitation of the study

There is very limited understanding about the impacts of climate change and the adaptation measures in these remote areas of Nepal. Nepal has very diverse microclimatic and geophysical conditions within small areas. Therefore, the best way to measure the impact of climate change would be conduct researcher at the community level. The data on temperature and precipitation were collected from were collected from the existing metrological stations in and around the study area, and not exactly from where the villages are located. Community and household level studies yield information about perception local knowledge and adaptation measures and provide basis for development of strategies to fight climate change locally. This research seeks to investigate impact of climate change in agriculture and livelihood and adaptation measures adopted by the local people in the hilly areas of Nepal.

Humidity data could not be considered in weather parameter since the data was not available for Limba VDC and very limited numbers of meteorological stations were present. Data on weather parameters (Rainfall and Precipitation) were collected from nearest stations from the sites including other stations of district. It only provides general information about specific regions more intensive researches should be conducted to generalize the completely hilly region of Nepal.

1.6 Review of Literature

1.6.1 Review of the Studies on Climate Change and Agriculture

Following the industrial revolution, the rate of misuse of natural resources as well as human population increased exponentially. Within a decade, the impact of exploitation on environment started being visible in the form of ozone layer depletion, smog, acid, rain etc. After the historical Stockholm conference on Human Environment in 1972 AD, the world for the first time was attracted towards the environmental issue. It was in this conference that the relationship between economic development and environmental degradation was first placed on international agenda. It paved the way in succeeding years to integrate environmental concerns into economic planning and decision-making (Hoskins 2002)

Acharya (2012) revealed that the higher side temperature rise seems terrible, as it is nearly 2.0°C on an average in the western Nepal, which is almost three times of the lower average temperature. Such temperature rise in Nepal, if compared to global trend, is significantly higher. Furthermore, Hills and high hills are more vulnerable to climate change.

The impacts of climatic variations and climate change on soils of mountain region of Nepal could be examined in their implication on floods, droughts, desertification, soil erosion etc. The top layer of the soil is one supporting most of the plant growth, and part with higher direct interactions with climate and vegetation, and more influenced by human activities. Climate is probably the main variable that influence, directly or indirectly the topsoil, and particularly the surface layer. Other surface processes are caused by the properties of the soil itself (Pla, 2002)). Land degradation is the loss of utility or potential utility of land or decline in soil quality caused through misuse by human (Barrow, 1992).

Asia - Pacific partnership on clean development and climate was adopted in January 2006 by the governments of Australia, China, India, Japan, Republic of Korea, and United States of America. This is intended to provide a framework among these six countries for building partnership in common interest such as energy, environment, and climate change, being consistent with the principles of UNFCCC. Unlike Kyoto Protocol, no any emission reduction target has been set and emphasizes for co- operation between these countries for developing cleaner technologies, transfer of technology and clean information sharing between these countries (Asia- Pacific Partnership on Clean Development and Climate Character, 2006)

According to the Fourth Assessment report of intergovernmental Panel on Climate Change (IPCC, 2007), the average global temperature rose by 0.74°C over the last hundred years. It dispelled many uncertainties about climate change. Warming of the climate system is now clear. It is clear that global warming is mostly due to man-made emission of greenhouse gases mostly CO₂. It gives detailed projections for the 21st century and these show that global warming will continue and accelerate. The best estimates indicate that Earth could warm by 3°C by 2100. Even if countries reduce their greenhouse gas emissions, the Earth will continue to warm.

Panta (2009) reviews the literature on both the aspects and test empirically that what affects emissions of carbon dioxide to the atmosphere. Data on carbon emissions, energy consumption, and agriculture related national level variables are obtained for 120 countries from the World Bank's Green Data Book. Multiple linear regression analysis revealed that agricultural land, irrigation, forest area, biomass energy use efficiency negatively affects the Carbon dioxide emission. However, fertilizer use and per capita energy use affect it positively. The analysis confirms that the people in rich countries are more responsible for carbon emission than the people in poor countries. It recommends for cross subsidization for low external input agriculture, particularly for organic farming in poor countries.

Rapid increasing in CO₂ and other greenhouse gases in the atmosphere is causing climate change. Changes in climatic factors like temperature, solar radiation, and precipitation have potentials to influence crop production. Enriched CO₂ has shown positive impacts on yield of major crops in all geographical zones. However, overall impact of climate change in agriculture sector will have negative impacts in the end (Malla, 2008).

Studied about the perception of local people on climate change and its impacts in the Bhimeswor municipality of Dolakha district shows that temperatures have increased and rainfalls have decreased with changes in the timing of the rains. Loss of species outbreak of diseases and pests, rapid encroachment by invasive species and emergences of human disease are observed due to climate change. Local people also perceived that the changes have occurred in flowering, fruits, vegetables, and timings of farming. (Nepal, 2009).

Warming trend in the Himalayas and irregular pattern of precipitation has direct impact on water resources. Research found that clear warming trend in the Nepal Himalayas which will

cause an accelerated glacier melt and increase water availability at the beginning but ultimately will decrease it after the glacier disappear. Due to irregular pattern of precipitation, there is a usual problem of floods and landslides during the rainy season because of too much water, whereas there is a common problem of drought during the dry season because of too little water (Chaulagain,2006).

Climate change will affect people of different genders, ethnicities, caste, and geographical regions differently. Rising temperatures, unpredictable precipitation patterns, and an increase in extreme-weather events will have a disproportionate impact on women who depend on subsistence farming for their livelihoods. In a traditionally male-controlled society such as Nepal, there is a restrictive opportunity structure and livelihood options are limited. Upholding their gendered roles, women maintain responsibility for domestic functions such as housekeeping, child rearing, cooking, and fetching water and firewood. Access to education, economic independence, and fair remuneration practices are typically enjoyed more by men than women.(Patricia Synnott).

Cline (2007) infers that the agricultural damages tend to be greater toward the equator, and hence concentrated in developing countries. Yields and agricultural production potential would fall about 15 to 30 percent in Africa and Latin America and 30 to 40 percent in India. For the United States, the effects would be severe for the south but milder and conceivably even positive for a while for the north. Productivity losses would range between 20 and 30 percent in the southeast, and from 20 to 35 percent in the southwest plain and Mexico.

Dell, Jones and Olken (2011) revealed three primary results that (a) higher temperatures substantially reduce economic growth in poor countries (b) higher temperatures appear to reduce growth rates, not just the level of output, and (c) higher temperatures have wide ranging effects, reducing agricultural output, and political stability.

Strategic adaptation refers to planning, policies, or strategies at the national level that proactively responds to the potential effects of CC. This includes direct construction of infrastructure, capacity building, disaster relief planning, or a host of different methods that increase national resilience to the potential impacts of CC on both ecosystems and human populations. Because most of these impacts will be felt primarily is fundamentally about water management (Bates et al., 2008). For a country like Nepal that is so heavily dependent on agriculture for livelihoods and GDP, the impacts of CC on water resources are of critical

importance. Strategic planning will thus entail emphasizing newer more sustainable agriculture techniques that are less water intensive refocused efforts on the rehabilitations of water infrastructure and development via expansions in storage and irrigation, and reevaluating water management within the context of the impacts of CC.(IWMI, 2009).

In South Asian countries, particularly India and Bangladesh, farmers are already adapting to changing conditions by using traditional seed exchange practices that are part of established seed systems (Gautam et al., 2008). Farmers can also use their knowledge of abiotic stress tolerance and adaptability in their materials and work with plant breeders to develop varieties that are adapted to changing local conditions and process improved yields and quality (Jarvis et al., 2007). Many adaptation practices involving crops and livestock have been reported (e.g. Reid and Swiderska, 2008).

Traditional farming management practices and farmers innovations are clearly a key element in local adaptation to climate change. While scientists and policymakers work to find solutions, local farmers have already amassed considerable experience of how to cope, based on their observation in the field (Reid and Swiderska, 2008). Therefore, it is very important to document the adaptation practices that have been evolved in the farmers' fields.

By analyzing 166 stations for monthly precipitation data and monthly temperature, records from 44 stations for the period of 30 years (1976 -2005) over Nepal were considered. It shows the spatial variation of temperature and precipitation. The eastern, central, western and far western development regions represented a positive trend in annual precipitation while most of the mid –western development region observed a decreasing trend. Moreover, the spatial variation of the annual mean temperature is in increasing trend almost in the entire country. The rate of temperature increase has been observed high in northern part of the country than in the southern parts (Practical Action, 2009).

By analyzing of rainfall with 45 stations during 1960-2009 indicated that annual mean trend by 0.07 mm per year in the Eastern Development Region. Likewise, the annual mean seasonal trends are all positively changed in overall EDR. In the case of annual mean among the 11 different types of trends with significantly changed, in which, pre- monsoon, sub-tropical and cold temperate region by 0.152mm, 0.184 mm and -0,184 mm and – 0.178 mm per year respectively. (Rai, 2009).

The changes in temperature and precipitation result change in water availability. Relatively small changes in temperature and precipitation can have large effects on soil moisture status and the volume and timing of runoff (Hayes, 1991).

Rijal, (2010), studied about the Climate Change and Livelihoods: Observations from Madi Watershed, Western Nepal shows these changes have significant implications on people's livelihood activities directly or indirectly affecting different productive activities, bio – diversity, infrastructures and health. The effects will be both positive n negative and vary by locality.

Nepal is much vulnerable to climate change. Nepal has already started to experience impacts of climate change in a number of ways, in which most critical one being the agriculture sector since more than 80% of the population heavily relies on this sector. Torrential rain, flash floods, mass movement, landslide, GLOFs are some of the major disasters occurring as a result of changing climatic patterns in Nepal, thereby affecting the agricultural production and food security in the country. The level of vulnerability will be more pronounced in higher altitude; in the mountains and hills, where majority of the people rely on subsistence farming. Despite receiving continuous financial and technical assistance from foreign donors, the process of adaptation to climate change is slow and discouraging. (Karki,R.&Gurung,2012).

Upadhyay, (2014), studied anthropological perspectives on natural resources management, climate change, and global warming. In the study he, Climate change is ecological colonialism at its fullest development—its critical scale—with sweeping social and cultural implications. Anthropological lens seek to respond to climate change at the local, regional, national, and global scales and are helpful in reflecting the understandings in application and seeking ways to pool resources with communities to assist them in addressing their climate change concerns or in bridging the science-community dissection---understanding and analyzing individual human behaviors, their institutions, human-environment relation, micro-macro structural relations, and others, is important part of resolving the discrepancy between agency and structured based approaches, and in the process cultural structural change does play vital role in altering human activities, social and natural resources management pattern etc.

There has been twelve warmest years since 1975 to 2007 (e.g. 2006 were the warmest year). Late or pre-monsoon, unusual precipitation, decreased rainy days and intense rainfall events caused more runoff and low groundwater recharge. Extreme fog conditions have been

observed in the recent years in Terai regions. Traditional rainfalls of Jestha and Ashar (mid July) have been shifted in Shrawan and Bhadra in Kathmandu. It has affected negatively in the paddy production. The Kathmandu Valley frost day has decreased, winter cold shifted to a month later than regular and snowfall in Kathmandu (Feb 2007, after 60 years).

The Eastern Terai faced rain deficit in the year 2005/06 by early monsoon and crop production reduced by 12.5% on national basis. Nearly 10% of agriland was left fallow due to rain deficit but mid-western Terai faced heavy rain with floods, which reduced production by 30% in the year (Regmi, 2007). Early Maturity of the crops due to increase in temperature may help to have more crops in the same crop cycle (NARC annual report). Shifting of climatic zones has been observed in the country. Extinction of natural vegetation: local basmati rice varieties, some local wheat, maize and other agricultural crops was also observed. Cold wave in Nepal in 1997/98 had negative impacts on agricultural productivity and showed reduction in the production of crops by 27.8, 36.5, 11.2, 30, 37.6, and 38 % in potato, Toria, Sarson, Rayo, lentil, and chickpea respectively (NARC annual reports from 1987/88 to 1997/98,).

Nepal lies near the northern limit of the Tropics; a very wide range of climates from Subtropical in the southern Terai to Arctic in the northern high Himalayas exists here. The remarkable differences in climatic conditions are primarily related to the enormous range of elevation within a short north south distance. The presence of the east-west extending Himalayan massifs to the north and the monsoonal alteration of wet and dry seasons also greatly contribute to local variations in climate (Wikipedia).

The impacts of less water during the dry months are much easier to visualize, as recent winter droughts have continued to show the effects of low water supply. During the drought of fall 2008 to spring 2009, agricultural systems experienced significantly reduced crop yield, resulting in food insecurity for millions. Such effects would be augmented by a more intense dry season. Western regions will be the most detrimentally affected because they rely heavily on winter rains and cannot depend as reliably on summer monsoon rains, which are not as intense in the west due to the natural pattern of rainfall in intensity from east to west (HMG, 2005).

Another particularly significant threat in the Himalayan and directly correlated to rising temperatures are glacial lake outburst floods (GLOFs) that result from rapidly accumulating

water into glacial lakes that then burst, sending flash floods of debris and water from high elevations, causing havoc on downstream communities and damaging valuable infrastructure like hydropower facilities and roads. There are approximately 9,000 such lakes in the Himalayas, of which 200 are said to be in danger of bursting (Bajracharya et al.,2007). High rates of glacial melt due to increases in temperature are adding to this threat, as the rate of such incidents increased between the 1950s and from 0.38 to .54 events per year (Bates et al., 2008).

Though determining how agricultural systems in Nepal will be affected by the potential impacts of CC is difficult due to the lack of data in the country and the uncertainty in the climate models, there is nevertheless little doubt that significantly more pressure will be placed on food systems that are already incapable of feeding the domestic population. Extreme poverty and high levels of hunger make even the slightest fluctuation in climate potentially disastrous to the economy. The population is thus extremely vulnerable, not only to longer term CC that will ultimately reduce water availability and limit crop productivity, but even more so to the immediate threats of increasingly frequent GLOFs, Landslides, flash floods and droughts (IWMI, 2009).

IPCC, 2007 projects that there will be a general increase in the intensity of heavy rainfall events in the future, and an overall decrease as many as 15 days in number of rainy days over large part of South Asia. This will cause significant warming particularly at higher elevations, leading to reduction in snow and ice coverage, increased frequency of extreme events like flood, drought, and increased precipitation (NAPA/MoE report, 2010).

The interim prepared, as guideline for development during interim period in Nepal, does not pay any special attention to climate change but simply identifies potentiality of forest sector to benefit from carbon trading. Like other plans, this plan also stresses for conserving economy through increased investment in agriculture and electricity sector in addition to others (NPC, 2007).

1.6.2 Climate Change Policy

The Government of Nepal in co-operation with worldwide fund has prepared a draft on climate change policy, 2009. The emphasizes for incorporating the climate change issues in other related laws policies and master plans. The policy highlights over seeking opportunities

from Clean Development Mechanism (CDM), Reduced Emissions from forest Degradation and Deforestation (REDD) and Least Developed country fund. It also identifies challenges and problems such as lack of resources data and manpower and limited information is available on change include institutional capacity building management of natural resources, reduction of greenhouse gas emission and environmental pollution control disaster management and risk minimization and adaptation (MOST, 2009).

The participatory approach is the major thrust for implementation of all these strategies. Similarly, capacity development and empowerment local communities, advantaged groups inclusive governance, and gender issue have been addressed in all these strategies. This has also acknowledged in efficiency in administrative procedures of the government and lack of financial and human resources for implementation of the strategies envisioned.

As the impacts are increasing, Nepal is responding to the impacts of climate change. Realizing the national needs and as solidarity to the international process, Nepal is making robust efforts to address climate change through policy formulation, institutional arrangements and strengthening, program development and implementation. Climate Change, COP 22, Nepal.

National Planning commission 14th planning in order to implement the above policies effectively, the strategies and working policies are as follows:

- Formulation of environment conservation rules and regulations and make strongly mechanism and developed institutional capacity;
- Formulating and implementing an action plan for climate adaptation and low GHG emission by ensuring public- private partnership;
- Emphasizing the regular implementation of public awareness and capacity building programs;
- Introducing agriculture and disaster insurance in climate change affected areas,
- Creating a favorable condition, through financial and technical facilitation, for communities involved in carbon sequestration to yield the maximum benefits from those activities;
- Implementation of local favorable work planning to national favorable work planning;
- Managing solid waste as a resource;
- Emphasizing the implementation of preparedness programs to fight against disaster and epidemics.

1.6.3 Impact of Climate Change in Nepal

Increase in temperature: The study based on the data from 1977 to 2004 shows that the mean less in the lower altitude and high in the higher altitude (APN, 2005; Baidya et al., 2008, Shrestha et al., 1999). The study carried out in the regions around Bay of Bengal from Nepal in north to Malaysia in south, shows that increase in temperature is more predominant in Nepal in comparison to other countries. (Quadir et al., 2004). The degree of increase in temperature is higher in winter season compared to summer season.

Change in rainfall pattern: There is increasing trend precipitation in places below 1500m elevation, while decreasing trend above 1500m (Baidya et al., 2008). The study of monsoon rainfall from period 1971 to 2005 shows that there is linear increasing trend of about 2.08 mm/ year with large inter-annual variation (APN, 2005). Due to reduced rainfall, electric generation sector of Nepal has opted to switch to diesel power plants. There have been power cuts for more than two-thirds of a day showing cause and river flow has been reduced. There is increase in number of flood days in certain rivers in Nepal. While reduction in dependable flow of certain rivers in dry season.

Increase in extreme climatic even: The total precipitation and extreme events also have rising trend and projected to rise in future. The rises in frequency of climatic extreme events such as rainfall causing floods and landslides have adversely affected agricultural production (Regmi and Adhikari, 2007). Mountain settlement areas of Nepal are prone to landslides and flooding and hence, more vulnerable to climate change. This vulnerability is particularly exacerbated during extreme weather events (MOPE, 2004).

Melting of glaciers: The Himalayan glaciers have been retreating faster rate, for example Imja glacier is melting at rate of 7.4m per year and about 20 glacial lakes are in verge of outburst (Bajracharya et al., 2007). The formation of these lakes and continuation of size growth of these increased risk of glacial lake outburst. This results increase in flooding, landslides, and sedimentation (Agrawal et al., 2003).

Decline in Agriculture production: The agricultural sector of country relies upon summer monsoon rainfall that contributes 75 percent of total annual rainfall while average rainfall of Nepal is 1700 mm per year (ADB and ICIMOD 2007). The events such as cold waves rain deficit and floods have incurred losses in agricultural production for an instance, shift in

traditional rainfalls from mid-July to mid-August have caused failure of paddy production in Kathmandu. The extinction of rice varieties like local basmati rice has been observed.

Extension of agricultural area: The impact of climate change is not always negative. Regmi and Adhikari (2007) reported that people have started cultivating cauliflower, chili tomatoes, cabbage, and cucumber in Manang and Mustang where it was not possible to grow these vegetables earlier.

Incidence of fire: The winter has been drier in recent years and the driest in year 2009. The forest fires have flared in many higher elevated national park and conservation areas of Nepal bordering to India and Tibet. The dryness in winter has been increasing every year and this year has been the most severe year.

Spreading of diseases: In recent decade, incidence of Kala-azar especially in Terai region of central and eastern Nepal has increased. However, in 1998 it was reported in areas beyond its usual range (MOPE 2004). Similarly, sub-tropical region of Nepal has become more suitable for Japanese encephalitis.

1.6.4 Climate Change Vulnerability

Vulnerability is a term that describes the susceptibility of a group to the impact of hazards. A system is likely to experience harm due to its exposure to hazard to the degree. It is determined by the capacity of a system to anticipate, cope with resist, and recover from the impact of hazard. Exposure to natural hazard of the community is increasing day by day making it more vulnerable with increasing global change and frequent extreme event (Tuner, 2003). Vulnerability is deeply rooted within the framework of societies, since it is determined by social systems and power at a local national and international level, not by the natural environment.

Brook, (2003) classifies vulnerability as biophysical vulnerability is defined in terms of hazard and related to outcome of occurrence of hazard or damage incurred by the system due to action of hazard upon the system. While social vulnerability is defined, independent of hazard and it is the inherent current state of the system or communities. It may also be defined as one of the determinant of biophysical vulnerability.

In context of climate change, O Brian et al., (2004) classifies vulnerability as 'end- point' and 'were startingpoint' interpretation of vulnerability. The 'end-point' interpretation mainly focuses on climate change mitigation and compensation policy and technical adaptation. While 'starting point' interpretation focuses on vulnerability of society to climatic hazards, adaptation policy, and sustainable development of societies.

Vulnerability is the degree to which a system is susceptible to and unable to cope with adverse effects of climate change including climate variability and extremes. Vulnerability is a function of the character magnitude and rate of climate change and variation to which a system is exposed, its sensitivity and its adaptive capacity (IPCC, 2007).

IPCC Third Assessment Report defines climate change impact, vulnerability and adaptation assessment as the practice of identifying and evaluating the detrimental and beneficial consequences of climate change on natural and human system, identifying, and evaluating options for adapting to climate change. IPCC Third Assessment Report (TAR) describes vulnerability as, "the degree to which a system is susceptible to or unable to cope with adverse effects of climate change including climate variability and extremes. Adaptations to climate change are defined in the same report as adjustment in natural or human systems in response to opportunities. Exposure is defined in the same report as "The nature and degree to which a system is exposed to significant climatic variation." Sensitivity is "the degree to which is a system is affected either adversely or beneficially, by Climate - related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise)." Adaptive capacity is "The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages to take advantage of opportunities or to cope with the consequences."

Nepal demonstrates diverse geo-physical and climatic conditions within relatively small areas resulting vast biological diversity, therefore, it is an ideal place to study climate change impacts on a vulnerability and risk assessment of natural hazards and most of them are based on the available information of the past without or in only some extent to climate change related disaster. Some of them are Dhital, Khanal&Thapa(1993), Mool, Bajaracharya& Joshi,(2001), Khanal, (2005), ICIMOD (2007). Although Nepal is responsible for only about 0.025% of total annual greenhouse gas emission of the world (Karkai, 2007) it is experiencing the increasing trends and the associated effects of global warming.

The response for country like Nepal to these consequences is adapting to these changes. The capacity to adapt to climatic hazards and stresses depends on countries wealth resource and governance (Kates, 2000). The climate change risk can be traced by studying the rate of snowmelt, landslides, flooding and changing of vegetation. For vulnerable assessment, the place based (micro- scale) study is more relevant than the larger area if we give due consideration to spatial variation of natural hazard and vulnerability (Tunner,2003. As. cited in Sharma 2009).

The degree of vulnerability for the livelihood will depend on availability and accessibility of factors such as arable -land and water resources farming technology and inputs, crop varieties knowledge, infrastructure, agricultural extension services, marketing and storage systems rural financial markets and wealth etc. (Smit and Pilifosova, 2001). Regmi et al., (2008) state that the poor and marginalized people are more vulnerable to impact of climate change as they are heavily depended upon natural resources, lack access to technology, information and infrastructure. Mirza, (2003) studied vulnerability of communities to floods in Bangladesh and concluded that vulnerability to extreme climate hazards increases due to unemployment, high population density, illiteracy widespread poverty, enormous pressure upon rural land and economy dominated by agriculture.

The adaptation measures complementary to development are desirable (Ribot et al., 1996). The adaptation measures are, aimed at reducing vulnerability of people to climate change and necessary care should be taken that these measures do not have detrimental effect upon the vulnerability (Hedger et al., 2008). However, some adaptation measures aggregate existing vulnerabilities (Westerhoff and Smit, 2009) for example: the shrimp farming though has economic and livelihood benefits against climate change but worsens vulnerability to sea level rise (Agrawala et al., 2005).

1.6.5 Adaptation to climate change

Adaptation refers to outcome of series of action under taken at different spatial scales to cope or adjust in given new environment created due to stress or hazards or opportunity (Smit and Wandel, 2006). An adaptation practice varies depending upon spatial and temporal scale, nature of sector: actors involved actions climatic zone socio-economic base or combination of these factors and others (Yohe and Tol, 2002). The adaptation programs and policies should be designed as such that they will address cross sectorial issues of poverty alleviation, bio-

diversity, reduction of land degradation and soil erosion and increase food security enabling achievement of sustainable development at various scales (FAO, 2008). Smith (1997) explains about two types of adaptation measures:

(i) Reactive adaptation measures taken after the impact of climate change is felt. The local level adaptation measures taken after disasters fall under this category.

(ii) Anticipatory adaptation refers to actions under taken before effects of climate change are felt.

Policies and plans like National Adaptation Plans of Action are regarded as anticipatory adaptation measures (Bohle, 2001; Burton et al., 2003). Earlier, the adaptation studies were scenario- driver based on Global Model, also known as top- down approach. The studies were limited to modeling the impact of temperature, rain and sea level rise (Alast et al., 2008), but did not take into account the adaptive capacity of the societies and individuals. The bottom-up adaptation assessment approach involves local stakeholders in examining current adaptation measures and policies (Alast et al., 2008).

The water springs in the mid- hills of Nepal have been drying up in the recent past (Gurung and Bhandari, 2009) and Jianchu, Shrestha, Vaidya, Erikson and Hewitt (2007) reported that as climatic patterns change, so do the spatial distribution of agro- ecological zones, habitats, distribution patterns of plant diseases and pests which can have significant impacts on agriculture and food production.

"Perception" is the process by which we receive information or stimuli from our environment and transform it into psychological awareness. It is interesting to see that people infer about a certain situation or phenomenon differently using the same or different sets of information (Ban and Hawkins 2000).

Knowledge, interest, culture, and many other social processes that shape the behavior of an actor who uses the information and tries to influence that particular situation or phenomenon (RECOFTC, 2001 cited in Banjade 2003).

1.7 Outline of the Study

The study has been organized into six chapters. The first chapter include introduction that follows by statement of the problem, objectives of the study, limitation of the study, review of literature and significance of the study.

The second chapter discussed on theoretical framework of the study and research methodology, which include methods of data collection, data sources and methods of data analysis.

The third chapter includes the introduction of the study area including both physical and socio cultural aspects at also includes population, caste ethnicity, occupation, income, and education.

The fourth chapter deals with local people's perception on climate change, landslide, drought, disaster, precipitation, temperature, water resources, human health, and disease.

The fifth chapter deals with agriculture change in farming system, fertilizer, labors, current adaptation strategies analysis of perception parameters and major issues in agriculture related to climate change etc.

The last chapter six deals with overall findings, conclusion, and recommendation.

CHAPTER-II

METHODOLOGY

2.3 Method of Data Collection

The hydrological and metrological data such as daily average temperature and rainfall data were obtained from the DHMPhidim Panchthar and analyzed using regression equation and correlation. The perception of the people on climatic variables and the results of rainfall analysis are compared based on seasons (early monsoon, monsoon and post monsoon seasons). Similarly, three focus group discussions (FDGs) were conducted in the landslide prone areas; at Limba VDC. People, who have first-hand experience in early warning system such as farmers, Foresters VDC secretary, schoolteachers, and local NGOs, were invited in the FDGs. In total, 40 people participated in the FDCs. In the beginning, they were asked to prepare a list of reliable media for information transformation that are reliable for local context. Total 60 households (25 Female and 35 Males, older than 25 to 85 years old) were randomly selected for the interview. Those respondents were selected from each category of people including all gender, ethnicity, education, economic class, and geographical location. The detail characteristics of the VDC inhabitants were collected from the respective VDC office. In order to meet the study objective, One VDC from three wards namely Lumangdin, Limba and Lekhgaun were purposively selected representing local communities and vulnerability group. In order to collect primary information, those household whose livelihood are closely associated with natural resources and closed to community forestry area were selected interview. For the questionnaire survey, 20 households from ward no. 4 (Lumangdin) for mixed caste community and lower belt, 20 households from ward no.7 (Limba) for Limbu and Tamang community and middle belt, and 20 households for Rai and other community respectively from Lekhgau ward no 8 of Limba VDC were interviewed by using the structured questionnaire totaling a sample size of 60. The information with regard to the experience of the respondent in cultivating the crop in question, availability of wild flora and fauna changes in rainfall, seasonal change in temperature and their effect on the time of planting and yield and the adaptation strategy if any were collected.

2.2 Methods of Data Analysis

Data collected from the household surveys were analyzed using the Statistical Package for Social Science (SPSS) software and Microsoft excel. Descriptive statistics such as frequency and correlation were used to compare climate change impacts and adaptation strategies in the study area. Qualitative information such as farmers' perceptions regarding climate change

was analyzed using frequencies and percentages, which subjected to the correlation of independence. This is in the form of tabular and writes up form. Separate analysis has been done for each ward. This study utilizes both primary and secondary data and information. The secondary information has been collected from published sources such as Department of Hydrology and Meteorology. Rainfall and temperature data of Phidim station was analyzed from 1989- 2013. A correlation analysis was also carried out to see the relationship of rainfall and temperature on the production of paddy and maize in Panchthar.

Annual compound growth in precipitation and temperature in all two sites has been analyzed by using the following formula.

(i) Y depends on X is

$$b_{yx} = \frac{N\sum xy - \sum x \sum y}{N\sum x^2 - (\sum x)^2}$$

Where, N= Number of Year x=rainfall y = temperature

\sum = Summation

(ii) $y = a + bt$

Where

y=temperature or rainfall

t= time (year)

"a" and "b" are the constant estimated by the principle of least squares

The annual, monthly, and seasonal mean rainfall and mean temperature were analyses and their trends were studied. Microsoft excel was used to analyze rainfall and temperature data and surfer program was used to present the information over ward level and district level.

CHAPTER-III

THE STUDY AREA

3.1 Physical Settings:

The research was conducted in one hilly VDC of Panchthar District. Limba vdc is one of the hilly VDCs of eastern region of Nepal. It is situated at 26°53'N and 26°54'N to 87°34'E and 87°36'E total area covered by this VDC is 38.71 km². District headquarter is Phidim and this VDC is located in the Panchthar District, Mechi Zone, Eastern Development Region of Nepal. Panchthar District there is 41 VDCs. Limba that lies in the southern part from the Panchthar District. It extends about 38.7 km² from east to west and about 8 km from north to south. Its geographical limits are. This area consists of one region connected by the Nawakhola the boundary is mostly demarcated by the Bijule Khola, Panchami Khola,

Dhwase Khola, Nawakhola, Kampu Khola, Limba Khola are the main river, which flows in the border of this VDC. Limba is one of the most populated VDC as compare to other VDCs. The VDC shares its boundaries with Kurumba and Rabi VDC on the eastern part and Aarubote and Hangu on the north. On the western part it share its boundary with Durdimba VDC. Similarly on the southern part there are two districts, (Ilam and Morang) sharing the boundary. Panchthar of Limba is defined as vulnerable site for the impacts of climate change by vulnerability. The research was conducted in one hilly VDC of Panchthar District (Limba).

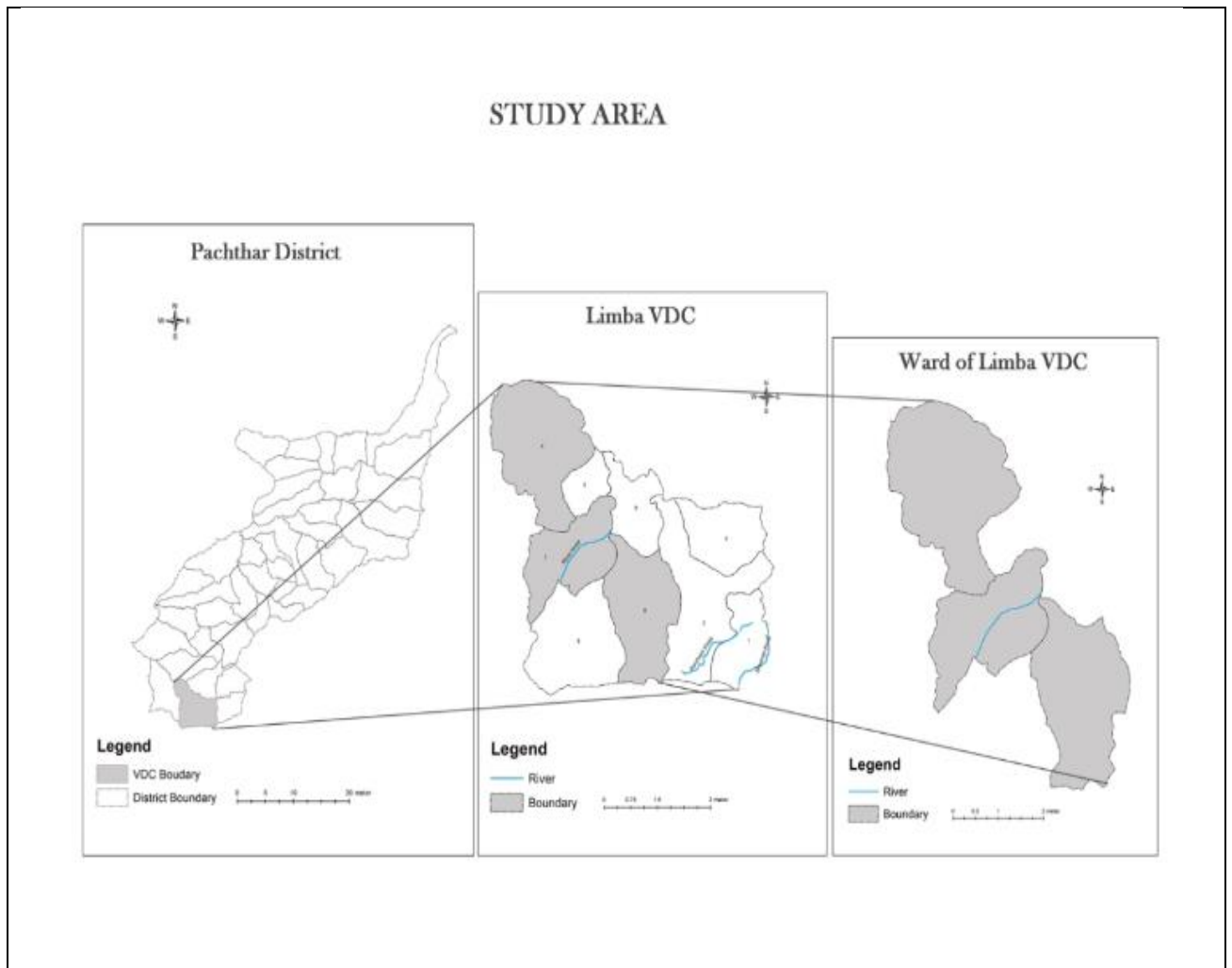


Figure 1: Study Area

3.1.1 Land Use/ Land Cover

Land use/ land cover is related with several human activities such as agricultural, grassland land, forestland etc. Land has been used differently in various places or geographical regions according to the need of residents. Land is used mostly for agricultural purpose in rural area where as urban area is used in different purposes: like residence, constructions of industries. Uncontrolled population growth has increased pressure on the land. Growth factor also plays a vital role for changing in land use cover.

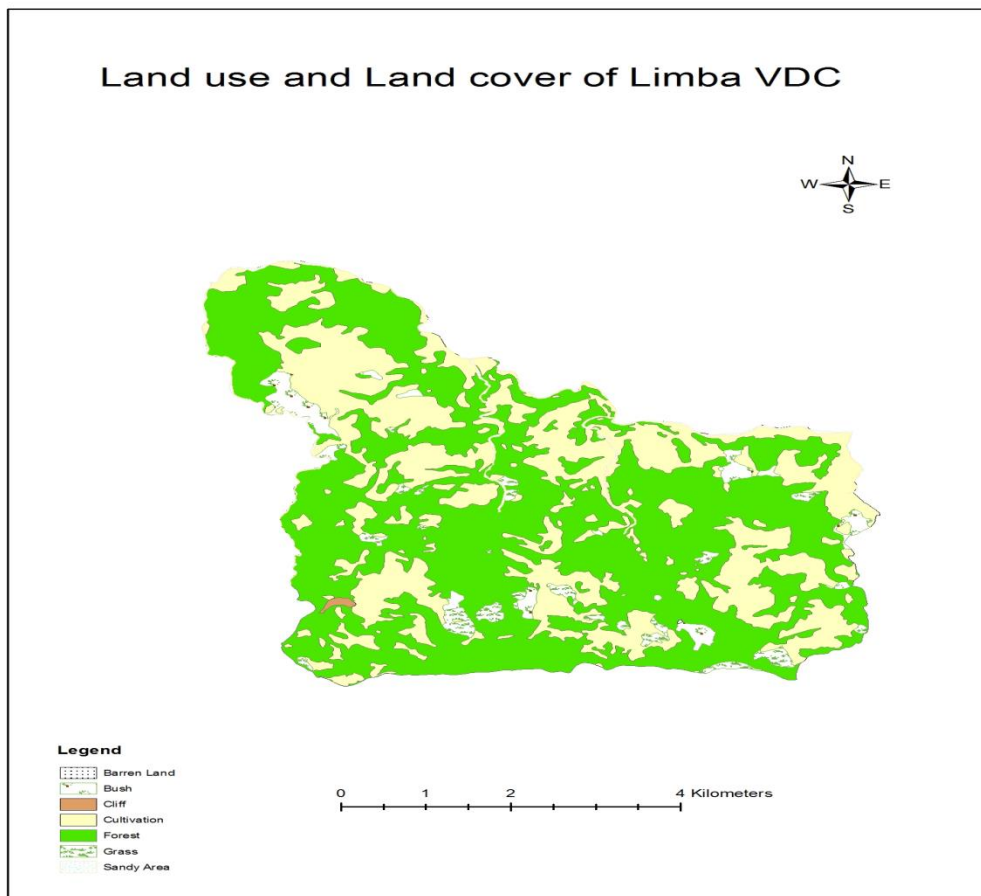
The land use/ land cover of the Limba VDC is various. Table 3.1 shows Forest land covers is dominant 23.177kmsq of the total land. Likewise, Cultivation land covers 13.187 km.sq, grass 0.887, Barren land 0.003, Cliff 0.0505, Sandy area 0.397. Bush 1.050 and Grass 0.887km.sq area covers of Limba VDC. Some other land use/land cover is shown table and figure.

Table 1: Land use/ Land cover

S.N	Land use type	Area_kmsq
1	Barren land	0.003
2	Cliff	0.050
3	Grass	0.887
4	Bush	1.050
5	Sandy Area	0.397
6	Cultivation Land	13.18
7	Forest Land	23.17

Source: Topographic map2010

Figure 2: Land Use of Study Area



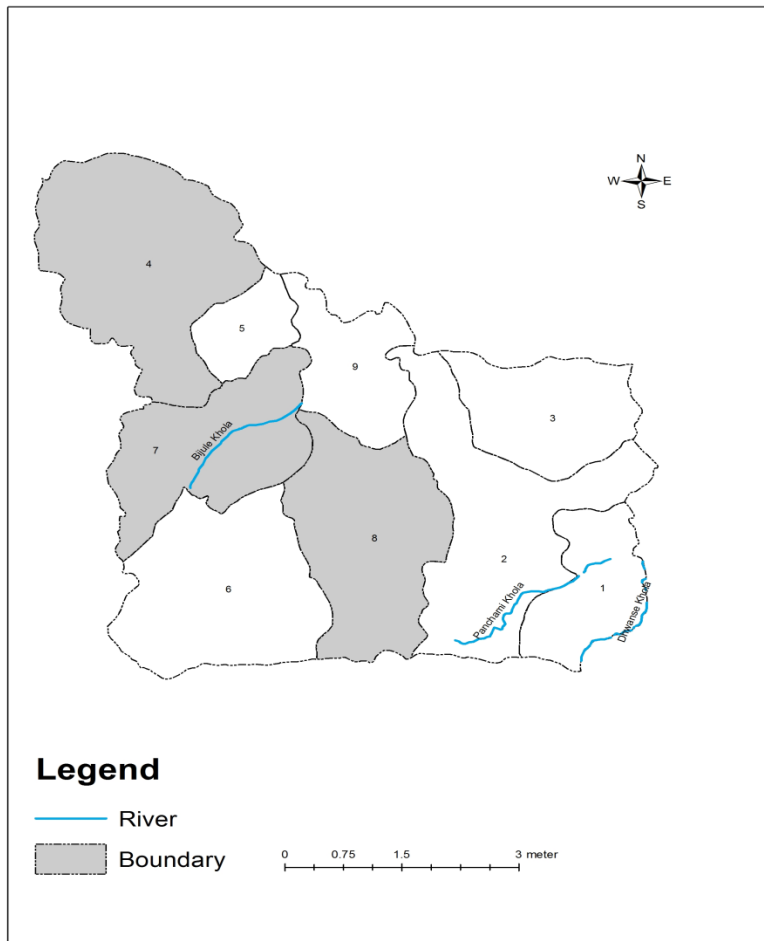
Source: Topographic Map 2010

3.1.2 Drainage Pattern of Limba VDC

There is no main river of VDC but flow line and cannel, Small River is more important in this area. Wheregiving to alocal peoples remaining to climate change many small river are

losing water, all people depend on some of the small rivers for everything from agriculture to clean drinking resources. The drainage system of the VDCs is shown in figure 4.

Figure 3: Drainage Pattern of Study Area

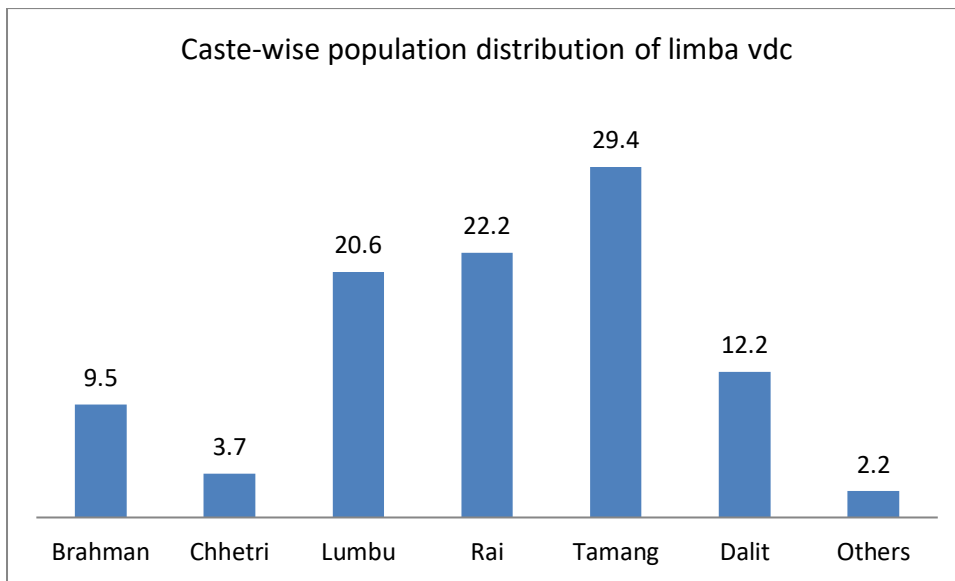


Source: Field Survey, Topographic Map 2010

3.2 Socio-economic condition

3.2.1 Population Distribution by Caste/ Ethnicity: Total population is 4,405 with 2011 males and 2,394 females and the numbers of household 934. The dominant ethnic group is Tamang in Limba VDC, but in Lekhgauward, no eight Rai is dominant, Limba 7 Limbu is dominant ethnic group and Lumangdin ward no four-mixed cast dominant. Table No. shows that, around 30 percentage of the population is Tamang, Rai 22.2%, Limbu 20.6%. But below 15 % of the total population are Dalit, Brahman, Chhetri and other in there.

Figure 4: Caste-wise Population Distribution of Limba VDC



Source: VDC Profile of Limba 2070

3.2.2 Gender of respondents

Though the geographical location of the study site was predetermined, gender of eventual respondents was not considered a factor since a respondent represented a household. With this strategy, respondents were either a household head or spouse though in exceptional cases another adult member of the householder.

Lumangdin had the biggest variance in gender of questionnaire respondents with 40% Females and 60% males contributing to the study. Other VDC's did not indicate a wide difference in gender composition of respondents.

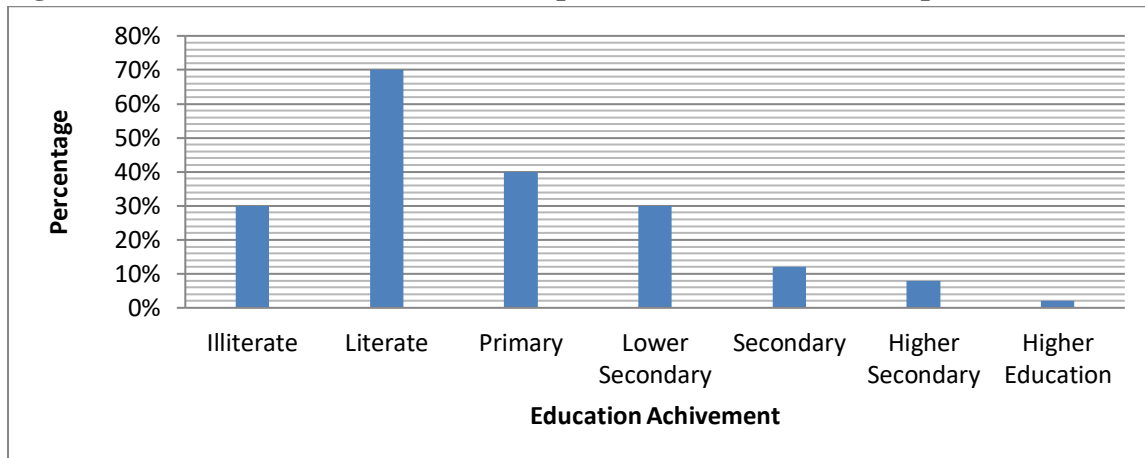
Overall, the gender composition of questionnaire respondents was 42.7% male is and 57.3 female. The gender composition of Focus Group Discussion respondents was 50 percentages for males and 50% for female has, however the three(3) semi-structured interview respondents were all males.

3.2.3 Education Achievement

More than 30 percent of households are illiterate, although every household has children going to school at present. The literacy status of the sample households of the study sites were categorized into two groups. The respondent who did not know how to read and write were classified as illiterate. The literate people are classified into different sub-groups such as

primary who had 1-5 year of formal education; those who had 6-10 years of formal education belonged secondary, the respondent who had 12 years of formal education belonged higher secondary; the respondent who had an associate degree or above were classified as higher education. Education status of respondents is represented as follows:

Figure 5: Education Achievement of Respondents and Without Respondents

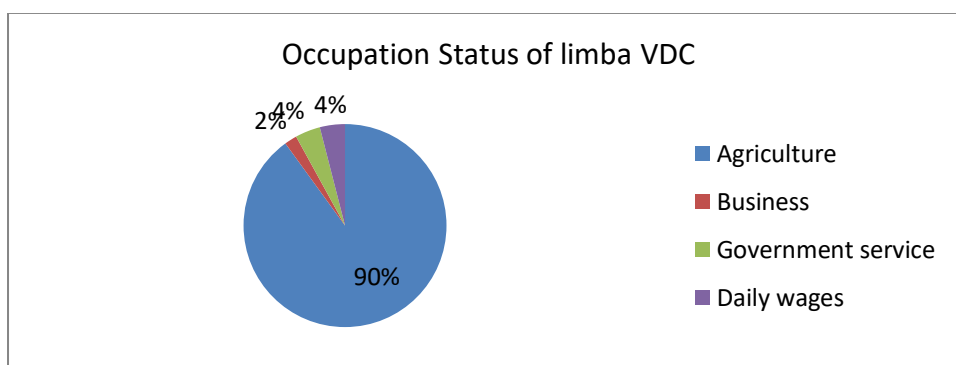


Source: Village Profile Limba VDC, Panchthar

3.2.4 Occupation Status

The Population in the area depends on farming as the main source of their livelihood. Local People in this area are engaged in different occupation. The sale of Potato, Paddy, Maize, Millet, Bean, Cardamom, Ginger, Garlic, Onion, Boom grasses contributes nearly 90 percent of the areas income and the sales of livestock products and vegetables contribute the rest. However, Agriculture is the main occupation of the villagers. About 90 percent of the people in agriculture, Business 2percent, and government service, 4 percent daily wages percent were involved. The people also depend on forest resources to for timber, cattle bedding and non-wood forest products to support their livelihood.

Figure6: Occupation Status of LimbaVDC



Source: Village Profile Limba VDC, Panchthar

3.2.5 Income sources

The farmers earn from both agriculture and non- agricultural sources. The agricultural source constitutes the income from the sale of the crops, fruits and vegetables, livestock and poultry. The non-agricultural source consists of the income from business, teaching, civil service government, pension, health services, wage labor, remittances, and the like. The agricultural source was the dominant source in all the VDCs. The horticulture sub-sector has been an important source of cash income under the agricultural income sources contributing to about 60 percent to the total annual household cash income. The teaching in the school, operating small household businesses and the remittances received from abroad were the major sources contributing to the non-agricultural income.

3.2.6 Household energy consumption and forest products of collection (20 year ago)

Firewood is a major source of fuel wood for all household in all study VDCs. The households of Limba used to collect firewood and fodder for livestock from both community forest and privet forest but the collection amount from community forest was lesser than privet forest. While other wards, the major source of firewood and fodder was privet forest 20 years ago. Leaf litter is major sources of organic manure in all study Wards. The collection of leaf litter from privet forest ranged between 200 bhari per year study area. Most of the households from all study areas except used to collect poles from community as well as privet forest. Since indigenous people are closely associated with nature, they used to consume the wild fruits and vegetables from the forest. The major foods that the people consumed are mushroom, bamboo and other wild fruits. People used to collect medicinal plants for the treatment of some diseases.

3.2.7 Household energy consumption and forest products of collection at present

According to the field survey conducted in Limba VDC almost all local people depend on firewood for cooking purpose and some people used gas and Bio-gas and electricity, solar for lighting. The fuel wood, fodder and leaf litter demand has increased in all study areas except and source of collection is limited on privet forest as compared to community forest. The bamboo shoots, wild fruits, and vegetables are now less available in community forest and the households are collecting these products in fewer amounts from their privet forest. All households of all VDC except are collecting medicinal plants from their privet land but the households of study area are planting medicinal plants on their privet land. At present, the people have started plantation on their privet land and they were fulfilling their fuel wood and fodder demand from that forest. Therefore, the reason behind the decrease in access to the

community forest might be the sufficient private forest and less access to the community and government forest. On the other hand due to the lack of proper care and management practice of the community forest, the forest products are decreasing at present. Nowadays they use gas, biogas so the demand of fuel wood is decreasing.

3.2.8 Biodiversity

Detail information on biodiversity was difficult to obtain since it needs long observation such as variation in species availability, density, and distribution. It is difficult to draw conclusion on how forestry and biodiversity have been affected by climate variability. Firewood consumption for cooking and heating has increased pressure on forest resource. Weed species like "banmarahas" has spread widely posing threat to existing tree species.

CHAPTER- IV

DATA ANALYSIS

4.1 Climate Change Impacts and Responses

4.1.1 Average annual rainfall and temperature: The figure below shows the decreasing trend of rainfall at Panchthar district given by Phidim metrological station. It is seen that the maximum rainfall is in the year 1991 with the average rainfall 148 mm and the minimum rainfall is in the year 2001 with the average rainfall 79.1mm. The figure shows that the decreasing trend is not smooth but it has been increasing and decreasing simultaneously. The rainfall and temperature correlation -0.3200 mm per year decreasing rainfall where rainfall depends on temperature. The figure also shows the slight increase in the temperature at Panchthar district in 24 years. The maximum temperature was found in the year 2010 with average temperature 28.3 degree Celsius and minimum temperature was found in the year 1991 with the temperature 21.4 degree Celsius. From this below chart, we can say that the effect of climate change was also seen in the Panchthar district. Slight increase in the temperature has cause the highly decrease in rainfall.

Table 2: Average Rainfall and Temperature Data in 1989-2013 Panchthar

year	average rainfall mm	temperature °C
1989	128.9	21.8
1990	137	25.8
1991	148	21.4
1992	100.9	22.5
1993	107.1	25.1
1994	83.4	26.4
1995	114.3	26.3
1996	119.1	26.3
1997	113.8	25.4
1998	127.9	26.3
1999	108.8	27.1
2000	114.1	26
2001	79.6	23.9
2002	113.1	25.9
2003	136.3	25.6
2004	86.4	23.1
2005	102.9	27
2006	109.2	26.8
2007	119.7	26.4
2008	106.3	27.1

2009	86	28
2010	106.3	28.3
2011	101.6	27.3
2012	85.3	27.8
2013	89.4	27.3

Source: Department of Hydrology and Meteorology

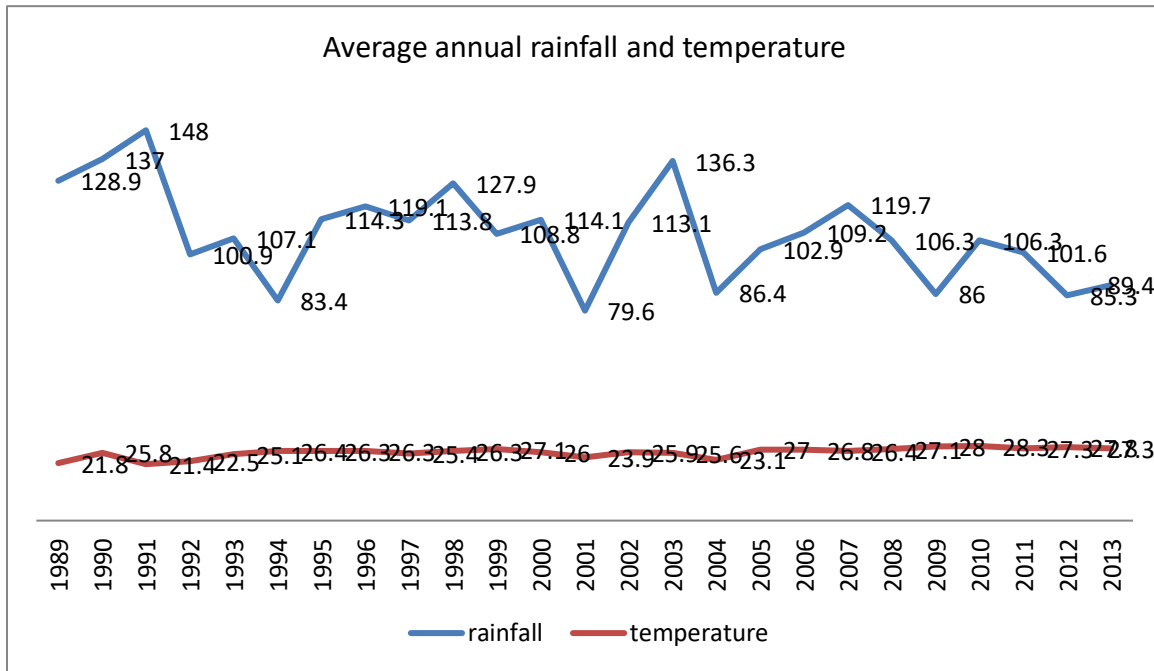


Figure 7: Average Annual Rainfall and Temperature 1989-2013

4.1.2 Mean monthly rainfall:

The 24 years average monthly rainfall shows that July is the rainiest month with average rainfall 309.8 mm while November and December are the driest month with only 8.8 and 8.1 mm of rainfall.

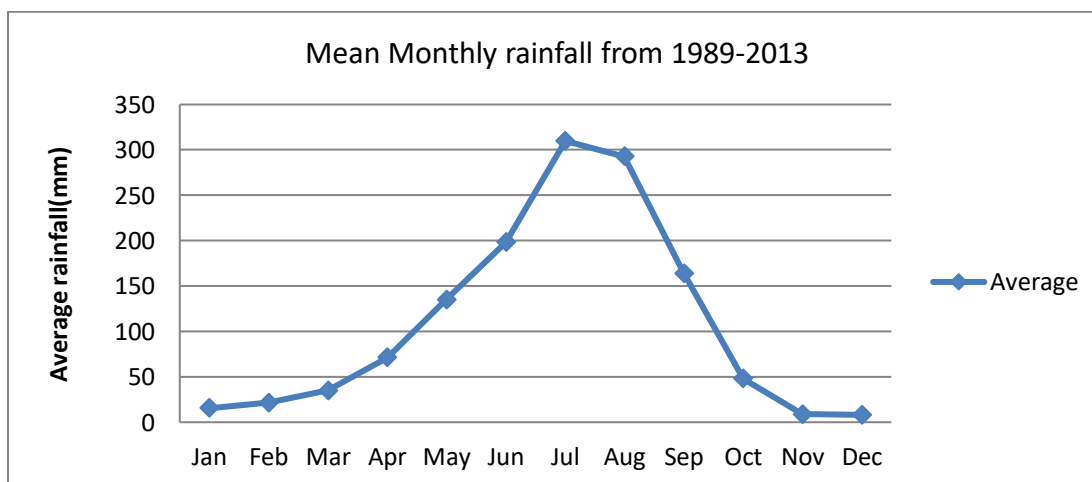


Figure8: Mean Monthly Rainfall (mm) from 1989-2013

4.1.3 Average rainfall of the winter months: January, November, and December are the winter months. Among these three months November, slightly decrease December of rainfall. Figure below shows the monthly January average rainfall 15.5mm while November and December are the 8.8mm and 8.1mm of rainfall.

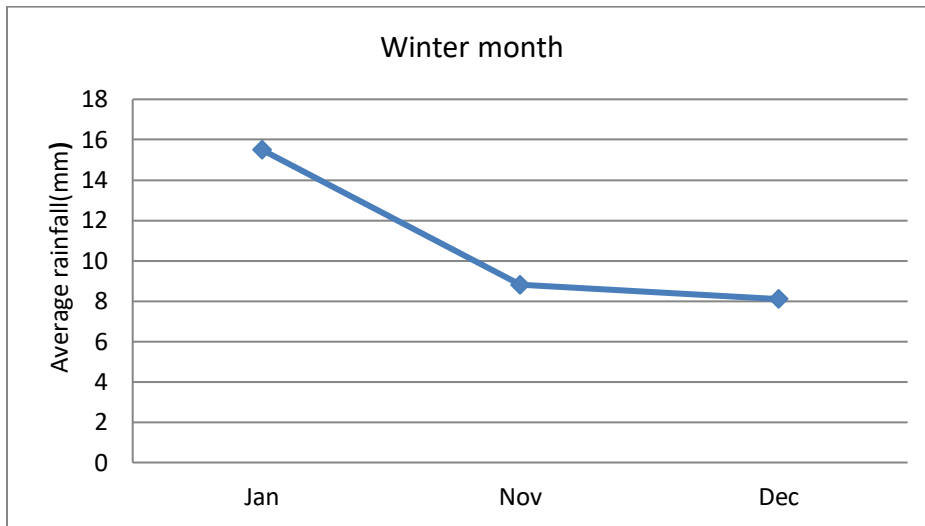


Figure9: Average Rainfall of TheWinter Months from (1989-2013)

4.1.4 Average rainfall of the monsoon:Figure below shows monthly distribution of rainfall of monsoon months in each decade. The rainfall for monsoon had varied in each decade. In comparison to other decades; 1989-2013 average monsoon month there was decline in amount of rainfall. However, the amount of rainfall inJune, July, andAugust at the different decade are higher as compared to other decades like May and September.

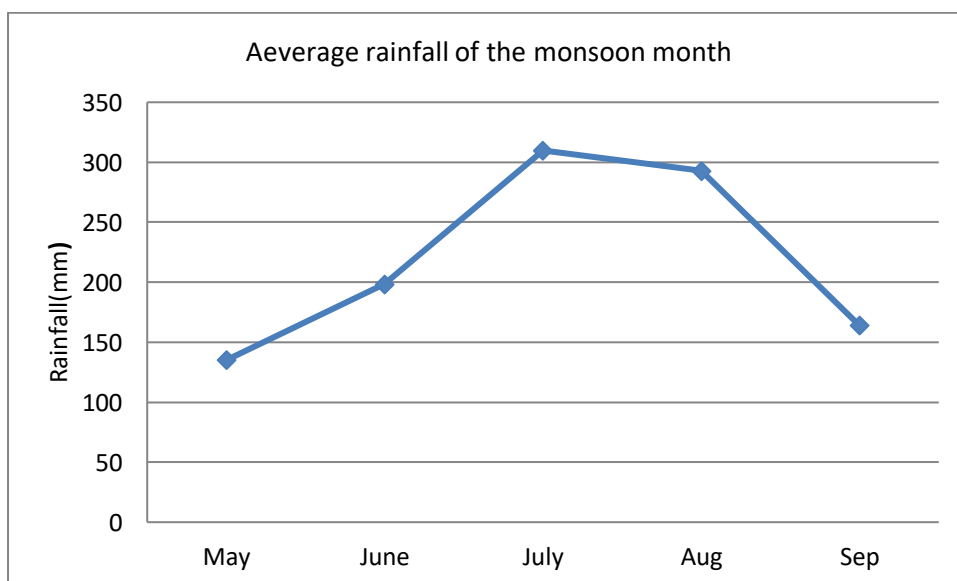


Figure 10: Average Rainfall of theMonsoon Month 1989-2013

4.2 Temperature

4.2.1 Mean annual temperature: The figure also shows the slight increase in the temperature at Panchthar district in 24years. The maximum temperature was found in the year 2010 with average temperature 28.3 degree Celsius and minimum temperature was found in the year 1991 with the temperature 21.4 degree Celsius.

Table 3: Mean Monthly Maximum and Minimum Temperature (°C) in 1989-2013

Temperature(°C) Panchthar				
S.N	Month	Maximum	Minimum	Average
1	Jan	18.5	6.3	12.4
2	Feb	20.4	7.2	13.8
3	Mar	25.8	11.2	18.5
4	Apr	27.4	14.7	21.05
5	May	29.5	16.2	22.85
6	Jun	29.9	19.3	24.6
7	Jul	27.9	20.6	24.25
8	Aug	29.2	19.6	24.4
9	Sep	27.6	18.6	23.1
10	Oct	27.8	15	21.4
11	Nov	24.8	10.8	17.8
12	Dec	20.9	7.8	14.35

Source: Department of Hydrology and Meteorology

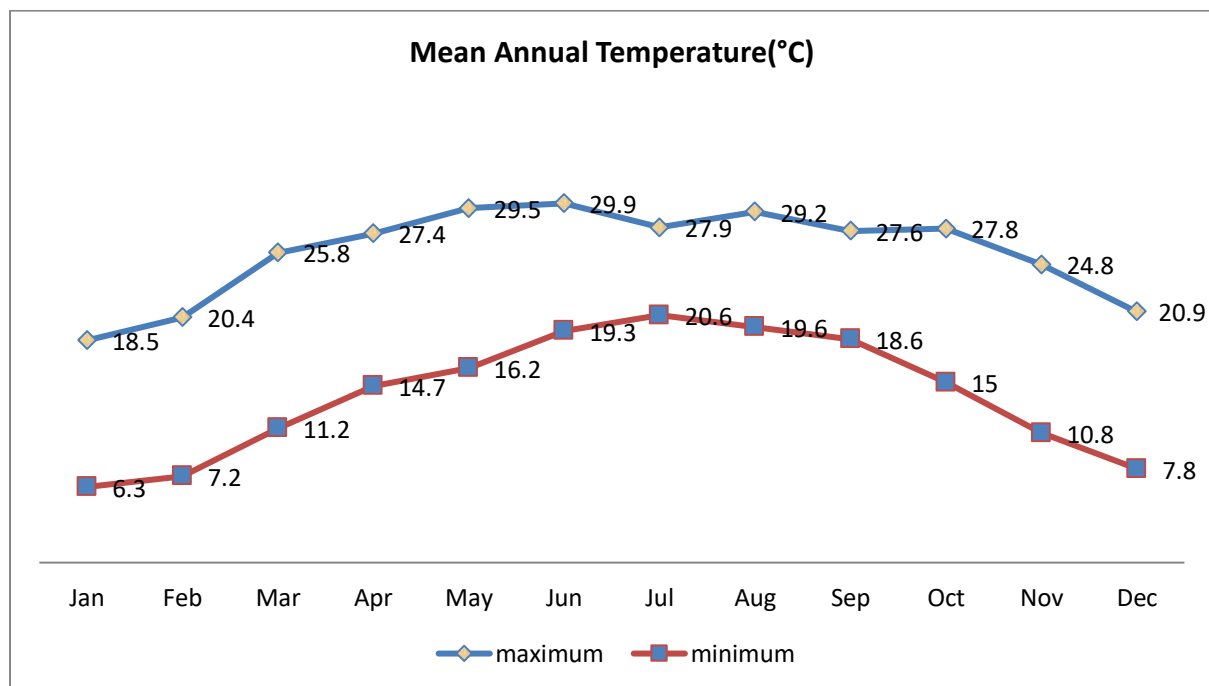


Figure 11: Mean Annual Temperature (°C)

4.2.2 Mean monthly maximum temperature: The monthly temperature analysis shows that temperature ranges its highest value in June (29.9°C) while the lowest temperature value was recorded at January (18.5°C). Winter month accepts minor aggregate of rainfall, which was proved as the evidence of drought in the study area.

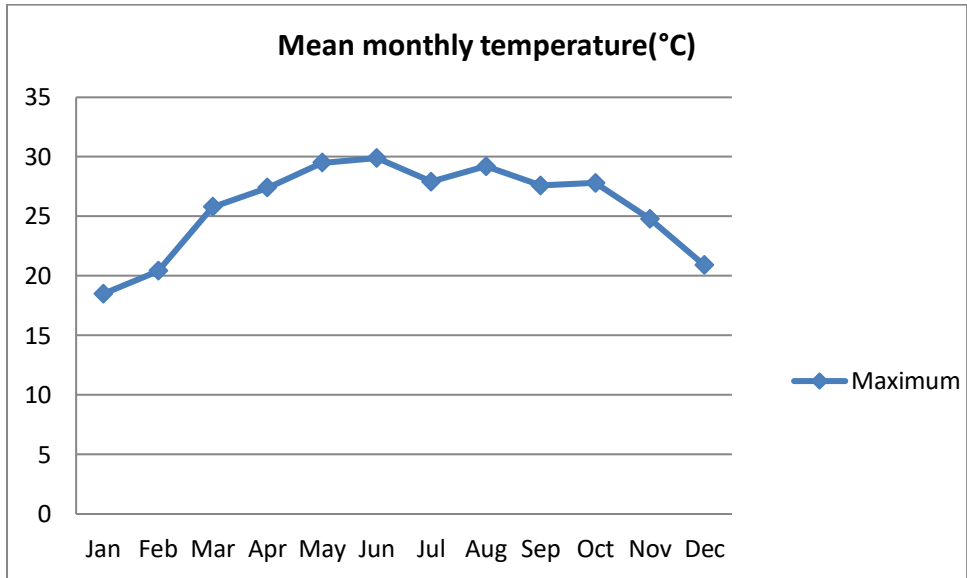


Figure12:Mean Monthly Max Temp (°)from 1989-2013

4.2.3 Mean monthly temperature: The 24 years average monthly rainfall shows 1989-2013 that July is the rainiest month with temperature 24.6(°C) in June whereas January and February are the lowest month with only 12.4(°C)and 13.8(°C) of temperature.

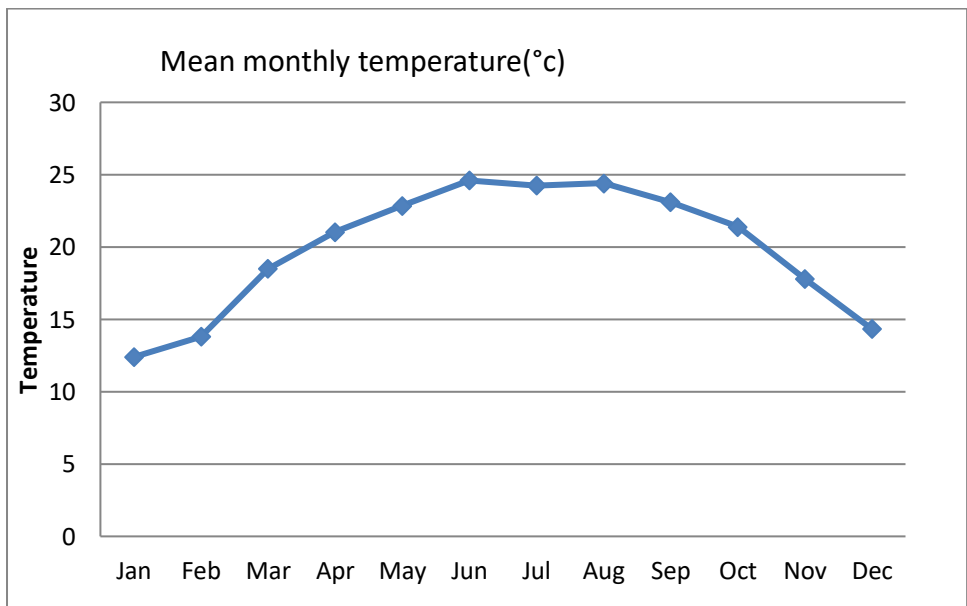


Figure13:Mean Monthly Temp (°)from 1989-2013

4.3 People's Perception on Climate Change

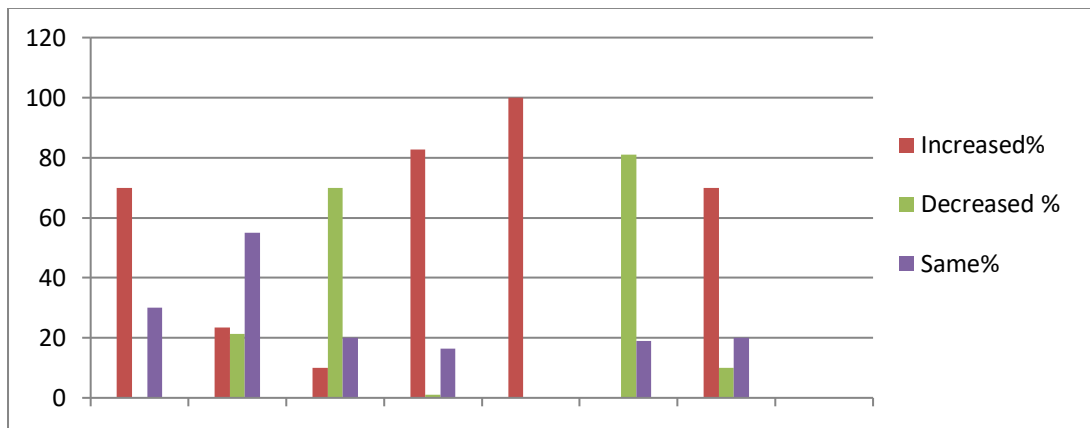
Climate change has become a serious issue seen to have negative impacts on the rural livelihoods through a range of associated changes taking place, such as rise in temperature, erratic rainfall, and continued dry spells. All of the respondent's perceived change in the microclimate of the locality. Study revealed that 88 Percent of respondents experienced the occurrence of monsoon rain after the usual time, 2 percent before the usual time whereas 2 percent experienced no change. Similarly, 12percent experienced occurrence of winter rain after the usual time and 2 percent experienced no change. Experienced occurrence of rainfall was not consistent over the area. There occurred shift in rainfall pattern. More respondents in comparison to the winter rain observed shift in monsoon rain.

Decrease in length of winter was experienced by 70 percent of the respondents. Similarly, 82.7 percent experienced increased occurrence of drought whereas all respondents experienced increase in length of drought period. Drought and its length have significant effect on water sources. Eighty percent respondents found decrease in water sources in recent years. Rainfall pattern has become erratic. Fifty-six percent observed increased frequency of heavy rainfall in short periods. Life in the study area have become difficult in recent years due to shift in rainfall pattern, decreased amount of rainfall, increased length and frequency of droughts associated with decreased water sources.

Table 4: Change in Microclimate as Perceived by Respondents

Responses	Increased%	Decreased %	Same%
Change in hotness of summer days	70	-	30
Change in degree of coldness	23.5	21.4	55.1
Change in length of cold winter	10	70	20
Change in drought pattern	82.7	2	16.3
Change in length of drought	100	-	-
Change in no water sources	-	81	19
Heavy rainfall in short period	70	10	20

Figure 14: Change in Microclimate as Perceived by Respondents

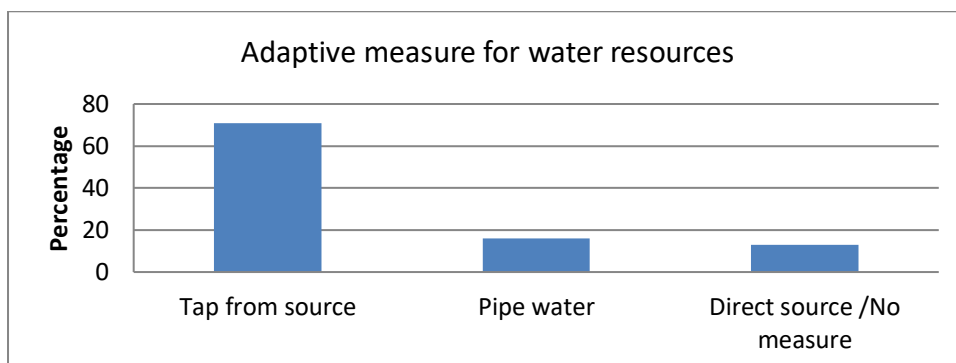


Source: Field Survey, 2014

4.4 Water resources

The 71 percent respondents told that they use tap for drinking and other purpose. The 16 percent respondents told that they were using pipe water the source of water by their communities making canal for drinking and other purpose and 13 percent respondents told that no measure was applied for drinking and other purpose and they were getting water from direct source where it is possible. At the rainy season, they got water from nearer source but at summer season, the source of water nearer to the community people had to walk for distance (30minutes) to get water. People of Limba VDC use different strategies to fulfill the water needs. Most of the agricultural activities are performed on the rainy season. Me many seasonal crops are planting despite the lack source of water resources. They have made canal from water resources to their communities to full –fill their need of water. Pipe taping system is also adopted there which has made by government support.

Figure 15: Adaptive Measure for Water Resources

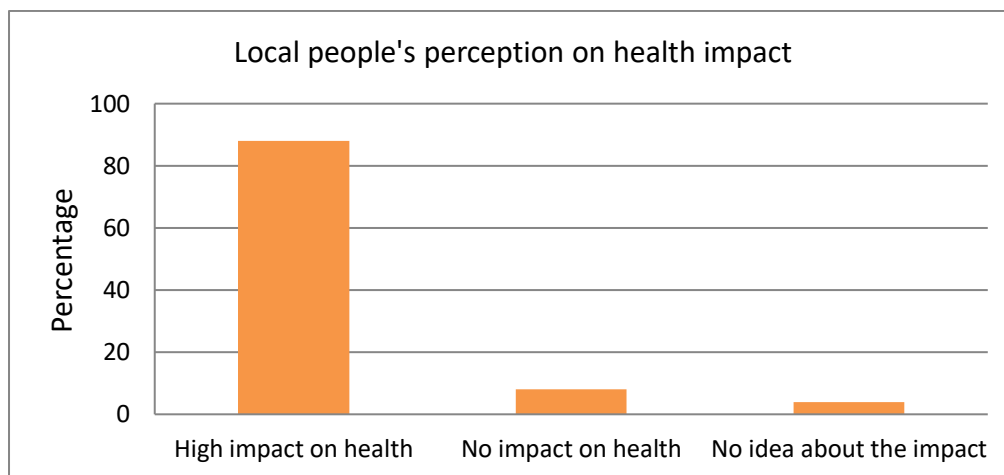


Source: Field Survey, 2014

4.5 Human Health and Disease

According to respondents the patterns of rainfall and snow, hoar- frost fall changed due to season due to change in temperature in the study area that had both direct and indirect effects on health human binges. 88 percent respondents said that there was high impact on health where as 8 percent respondents said no impact on health and 4 percent respondent reported that they had no idea about the impacts.

Figure 16: People's Perception on Health Impact



Source: Field survey, 2014

The local communities have observed prevalence of mosquito and fly in recent years were the cause of diseases. The people also perceived the occurrence of disease like Diarrhoea, Typhoid, Cholera, Jaundice, Eye infection, Headache, and cold fever. This increase of number of mosquitoes was the result of climate change and increasing rate of temperature. Many impacts on health have been seen on Limba VDC Panchthar and increasing day by day. For serious health problem they used to go to the hospital and normal health problem, they used to go to health post situated at Limba-7. They also apply local techniques like using mosquito net while sleeping, boiling water before drinking, eco- sanitation as constructing toilets, etc.

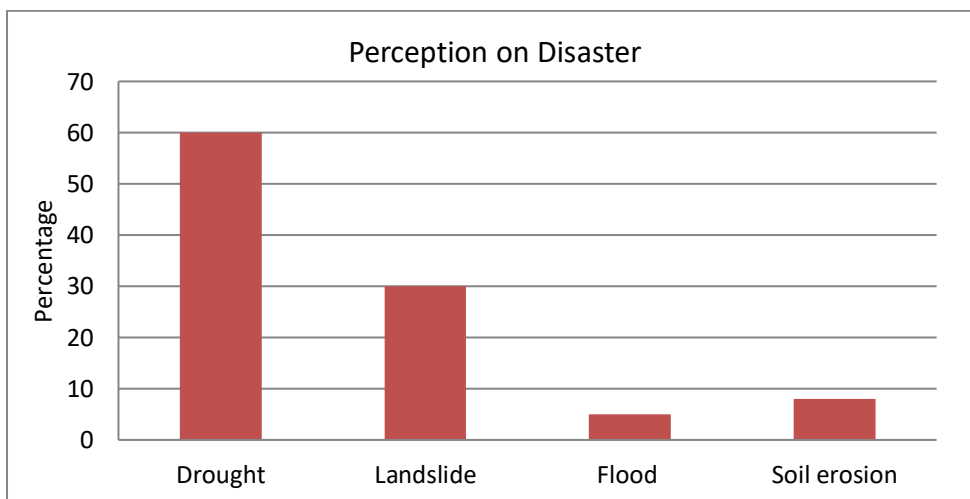
Based on the field survey, it can be said that some new diseases in crops as well as in human population are observed in recent years. New diseases observed by local people in crops in the study area are Katlekira particularly in fruits, Ratokamila in potato, liakira in vegetables, and khumrekira in maize and millet. Some new diseases noticed in human population are fungus, respiratory diseases, uric acid, and protein deficiency diseases.

4.6 People's Perception on Disasters

In rainy season, landslide affects water sources, which have impact on irrigation and drinking. Huge landslide at cannel (kulo) road in monsoon season. In rainy days landslide frequently damages agricultural field of Limba VDC some ward and some place affect households.No effective measure are used to control land used slide but some villagers made retaining wall to control it but it is not so effective. People here have low income and cannot afford high cost and their local attempt to control landslide is limited.

Landslide was a major natural disaster in Limba VDC, which damage agricultural field, and black topped road. Among the total respondents 30 percent said that landslide is the prominent natural disaster 60 percent respondents said drought, 5 percent said flood and 8 percent said soil erosion as a serious disaster problem created by climate change in this area.

Figure 17: People's Perception on Disaster



Source: Field Survey, 2014

CHAPTER- V

IMPACTS OF CLIMATE CHANGE ON AGRICULTURE

5.1 Change in Farming System

All the respondents expressed that the climatic changes they observed affect their farming activities. The main impact highlighted by local farmers was low crop production. Monsoon has become unpredictable, sometimes arriving late and sometimes arriving early. When late, the rice transplantation is delayed and production decreased. Peoples would not have to delay transplantation if there was more water available for irrigation over the last 10 years ago. Local peoples have also observed that the temperature has gotten warmer. Fruits are now maturing quickly. Rice, wheat maize etc., are maturing 20-30 days earlier. Warmer temperatures often create a more hospitable environment for pest. Local farmers have noticed that new types of insects and disease are damaging crops. Some claimed that the pests have become epidemic, while others did not seem concerned. A few have tried using pesticides, but without much success. Most of the people have experienced changes in agro biodiversity and farming system. Many especially of rice. New cultivars are being introduced to increase production and local cultivars are becoming extinct.

Twelve percent of the respondent of the respondents experienced decrease and rice production. Farmer did not experience any significant change in maize and millet production. Twelve percent experienced increase in maize production while 8% experienced decrease. Eight percent observed decrease in millet production and 92% experienced no change. The increase in productivity was due to the adaptation of new cultivars and the reduction was due to the inability of local cultivars to adapt in changing climate.

Cultivars that were common few years back now have become extinct or rare. Ninety four percent of the respondents observed disappearance of existing cultivars of cereal and same percentage observed introduction of new cultivars. This was the most important adaptation strategy of the local people of fight low productivity. They have started growing high yielding and more adaptive cultivars to adapt in the changing climate.

Local people have adapted strategies to minimize environmental risk and ensure food security. The main concern for construction of level terraces on steep hill slopes is to reduce erosion on one indicator and obtain benefits of irrigation. Ethnic people have made terraces in hill slope. Another strategy adopted by the villagers is choice of crops. Maize, Millet, Wheat,

Barley Potato and Bean are grown in unirrigated lands. Paddy is irrigated land. Native varieties are resistant to local climatic deviation and ensure food even though is low. Imported improved varieties though have high production potential but are less resistant to climatic stresses such as windstorm, hail, and rain. Farmers in Limba VDC use both improved and local varieties of maize. Intercropping of different varieties of crop having different growing period is also practiced. Grains are stored in Bhakari"(system of food grain storage) for deficit month and "Sahayog"(provision of free labour) for crisis management. Diversification of income through crops, livestock, wage from construction work, porter age is strategies used to minimize risks. In recent days, remittance is used for crisis management.

Livestock is an important source of income of the people living in the hills generally. It is also an important source for manure of plant nutrient. However, the growth of livestock farming depends on the availability of fodder from grazing land.

Untimely rainfall and drying of water sources decrease agriculture production. Increasing temperature trend obtained from observation and that felt by the community matches. People have stopped planting chili, garlic, Bean, Potato, Zinger, Onion for which Limba was famous. About 50% crop failure occurred due to wilting of chili, potato due to fungus. Frequency of occurrence of fungus is high due to increase in temperature.

5. 2 Drought resistant crop

Result from group discussion, in- depth interview and consulting opinions of professional divisions and sectors as well as experts on the drought resistant crop for summer season one cropland is green bean. That is local bean seeding with small seeds. Green bean is planted in late of March. It has short growing duration that takes about 60-70 days for harvesting. This helps release land in time for cultivating next crops. Cultivating green bean can save the water sources for irrigation; therefore, it is suitable with the area that is in danger of drought. The plants by products are source of fertilizers containing protein. It can reduce the amount of chemical fertilizers for crops, protect lands, and enhance land fertilization. Techniques for cultivation and caring will consider to local knowledge and notices in green bean planting techniques.

Table5: Missing or rare and newly introduced cultivars of different crops




















































Crops	Missing and rare cultivars	Newly adopted cultivars
Rice	Atte, Tauli, Chirankhe, Belkuthi Pokhareli, Rudwa, Kanchi Mansuli, Seti Mansuli,	Basmati, Ranjit mansuli Pokhareli, Jeerasarry, Bhotemansuli, Fourty- four etc
Maize	Seti makae, Paheli, Calig Ashare makae	Hybrid(unknown), American, Sathiya, Manakamana, Chepte, Murali
Millet	Dalle kodo, Fyakre kodo, Jhutte Kodo	Nanga Katuwa Kodo
Vegetables	Eskush, karela, Barela Saag, Chichinda Ghiraula	Cauliflower, Tomato Simi Brocauli, Banda, Sqash, Gajar, Chamsur ,palung, ginger, garlic, onion etc.
Potato	Seto aalu, Rato aalu, Kusume	B2 Aalu, Holane
Radish	Local mula, Gante mula, Rato mula	Chalise mula, Hybrid mula
Daal	Rajma, Kalo ,Panhelo, Banmara, Simi Bhatmas, Gahat	Rahar, Musuro Geeu Simi, Nepali Bhatmas
Cardamom	Jirmale , Seremna	Dambershahi, Jirmale Varlang
Fruits	Mango, Banana, Gwaba. Orange, Sweet orange, Sugarcane	Kiwi, Ground Apple, Pineapple Anar Graphs etc.

Thirty-eight respondents experienced change in planting time in cereals crops. Rice was previously planted in Jestha nowadays it is planted up to last week of June. According to them, it was due to delayed monsoon. Respondents had not experienced change in planting time of maize, millet, and vegetables some of the farmers found early ripening in maize. Respondents had not experienced any major changes in flowering time of major cereals. Some of the respondents observed change in flowering time in pear and sisno (*Urtica dioica*). Previously flowering time of pear was March, nowadays flowering occurs in October. Similarly, in case of sisno flowering time has changed from July to October

Farmers have experienced appearance of new weed species. Ilame jhar (*Ageratum Sp*) having dull leaf Parpare jhar, Tike jhar etc are becoming dominant in the crop fields. Ilame jhar (Banso, Ratneulo, Alu jhar etc, have almost missing.

Table 6 shows that the local agriculture seasonal calendar can avoid two rainy months of June and July. Local people mentioned that agricultural production and cultivation have induced many changes recently and shift of the seasons in a year.

Table 6:20 years ago seasonal calendar in Limba VDC

Crops	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Summer Paddy	W 	W 		H 							S,F 	T 
Winter Paddy	S,F 	T,S 	T 	T 	w 	W 		H 				
Summer Maize			H 						F 	S 	S, 	W 
Winter Maize	W 	W 			H 	H 					S,F 	T,S 
Wheat		H 							S,F 	ST 		W 
Millet		F,T,S 	T 	T 	W 		H 	H 				
Mustard					F,S,T 			H 	H 			
Potato	W 	W 		H 	H 						F,S,T 	F,S,T 
Bean			F 	S,T 	S,T 	W 		H 	H 			
Others								F 	S,T 			H 






















































F=Field Preparation S= Seeding T= Transplanting W= Weeding
H=Harvesting Size of Working days= 

Table 7: Present major crop grown, its calendar, and change in crop and cropping calendar in Limba VDC Source: Field survey, 2014

Crops	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Summer Paddy	T 	W 		H 	-						F,S 	F,T,S 
Winter Paddy		F, S 	T 	T 	W 	W 		H 				
Summer Maize			H 						F 	S 	S, 	W 
Winter Maize	S,T 	W 			H 	H 					S,F 	F,T,S 
Wheat		H 							S,F 	,ST 		W 
Millet		F,T,S 	T 	T 	W 		H 	H 				
Mustard					F,S,T			H 	H 			
Potato	W 	W 		H 	H 						F,S,T 	F,S,T 
Bean			F 	S,T 	S,T 	W 		H 	H 			
Vegetables	S, 	T 	T 	W,S 				F, 	S,T 	S,T 		H 

F=Field Preparation S= Seeding T= Transplanting W= Weeding
H=Harvestings Size of Working days= 

5.3 Fertilizer Use

During the study, this research has found that, there is no evidence of using chemical fertilizer. Only Compost manure is used which is product of decomposed leaves of tree, which is used while cultivating land. Because of the lack of transportation facility using chemical fertilizer is not more possible there. However, little using chemical fertilizer. Therefore, the only use compost manure. However, the dose of the fertilizer varies in accordance to type of crops they use. They use much more manure in vegetable, potato, maize, barley, wheat paddy, and millet. During the time of cultivation of barley crops, they keep their in the target cultivated land and manure of cattle becomes beneficial compost manure and enough for the barley cultivation.

There is vast contrast between the quality of fertilizers, which was used 20 years ago, and in current time during cultivation in the Limba VDC where area are 13.187km.sq.

Table 8: Use of the fertilizer in 20 years ago (kg per units) and (chemical per kg)

Crops	Cultivated area in (ropani)	use compostmanure (doka)	fertilizer use (kg)
Maize	10	100	15-
Potato	7	60	-7
Wheat	5	33	8
Millet	5	30	-
Paddy	12	50	-
Barleys	2	10	-

Source: Field Survey, 2014

The maximum use of compost manure contains in in maize and potato cultivation that is around 70 doka. The cultivate maize and potato combine but they use less fertilizer for millet farming, which is in average six6 kg per ropani. Sometime some farmer is little chemical use in wheat. Sometime some farmers tie their cattle in the field and their manure is enough for fertilizer while cultivating millet and barley.

Table 9: Current use of manure doka and per kg in ropani

Crops	Cultivated area (ropani)	Use compostmanure in (doka)	fertilizer use (kg or packet)
Vegetable	5	30	5kg
Potato	3	40	-
Maize	12	70	20kg
Paddy	8	40	10kg
Bean	3	20	-
Wheat	2	15	5kg
Millet	3	12	-

Source: Field Survey, 2014

While analyzing the current cultivation system, it is proved that they use maximum compost manure and chemical for the combined used and mixed cultivation of cropping system like maize and potato, potato and vegetable. For which they use average compost manure and chemical fertilizer and pest mostly use in vegetable.

5.4 Change Fertilizer Use

Quantity of fertilizer used in cultivation has been changed according to the period. Comparatively there is much of compost manure and chemical fertilizer in the ratio of past 20 years. Twenty years ago, they used more compost manure like manure. Similarly, in the case of the wheat, barley and millet is decreasing according survey. However, vegetable potato and other cash crop have increased with the ratio. So comparatively, there is different between increased ratio of manure and chemical fertilizer practice for different crops but one fact is that ratio is increased in comparison to past uses. Still they use do same chemical fertilizer for their crop cultivation because increasing production.

5.5 Labors

Labor is another major input of agricultural production in the study area two types of labors are used, one is human labor and another is animal labor (Ox). In Limba VDC human labor is very important in seeding to harvesting period in all crop grown. Animal labor is used in land preparing period of cropping.

Whereas analyzing the collected information in the field research, there is difference between the patterns of labor use in cultivation of crop, which varies from past cultivation. A labor use

varies according to the type of crop. Comparatively they use more labor for paddy, millet maize and less for wheat, potato's, vegetable, bean cropping. However, they use minimum labor for the barely cultivation. Similarly, they used average 40 percentage hire labor paddy, maize, wheat. No changeability can be proved in case of labor uses in this research area. There was use of human and animal labor used for cultivation and this tradition is still the main tool for cultivation. They did not use any modern technique, instruments, and advance technology for cultivation. Totally, tradition system of labor use is the main cultivation system of this area. Nowadays agriculture sector is also mostly affected due to lacking of labor. The main reason behind this is the young people are attracted towards foreign countries in search of employment. Which has also affected the production amount and abandon land agriculture system of this Limba VDC.

5.6 Climate Adaptation and Disaster Risk Reduction

Local People of Limba have adopted strategies to reduce the risk associated with climate variability and changes. Different strategies for water and agriculture production are being used. They various strategies to survive in a variable environment throughout history. In the rapidly changing economic, social and environmental contexts, only and sustainable adaptation strategies can ensure a secure lifestyle. Subsistence local peoples have adopted several strategies for coping with climate change and food nutrition insecurity, many of which are unmanageable over the long term. Vulnerable households often respond to food insecurity by missing dinnertimes, harvesting wild plans, reducing food eating, relying on food aid, selling assets such as livestock, and changing sanitation practices.

Landslides, decrease in water sources, occurrence of mosquito, long drought periods, decrease in agriculture productivity, incidence of human, and plant diseases were found to be the major threats to the livelihood of the people. Agriculture is the main source of livelihood. Low productivity of cereal crops, droughts, and loss of water sources has increased food insecurity in these hills. Usual winter rains in Nepal have vanished since last 12 years (Dahal, 2008). Thus, farming has become difficult. Forty eight percent occurring in their communities and 52% do not know the cause of these changes. The main limitations of adapting these strategies are limited resources and knowledge of the local people. New cultivars of crops have been introduced to increase the agriculture productivity. Stalls are constructed to prevent landslides. Local irrigation canals (kulo) are being constructed to irrigate agricultural land in drought periods. Fifty- six percent of the respondents found overcome droughts. Seventy percent productivity of crops. It was observe of new cultivars

and cultivation of cash crops helped people to match climate. Vulnerable households often respond to food insecurity by skipping meals, harvesting wild plants, reducing food intake relying on food aid, selling assets such as livestock and changing sanitation practices (cleaning, showering, and washing less frequently). Coping strategies adopted by people in rural areas. While local women have fewer opportunities to migrate, men often in order to search for employment and lessen the problem on households of feeding one more person. At present food, insecurity and poor harvests have pressed farmers to also explore cash generating activities such as cross- border trade and day labor.

Formulating and implementing integrated programs taking into consideration the objectives and provisions of the conventions related to climate change desertification and biodiversity. Identifying the people, communities, and areas impacted by climate change and implementing adaptation and impact mitigation measures based on local knowledge skills and technologies. The initiative of the local to adapt changing climate and the constraints are listed in table.

Table 10: Impacts of climate change, communities adaptation strategies and constrains

Impacts	Local Adaptation Measure & Constraints
Landslides	<ul style="list-style-type: none"> • Stone walls • Afforestation • Lack of funds and manpower
Food insecurity	<ul style="list-style-type: none"> • Skill development for Alternative income activities • Market facility • Lack of knowledge and resources
Human Disease	<ul style="list-style-type: none"> • Lack of health facilities • Clinic
Drought	<ul style="list-style-type: none"> • Local irrigation canals (Kulo) • Adaptation of drought resistant cultivars • Lack of fund, resources and manpower • Unavailability
Appearance of mosquito, other harmful insects and related diseases	<ul style="list-style-type: none"> • Mosquito nets • Unavailability
	<ul style="list-style-type: none"> • Adaptation of high yielding crop

<p>Decrease in agriculture production</p> <p>Incidence of plant diseases</p>	<p>varieties suitable to changed microclimate</p> <ul style="list-style-type: none"> • Develop skills for alternative livelihood e.g. income generation activities, awareness rising etc. • Cultivation of cash crops • Unavailability of seeds, fertilizer • Lack of relevant knowledge and skills • Local pesticides • Synthetic pesticides • Disease resistant varieties • Lack of Knowledge • Expensive
<p>Incidence of animal diseases</p>	<ul style="list-style-type: none"> • Veterinary facility

Source: Field Service 2014

5.7 Analysis of Perception Parameters

Local people reported climatic conditions have affected third ail activities and their livelihoods. One example given was that invasive species were becoming prevalent and widespread, threatening to dominate the local native species. Moreover, invasive species in agriculture hamper the growth of potatoes and vegetables. The wildflowers were also found to dominate the fodder grasses available for the livestock, which was identified as main reason for shortage of fodder resulting in a reduction of livestock products. For this analysis,

the following perception variables were considered. The household were asked touse the options as strongly agree (score 1), somewhat agree (score 2), Ido not know (score 3), somewhat Disagree (score 4), strongly disagree (score 5) to the following statements.

1. The environment in this village is changing due to human activities.
2. The winter is not becoming too cold.
3. The summer is becoming too hot.
4. The winter period is becoming short.
5. Rainfall is decreasing every year during rainy season.
6. Rainfall is decreasing every year during winter season.
7. The weather is becoming dry every year.
8. The yearly rains are not supporting crop production as before.
9. Climate change has lead to crop infestation and diseases.
10. The cost of food crops are increasing because of climate change.
11. Climate change has lead to the decline of forest resources
12. There is now scarcity of fuel wood
13. The fodder species in the forest is declining
14. The number and types of wild birds in your locality is decreasing.
15. The number and types of wild animals in your locality is decreasing.
16. There have been increase incidences of floods during the rainy season.
17. There have been increase incidences of droughts during the rainy season.

The lower the score, the more they strongly agree score (12) just agree (24) on the above statement strongly disagree (48). The score of more than 48 and equal or below 60 indicates that they do not know or aware about the given statement whiles the score above 36 and equal or below 48 some disagree in case of study area. Strongly agree score 12 and just agree 24 on the above statement. The score of more than 48 and below 60 indicate that they are do not know or aware about the given statement while score above 36 and indicate disagree 48 and strongly disagree 60. Respondent or indigenus people perception score given below table shows. Local people agree on the statement environment in this village is changing due to human activities (statement no.1) and all of the households of the study area strongly agree summer is becoming hot (statement no.3) and disagree rainfall is decreasing every year during winter season (statement no. 6), Strongly agree climate change has lead to crop infestation and disease (statement no.9) , Strongly disagree climate change has lead to decline

forest resources(statement no .11)totally strongly disagree there is now scarcity of feaulwood (statement no.12), agree the fodder species in the forest is declining (statement no 13) and the number of wild birds are decreasing in your locality (statement no 14) on the other hand the households in ward no 4 ,ward no 7 and ward no 8 all respondent strongly agree on the statement there have been increasing incidences of drought during the rainy season and There have been increase incidences of floods during the rainy season. (Statement no 16).

Table 11: Average score of the perception variables by localpeople

Perception parameter statement number	Respondent score
1.The environment in this village is changing due to human activities.	24
2. The winter is not becoming too cold.	36
3. The summer is becoming too hot.	12
4. The winter period is becoming short.	48
5. Rainfall is decreasing every year during rainy season.	12
6. Rainfall is decreasing every year during winter season.	48
7.The weather is becoming dry every year.	48
8. The yearly rains are not supporting crop production as before.	24
9. Climate change has lead to crop infestation and diseases.	12
10. The cost of food crops are increasing because of climate change.	24
11. Climate change has lead to the decline of forest resources	48
12. There is now scarcity of fuel wood	60
13. The fodder species in the forest is declining	24
14. The number and types of wild birds in your locality is decreasing.	12
15. The number and types of wild animals in your locality is decreasing.	24
16. There have been increase incidences of floods during the rainy season.	12
17. There have been increase incidences of droughts during the rainy season.	12

Source: Field Survey, 2014

5.8 Major Issues in Agriculture Related to Climate Change

Increased economic loss: Economic losses are significant and dramatic. Nepalese rupees were lost due to natural disasters an average of nearly 1208 million Nepalese rupees per year. The accompanied indirect losses, in terms of lost time and opportunities, and the lack of services and the effects thereof, may be several times more than the above figure. Limited information is available on the differential impact of these disasters on men and women, youth elderly and people with disabilities.

Loss of agriculture land by flood: In Limba VDC, it has been informed that about some area of agriculture land have been destroyed by river flooding and they became infertile land due to sand deposition.

Loss of road infrastructure by flood and landslides: Basically, in monsoon season downstream section of watershed, road infrastructure was partially damaged by seasonal flood and landslide.

Current handling strategies are scarce (rare): Local communities are already undertaking several local handling strategies. These include changing crops such as growing vegetables instead of grain crops, diversification of enterprises, rain water harvesting and erosion control measures. However, these examples are few in number compared to the vast numbers of population facing climate related uncertainty and impacts. Importantly the poorest and women in particular, are the least able to adapt, lacking the resources to undertaken new activities, the mobility and confidence to seek information and the time and energy to take on more hard labour. The handling strategies are clearly not enough to manage the future expected changes in climate and associated impacts.

Few advantages focus on agriculture: Agriculture being the most vulnerable and highly exposed sector to related impacts, there are few focused interventions on agriculture. Climate change initiatives remain to progress at a slow pace while increasing evidence of climate change related impacts in agriculture remains to grow. Much discussion remains regarding the differentiation of ongoing poverty related impacts with those directly linked to climate change. These national level initiatives are likely to remain into the future, but adaptation is urgent.

Reasons for the losses are attributed to insufficient public awareness, lack or inadequacy in preparedness, lack of coordination among inter-government agencies, inadequate financial resources, low level of technical know-how and skill in mitigation of natural disasters and adaptation to climate change, and a strong concentration of knowledge and skills in academic centers alone, without appropriate information distribution contribute to the vulnerable population groups. Lack of proper land use vulnerabilities. Women are often among the most marginalized people and have limited access to property of land and other resources.

Livestock Rising: To solve the crisis of small magnitude, indigenous, poor rural households have the opinion that loan can be repaired by keeping animals on shared basis which gives some return after a few years. Either when people fall in debt from crop damages due to hailstones, drought, or others or if active members get sick who were supposed to earn money

in such have? To meet the financial requirements for the construction of houses and observe social resources and services, the first option they have is to sell animals and chickens.

Impacts on livelihood: Changing rainfall pattern or variation of rainfall intensity and duration is increasing (Baidhya *et al.*, 2007). The pattern of monsoon is changed into more erratic of short duration with decreased number of rainy days as before. This type of monsoon has increased the frequency of landslide in the hilly region. Deforestation and slope factors are the aid for intense rainfall to create landslide. Local People, those subsistence farmers have limited land, and incomes are impacted more. Marginal or subsistence farmers are those having marginal farmland, typically less productive, small land parcel, and steep topography, un-irrigated and unfertile land or are sharecroppers or landless agriculture labor (Tiwary, 2005). Their production is unpredictable depending upon monsoon for irrigation. If monsoon is favorable, they have production otherwise, their production is hopeless. They have hardly food supply for few months. People have also become landless because of the nature disaster called landslide. This has made the farming unsustainable there because of which people who are landless have become agriculture labors in others farmland and most of them suffered from unsustainable farming have chosen to out migrate for better earning. This out migration is yet another factor for unsustainable farming. Unsustainable farming is clearly a push factor from undeveloped place while opportunities outside are pull factor (Gill, 2003). The good remittance from the abroad and within from the country has led to abandon the agriculture profession because of their improved living standard. They are now able to buy rice and daal instead of the traditional food "dhido". Climate sensitive unsustainable farming affects the livelihood and livelihood impacts back again to farming leaving agriculture more unsustainable.

CHAPTER- VI

SUMMARY, CONCLUSION AND RECOMMENDATION

6.1 SUMMARY

This study was conducted in Limba VDC Panchthar district to find the impacts of climate change on local livelihood of people and the coping strategies to be adapted by the people at local level. The statically analysis of temperature data from 1989-2013 in the Phidim station showed linear trend of increase mostly in the winter period. Over the 24 years examined, rainfall is characterized by large inter annual variability with a substantial decrease in the amount of rainfall were -0.32 mm per year decreasing in study area. Climate change is real and ongoing, so there is a need of impact identification and adaptation to cope with exposures in agricultural sector. The people are more likely to notice changes in the timing of the rains, process of rains and many people are likely to notice a change in the frequency of droughts. Impacts were in loss of kinds, outbreak of diseases and pests, rapid spread by worrying, and emergence of human diseases. Peoples have much knowledge on cultivation techniques and seedling that have likely to apply for climate change adaptation. Although they may not have full reason for all their observations and experiences, they can help advance our understanding of climate change and its diverse impact. Local people also observed that the changes have followed in flowering and maturing of fruits and vegetables and timing of farming. The local people are trying their best to adapt to and cope with those changes through their daily livelihood activities and cultivation practices. They have been changing their agricultural production activities: vaccination, pest, and disease prevention measures and new farming techniques. The higher the local people's awareness on climate change, the higher is the effectiveness and efficiency of prevention and control measures against climate change impacts and natural disasters.

Local people mostly stay in their own area and they do not want to migrate anywhere to save their culture. Due to this reason, they are highly affected by climate change. From my study, we can say that local people have different culture and agriculture system according to altitude. Local People in this VDC are engaged in different occupation. The most vulnerable to climate change are the poor and marginalized who generally are least able to cope with disasters, live in areas most at risk to hazards, and generally have the least information, knowledge, and resources to reduce their risk. Local peoples have noticed drastic changes in weather patterns. Monsoon has become unpredictable, sometimes arriving late and sometimes

arriving early. When late, the rice transplantation is delayed and production decreased. Local Peoples would not have to delay transplantation if there was more water available for irrigation over the last 10 years ago. Localpeoples have also observed that the temperature has gotten warmer. Fruits are now maturing quickly. Rice, wheat maize etc., are maturing 20-30 days earlier. Warmer temperatures often create a more hospitable environment for pest. Farmers have noticed that new types of insects and disease are damaging crops. Someclaimed that the pests have become epidemic, while others did not seem concerned. A few have tried using pesticides, but without much success The predicted impacts of climate change will heighten existing vulnerabilities, inequalities and exposure to hazards and will therefore impact most on those least able to cope. The local peoples receive cash income from both agriculture and non-agriculture sources. The non- agricultural source was the dominant source in all ward VDCs. The horticulture sub sector is an important source of cash income under the agriculture income sources contributing to about 60 percent to the total annual household cash income. The average food self-sufficiency which is defined in terms of number of months the own farm production is sufficient to food the family. The majority of the households head have not perceived the changes in the rising season of crops. Fire hood is major source of fuel wood for all household in all study VDCs. The household of used to collect fire hood and fodder for livestock from both community forest and privet forest but the collection amount from community forest was lesser than privet forest. While for other VDC, the major source of firewood and fodder was community forest at 20 years ago. Leaf litter is major source of organic manure in all study area. Localpeople from community forest and privet forest used to collect leaf litter, fodder firewood. The use of cattle shed and other related purpose in Limba VDC In rainy season, landslide affects water sources, which have impact on irrigation and drinking. Huge landslide at cannel (kulo) road in monsoon season. In rainy days landslide frequently damages agricultural field of Limba VDC some ward and some place affect households.

Quantity of fertilizer used in cultivation has been changed according to the period. Comparatively there is much of manure and chemical fertilizer in the ratio of 20 years. Twenty years ago, they used more compost manure. Similarly, in the case of the wheat, barley and millet is decreasing according survey. However, vegetable potato and other cash crop have increased with the ratio. So comparatively, there is different between increased ratio of fertilizer and chemical fertilizer practice for different crops but one fact is that ratio is increased in comparison to past uses. Still they use do same chemical fertilizer for their crop cultivationbecause increasing production.

Looking at the emerging climate trend based on data analysis and local people's perception on climate change and agriculture system change,unusual rainfall having impacts on agriculture based livelihood system in coming future. There is need therefore to integrate this local knowledge into formal mitigation and adaptation policies. Major issues in agriculture related to climate change.

6.2 CONCLUSION

The changing climate is challenge for both current and future generations. Its impacts are increasing the vulnerability of societies around the world. There was partial awareness, knowledge, and capacity at local level to understand climate change situations, address issues, and conduct long- term planning due to the lack of climate related data of their area. Government should therefore, place priority to install metrological station to provide knowledge to the local people regarding the statistical information about changes in temperature and rainfall in their area. Major part of crop cultivation is rain fed so irrigation investments are required to help farmers to adapt the long and unpredictable droughts. There are noticeable changes in rainfall and temperature pattern. Total annual rainfall is decreasing and the pattern is becoming unpredictable. This is associated with long droughts and disasters such as landslides. Trend of temperature shows an increasing trend in maximum temperature and a decreasing trend in minimum temperature. Introduction of mosquito and diseases of warm regions in the study areas supports the evidence of increase in temperature. Loss of local cultivars of crop, shift in planting time of rice, increased frequency of plant and animal diseases of warm regions, increased frequency of landslides, forest fires and loss of natural biodiversity provide evidence of the changing scenario of the study sites. The findings of this study can be useful for making effective drought, flood and landslide management strategy, policy, plan.

6.3 Recommendations

There is a need impact identification and adaptation to cope with vulnerabilities in agricultural sector. The climate impacts on the livelihood of people's need anapproach to tackle the issues. Based on the findings of the study, the following recommendations and policy measures are suggested, which are follows as:

- Rainwater harvesting uses different technologies to collect and store rainfall in order to chance the demands of people's consumption.

- Develop heat, drought resistant varieties, insect pest resistant varieties and increase mechanism of IPM (Integrated Pest Management).
- Develop cooperation and coordination with neighboring country to cope with vulnerabilities.
- Develop climate- forecasting system for reducing hazards.
- Reduce carbon and water loss from soil.
- To promote climate adaptation, mitigation and carbon sequestration; to mobilize the financial resources and make it accessible for expanding activities in technology development and transfer and capacity building for the formulation, implementation, flow to the grassroots level.
- To make natural resources management climate-friendly for socio-economic development and climate-resilient infrastructure development,
- To increase public awareness, enhance capacity and promote negotiation skills through multi- stakeholder participation.

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APPENDIX I: QUESTIONNAIRE

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Questionnaire for Household Survey
People's Perceptions on Climate Change and Agriculture
A Case Study of Limba VDC in Panchthar District

Survey Site: District; Village: _____ Ward No: _____

Group :-----

Name of householder : Ethnicity: -----

Contact phone Number :-----

Name of interviewee : Contact phone Number:

Name of investigator :-----

Survey date :-----

Questionnaire Number :.....

Name of Checker:-----

A. Family basic situation:

01. How many members does your family have at the beginning of 2014? _____ people

02. From the beginning of 2003 to the end of 2013, is there population change in your family? 1. Yes
2. No

03. The text description about population change of your family

Individual Code	01.	02.	03.	04.	05.	06.	07.	08.	09.	10.
	Gender 1. Male 2. Female	What is your relationship to the household head? Code	Current status of registration 1. Rural 2. Urban 3. No	Physical condition 1. Good 2. General 3. Poor 4. Very poor	Have you any illness?	Age year	Educational level 1. Illiteracy 2. Literate /informal 3. Preschool 4. Primary school 5. Secondary school 6. higher Secondary school 7. college	Have you received technical or professional training 1. Professional training 2. Apprentice 3. 1+2 4. No=» 12	What kind of training you received ? 1. Agricultural machinery 2. Agricultural technology 3. Veterinary 4. Building technology 5. Driving 6. Cooking 7. Tailoring 8. Health personnel 9. Other(Descriptions)	Marital status 1. Married 2. Divorced 3. Widowed 4. Unmarried 5. Remarried
Members of the family	1									
	2									
	3									
	4									
	5									
	6									
	7									

B. Resident information

01. How many houses do you
have?
2. Are you sharing it with others?
1.Yes; 2.No
3. What is your housing
condition?
1. Thatched cottage; 2. Mud
house; 3. Wood house , 4. Brick
house; 5. Other (descriptions)
4. The Homestead area m²
The housing aream²
5. How long has the house being
built or bought ? _____year
6. How much money did you pay
for building or buying this
house?rupee
7. Did it renovate or maintain
from 2003 to 2013
(1.Yes , 2.No)
8. How much money does the
house cost now?rupee
- 9 How far is your house to the nearest marketkm/hours
10. How far is your house to the nearest hospital _____km
11. How far is your house to the nearest school _____km
12. How far is your house to the nearest sources of drinking water _____km
13. Is there a road near yours house (1Yes ; 2.No) _____
14. What is your mode of transportation (1. Motorcycle, 2. Automobile, 3. walk) _____
15. Road types (1.Cement pavement 2.Gravel)
16. Whether access to electricity (1. Yes, 2. No) _____ If yes how many hours:
17. Is there piped water for drink? (1. Yes, 2 No)
If 1, then When did you build pipe system?
How much you spend on piped water.
18. The financial sources of building piped water are from (1. Remit; 2. Sale of agricultural products; 3 Sale of
livestock; 4 other sources.)
19. Do you have planned to build piped water? (1. Yes, 2 No)
20. Did you face water scarcity in past decade?
21. Is the water of the piped enough? (1. Yes, 2 No)
22. Do you have any plan for piped water? (1. Yes, 2 No)

23 Where do you wash clothes every day?
 (1. At home; 2. At the wells; 3. At the stream; 4. At the river; 5, Other)

24. If no piped water and well, then the distance of bringing drinking water to your home.

and 10 years ago, the distance was .km.

25. In drought season, how many hours a day are spent to bring drinking water?

C. The input of agricultural land (Totals)

		04	05	06	07	08		
		Inputs factors (2013)	Units (kg/ Package)	How many do you buy in 2013		Price /Unit	Before 20 years	Remarks
				Quantity	Weight/ kg			
A	Seeds and seeding (Code)							
b	Chemical fertilizers (Code)							
C	Mulch film							
D	Pesticides							
E	Herbicides							
F	Manure							

Fertilizer code : 1-Compound Fertilizer ; 2-Highly effective compound fertilizer ; 3-Phosphate fertilizer ; 4-Nitrogen fertilizers; 5-urea ; 6-Potash ; 7-Others

01. When did you start to use chemical fertilizer?

02. When did you start to use mulch film?

03. The money to buy Chemical fertilizer, herbicide, pesticide, and mulch film are from:

- 1. Remit; 2. Sale of agricultural product, 3. Sale of livestock, 4. Borrow money, 5 .Other

04. Buy maize seeds or produce/choose seeds?

- 1. Buy seeds from the market. 2. Produce/choose seeds by myself. 3 Other.

05. Buy rice seeds or produce/choose seeds?

- 1. Buy seeds from the market. 2. Produce/choose seeds by myself. 3 Other.

06. Buy wheat seeds or produce/choose seeds?

- 1. Buy seeds from the market. 2. Produce/choose seeds by myself. 3 Other.

07. Buy millet seeds or produce/choose seeds?

- 1. Buy seeds from the market. 2. Produce/choose seeds by myself. 3 Other.

08. Buy vegetable seeds or produce/choose seeds?

- 1. Buy seeds from the market. 2. Produce/choose seeds by myself. 3 Other

9. Do you ever receive subsidies from the government to buy chemical fertilizer, seeds, mulch film, pesticides, and herbicides?

- 1. Yes; 2, No.

D. Reason of Increase and Decrease Regarding the Production and Cropped Area.

S.No	Crop	Reason of Increase		Reason of Decrease	
		Area	Production	Area	Production
1					
2					
3					
4					
5					
6					

E. Calendar of Activities:

a) Agriculture (calendar or cropping pattern)

Do you wait for rain for sowing?

.....

Do you have enough water?

.....

1. 20 Years Ago Cropping Calendar

F= Field preparation
H= harvesting

S = Seeding

T = Transplantation,

W= Weeding

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Crops												
Summer paddy												
Winter paddy												
Summer maize												
Winter maize												
Wheat												
Millet												
Mustard												
Potato												

Others												

2. Present Major Crops Grown, its Calendar and Change in Crop and Cropping Calendar:

F= Field preparation

S = Seeding

T = Transplantation,

W= Weeding

H= harvesting

	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Crops												
Summer paddy												
Winter paddy												
Summer maize												
Winter maize												
Wheat												
Millet												
Mustard												
Potato												
Others												

F. Sources of Family Annual Income (Last year):

S.N.	Sources	Annual income in Rs.	past
1	Agriculture		
2	Horticulture and Vegetables		
3	Live Stock		
4	Service		
5	Remittances		
6	Cottage industry		
7	Pensions		
8	Other sources		

G. Household Consumption Expenditure and Others forms Expenditure:

S. N	Forms of expenditure	The amount of expenditure (Rupee)
A	Daily spending (clothes, food)	
B	Medical expenses	
C	Children education expenses	
D	Fuel/energy	
E	Treat or gift	
F	Catering expenses, such as birthdays, wedding ceremony, funeral and so on	
G	Others	

H.1 Household Energy Consumption/ 20 yearsago:

	01	02	03	04	05	06
	Fuelwood	Straw	Coal	Liquefied gas	Biogas	Electric
	Kg/ Bhari	Kg/Bhari	kg	Tank	m ³	kw.h ⁻¹
The year of 2013						

H.2 Household Energy Consumption/Present:

	01	02	03	04	05	06

	Fuelwood	Straw	Coal	Liquefied gas	Biogas	Electric
	Kg/ Bhari	Kg/Bhari	kg	Tank	m ³	kw.h ⁻¹
The year of 2013						

I. The Forms of Loans and Borrowing:

01	02	03	04	05
Did you get loan in 2013?	The form of loan	The reason of loan	Whether or not need mortgage	The mortgaged property
1. Yes 2. No	1. Private loan (High interest rates) 2. Private loan (low interest rates) 3. Private loan (no interest rates) 4. Bank loan	1. To purchase production factors 2. Family suffered the accident 3. Doing business 4. Other	1. Yes 2. No	1. House(s) 2. land 3. Other

J. Other Livelihood Actions/past:

01	02	03	04	05	06	07	08
The source of fuelwood? 1. From own land 2. From common land; 3. Buy	How many hours spent to collect fuelwood? Hours	How many days in collecting fuel wood in a year days	The distance of collecting firewood in 2013 km	The weight of fuel wood collected in 2013 kg	The weight of fuel wood collected in 2003 kg	Ever facing fuel wood shortage 1. Yes. 2. No	Strategies to solve fuelwood shortage?
01	02	03	04	05	06	07	08
The source of fodder? 1. From own land; 2. From common	How many hours spent to collect fodder?	How many days in collecting fuel wood in a year	The distance of collecting fodder in 2013	The weight of fodder collection in 2013	The weight of fodder collection in 2003	Ever facing fodder shortage 1. Yes. 2. No	Strategies to solve fodder shortage?

land;			km	kg	kg		
3. Buy		days					

K. Local Perception of Climate Change:

01	02	03	04	Negative effects of climate change					
				On staple crops	On vegetation	On livestock	On orchard	On health	Disaster
Are you aware of the climate change in recent decades?	When are you obviously aware of climate change? Date	How do you know about climate change? 1.yourself 2.TV 3.Broadcast 4.Newspaper 5Network 6other people 7 other way	Positive effects of climate change 1. Long growing season 2. 3.	1. More rodents and pests 2. Reduced yield 3. Relying on irrigation 4. Land abandonment 5. Increasing input costs 6. Collapse of terracing land; 7. Other ()	1. More rodents and pests 2. Reduced yield 3. Relying on irrigation 4. Land abandonment 5. Increasing input costs 6. Collapse of terracing land 7. Other ()	1. More disease; 2.livestock loss 3. More time to get fodder	1. More rodents and pests. 2. Reduced yield. 3. Trees drying up	1. More disease 2.Sanitation 3.Famine	1. Drought 2. Landslide 3. Floods 4. Wash out roads and bridges
1.Yes 2.No									

L. The adaptation strategies of climate change

01. Your adaptation strategies follow directions of:	02 Staple food	03 Vegetation	04 Livestock	05 Orchard	06 Livelihood strategies	07 Restricted factors of livelihood change	08 Who will you tend to ask for help during disasters?	09 Which means of help do you need from government?
1. Government 2. Community 3. Media 4. Self-decision	1. Change crop varieties 2. Change planting time 3. Change from rice to millet; 4. Increasing agricultural input 5. Irrigation 6. Using new technology 7. Other ()	1. Change varieties 2. Change planting time 3. Using pumped water 4. More fertilizer 5. Other()	1. Reduce livestock number 2. Increase livestock number 2. Buy fodder	1. Irrigation 2. Change varieties	1. Extension. (Buy/rent more cropland;) 2. Intensification (Input more labor, fertilizer, pesticide, buy tractor) 3. Diversification (Do small business) 4. Migration (labor migration)	1. Lack of money 2. lack of technology 3. Lack of water resources 4. Poor infrastructure 5. Lack of labour 6. Other ()	1. Local government 2. Communities 3. Relatives or friends 4. NGOs 5. The Buddha 6. Other	1. Subsidies 2. Loan 3. Road 4. Piped water. 5. Well 6. Irrigation system. 7. Hospital 8. Other ()

M. Analysis of Perception Parameters:

For this analysis, the following perception variables were considered. The household were asked to use the options as strongly agree (score 1), somewhat agree (score 2), I don't know (score 3), somewhat Disagree (score 4), strongly disagree (score 5) to the following statements.

1. The environment in this village is changing due to human activities.
2. The winter is not becoming too cold.
3. The summer is becoming too hot.
4. The winter period is becoming short.
5. Rainfall is decreasing every year during rainy season.
6. Rainfall is decreasing every year during winter season.
7. The weather is becoming dry every year.
8. The yearly rains are not supporting crop production as before.
9. Climate change has led to crop infestation and diseases.
10. The cost of food crops are increasing because of climate change.
11. Climate change has led to the decline of forest resources
12. There is now scarcity of fuel wood
13. The fodder species in the forest is declining
14. The number and types of wild birds in your locality is decreasing.
15. The number and types of wild animals in your locality is decreasing.
16. There have been increase incidences of floods during the rainy season.
17. There have been increase incidences of droughts during the rainy season.

