Understanding indigenous people's perception on Climate Change Impact on Floral and Faunal species in the Kanchenjunga-Singalila Complex, Eastern Nepal

Research Report

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We strongly believe that findings and recommendations made in this study report will be useful to all level of stakeholders working in different sectors to formulate strategies and support and empower the communities to build their capacity for climate change adaptation and mitigate its negative impacts on their livelihoods and bio-diversity conservation.

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List Of Acronyms

CF	Community Forest
CFUG/s	Community Forest Users Group/s
CEPF	Critical Ecosystem partnership Fund
FUG/s	Forest Users Group/s
GF	Government Forest
IPCC	Inter Governmental Panel For Climate Change
KIS	Key Informant Survey
NGO/s	Non-Governmental Organization/s
NARC	National Agriculture Resource Council
NTFP/s	Non Timber Forest Product/s
PF	Private Forest
PRA	Participatory Rural Appraisal
VDC/s	Village Development Committee/s

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Executive Summary

In the recent years, there has been extensive interest in measuring the impacts of climate change biodiversity. However, there are very little empirical research and studies in Nepal. Peoples themselves are one of the best relevant sources of information to study climatic changes as they can provide long term climatic signals. Indigenous people have been experiencing the phenomenon of climate change making reference to various living organisms. They have been realizing the changes in different activities and qualitative aspects than normal in various biological resources surrounding them. This study in general aims to examine the ways by which indigenous people perceive climate change on natural resources, assess the effect of climatic parameters on livelihood of the people and identify indigenous peoples' adaptation and mitigation strategies in Eastern Himalayan region of Nepal. This study utilizes both primary and secondary data and information. In order to collect primary information, 4 VDCs were purposively selected representing in two districts. Around 208 households representing different ethnic communities were selected and interviewed by using the structured questionnaires. In addition, PRA and KIS techniques were also adopted. This study examines the indigenous peoples' perception of climate change impacts on flora and fauna, assess the livelihood impact and document the adaptation and mitigation strategies in Eastern Himalayan region of Nepal.

CHAPTER I

1 Introduction

1.1 Background

The climate change has become a serious issue among scientists, countries, governments, I/NGOs, and community based organizations due to the abrupt changes occurring everywhere. The global average surface temperature has increased by about 0.6ºC during the twentieth century (IPCC, 2001a,). Much of this change has been attributed to increasing concentration of green house gases such as CO_2 produced by human activities. Many analyses show that the temperature increase in the twentieth century has been greater than in any other century during the past 1000 years (ibid). The 1990s was the warmest decade of the millennium and 1998 was the warmest year on record (IPCC, 2001a,). Natural and human systems are expected to be exposed to direct effects of climatic variations such as changes in temperature and precipitation variability, as well as frequency and magnitude of extreme weather events. Similarly, there are indirect effects of climate change such as sea level rise, soil moisture changes, changes in land and water conditions, changes in the frequency of fire and changes in the distribution of vector-borne diseases (ibid).

Studies show that developing countries are more vulnerable to climate change and are expected to suffer more from the adverse climatic impacts than the developed countries (IPCC, 2001a,). In a humid climate like that of Nepal, there will be changes in the spatial and temporal distribution of temperature and precipitation due to climate change, which in turn will increase both the intensity and frequency of extreme events like droughts and floods (Mahtab, 1992). Increases in temperature result in a reduced growing season and a decline in productivity, particularly in South Asia (Pachauri, 1992). A warming climate would increase water demand on the one hand and would decrease river flows on the other. Reduced river flows will affect the hydro power generation, inland water transport and aquatic ecosystem. Similarly, reduced water availability may create conflicts between water users within and among nations (ibid).

The major rivers of Nepal are fed by melt-water from over three thousand glaciers scattered throughout the Nepal Himalayas. These rivers feed irrigation systems, agro-processing mills and hydroelectric plants and supply drinking water for villages for thousands of kilometers downstream (Agrawala et al., 2003). Climate change will contribute to increased variability of river runoff due to changes in timing and intensity of precipitation as well as melting of glaciers. Runoff will initially increase as glaciers melt, then decrease later as de-glaciations progresses (ibid).

Indigenous Peoples who are vital and active parts of many ecosystems may help to enhance the resilience of these ecosystems. Their livelihoods depend on natural resources that are directly affected by climate change, and they often inhabit economically and politically marginal areas in diverse, but fragile ecosystems. In addition, they interpret and react to climate change impacts in creative ways, drawing on traditional knowledge as well as new technologies to find solutions, which may help society at large to cope with the impending changes (Jan and Anja, 2007).

1.2 Rationale of the Research Work

Himalayan country like Nepal is most prone to climate change. The poor people are more vulnerable to climatic extremes as well as gradual changes in climate than the rich because they have less protection, less reserves, fewer alternatives and a lower adaptive capacity and because they are more reliant on primary production (IPCC, 2001b,;AfDB et al., 2003,).

Climate change may alter rainfall and snowfall patterns. The incidence of extreme weather events such as droughts, storms, floods and avalanches is expected to increase. This can lead to loss of lives and severely reduce agricultural production (IPCC, 1998). Traditional wisdom and knowledge to cope with such natural hazards that once ensured food security may no longer prove effective (Jenny and Egal, 2002). Climate-induced natural hazards have very serious human implications because they affect the livelihood security of the majority of the population (Swaminathan, 2002,). About 29% of the total annual deaths of people and 43% of the total loss of properties from all different disasters in Nepal are caused by water-induced disasters like floods, landslides and avalanches (Khanal, 2005,).

Lack of long-term instrumental climatic data is one of the major problems of studying climate change and its impact in Nepal. Peoples themselves are one of the best relevant sources of information to study climatic changes as they can provide long term climatic signals. Indigenous people have been experiencing the phenomenon of climate change making reference to various living organisms. They have been realizing the changes in different activities and qualitative aspects than normal in various biological resources surrounding them. Their experiences and realization of change in climate with respect to the change in behavior of bio-resources need to be studied in order to understand the exact change pattern of the climate, its effect on the biological resources (floral and faunal species) and to develop the various mitigation and adaptation measures.

1.3 Objectives

The general objective of this study is to understand the indigenous peoples' perception of climate change impacts on flora and fauna in Eastern Himalayan region of Nepal. The specific objectives are:

- To examine the ways by which indigenous people perceive climate change on natural resources (wildlife, birds, plants, agricultural crops/commodities, water resources);
- To assess the effect of climatic parameters on livelihood of the people (availability of food, fuel wood, fodder, water etc.); and
- To identify indigenous peoples' adaptation and mitigation strategies.

2 Geographical Area

The North Eastern part of Ilam and Panchthar is a trans-border area which falls on the important biological corridor in Kanchenjunga-Singalila Complex and also in the Eastern Himalaya. This is one of the globally identified hotspots of biodiversity. The area is unique in its topographic features and richness in terms of flora and fauna. Its north and south slopes are the Nepalese extension of the Singalila range, which forms the eastern border of Nepal and India. The existing forest provides habitat for different flora and fauna that are important from conservation point of view. It is one of the major corridors for wildlife movement forming a globally important

biological corridor. The people of the area are rich in culture and religions and are of mixed ethnic groups consisting of Rai, Limbu, Sherpa, Gurung, Thami, and Lepcha. The Rai and Limbu call themselves as the worshipper of nature, viz they live close to nature. They worship river, rocks, water sources, animals, birds etc. and are very essential for their food, agriculture, livelihood and cultural activities.

3 Relationship with the Eastern Himalayas Ecosystem profile and strategic direction 4

The proposed research work will be conducted in the Kanchenjung-Singalila Complex which falls under the eastern Himalayas which is identified as priority landscape of CEPF. The proposed research work address on climate change issues, adaptation and mitigation together with the perceptions of indigenous people residing in the landscape. The people of the area are rich in culture and religions and are of mixed ethnic communities, who live in close relation with the nature and gifts of nature. Indigenous peoples themselves are one of the best relevant sources of information to study climate changes. The understanding of climate change by these people and their experiences need to be studied to better understand the climate change and its impact to develop a long term mitigation and adaptation measures. The project has been developed in line with CEPF Strategic Direction 4 and investment priorities 4.2 of the Strategic direction.

CHAPTER II

1. Review of Literature

1.1. Climate and Agriculture in Nepal

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.

Nepal experiences the seasonal summer monsoon rainfall from June to September. Most of the days during June to September are cloudy and rainy. Heavy incessant rains and periods of dry spells are not uncommon during these months. About 80 % of the annual precipitation in the country falls between June and September under the influence of the summer monsoon circulation system. The amount of precipitation varies considerably from place to place because of the non-uniform rugged terrain. However, the amount of summer monsoon rains generally declines from southeast to northwest. Although the success of farming or crop harvest is almost fully dependent on the timely arrival of the summer monsoon, it periodically causes problems such as landslides, subsequent losses of human lives and farmlands, loss of other infrastructures (not to mention great difficulty in the movement of goods and people) and large scale flooding in the plains. Conversely, when prolonged breaks in the summer monsoon occur, severe drought and famine often result. The winter months December to February are relatively dry with clear skies. However, few spells of rain do occur during these months.

The winter rain decreases in amount from northwest to both southward and eastward direction. During April to May the country experiences pre-monsoon thundershower activities. The pre-monsoon rainfall activities are more frequent in the hilly regions than in the southern plains. The period of October and November is considered as a post monsoon season and a transition from summer to winter. During October the country receives a few spells of post-monsoon thundershowers, similar in character to the pre-monsoon ones. The annual mean precipitation is around 1800 mm in Nepal. But owing to the great variations in the topography, it ranges from

more than 5000 mm along the southern slopes of the Annapurna range in the central Nepal to less than 250 mm in the north central portion near the Tibetan plateau. The onset of the monsoon in early June checks the increase in daily temperature over the country. Therefore, the maximum temperature of the year occurs in May or early June. Temperature starts decreasing rapidly from October and reaches the minimum of the year in December or January. Although normally the temperature decreases with height, there are also spatial variations in temperature in Nepal influenced by topography. Terai belt is the hottest part of the country, where the extreme maximum temperature reaches more than 45º C. The highest temperature ever recorded in the kingdom was 46.4º C observed in Dhangadhi, a town in far western Terai, in June 1995.

There has been twelve warmest years since 1975 to 2007 (eg. 2006 was 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 agri- land were 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 (Source: NARC annual reports from 1987/88 to 1997/98,).

Fig.1 shows the trend of average maximum temperature in Nepal, and that warming was higher than average in more than 12 years. Nepal's temperature has increased by 1.8^0C during last 32 years. In Nepal average temperature increase was recorded as 0.06^0C per year and that in Terai and Himalayas was 0.04^0C and 0.08^0C/year respectively (Shrestha et al., 1999). It may be due to solar radiation absorbed by glacial lakes as well as radiation absorbed by land because of snow melting in the Himalayan region.

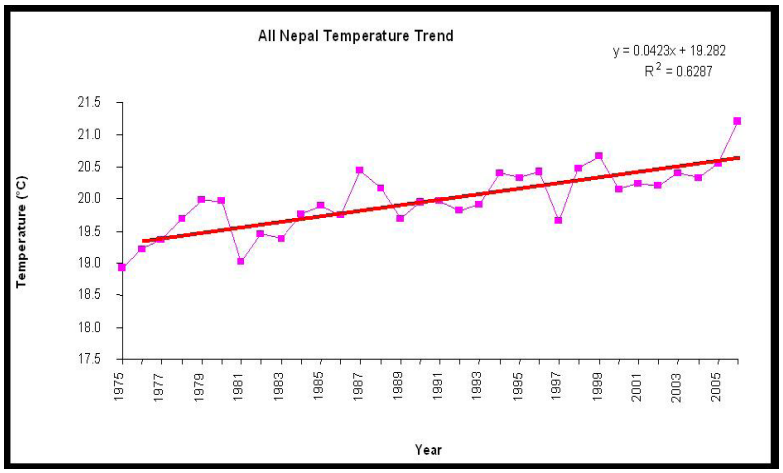

Figure 1: Trend of average annual maximum temperature of Nepal (Source: Baidva and Karmacharva. 2007)

Fig.2 shows the trend of average rainfall in Nepal. It shows more erratic pattern of precipitation in the country. Rainfall was recorded minimum in the year 1972, 1977, 1992 and 2005 and maximum in the year 1975, 1985 and 1998 respectively. Erratic rainfall events (i.e. higher intensity of rains but less number of rainy days and unusual rain) with no decrease in total amount of annual precipitation have been experienced. Such events increase possibility of climatic extremes like irregular monsoon pattern, droughts and floods. For example, there were rain deficit in Eastern Terai and western regions, normal rain in far western region and heavy rain in the mid western region creating flood, landslide and inundation.

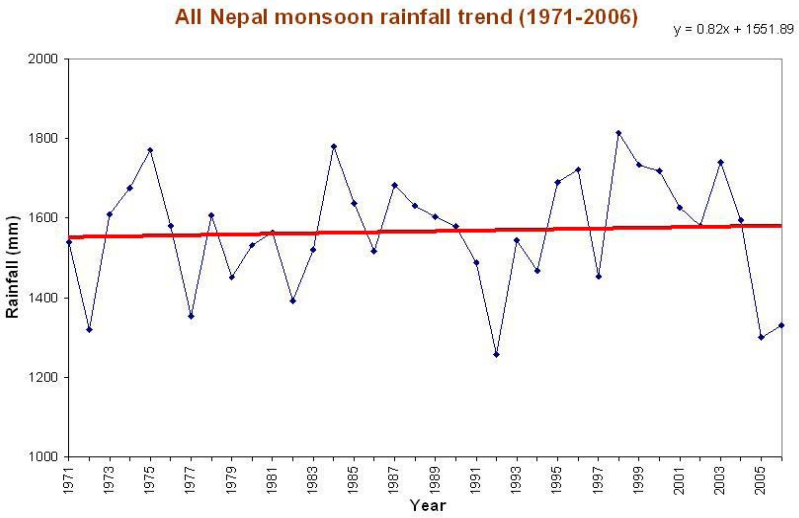

Figure 2: Trend of total precipitation (Source: Baidya and Karmacharya, 2007)

1.2. Indigenous People and Climate Change

Indigenous knowledge is a powerful asset and social capital in many countries of Asia and the Pacific, which are vulnerable to climate change. Indigenous knowledge is dynamic in the sense that people continue to generate new local knowledge on various coping strategies. Indigenous coping strategies resemble scientific methods in their reliance on systematic observation of natural phenomena. Indeed, many indigenous coping strategies which were once considered primitive and misguided are now seen as appropriate and sophisticated (Chambers, 1983). Indigenous coping measures tightly link local knowledge, social responsibility and equity. Integration of such knowledge in adaptation plans can, therefore, address broader social concerns more effectively. Both Indigenous knowledge and climate change adaptation are multi-level and multi-sector endeavors. The adaptation options and strategies that we design must be, therefore, both proactive and reactive, relying on local experimentation and innovation, and community involvement.

Understanding local culture models and indigenous knowledge is essential for effectively communicating new strategies on climate change adaptation. Moreover, indigenous communication channels increase the rate of dissemination and utilization of adaptation strategies, as they provide mechanisms for facilitating understanding and communication. The concept of integrating local knowledge in climate change adaptation plans fits well in the framework of sustainable development with 3E criteria– (environmentally sound, socially equitable, and economically efficient).

1.3. Indigenous People, Biodiversity and Climate Change

Indigenous peoples universally use biodiversity as a buffer against variation, change, and catastrophe. Indigenous peoples have been using biodiversity over space and time, among species and varieties, in forests and agriculture, from landscape to genetic levels. Biodiversity is central to indigenous environmental management and livelihoods. Biodiversity is especially important among indigenous societies living on the margins of fragile and changing ecological, economic, and political systems.

During human history, climate change, societal change and biodiversity have been closely linked. We focus on the development of agriculture as a major human advance, but setbacks – such as loss of crop biodiversity, both domesticated species and landraces – are equally salient

features in human history. Today, we see many links between global warming and biodiversity. Climate change is greatest at high elevations and simultaneously biodiversity is among the highest on earth.

Indigenous peoples are fighting loss of biodiversity and adapting to climate change through migration, irrigation, water conservation techniques, land reclamation, changing where and at what elevation plants are cultivated, livelihood adaptation and myriads of other techniques. Nonetheless, as climate change threatens biodiversity, it simultaneously removes the major defense that indigenous people have against variation and change. Their primary tool for adaptation is at risk.

1.4. Indigenous Peoples observe climate change

While climate models can paint the bigger picture of climate change and provide estimates for the likely consequences of different future scenarios of human development, they are not very good at providing information about changes at the local level. In recent years, there has been an increasing realization that indigenous groups are a valuable source of this information. Most published reports on indigenous observations of climate changes have come from Arctic regions where the co-operation between scientists and indigenous peoples is strongest. However, as the symposium amply demonstrated, it is not only in the Arctic where indigenous peoples are observing climate changes. From the British Columbian coast to the Kalahari Desert to the English countryside and to the Himalayan Mountains, local people are noticing changes in climatic conditions which include like temperature change, change in rainfall and snow, change in season and phenology, change in wind/waves/storms, variation in years, changes in glaciers, snow cover, ice and species variations.

1.5. Indigenous Peoples adapt to climate change

Indigenous peoples are not only keen observers of climate changes but are also actively trying to adapt to the changing conditions. Some of the strategies that people apply for adapting to climate change include diversifying resource base, change in varieties and species, change in timing of activities, Change in technology, Change of location, change in resources and/or life style, exchange of resources and management.

1.6. Indigenous Peoples interpret climate change

Scientific explanations of climatic changes have mainly concentrated on anthropogenic and greenhouse gas emissions without giving much interest on local interpretations of observed climate changes. Whether or not scientific models are incorporated into local explanations depends on the status and accessibility of science within a culture and on the influence of media.

Many local interpretations contain strong ethical elements, often framed in terms of a cosmological or spiritual balance, which has been upset. These interpretations are not created ad hoc to explain present-day climate changes, but have in many instances their roots in traditional ways of interpreting climatic and weather phenomena as signs of something more than mere biophysical processes.

Many traditional peoples see climate change as having spiritual and social causes, there are also inverse examples of climate changes being perceived as a threat to local deities and spiritual powers. Local views of climate changes are characteristically interwoven with other environmental and societal problems. One example is proposed oil and gas drilling and tanker traffic along the north coast of British Columbia that the Gitga'at and other local communities resist because of concerns over both pollution and climate change.

In general, local interpretations of climate change may help people better make sense of observed climate changes, but do not necessarily empower them to act. This is especially the case where climate change threatens landscape features of spiritual value, or where the culprits of climate change are perceived to be outsiders.

CHAPTERIII

1 Study Methodology and Analysis

1.1. Data sources

This study was conducted in the 5 Village Development Committees of Ilam and Panchthar districts of Eastern Nepal. These sites comprise of indigenous groups like Rai, Limbu, Sherpa, Sunuwar, Gurung and Lepcha whose livelihood, culture, religious rites and traditions are closely associated with natural resources. This study has used both primary and secondary data and information. The secondary sources consist of published and unpublished reports at national, district and village level related to production of crops, livelihood, community forestry etc.

1.2. Research design

The study is both explorative and structure survey type in nature. Data obtained form household survey, group discussion; key informants interview and the secondary sources have been used for analysis and interpretation. The information was explored from the related institutions at different levels.

- **From District level agencies:** It consists of getting information from District Forest Office, District Development Committee, NGO/s business/trade communities.
- **Key informants survey (KIS):** It consists of key persons at the district level government and non-government agencies, village chiefs, members of the FUG(s) at the village level and related ones.
- **Rapid Rural appraisal method:** This technique was used to collect additional information. Well experienced persons aware of the local situation for long time were requested to for information. Besides, topography, land use system, resource management practices adopted by the people was observed during the field survey.
- **Field Reconnaissance Study:** To develop initial understanding about the study area and be familiar with villagers, a reconnaissance study was performed. The researcher visited District Forest Office, District Agriculture Development Office, VDCs' Office and District NGOs to share the idea with each other in order to avoid any kinds of misunderstanding during the interview with the respondents. Such discussions were very useful and important for the field surveys and build trust with the villagers.

1.3. Sample size

This is an exploratory type of research. The purposive sampling was conducted in the VDCs situated within the Kanchenjunga Singhalila Complex. In order to meet the study objective, 5 VDCs from two districts namely Panchthar and Ilam were purposively selected representing ethnic communities. In order to collect primary information, those household whose livelihood are closely associated with natural resources and closed to community forestry area were selected for interview. For the questionnaire survey, 30 households from Prangbung VDCs of panchthar district and 25 households from Puwamajhuwa VDC for Sunuwar community, 50 households from Maimajhuwa VDC for Rai community, 50 households from Mabu VDC for Sherpa and Gurung each, 28 and 25 household for lepche and Thami community respectively from Jogmai VDC of Ilam District were interviewed by using the structured questionnaire totaling a sample size of 208. 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 and snowfall amount and time of rainfall, seasonal change in temperature and their effect on the time of planting and yield and the adaptation strategy if any were collected.

1.4. Analytical techniques

The descriptive analysis of the collected information and data has been carried out. This is in the form of tabular and writes up form. Separate analysis has been done for each VDCs. 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 Ilam tea estate of Ilam district was analyzed from 1976-2007. A correlation analysis was also carried out to see the relationship of the rainfall and temperature on the production of maize and millet in Ilam.

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

$y = a\, b^t$ or taking natural log it can be written as

$\ln y = \ln a + t \ln b$

where,

y = dependent variable i.e. temperature, precipitation

a = intercept term

t = time period as 1976 =1; 1977 = 2 …

1.5. The research question

The research questions to be answered by this study are

- What parameters determine the climate change?
- How much is the effect of climatic parameters on the availability of wild flora and fauna?
- What is the effect of climate change parameters on food availability?
- How do Indigenous people perceive climate change impacts with reference to flora and fauna?

1.6. Study area description

The North Eastern part of Ilam and Panchthar is a trans-border area which falls on the important biological corridor in Kanchenjunga-Singalila Complex and also in the Eastern Himalaya. This is one of the globally identified hotspots of biodiversity. The area is unique in its topographic features and richness in terms of flora and fauna. Its north and south slopes are the Nepalese extension of the Singalila range, which forms the eastern border of Nepal and India. The existing forest provides habitat for different flora and fauna that are important from conservation point of view. It is one of the major corridors for wildlife movement forming a globally important biological corridor. The people of the area are rich in culture and religions and are of mixed ethnic groups consisting of Rai, Limbu, Sherpa, Gurung, Thami, and Lepcha. The Rai and Limbu call themselves as the worshipper of nature, viz they live close to nature. They worship river, rocks, water sources, animals, birds etc. and are very essential for their food, agriculture, livelihood and cultural activities.

1.6.1. Physical features

The landscape surrounding Mt Kanchenjunga spreads over a wide spectrum of ecological zones in the Himalayas area of eastern Nepal, Darjeeling and Sikkim in India, and western Bhutan. There are 12 important protected areas within Kanchenjunga landscape covering about 10,000 sq. km: the Kanchenjunga Biosphere Reserve (2192 sq. km) together with five other wildlife sanctuaries in Sikkim, India; the Singhalila National Park, Senchel Wildlife sanctuary, Mahendra

Wildlife Sanctuary and Neora Valley National Park in Darjeeling, India; the Kanchenjunga Conservation Area in Nepal and Toorsa Strict Nature Reserve that connects with Jigmi Dorji National Park in western Bhutan. The area is part of one of the 34 Biodiversity Hotspots in the world.

1.6.2. Climate

The climate of this district as a whole is dry & cold in winter and hot & rainy in summer.

1.6.3. Flora & Fauna

Due to diverse habitat, the area is very much rich in flora and fauna. The presence of at least 2500 flowering plant species has been reported by Shrestha. The same author reported 15 species of endemic plants, 24 species of Rhododendron and high presence of legume species (up to 60 species) within a short collection. Medicinal plants such as *Swertia chirata, Picrorhiza kurooa, Dactylorhiza hatagirea , Berginia ciliata* and other various herbs are also reported. Other high value plants include *Arundinaria Species, Rubia manjith* and *Daphne Speices*. Along with these, 5 threatened plant species, 5 rare and 1 endangered species are also available in this area. Among the fauna, the recorded species are Red Panda, Himalayan yellow throated martin, jungle cat, Himalayan mouse – hare, Blue sheep, Snow leopard etc. Carpenter, Ghimire and Brown recorded over 52 species of Avifauna from the area. Some notable bird species recorded in the area are Allied Warbler, Blood Pheasant, Crossbill, Golden Breasted Tit, Babbler, Kalij, Pheasant, Snow pigeon, Tibetan Snow Cock, Steppe Eagle, Golden Eagle, Bearded Vulture, Velvet fronted Nuthatch and others.

1.6.4. Culture and inhabitants

Lepchas and Limbus, the indigenous tribal people have special identity in terms of their culture. Beside these, other tribal cultures have also been preserved. Different festivals of the tribes that fall in various seasons are celebrated enthusiastically and with great zeal. The main festival observed here are the Hindu Festival, Lepchas' New year, Limbus' festival etc. Dhan nach is famous for all Limbus family. Nowdays this dance is performed during every feast and festival during the full noon day in kartik (Oct-Nov.), in Maipokhari during Kartik Ekeadashi (11th day

of moon in kartik) and also during Ropain jaatra. Chyabrung dance specially takes place during religious festival and weeding ceremonies and is very famous amongst the limbus' community. Lakhe naach is also popular among the Newars community; most people participate in this dance. This festival starts with the Naag Panchami and lasts till Krishana astami in August. Ropai jatra is performed on the following market day immediately after the Gaai jatra .This dance takes please in Ilam, Fikkal and Mangalebare.

Chandi naach is in vogue especially amongst the Rais' family. After addressing their gods and goddesses, they dance in a queue with Chamer(tail of yak used to fan god) in their hands synchronizing with the rhythm of drum and Jhyamta (a musical instruments).The dance which takes place during spring season(Udhali and Ubhali) also take place during special occasions now days. Like wise Maruni dance and sarangi dance are also famous in the eastern region.

1.6.5. Vegetation

Duet to diverse topography, altitude and aspects the area exhibits different types of vegetations ranging from subtropical, temperate, sub-alpine to alpine. The area represents all the vegetation found in Nepal. Subtropical vegetation in the lower mid-hills to alpine grasslands in the high hills and mountains. Major vegetation found on the area include sub-tropical hill Sal forest subtropical evergreen to semi evergreen forests, Alnus forest, Castanopsis, *Schima wallichii*, Oak laural forest, *Quercus lamellose* forest, *Quercus semicarpifolia* forest, mixed broadleaved forest, *Tsuga demosa* forest, *Abies spectabilis* forest, *Larix griffithiana* forest, *Juniper indica* forest, Rhododendron forest, *Betula utilis* forest, Alpine shrubs and Alpine pastures.

CHAPTER IV

1 Result and Discussion

1.7. Analysis of hydrological and meteorological information

The analysis showed that there has been 0.055^0c (i.e 0.91% per annum increase in the temperature of January) per annum increases in temperature of Ilam district between the years 1976-2007. The highest and lowest recorded maximum temperature for January during this period was 19^0c and 14.2^0c in 1999 and 1978, respectively. Similarly, there has been 0.071% per annum increase in temperature in the month of July between1976-2007. The average rainfall in the month of January between1976-2007 is 11.89 mm while this has been 464.64 mm in the month of July.

The correlation analysis between maize yield and total rainfall of the months March to May is found to be negative (-0.16548) and maize yield and temperature of the months March-May is found to be positive (0.245538). The correlation analysis between millet yield and total rainfall of the months Jun-August is found to be negative (-0.17032 and -0.20268 respectively). Likewise the correlation between potato yield and average temperature of the months February to August is found to be positive (0.6293) and that of between total rainfall and yield of potato between the same months is found positive (0.8087)

The yield data of potato, maize and millet between the years 1976 to 2007 of Ilam were analyzed. It is revealed that the per annum growth in yield of maize and millet is 28.56 kg and 13.34 kg per hectare respectively.

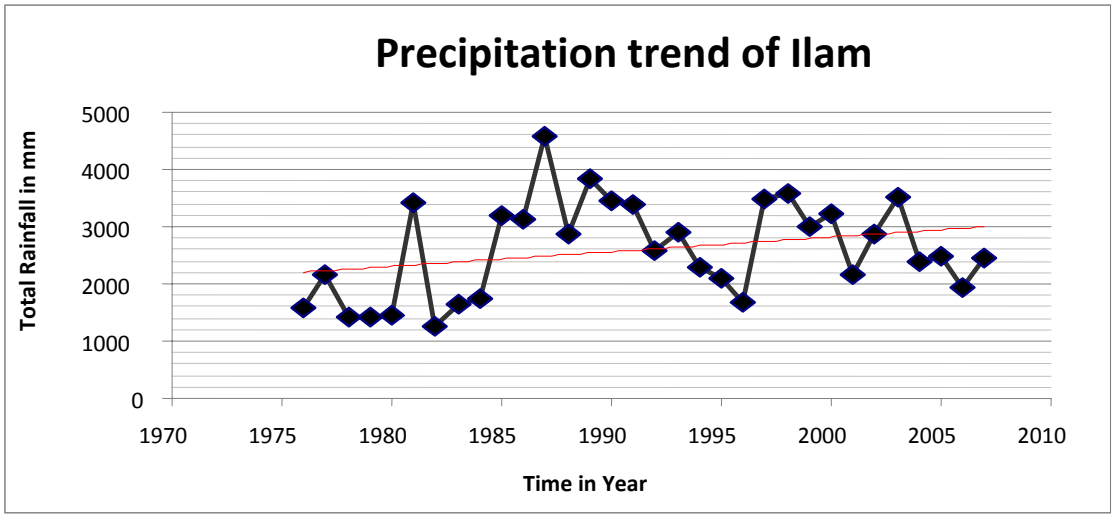

Fig: Rainfall Trend of Ilam

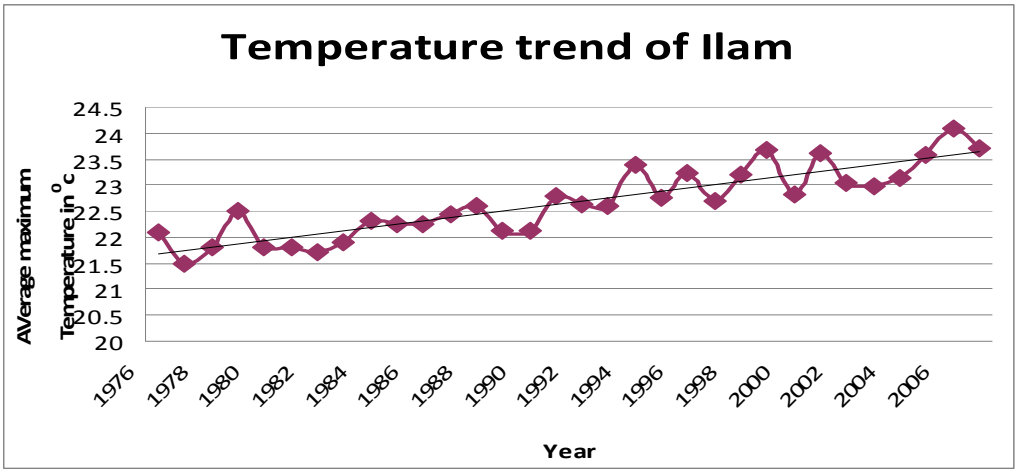

Fig: Temperature Trend of Ilam.

1.8. Socio-demographic information:

The average age of the household head is ranged between 41 to 57 years, was the highest for the Mabu VDC with caste Gurung and the lowest for Jogmai VDC with caste Thami (Table 1). The average household size ranged between 2.5 (for Puwamajhuwa) to 3.6 (for Mabu, Sherpa). However, the working age population (between the ages of 16-59 years) ranged between1-2 (in number). The dependency ratio, which is defined as the ratio of the dependent population (less than 15 years and more than 60 years) to the working age population was the highest in the Prangbung VDC (0.7). It means a single working age population has to support equivalent number of other population with regard to supporting livelihood. In other VDCs, it appeared to be around 0.70.

The land is considered the principal asset in the rural areas. The average landholding size was at a range of 18 to 45 ropanies (20 ropani is equivalent to 1 hectare). This was the highest in Puwamajhuwa and the lowest in Maimajhuwa. However, if the agricultural land, i.e. the land under cultivation of crops, it was the highest in the Puwamajhuwa followed by Mabu, Jogmai, Prangbung and Maimajhuwa. The irrigated lowland or khet was the lowest but the highest proportion of uplnd (bari) in Puwamajhuwa and Maimajhuwa VDCs. The Jogmai and Prangbubg VDCs have the considerable size of the irrigated lowland.

Table 1 : Socio-demographic information of the survey VDCs

Age of the respondent (years)		**VDCs**						
		Puwamajhuwa Sunuwar	**Mabu (Sherpa)**	**Mabu (Gurung)**	**Maimajhuwa**	**Jogmai Lepcha**	**Jogmai Thami**	**Prangbung Limbu**
		47	49	51	48	44	41	48
Household size (no)	Total	3.60	2.50	3.25	2.7	3.1	2.8	3.15
	< 15 yrs.	1.26	0.55	0.6	0.8	0.9	0.9	1
	16-59 yrs.	2.16	1.75	2.35	1.6	1.65	1.7	1.85
	>=60 yrs.	0.18	0.20	0.3	0.3	0.55	0.2	0.3
Dependency ratio		0.66	0.42	0.38	0.68	0.87	0.64	0.70
	Agricultural land	44.36	20.34	30.94	17.64	17.39	30.7	20.04
	Khet (irrigated)	0	0	0	0	0	0.48	0.14
	Khet(rainfed)	0	0	0	0	0	0	0.067
	Bari(upland)	30	4.9	7.9	12.04	9.7	9.7	12.4
	Forest	13.96	15.44	23.04	5.5	6.79	19.76	6.933
	Kharbari	0.4	0	0	0.1	1.5	0.76	0.5

1.9. Cash income sources

The farmers earn from both agricultural and non-agricultural sources. The agricultural source constitutes the income from the sale of the crops, fruits and vegetables, livestock and poultry and NTFPs as well (Table 2). The non-agricultural source consists of the income from business, Teaching, 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 3 to 59 percent to the total annual household cash income.

The contribution of the business trade varied between 0.6 % in Puwamajhuwa VDC to 9.83% in Jogmai VDC. The teaching in the school, operating small household businesses and the remittances received from abroad were the major source contributing to the non-agricultural income. The highest cash income was observed in Jogmai, Lepcha (Rs 62120) and the lowest was in Prangbung (Rs 15009).

Table2. The Average Cash Income of the Surveyed Households (Rs.)

	VDCs						
	Puwamajhuwa (Sunuwar)	**Mabu Sherpa**	**Mabu (Gurung)**	**Prangbung (Limbu)**	**Maimajhuwa (Rai)**	**Jogmai (Lepcha)**	**Jogmai (Thami)**
Agricultural	**27406(83)**	**22240 (54.68)**	**11840 (26.06)**	**6475 (43.11)**	**11114(48.61)**	**24304 (74.32)**	**46080 (74.16)**
Crops	1146(3.4)	0	2160 (4.75)	67 (0.44)	3286 (14.37)	13607 (41.61)	26800 (43.14)
Fruits and vegetables	19560 (59.2)	15520 (38.15)	2840 (6.25)	1034 (6.89)	1824(7.98)	1750 (5.35)	2040 (3.28)
Livestock and Poultry	2300(7)	6720 (16.52)	6040 (13.29)	1367 (9.1)	3624(15.85)	8947 (27.36)	12640 (20.34)
Others agri.	4400(13.3)	0	800 (1.76)	4007 (26.67)	2380(10.41)	0	4600 (7.40)
Non-agriculture	**5600 (17)**	**18440 (45.32)**	**33600 (73.94)**	**8534 (56.86)**	**11743 (51.37)**	**8394 (25.66)**	**16040 (25.82)**
Business/trade	200(0.6)	3280 (8.06)	0	0	800(3.5)	3215 (9.83)	2000 (3.22)
Teaching	2600(7.8)	7600 (18.68)	4800 (10.56)	2667 (17.77)	4120(18.02)	0	0
Other non-agri.	2800(8.5)	7560 (18.58)	28800 (63.38)	5867 (39.09)	6823(29.85)	5179 (15.83)	14040 (22.6)
TOTAL	**33006**	**40680**	**45440**	**15009**	**22857**	**32698**	**62120**

Note: Figures in the parentheses indicate percentage share of the respective sources.

1.10. Food Self-sufficiency and Changes in Season

The average food self sufficiency which is defined in terms of number of months the own farm production is sufficient to feed the family, differed by the VDCs and ranged between 4 (Puwamajhuwa VDC) to 7.04 (Mabu, Gurung community).

The majority of the households' head have not perceived the changes in the growing season of the crops. But 56 percent of the households in Mabu (Gurung) VDC have perceived

the changes while this was only 8 percent in Mabu Sherpa community while non of the farmers of jogmai VDC perceived about change in growing season (Table 3).

Table 3. Food Self-sufficiency and Perception of the Changes in Growing Season

Particular	VDCs						
	Puwamajhuwa (Sunuwar)	**Mabu (sherpa)**	**Mabu (Gurung)**	**Prangbung (Limbu)**	**Maimajhuwa (Rai)**	**Jogmai (Lepcha)**	**Jogmai (Thami)**
Av. Food self-sufficiency (no. of months)							
	4	**4.6**	**7.04**	**4.034**	**4.42**	**6.14**	**5.64**
Changes in Growing Season(% of households)							
Yes	**20**	**8**	**56**	**33.33**	**8**	**0**	**0**
No	80	92	44	66.66	92	**100**	**100**

Farmers have also changed the crop type in the study area. They have changed cabbage to potato, maize to chiraito, mustard to potato and potato to chiraito. The farmers have also applied crop rotation practice. As the perception about the change in growing season varied among the farmers, this might be due to the lack regular observation made by the farmers on their crop field and lack of knowledge about the exact growing period i.e sowing to harvesting period of the crop. They have applied crop rotation practice without technical advice from the related institution but this is practiced by their own knowledge.

1.11. Perception about Climate Change and Crop Production

The perception about climate change of the households differed by the VDCs and ranged between 39% Jogmai to 20% in Puwamajhuwa and Prangbung VDCs. Over 96% of the households in Jogmai mentioned that the crop production rate is decreasing followed by 90 percent in Prangbung and 36 percent in Mabu Sherpa community. Most of the farmers of all VDCs report decrease in crop production. The measures undertaken by the people to increase crop production are the use of organic, inorganic fertilizers and the high yielding varieties of crops. It is also revealed that 50% of the farmers of Prangbung VDC have reported that there has been a change in crop harvesting time about 22 days earlier in maize (Table 4).

The farmers were found aware and they have feeling of about the weather abnormality and they have faced various climate induced disasters in their locality but the variation in perception about the heard of climate change might be due to the lack of information and electronic media about

what actually the climate change and lack of working organizations about climate change at local level.

Table 4. Perception about Climate change and crop production

	VDCs						
	Puwamajhua (Sunuwar)	**Mabu (Sherpa)**	**Mabu (Gurung)**	**Prangbung (Limbu)**	**Maimajhuwa (Rai)**	**Jogmai (Lepcha)**	**Jogmai (Thami)**
Hear about climate change (% HH)							
Yes	20	28	36	20	26	39.28	28
No	80	72	64	80	74	60.72	72
Crop production rate (% HH)							
Increasing	4	8	4	6.66	8	3.57	12
Decreasing	84	36	84	90	78	96.43	84
Constant	12	56	12	3.34	14	0	4
Change in crop harvesting time (% HH)	4	0	12	43.33	8	0	4
Yes (Early)	16	4	28	3.33	0	17.85	0
No	56	80	60	50	92	17.85	48
Don't know	24	16	0	3.34	0	64.3	48

1.12. Livestock and Fodder

Most of the households keep livestock for milk, meat, manure and draft power. The average number of livestock per household ranged between 4.44 in Puwamajhuwa (Sunuwar community) to 5.58 in Jogmai, Lepcha community (Table 5). This variation may be due to the availability of the forest land for grazing. Majority of the households has practiced stall feeding rather than open grazing. This may be due to the unavailability of land for grazing. The stall feeding is also practiced by some of the households of Mabu VDC (Sherpa community).

Around 4% of respondents comprising Limbu and Lepcha communities and 2% of Rai community have observed change in breeding season of domestic animals. According to them there is higher frequency of mating in cow and shorting of gestation period.

Table 5. Average number of livestock per household

	VDCs						
	Puwamajhuwa (Sunuwar)	**Mabu (Sherpa)**	**Mabu (Gurung)**	**Prangbung (Limbu)**	**Maimajhuwa (Rai)**	**Jogmai (Lepcha)**	**Jogmai (Thami)**
Cow	2.48	3.48	2.36	1.6	2.04	1.58	1.76
Buffalo	**0**	**0.08**	**0.16**	**0.067**	**0.28**	**0**	**0.28**
oxen	0.36	0	0.16	0.37	0.04	0.43	0.32
Sheep	**0**	**0**	**0.08**	**0**	**0**	**0**	**0**
Goat	**1.04**	**0.84**	**2.28**	**1.67**	**1.79**	**1.64**	**2.56**
Yak	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Horse	0	0.08	0	0	0	1.18	0
Pig	**0.56**	**0**	**0**	**0.9**	**0.3**	**0.75**	**0**
Total	**4.44**	**4.48**	**5.04**	**4.6**	**4.45**	**5.58**	**4.92**
% of HH having livestock	100	80	100	100	100	93	96
% of HH Open grazing	0	32	0	0	8	0	0
% of HH stall feeding	100	68	100	100	92	100	100
Change in Breading season (% of HH)							
Yes	**0**	**0**	**0**	**3.45**	**2**	**3.71**	**0**
No	60	45.46	76	62.068	94	66.67	54.17
Don't know	40	54.54	24	34.49	4	29.62	45.83

1.13. Firewood and sources of collection

Almost all the households use firewood for cooking purpose. The firewood use ranged between 0.47 bhari per day in Jogmai (Thami) to 1.084 bhari in Prangbung VDC (Table 6). The variation might be due to the access to forest for fuel wood from the forest and availability time to collect the firewood. Most of the households collect firewood from their own land in all VDC while the Sherpa community from Mabu VDC collects firewood from government forest as well. Both male and female of the households are involved in collecting the firewood in the Jogmai (Thami), Prangbung and Mabu (Gurung) VDCs, while the majority of male are involved for firewood collection in the Puwamajhuwa, Mabu (Sherpa) and Jogmai (Lepcha). Some of the households those who do not have enough private land and forest land and no enough access to community forest, buy from others.

Table 6. Firewood and sources of collection

	VDCs						
	Puwamajhuwa (Sunuwar)	**Mabu (Sherpa)**	**Mabu (Gurung)**	**Prangbung (Limbu)**	**Maimajhuwa (Rai)**	**Jogmai (Lepcha)**	**Jogmai (Thami)**
Average firewood consumtion (Bhari/day)	0.782	0.468	0.726	1.084	0.867	0.74	0.47
Sources of firewood (Response % of HH)							
PF	60	44	88	90	38	46.42	68
CF	28	4	12	0	26	14.28	8
GF	0	44	0	0	0	0	0
Both PF & CF	8	0	0	3.34	20	7.15	16
Buying	4	8	0	3.34	20	7.15	16
Firewood collection (Response % from HH)							
Male	56	60	12	10	16	53.56	40
Female	8	20	32	10	8	3.58	4
Both	24	12	56	76.66	72	39.28	56
Labor	12	8	0	3.34	4	3.58	0

The forest cover is declining in upper part of the Mabu VDC area (ward no. 9), where the forest is government type, and the people have to walk a day to fetch the fuel wood from the community forest. The forest fire has also contributed to the decline in forest resource. The people in the lower belt of all VDCs do not have enough access to community forest and fulfill their firewood need from their own forest and bari land, since they have planted fodder species in their private land. So the forest condition on their private land is found to be good rather than the community forest.

1.14. Forest products and their sources of collection:

1.14.1. Forest products and sources of collection (10 years ago)

Firewood is a major source of fuel wood for all household in all study VDCs. The households of Puwamajhuwa used to collect firewood and fodder for livestock from both community forest and private forest but the collection amount from community forest was lesser than private forest. While for other VDCs, the major source of firewood and fodder was private forest ten years ago. Leaf litter is a major source of organic manure in all study VDCs. The collection of leaf litter

from private forest ranged between 923 bhari (1 bhari equivalent to approx. 40 kg) per year in Prangbung VDC to about 2 bhari per year in Jogmai (Lepcha) VDC. The households from Puwamajhuwa and Maimajhuwa used to collect leaf litter from the community forest as well and the Sherpa community of Mabu VDC used to collect it from government forest. The use of poles for making cattle shed and other related purpose ranged between 1 bhari per year in Puwamajhuwa VDC to 3 bhari per year in Jogmai VDC. Most of the households from all VDCs except Mabu (Sherpa) used to collect poles from community as well as private forest.

Since indigenous people are closely associated with nature, they used to consume the wild fruits and vegetables from the forest. The major food that the people consumed are mushroom, bamboo shots, fronds, and other wild fruits like *Quercus* , *Castanopsis* species, etc. All of the households of all VDCs used to collect mushroom from community forest which ranged between 5kg per year in Puwamajhuwa VDC to 1kg per year in Jogmai VDC. The households of Maimajhuwa VDC used to collect bamboo shots and wild vegetables from community forest (5kg/year and 2kg/year respectively) and non of the households of Puwamajhuwa used to consume bamboo shots but they consume highest amount of wild vegetables (3kg/year) and wild fruits (10kg/year) from community forest and other VDCs used to collect it from their private forest. Indigenous people used to collect medicinal plants for the treatment of some diseases. The collection of medicinal plans from community forest is less but the people of Puwamajhuwa VDC used to collect it more than other VDC from community forest but non of the households from Prangbung and Mabu (Gurung) had collected and used medicinal pants.

Table 6.1. Forest products and sources of collection (10 years ago)

Average amount collection Bhari/Year	VDCs						
	Puwamajhuwa (Sunuwar)	Mabu (Sherpa)	Mabu (Gurung)	Prangbung (Limbu)	Maimajhuwa (Rai)	Jogmai (Lepcha)	Jogmai (Thami)
Fuel wood P.F	475.6	141.2	163.2	455.5	267	67.86	72.8
C.F	115.2	4	47.6	17.83	297	21.8	13.6
G.F	0	85.6	0	0	1	0	0
Fodder P.F	484.4	960	1525	1717	585	445.7	792.8
C.F	372	56	376	48.7	326	0	84
G.F	0	86	0	0	60	0	0
Leaf Litter P.F	231.8	540.4	719.6	923.7	227	1.78	17.6
C.F	113	14.6	117	25	149	0.36	8.4

G.F	0	94	0	0	29	0	0
Poles P.F	0.24	1.76	2.2	1.57	0.42	1.39	2.76
C.F	0.24	0.08	0.88	0.1	3.42	0.32	0.36
G.F	0	1.36	0	0	0	0	0
Mushroom P.F	1.44	1.08	0.76	1	0	0.93	1.84
C.F	5.28	0	0.4	0.03	1.88	0.43	2.28
G.F	0	0	0	0	0	0	0
Bamboo shot P.F	0	1.72	0.48	0.27	0.06	0.96	0.4
C.F	0	0	0.2	0	5	0	0
G.F	0	0.12	0	0	0	0	0
Wild veg P.F	0.76	3.76	0.96	0.6	0.08	3.43	4.32
C.F	2.84	0	0.08	0	1.6	0.32	1.24
G.F	0	0.52	0	0	0	0	0
Wild Fruit P.F	0.32	0	0	0	0	2.54	0.88
C.F	10.9	0	0	0	6.78	0.14	0.32
G.F	0	0	0	0	0	0	0
Medi.plants P.F	1.6	0	0	0	0.24	0.32	0.48
C.F	2.32	0	0	0	0.9	0.04	0.08
G.F	0	0.04	0	0	0	0	0

***Note: Fuel wood, fodder, leaf litter and poles quantities are in Bhari and Mushroom, bamboo shots, wild vegetables & fruits and medicinal plants are in Kg/year.**

1.14.2. Forest products and sources of collection (At present)

The fuel wood, fodder and leaf litter demand has increased in all VDCs except Prangbung and Jogmai (Thami) and source of collection is limited on private forest as compared to community forest. The bamboo shots, wild fruits and vegetables are now less available in community forest and the households are collecting these products in fewer amounts from their private forest. All the households of all VDCs except Mabu (Sherpa) are collecting medicinal plants from their private land but the households of Mabu (Sherpa) are planting medicinal plants on their private land.

At present the people have started plantation on their private land and they were fulfilling their fuelwood and fodder demand from that forest. So 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.

Table 6. 2 Forest products and sources of collection (At present)

Average amount collection Bhari/Year	VDCs						
	Puwamajhuwa (Sunuwar)	**Mabu (sherpa)**	**Mabu (Gurung)**	**Prangbung (Limbu)**	**Maimajhuwa (Rai)**	**Jogmai (Lepcha)**	**Jogmai (Thami)**
Fuel wood P.F	770	169.2	241.4	422	300	96.07	62
C.F	37.2	2.4	21.6	4.67	114.4	13.93	14.4
G.F	0	100.8	0	0	0	0	0
Fodder P.F	682	918	1962	1740	741	808	992
C.F	198	2.4	2.4	1.33	72.8	1.79	128
G.F	0	160	0	0	0	0	0
Leaf Litter P.F	370	357.2	646.8	650.3	281.6	17.32	26.4
C.F	168.4	0	0	0.5	78.1	0.72	8.8
G.F	0	102	0	0	28.8	0	0
Poles P.F	0.58	2.24	1.92	1.1	0.68	1.22	2.28
C.F	0	0	0.04	0	0.46	0.1	0.44
G.F	0	1.792	0	0	0	0	0
Mushroom P.F	0.88	0.76	0.48	0.17	0.04	0.36	1.16
C.F	1.52	0.08	0	0	0.24	0.07	1.44
G.F	0	0.2	0	0	0	0	0
Bamboo shot P.F	0	1.88	0.4	0.07	0.1	0.18	0.04
C.F	0	0	0	0	0.16	0	0
G.F	0	0.12	0	0	0	0	0
Wild veg P.F	0.92	3.46	0.44	0.54	0.1	2.54	2.72
C.F	3.8	0	0	0	1.02	0.1	0.52
G.F	0	0.44	0	0	0.08	0	0
Wild Fruit P.F	0.16	0	0	0	0	0.86	0.52
C.F	3.04	0	0	0	0.74	0.07	0.16
G.F	0	1.84	0	0	1.12	0	0
Medicinal plants P.F	4.04	0	0.28	5.74	0.2	0.18	0.4
C.F	1.48	0	0	0	1.04	0.04	0.12
G.F	0	0	0	0	0	0	0

***Note: Fuel wood, fodder, leaf litter and poles quantities are in Bhari and Mushroom, bamboo shots, wild vegetables & fruits and medicinal plants are in Kg/year.**

1.15. Perception of the local people about forest condition:

The average perception percentage of the households about the forest condition comparing present and past (10 years ago) ranged between 4.32 to 27.02 relating to private forest that was

very good and is good now. The perception about the private forest showed that the people are becoming more conscious about the forest and they have started plantation practices in their private land. The perception of the households has changed on different mentioned condition in comparison to past and present. The perception about the good condition of the private forest has increased from 41 to 60 while in case of community forest is constant. The perception about the very good condition of the community forest has decreased than 10 years ago. It showed that the community forest is decreasing. The same is true for the government forest. The average perception percentage about the government forest has decreased. It also showed that the government forest is also decreasing.

Table 7: perception about forest condition: (10 years ago and at present)

HH% perception on the following conditions (10 yrs ago)	**VDCs**							**Average**
	Puwamajhuwa (Sunuwar)	**Mabu (Sherpa)**	**Mabu (Gurung)**	**Prangbung Limbu)**	**Maimajhuwa (Rai)**	**Jogmai (Lepcha)**	**Jogmai (Thami)**	
P.F V. Good	0	0	8.34	14.81	3.12	0	4	4.324
Good	76	58.82	20.84	48.14	46.88	38.46	40	41.3
Degraded	24	41.18	70.82	37.05	50	61.54	56	48.65
C.F V. Good	16	25	16.67	4.34	3.03	3.57	4	10.37
Good	76	75	54.16	82.60	45.45	46.42	76	65.09
Degraded	8	0	29.17	13.06	51.52	50.01	20	24.53
G.F V. Good	0	27.28	0	0	0	0	0	3.89
Good	0	63.64	0	0	0	0	0	9.09
Degraded	0	9.08	0	0	0	0	0	1.29
% of HHs reporting their perception on the following condition At Present								
P.F V. Good	28	47.05	33.34	37.05	43.75	0	0	27.02
Good	72	47.05	62.50	55.55	56.25	61.54	68	60.41
Degraded	0	5.90	4.16	7.40	0	38.46	32	12.62
C.F V. Good	12	8.34	4.35	26.08	6.06	3.57	0	8.62
Good	76	91.66	91.30	73.92	78.78	60.71	24	70.91
Degraded	12	0	4.35	0	15.16	35.72	76	20.46
G.F V. Good	0	9.08	0	0	0	0	0	1.29
Good	0	63.64	0	0	0	0	0	9.09

Degraded	0	27.28	0	0	0	0	0	3.89

According to the observation made by the local people of the studied VDCs, there are different causes of increase and decrease in the forest condition. Most of the respondents of all VDCs have reported that the causes of increase in forest condition are as more trees plantation on private land, prohibition of open access in community forest, afforestation, selective cuttings and formulation of strict rules and regulations and awareness about the forest. While the causes of degradation of forest are as increased demand of fodder and fuelwood, over exploitation of forest products, increased human pressure, no monitoring from government agencies, illegal theft of timber and destruction of forest for settlement.

1.16. Availability of wild animals and their use:

The perception about change in availability of wild animals of the households also differed by the VDCs and ranged between 50 percent in Prangbung to 96 percent in Jogmai (Thami). Most of the households of the study VDCs has reported that there is change in availability of wild animals. The percentage about the change in availability of wild animals is above 50 percent in the study area. The major causes of change in availability of wild animals also differed by VDCs. Only 58% of the households from Puwamajhuwa VDC have reported that there is increase in number of wild animals but they have also reported that some wild animals like Jackals, fox etc are now not found in their locality. The percentage about the decrease in number has found high which ranged from 41 from Puwamajhuwa to 100 in Jogmai VDC. Another cause of decrease in wild animals is found as decrease in habiat, hunting and poaching. The illegal hunting and poaching practices is also found common in the study VDC. The major cause of extinction of Jackel in all VDC as reported by households is open disposal of poisonous dead animals in their locality.

The purposes of use of wild animals varied by households and VDCs in the study area. The households of Puwamajhuwa use Charchare bird in the treatment of charchare disease in the cow and as a pain killer for human. The dried body of charchare bird after grinding comes in to use. The people also uses monkeys's heart and liver in the treatment of Tuberculosis, gull bladder of snakes to cure paralysis, head and tongue of pahas for the treatment of measles and during cold and cough. Non of the households of Sherpa community of Mabu used wild animals but only one

house from Gurung community from the same VDC used Deer and fish for making domestic appliances and for Puja respectively. On the other hand only two households (out of 30HHs) of Prangbung VDC has reported that they have used Pahas and Fish for Puja (Hyumaya; the local name of the Puja offered by local limbu community).

Table: 8 Change in availability of wild animals , the causes of change and their use

% of HHs reporting that change in availability of wild animals	VDCs						
	Puwamajhuwa (Sunuwar)	**Mabu (Sherpa)**	**Mabu (Gurung)**	**Prangbung (Limbu)**	**Maimajhuwa (Rai)**	**Jogmai (Lepcha)**	**Jogmai (Thami)**
Yes	60	68	84	50	78	60.71	96
No	40	32	16	50	22	39.29	4
Increase in number	58.82	29.41	14.28	33.34	17.07	11.12	0
Decrease in number	41.18	70.59	85.72	66.66	82.93	88.88	100
Causes of Reduction							
Increase in temperature	0	12.5	9.09	0	8.69	39.28	23.80
Decrease in habitat	50	43.75	59.09	54.54	60.86	39.28	50
Hunting and poaching	50	37.5	31.82	45.46	30.45	21.44	23.80
others	0	6.25	0	0	0	0	2.4
No. of HHs using wild animals	17	0	1	2	14	23	15

The Dhami and Jhakri (witch hunters) of Maimajhuwa have been using wild animals and birds for different cultural and treatment of diseases. The birds used by dhami and jhakri as reported by local people are Tit, White cap redstart, Sun bird, whistling thrush, dhuinche, babblers. The beaks and legs of Simkukhura are used in treatment of wounds. Paa species are also common for the Kul puja and dhami jhakri for Rai community. Paa are also used as a fermenting agent by local people and the leg of eagle and minivet birds are use for treatment of diseases in human and cow respectively.

More than 50 percent households of the Jogmai has used wild animals. The skin, horn and legs of deer are widely used for making home decorative utensils. Paha during cold and cough, bone of tiger as medicine, whistling bird to cure Danta Harsa (Periodontitis), gull bladder of bear is used as medicine to cure malaria and flesh of jackel was used in the treatment of Bath (Uric acid).

1.17. 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 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 30) or just agree (score 60) on the above statement. The score of more than 60 and equal or below 90 indicates that they do not know or aware about the given statement while the score above 90 and equal or below 120 indicates disagree and above 120 indicates strongly disagree in case of Prangbung VDC while for Mabu (Gurung & Sherpa), Puwamajhuwa and Jogmai (Thami) the more they strongly agree (score 25), or just agree (score 50) on the above statement. The score of more than 50 and equal or below 75 indicates that they are do not know or aware about the given statement while score above 75 and equal or below 100 indicates disagree and above 100 indicates strongly disagree and for Maimajhuwa lower score is 50 and for Jogmai (Lepcha) the lower score is 28(Table10).

As per the average score given in Table 10, the households in Mabu, Maimajhuwa and Jogmai VDCs agree on the statement environment in this village is changing due to human activities (statement no.1),and all of the households of study VDC agree on the the rainfall is decreasing every year during winter season (statement no. 6), climate change has lead to crop infestation and disease (statement no.9), climate change has lead to decline forest resources (statement

no.11), there is now scarcity of fuelwood (statement no.12), the fodder species in the forest is declining (statement no. 13) and the number and types of wild birds are decreasing in your locality (statement no.14). on the other hand the households in Mabu(Gurung), Prangbung and Jogmai agree on the statement there have been increase incidences of droughts during the rainy season (statement no.17).

Table 10. Average score of the perception variables by VDCs.

Perception statements	VDCs						
	Puwamajhuwa (Sunuwar)	Mabu	Mabu	Prangbung	Maimajhuwa	Jogmai	Jogmai
1	67	69	53	82	125	49	48
2	78	69	60	88	127	74	52
3	61	88	57	77	114	39	36
4	61	59	39	57	102	70	66
5	68	78	55	70	96	57	44
6	45	55	30	47	74	50	38
7	80	84	50	62	130	52	44
8	80	95	54	93	132	32	30
9	57	60	49	66	116	61	58
10	70	61	52	73	118	50	49
11	53	74	80	83	118	63	61
12	68	75	86	74	100	68	62
13	62	78	89	80	118	61	49
14	59	68	68	89	120	44	38
15	59	75	65	83	109	49	40
16	72	93	60	62	147	62	53
17	79	90	52	66	119	64	52

1.18. Adaptation measures

1.18.1. Perceived threat

The households in the Puwamajhuwa, Mabu, Prangbung and Maimajhuwa VDCs perceived threat of climate change on own food production (household level food supply) and almost all VDCs perceived the threat of climate change on health, and fuel wood availability. The crop production of winter crops such as wheat maize and potato would be affected due to decreasing

amount of rainfall every year during winter season resulting into worsening of household food security in Prangbung, Maimajhuwa and Mabu VDCs. The erratic rainfall pattern during rainy season has resulted in late plantation of paddy crop in Prangbung VDC. This has effect on low yield of crop. Some households in Mabu Sherpa community perceived threat on instigating disaster while some other households from all VDCs perceived the threat on biodiversity quality and their sustainability (Table 10). The perception about the threat of climate change perceived by the local community varied accordingly. The variation might be due to the variation in the experiences and feelings of the people with references to the different parameters like health, food availability, disaster etc.

Table 11. Households' perception on the threat of climate change variables by VDCs.

Perception statements	(% of HHs saying Yes)VDCs						
	Puwamajhuwa (Sunuwar)	Mabu (Sherpa)	Mabu (Gurung)	Prangbung (Limbu)	Maimajhuwa (Rai)	Jogmai (Lepcha)	Jogmai (Thami)
Health	100	76	92	60	58	64.28	12
Food supply from own production	84	60	72	60	48	64.28	100
Fuel wood availability	64	32	20	23.34	34	3.57	16
Business	0	0	0	0	6	0	0
Instigating Disaster	8	24	92	33.34	20	0	0
Biodiversity quality and sustainability	36	32	16	10	16	32.14	32

1.18.2. Strategies adopted to mitigate the Impact:

From the data analysis the people of Puwamajhuwa and Mabu are seen to practice shorting growing season of different crops as an adaptation strategy to mitigate the climate change impact. Likewise water conservation practices are practice only on Puwamajhuwa VDC. While rainwater harvesting is practiced by 4% of Sunuwar and Gurung people of Puwamajhuwa and Mabu VDC respectively. Also mulching practice in agriculture has been applied as adaptive strategy in the same VDCs. Almost all the households of the studied VDCs no adaptation methods being practiced.

Table 12. Strategies adopted by households to mitigate the impact of climate change

Strategies	% of HHs						
	Puwamajhuwa (Sunuwar)	Mabu (Sherpa)	Mabu (Gurung)	Prangbung (Limbu)	Maimajhuwa (Rai)	Jogmai (Lepcha)	Jogmai (Thami)
Planting different varieties of crops	0	0	0	10	12	25	12
Cultivating different crops	4	0	0	3.34	4	25	12
Shortening growing season	12	20	0	0	0	3.57	0
Changing the extent of land put in crop production	0	8	0	0	0	0	0
Changing to irrigation methods/water conservation practices	4	0	0	0	0	0	0
Rain water harvesting	4	0	4	0	0	0	0
Use of chemical fertilizer	0	0	0	23.34	0	7.14	0
Use of organic manure	28	16	4	33.34	20	92.85	84
Use of bio-pesticide	0	12	4	0	0	0	0
Mulching	28	0	4	0	0	0	4
Construction of embankment in rivers	4	0	0	0	0	0	0
Other adaptive methods	8	8	0	0	6	0	0
No adaptation methods	72	76	92	60	76	7.14	16

Perceived hindrances to adapt modern techniques

The household's perception varied with regard to the hindrances to adaptation of modern techniques of combating climate change.

The perception about the statement lack of improved seed to adapt climate changes varied between VDCs which ranged between 30 percent Maimajhuwa to 80 percent Jogmai (Thami). The most important constraint faced by the households of Puwamajhuwa and Jogmai (Thami community) VDCs was the lack of access to irrigation water. Lack of current knowledge on adaptation methods was perceived as one of the constraints perceived by the household which ranged between 48 to 76 percent. Lack of financial resources to get modern technique and information on weather incidence was also considered the constraint in the study villages (Table 13).

Table 13. Households' perceived hindrances to adapt modern techniques

Perception statements	(% of HHs saying Yes)VDCs						
	Puwamajhuwa (Sunuwar)	Mabu (Sherpa)	Mabu (Gurung)	Prangbung (Limbu)	Maimajhuwa (Rai)	Jogmai (Lepcha)	Jogmai (Thami)
Lack of improved seeds	40	32	52	33.34	30	71.42	80
Lack of access to irrigation water	76	0	44	16.66	16	17.85	52

Lack of current knowledge on adaptation methods	76	48	64	63.34	62	50	44
Lack of financial resources to get modern techniques	52	52	44	23.34	38	39.28	28
Lack of information on weather incidences	32	28	8	40	36	46.42	52

1.19. Applied cultural and traditional practices

The cultural and traditional practices applied by the local community of the different studied VDCs also varied. Different communities are applying different methods according to their beliefs and norms. More than 50% households of Puwamajhuwa VDC applying some traditional practices, they are Sime-Bhume puja praying for nature, suro puja and nwagi during harvesting of crops, use of wooden box to store cereal crops, chandi puja, udhauli uvaili in every six months during planting and harvesting crops. None of the households of Mabu VDC has applied cultural and traditional practices. About 50% of the households of the Limbu community of Prangbung VDC have applied their cultural practices which are found as resemble with sunuwar community of Puwamajhuwa VDC. The traditional methods applied by Limbu community are Udhuali-uvaulu in every six months in Baishakh and Mangsir, sacrificing hens during cultivation of crops. The similar cultural methods are also applied by the Rai community of Maimajhuwa VDC which is named as Mangsire puja during harvesting crops.

The cultural and traditional methods applied by the Thami and Lepcha Community of Jogmai VDC is Found quite different than other communities of the studied VDCs. They have practiced the alternative seed treatment methods rather than the chemical means. They are using urine and dung of cow in order to treat the seeds of maize. They mix the maize seed with the cow dung during cultivation and they also uses powder ash to treat the seeds, the interesting believes of the Lepcha and Thami community about the hailstorm and heavy rainfall is burning Dhup to prevent heavy rainfall and placing Doko in upright position to avoid or to stop the hailstorm. The udhauli , uvauli and nwagi puja are also common for these communities.

1.20. Measures taken by indigenous people to protect agri-land:

The households of Puwamajhuwa has started to plant trees on their farmland, drainage controlling by constructing narrow lane and has established vegetation check dam in order to control erosion and to reclaim the gully. The same method methods like construction of sidewise dam, plantation of trees, mulching and narrow lane construction on farm land is common in the Mabu, Prangbung, Jiogmai and Maimajhuwa VDCs.

1.21. Recommendation to fight against climate change

Almost all households of studied VDCs has experienced the climate induced abnormalities in their locality. The households of Puwamajhuwa has reported that in order to fight against climate change there should be raise believes on good, public should made aware about climate change phenomena, forest should conserved, government should provide subsides to promote alternative energy technology, water conservation, proper irrigation facility, use of improved varieties of seeds and application of modern agriculture technology. The households of Mabu reported that eco-friendly techniques should apply on industries and factories in order to prevent pollution, use of chemical fertilizer should minimize, afforestation should be promoted, seasonal crop varieties should be adopted, trees should be planted nearby houses and nearby water sources, switching from traditional farming to modern one, modification of human behavior according to the climate, more research and study should be conducted better yield of crops, field monitoring and regular observation of agriculture system should be conducted by related district level agencies and agri-experts. The households of Prangbung VDC has reported that there is need of more money to combat with climate change. Along eith this, forest should be conserved, public awareness about climate change and wather incidences, organic farming, strict implementation of rules and regulations on inudstries and factories are recommended by the households of Prangbung, Maimajhuwa and Jogmai VDC.

CHAPTER V

1. Summary, Conclusion and Recommendations

1.1. Summary

There has been 0.055^0c per annum increases in temperature of Ilam district between the years 1976-2007. The highest and lowest recorded temperature for January during this period was 19^0c and 14.2^0c in 1999 and 1978, respectively. Similarly, there has been 0.071% per annum increase in temperature in the month of July between1976-2007. The average rainfall in the month of January between1976-2007 is 11.89 mm while this has been 464.64 mm in the month of July. The correlation analysis between maize yield and total rainfall of the months March to May is found to be negative (-0.16548) and maize yield and temperature of the months March-May is found to be positive (0.245538). The correlation analysis between millet yield and total rainfall of the months Jun-August is found to be negative (-0.17032 and -0.20268 respectively).

The yield data of maize and millet between the years 1976 to 2007 of Ilam were analyzed. It is revealed that the per annum growth in yield of maize and millet is 28.56 kg and 13.34 kg per hectare respectively.

to be positive.

The study area is mountainous with rugged topography. Majority of the people are living below poverty line. The average age of the household head is ranged between 41 to 57 years, was the highest for the Mabu VDC with caste Gurung and the lowest for Jogmai VDC with caste Thami (Table 1). The average household size ranged between 2.5 (for Puwamajhuwa) to 3.6 (for Mabu, Sherpa). However, the working age population (between the ages of 16-59 years) ranged between1-2 (in number). The dependency ratio, which is defined as the ratio of the dependent population (less than 15 years and more than 60 years) to the working age population was the highest in the Prangbung VDC (0.7). It means a single working age population has to support equivalent number of other population with regard to supporting livelihood. In other VDCs, it appeared to be around 0.70.

The farmers earn cash income from both agricultural and non-agricultural sources. The non-agricultural source was the dominant source in all the VDCs. The horticulture sub-sector is an important source of cash income under the agricultural income sources contributing to about 6 to 15 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 feed the family, differed by the VDCs and ranged between 4 (Puwamajhuwa VDC) to 7.04 (Mabu, Gurung community). The majority of the households' head have not perceived the changes in the

growing season of the crops. But 56 percent of the households in Mabu (Gurung) VDC has perceived the changes while this was only 8 percent in Mabu Sherpa community while non of the farmers of jogmai VDC perceived about change in growing season.

Firewood is a major source of fuel wood for all household in all study VDCs. The households of Puwamajhuwa used to collect firewood and fodder for livestock from both community forest and private forest but the collection amount from community forest was lesser than private forest. While for other VDCs, the major source of firewood and fodder was private forest at ten years ago. Leaf litter is a major source of organic manure in all study VDCs. The collection of leaf litter from private forest ranged between 923 bhari per year in Prangbung VDC to about 2 bhari per year in Jogmai (Lepcha) VDC. The households from Puwamajhuwa and Maimajhuwa used to collect leaf litter from the community forest as well and the Sherpa community of Mabu VDC used to collect it from government forest. The use of poles for making cattle shed and other related purpose ranged between 1 bhari per year in Puwamajhuwa VDC to 3 bhari per year in Jogmai VDC. Most of the households from all VDCs except Mabu (Sherpa) used to collect poles from community as well as private forest.

Since indigenous people are closely associated with nature, they used to consume the wild fruits and vegetables from the forest. The major food that the people consumed are mushroom, bamboo shots, fronds, and other wild fruits like bante, katus, etc. All of the households of all VDCs used to collect mushroom from community forest which ranged between 5kg per year in Puwamajhuwa VDC to 1kg per year in Jogmai VDC. The households of Maimajhuwa VDC used to collect bamboo shots and wild vegetables from community forest (5kg/year and 2kg/year respectively) and non of the households of Puwamajhuwa used to consume bamboo shots but they consume highest amount of wild vegetables (3kg/year) and wild fruits (10kg/year) from community forest and other VDCs used to collect it from their private forest. Indigenous people used to collect medicinal plants for the treatment of some diseases. The collection of medicinal plans from community forest is less but the people of Puwamajhuwa VDC used to collect it more than other VDC from community forest but non of the households from Prangbung and Mabu (Gurung) had collected and used medicinal pants.

The fuel wood, fodder and leaf litter demand has increased in all VDCs except Prangbung and Jogmai (Thami) and source of collection is limited on private forest as compared to community forest. The bamboo shots, wild fruits and vegetables are now less available in community forest

and the households are collecting these products in less amount from their private forest. All the households of all VDCs except Mabu (Sherpa) are collecting medicinal plants from their private land but the households of Mabu (Sherpa) are planting medicinal plants on their private land. As per the average score, the households in Mabu, Maimajhuwa and Jogmai VDCs agree on the statement environment in this village is changing due to human activities (statement no.1),and all of the households of study VDC agree on the the rainfall is decreasing every year during winter season (statement no. 6), climate change has lead to crop infestation and disease (statement no.9), climate change has lead to decline forest resources (statement no.11), there is now scarcity of fuelwood (statement no.12), the fodder species in the forest is declining (statement no. 13) and the number and types of wild birds are decreasing in your locality (statement no.14). on the other hand the households in Mabu(Gurung), Prangbung and Jogmai agree on the statement there have been increase incidences of droughts during the rainy season (statement no.17).

1.2. Conclusion

Climate change affects crop and livestock production practices and their yields. Negative effects are projected to be more prominent than the positive effects. The temperature in the area is increasing and rainfall pattern is also becoming erratic over the years. This has affected the agricultural production, fodder & fuelwood thereby threatening the food security and livelihood of mountain people.

The farmers have adopted different strategies to cope with the effects of climate change. Some have cultivated different crops while others have adopted varieties/crops to shorten the growing season and also practiced the mulching techniques. Some farmers have used organic manure to their crops. The mulching has been practiced extensively in Maimajhuwa VDC. The cultural and traditional methods applied by the Thami and Lepcha Community of Jogmai VDC is Found quite different than other communities of the studied VDCs. They have practiced the alternative seed treatment methods rather than the chemical means. They are using urine and dung of cow in order to treat the seeds of maize. They mix the maize seed with the cow dung during cultivation and they also uses powder ash to treat the seeds, the interesting believes of the Lepcha and Thami community about the hailstorm and heavy rainfall is burning sense stick to prevent heavy rainfall and placing Doko in upright position to avoid or to stop the hailstorm. The udhauli and

uvauli and nwagi puja are also common for these communities. The different worshipping methods are being applied by the local peoples of other studied VDCs. Farmers also face the constraints to further promote modern techniques that may help to mitigate the effects of climate change. The most important was the lack of access to irrigation water, current knowledge on adaptation and financial resources and information on weather incidence.

1.3. Recommendation

There is a need of impact identification and adaptation to cope with vulnerabilities in agricultural sector. Nepal being a least developed country, it is moving towards vulnerable situation due to climate change. As it is known, its effects cannot be completely controlled but effective planning and change in human habit towards a low carbon economy can slower down possible disasters.

There is a need to document and verify the indigenous knowledge and practices on scientific basis for further replication in the area.

The farmers should be made further aware about the effects and enhance their knowledge and skills, and support to avail the techniques and implements/equipments.

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