CHAPTER-I

INTRODUCTION

1.1 Background of the Study

Climate is an essential factor that has direct effects on agricultural production Developing countries are more vulnerable to climate change since majority of the populations depend on agriculture and lacks technical and financial capability. In addition, the agricultural sector is not only vulnerable to climate change but also has been stressed with the chronic problems of low returns from agricultural exports in developing countries. In recent years, climate change has been a topic of discussion in Nepal due to its increasing stress on water resources and other climate-sensitive resources there by affecting agricultural production, food security and livelihood.

Climate change is having a disproportionate effect on the lives of people living in poverty in developing countries. For developing countries like Nepal, climate change is not just an environmental phenomenon but also an economic, social and political issue. Nepal is among the most vulnerable countries on earth with regard to climate change.

Climate variability and risks have always been a part of agriculture, due to which farmers have developed many ways of managing risks. Searching and exchanging drought-resistant seeds and other a biotic stress-tolerant crop varieties and adopting and practicing specific soil and water management practices for marginal areas have long been core activities of the farming communities. Climate change introduces a new dimension to the problem. The unprecedented rate and magnitude of climate change presents great challenges to farmers, researchers and policymakers alike and all need to collaborate at local level to address this problem. There is abundant scientific evidence that agro biodiversity has an important role to play in ensuring the adaptation needed to maintain production.

In Nepal, the economy is dominated by agriculture. In the late 1980s, it was the livelihood for more than 90 percent of the population, although only approximately 20 percent of the total land area was cultivable, it accounted for, on average, about 60 percent of the GDP and approximately 75 percent of exports.Since the formulation of the Fifth Five-Year Plan (1975–80), agriculture has been the highest priority because

economic growth was dependent on both increasing the productivity of existing crops and diversifying the agricultural base for use as industrial inputs.

According to the World Bank, agriculture is the main source of food, income, and employment for the majority.

In trying to increase agricultural production and diversify the agricultural base, the government focused on irrigation, the use of fertilizers and insecticides, the introduction of new implements and new seeds of high-yield varieties, and the provision of credit. The lack of distribution of these inputs, as well as problems in obtaining supplies, however, inhibited progress. Although land reclamation and settlement were occurring in the Terai Region, environmental degradation and ecological imbalance resulting from deforestation also prevented progress.

Although new agricultural technologies helped increase food production, there still was room for further growth. Past experience indicated bottlenecks, however, in using modern technology to achieve a healthy growth. The conflicting goals of producing cash crops both for food and for industrial inputs also were problematic.

The production of crops fluctuated widely as a result of these factors as well as weather conditions. Although agricultural production grew at an average annual rate of 2.4 percent from 1974 to 1989, it did not keep pace with population growth, which increased at an average annual rate of 2.6 percent over the same period.Further, the annual average growth rate of food grain production was only 1.2 percent during the same period.

There were some successes. Fertile lands in the Terai Region and hardworking peasants in the Hill Region provided greater supplies of food staples (mostly rice and corn), increasing the daily caloric intake of the population locally to over 2,000 calories per capita in 1988 from about 1,900 per capita in 1965. Moreover, areas with access to irrigation facilities increased from approximately 6,200 hectares in 1956 to nearly 583,000 hectares by 1990.

Rice is the most important cereal crop. In 1966 total rice production amounted to a little more than 1 million tons; by 1989 more than 3 million tons were produced. Fluctuation in rice production was very common because of changes in rainfall; overall, however, rice production had increased following the introduction of new cultivation techniques as well as increases in cultivated land. By 1988

approximately 3.9 million hectares of land were under paddy cultivation. Many people in Nepal devote their lives to cultivating rice to survive. In 1966 approximately 500,000 tons of corns, the second major food crop, were produced. By 1989 corn production had increased to over 1 million tons.

The agriculture sector occupies almost one third of Gross Domestic Product (GDP) while about two third of country's population is dependent in this sector. Contribution of this sector to GDP was 33.12 percent in fiscal year 2013/14, which is expected to come down to 32.12 percent in FY 2014/15. This sector is expected to grow only marginally by 1.85 percent at basic prices. The growth rate of agriculture sector has not been satisfactory since last few years. Food crops production of Nepal (rice, maize, millet, wheat, barley, buckwheat) in current fiscal year 2014/15 is expected to total 9,266,000 MT with a decrease of 296,000 MT or approximately 3 percent decline in production than of the previous fiscal year. Total area under food crops cultivation in the current fiscal year is also estimated to have decreased from the previous year (economic survey, 2015).

Other food crops included wheat, millet, barley, and coffee, but their contribution to the agricultural sector was small. Increased production of cash crops, used as input to new industries, dominated in the early 1970s. Sugarcane and tobacco also showed considerable increases in production from the 1970s to the l980s. Potatoes and oilseed production had shown moderate growth since 1980. Medicinal herbs were grown in the north on the slopes of the Himalayas, but increases in production were limited by continued environmental degradation. According to government statistics, production of milk, meat, and fruit had improved but as of the late 1980s still had not reached a point where nutritionally balanced food was available to most people. Additionally, the increases in meat and milk production had not met the desired level of output as of 1989. Nepal has more than 50% of people engaged in agriculture. Food grains contributed 76 percent of total crop production in 1988-89.

In 1989-90 despite poor weather conditions and a lack of agricultural inputs, particularly fertilizer, there was a production increase of 5 percent. In fact, severe weather fluctuations often affected production levels.Some of the gains in production through the 1980s were due to increased productivity of the work force (about 7 percent over fifteen years); other gains were due to increased land use and favorable weather conditions. According to Statistical Information on Nepalese Agriculture

(2008/2009) only 65.6% of people depends on agriculture and 21% of land is cultivated whereas 6.99% of land is uncultivated.(SNA ,2008/2009).

Climate variability and risks have always been a part of agriculture, due to which farmers have developed many ways of managing risks. Searching and exchanging drought-resistant seeds and other a biotic stress-tolerant crop varieties and adopting and practicing specific soil and water management practices for marginal areas have long been core activities of the farming communities. Climate change introduces a new dimension to the problem. The unprecedented rate and magnitude of climate change presents great challenges to farmers, researchers and policymakers alike and all need to collaborate at local level to address this problem. There is abundant scientific evidence that agro biodiversity has an important role to play in ensuring the adaptation needed to maintain production.

In this context, the study of climate on agriculture is strongly needed for the country. Thus, an attempt has been made to investigate on the impacts of climate change and local Adaptation in Agriculture sector such as paddy, maize and wheat production.

1.2Statementof Problem

The majority of Nepal's present population depends on agriculture for their subsistence but still about 63% of the agricultural lands are deprived of modern irrigation facilities (FAO-2004). All crop water requirements of the non-irrigated lands are met solely by rainfall. The increased precipitation variability may create difficulties in cultivating these lands and could result in probable food insecurity for the population. Moreover, the agricultural land currently having irrigation facilities may not have sufficient water during dry seasons in the future due to climate change that may result in water stress in the agricultural sector of Nepal. Changing climatic conditions causing soil moisture reduction, thermal and water stress, flood and drought etc are putting the whole agricultural sector at serious risk (AFDB-2002).

In some cases, due to rugged topography and lack of roads, people cannot access food even when they could afford to buy it. Currently, about 31% of Nepal's total populations in below the poverty line and about 95% of them live in rural areas (MOF-2005). But still about 25% of population under poverty line. the poor people are more vulnerable to climatic extremes as well as gradual changes in climate then the rich because they have less protection, less reserves, fewer alternatives and a

lower adaptive capacity because they are more reliant on primary production(IPCC-2001,AFDB-2003). About 29% of the total annual deaths of people and about 43% of the total loss of properties from all different disasters in Nepal cause by water induced disasters like floods; landslides are avalanches (khanal-2005).

Therefore, it is the very important to quantify such impacts in other to identify the problems and adaption options and there by minimize the potential damage magnitude of climate in production of major crops such as paddy, maize and wheat on a local and regional scale. This study focus to climate change and local Adaptation in Agricultural in Kavre and Rupandehi of district. The study has been sought to find out the answer to the following problem.

1. What are the changing farming system and yields production in a changing climate?
2. What are the local adaptation measures adopted by the communities?

1.3Objectives of the Study

The major objective of this research is to study the climatic trends and changes in agricultural production, farming system in Kavre and Rupandehi District and to document the adaptation measures adopted by the local people.

The specific objectives of the study are;

i) to know the changing farming system and yields in a changing climate in Kavre and Rupandehi District.

ii) to study the local adaptation measures adopted by the communities in Kavre and Rupandehi District.

1.4 Significance of the Study

Agriculture is the largest sector and backbone of Nepalese economy and more than 76% of population depends on this sector (NPC-2010). agriculture sector contributes about 36% of the total GDP of the country , thus Nepalese economy depends heaving on agriculture .agriculture is very much sensitive to climate change causes the extreme impacts on agricultural production and the adaptation measures in these remote areas of Nepal. In context of Nepal lack of research and credible evidence is the major challenge for fighting with impact of climate change. Nepal has very diverse microclimatic and geophysical conditions within small areas. So the best way

to measure the impact of climate change would be conduct researches at the community level. Community and household level studies yield information about perception, local knowledge and adaptation measures and provide basis for development of strategies to fight climatechange locally. This research seeks to investigate impact of climate change in agriculture and adaptation measures adopted by the local people in the Kaver and Rupandehi District of Nepal. In such a situation study is quite significant.

1.5 Limitations of the Study

Study is conducted only in 20/20 household survey in each each district. This study alone cannot generate complete idea about climate change, its impact and adaptation measures in the hill and Tarai of Nepal. It only provides general information about specific regions. More intensive researches should be conducted to generalize the whole hill and tarai region of Nepal.

1.6 Organizations of the Study

This thesis is broadly divided into six different chapters via, introduction, review of literature, research methodology, climate change and its effects on agricultural crops of Kavre and Rupandehi districts and adaptations and lastly critical evaluation, conclusion and recommendation. The first chapter includes the background, statement, problem, objective, limitation and lastly organization of the study. The second chapter includes review of literature; in which theoretical frame work of climate change and its effects on agricultural crops shown which are divided into two segment one for Kavre and another for Rupandehi Districts. The third chapter focus on research methodology in which different sub topic are included. Chapter four is focused on description of the study area. Chapter five includes critical evaluation, conclusion and recommendation of the study. And finally this paper is closed with references.

CHAPTER-II

REVIEW OF THE LITERATURE

In this chapter it analyzed theoretical reviews and reviews of past study. In theoretical review it focused on climate changes and its impacts on agriculture and process of adaptation.

2.1 Theoretical Review

Agrawal, A. (2008) Climate change is now becoming a serious social and environmental problem of the world and development issue in developing countries. The decade long negotiation on climate change has progressed in policy debate but contributed less in terms of real action on ground. This study tried to explore and analyze governance and financing on climate change adaptation with particular reference to Nepal using political economy and institutional analysis framework. The findings suggest that Nepal has attempted, but not been able, to capitalize on international and national funding and implementation of its adaptation priorities. The national outlook and public support is positive in Nepal. There are, however, some issues around institutional and financial mechanisms. Lack of policy coherence, donor aid fatigues and sectoral fragmentation of programmes are together preventing the environment for adaptation to climate change in Nepal. This is impaired by the lack of sufficient information on country's exposure to climate change which constrains decision making at different levels. One of the plausible strategies to overcome the governance challenges can be decentralized mainstreaming actions that promote collaboration and engagement among various actors.

The capacity to deal with climate change uncertainty and innovations around shaping implementation demands for new skills, knowledge, technology and capacity. It should go beyond national and sector specific limited capacity to more broad knowledge and capacity at various levels ranging from community to policy makers. Centralized information and knowledge management should be challenged with innovative and flexible and shared learning dialogue and knowledge transformation from one village to another, district to district, generation to generation and beyond administrative and political boundaries. Technology transfer debate has to happen within climate change community, government and donors. Similarly, the capacity

need should be identified from a different paradigm that fosters capacity of recipient rather than experts and higher level agencies.

Huq, S. (2009), views on mitigation have increased the need of urgent actions on adaptation for individuals, communities and nations for securing livelihoods and sustaining development achievements. This fact was agreed by international community as reflected in the Bali Action Plan (decision 1 c and d) (United Nations Framework Convention on Climate Change. The Cancun Agreements reaffirm putting adaptation of the same importance to recognizing unequivocal warming of the climate system mostly due to anthropogenic greenhouse concentrations. These international agreements on adaptation warrant appropriate actions globally to support the vulnerable communities residing in poor and vulnerable. On the other hand, mainstreaming progress has been limited by the international discussion and negotiation around adaptation financing. While there is no universally accepted definition of mainstreaming, it has been variously defined and described.

Bird, N. (2011), change in the region got proper attention from scholars only in the late 1990s, for instance. The focus was on measuring greenhouse gases, identifying general impacts as well as specific impacts on water and snow /glaciers, calculation of the temperature rise and also on communication aspects of climate change. Only after 2000, particularly after 2007, climate change became one of major concerns in academia in Nepal from diverse perspectives.

The form of natural and social science research, development programs and policy making. Therends is increasing more rapidly in recent days and has generated a substantial number of literatures. These references touch various aspects of the climate change in the region in the different extents. The current bibliography is an attempt to explore the landscape of climate change writing in Nepal.

Dahal, N., (2008), Agricultural production comprises 32% of Nepal's gross domestic product but only 13% of that production is traded in markets. Agricultural lands are primarily divided between three agro ecological zones: the lowlands of the Terai (which comprise 43% of total cultivated land), the regions of the lower hills and mountains of the upper Himalayas. Rice is the primary crop in the lower elevation regions of the country, wheat is grown in the Terai and the valleys of the Himalayas, and corn is the principle crop of the hilly regions, Nepal was able to meet all of its

domestic cereal needs, but as population growth has outpaced agricultural productivity, it has been forced to heavily rely on food imports, primarily from India and other countries in the region. Crop productivity, at 20-30%, is significantly lower than that of the rest of South Asia. This can be attributed to a variety of factors. Most production is at subsistence levels and limited to smaller, nonindustrial operations.

Maraseni, T. N. (2012), Farmer landholdings are extremely small, with less than 100,000 farmers owning more than 0.3 hectares (ha) of cropland and the vast majority farming on less than 0.5 ha (IRIN 2008a). Land degradation from unsustainable land use also severely limits crop productivity. Overgrazing, rampant deforestation, overuse of chemical fertilizers, and unscientific farming practices have all contributed to widespread topsoil erosion and nutrient loss, contributing to already naturally frequent occurrences of landslides in the hills and floods in the lowlands Peer-reviewed studies analyzing regional changes due to global CC in South Asia - and even more so in Nepal are limited, especially in relation to water resources, because of the difficulty in scaling down the general circulation models (GCMs), a lack of long-term climate records, and the natural high variability of water supply outputs do not have sufficient spatial resolution to provide information on changes across the different elevation zones. A variety of different non-climate factors that have varying effects on water resources and agricultural systems in the region, including pervasive resource mismanagement and rapid population growth, also cloud the effects of CC. There are, however, general trends that have been corroborated by ground level observations of various communities in Nepal that do at least give a basic framework of the identified and projected changes, including glacial melt, changes in precipitation patterns, and increasing water stress into the twentieth century, with most of South Asia projected to be under water stress.

Patt, A. (2010). Summarizes information that is available in existing literature on the primaryClimate variables, i.e., temperature, precipitation and runoff for Nepal .There were also issues around institutional governance due to weak monitoring system and law enforcement. It was further damaged due to high political interferences and corruption cases. The political instability in the centre is affecting the fiscal planning and budgeting system as well as largely on the government’s development programme and reach in rural areas. “Political instability for the last two decades and current stalemate over agree(ing) a new Constitution has inhibited government

agencies to focus on mainstreaming agenda". Many of the stakeholders, during consultation, highlighted issues around transparency and corruption providing examples of development planning. Interestingly expenditure of development budget was also a problem as many government bodies had not met their annual target.

Helvitas (2011, observed studies on climate trends suggest that from 1960-2003 there have been no increases in annual temperature over Nepal (World Bank 2009b; McSweeney et al. 2008). Other studies cite an increase in temperature in recent years (Cruz et al. 2007; Agrawala et al. 2003), with more pronounced warming at higher altitudes (Liu and Chen 2000; Bhutiyani et al. 2010). There has been a small but significant increase in the frequency of hot nights and a significant decline in the annual frequency of cold days and nights. Hot nights have increased by 2.5% (GCMs predict that the country is expected to become warmer with more frequent heat waves and less frost. Average temperature is predicted to rise significantly by 0.5 to 2.0 ºC by 2030 , 1.3 to 3.8 ºC by 2060, and by 1.8 to 5.8 ºC by 2090. The number of days and nights considered hot by current climate standards is projected to increase, occurring on 11 to 18% of days and on 18 to 28% of nights by the 2060s. The greatest increase is projected to occur during the months of June to August.

Reid, H. (2009) Projected mean annual precipitation for Nepal does not show a clear trend with reference to both increases and decreases: -34 to +22% by the 2030s; -36 to +67% by the 2060s; and -43 to +80%. This is, in part, because the exact effects of CC on precipitation levels in the region are based on complex factors governing the Asian monsoon and their interaction with increased carbon dioxide (CO) levels, which is not well understood. Nevertheless, there is general agreement in recent models and studies that the monsoon will at the very least become more variable in the coming decades. Various studies, including those from the Intergovernmental Panel on Climate Change (IPCC), indicate that on a general level the summer monsoon (June to August) will become more 'intense', but also more variable, meaning more frequent heavy rainfall events, even as the number of rainy days decreases. Although monsoon rainfall projections for Nepal do vary, more models suggest an increase rather than a decrease towards the end of the century.

Khadka, R. B., (2012), studies indicate that multiple variables, including major land use changes, increasing aerosol emissions, and elevated CO levels due to CC, could all potentially trigger abrupt transitions between two stable states of the monsoon in a

“roller coaster scenario,” leading to either a more dry monsoon, with significantly less precipitation than current levels, or a more wet monsoon, with much greater rainfall intensity. These authors conclude that the monsoon would most likely be weakened initially, leading to a dryer state in the short term due to the effects of land use changes and greater aerosol production from increasing industrialization on the Indian subcontinent, followed by a more wet monsoon in the long term as the effects of increased CO2 levels become increasingly significant.

O’Brien, K. L. (2007), Further conflating any understanding of predicted changes to precipitation levels are these effects of aerosols like black carbon or soot. Such effects are primarily felt through atmospheric brown clouds (ABCs), “regional scale plumes of air pollution that consist of copious amounts of tiny particles of soot, sulphates, nitrates, fly ash and many other pollutants” that hover over parts of the globe (including South and East Asia) with concentrated industrial emissions, limiting summer monsoon rainfall, contributing to glacial retreat in mountainous regions, and ultimately affecting crop yields.

Dahal, N., (2008) Nepal as the 4th most vulnerable, indicating the extreme vulnerability situation of the country 4. Disease epidemics, andslide, floods, forest fire, thunderstorms and cold waves have dominated disaster events in the past. In the last two years over 1.9 million people have been severely affected by similar events.

There are evidences showing the strong linkages between poverty and climate change

Helvitas (2011) Nepal’s climate is largely the function of altitude and aspect due to its mountainous topography. There are several distinct micro-climatic areas that consist of peculiar climate conditions. There is a large spatial variation in annual rainfall across Nepal ranging from less than 150 mm to more than 5,000 mm, and similarity with its temperature. The change in temperature and precipitation observed so far for the last 30 years is uneven pattern despite variation of temperature which is higher in higher altitude. The rate of warming in the Himalayas is greater than the global average, confirming that the Himalayas are among the region’s most vulnerable to climate change. Although not enough, impacts were seen in hydrological systems, agriculture and weather related hazards such as drought, extreme rainfall, and forest fire.

Ayers et al. (2011) argue that the real drivers of the global political economy of climate change are the evolving financial architecture at both international as well as National level. This implies that understanding the climate financing at National level

is key to understanding climate change governance in general. Nepal has submitted its NAPA to UNFCCC. The total 9 programmes prioritized in NAPA as most urgent and immediate require 350 million USD to implement; the total requirement for implementing NAPA is over billion US dollar for coming 3-5 years. The detailed climate financing Nepal has available weather data for only a short period since 1975 for analysis and they do not represent all the diverse climatic situation of the country. Sparsely distributed and redundant data cannot represent the country's climate system and its change. So,there is a gap in climate information in Nepal. There were uncertainties for the future as there was lack of sufficient data to predict future climate scenario. Other factors, such as land use practices, massive deforestation and unsustainable development practices, often made development more challenging in Nepal.

Climate change creates new ecological niches that permit the entry, Establishm ent and spread of pests and diseases into new geographical areas. Higher temperatures speed up the lifecycle of some pests and disease vector insects so that populations grow faster. Rainfall variability, carbon dioxide concentration the atmosphere, extreme we after events and the characteristics of hosts and ecosystems (e.g. Monoculture,biodiversity, natural enemies) further impact the spread of plant pests. This occurrence can negatively affect crops and there availability of food of appropriate quality by increasing production volatility.

O'Brien, K. L. (2007), Climate change is a multifaceted problem and demands the involvement of multi-sectors and institutions. It challenges the traditional sectoral approaches and demands for cross sector response and coordination. Mainstreaming offers the opportunity of addressing the multi-dimensional complexities in adaptation and leading towards more harmonized and collective response United Nations Framework Convention on Climate Change (2011).

Communities adopt different coping mechanisms to deal with the impacts of climate variability. Climate risk management strategies include soil, land and water management, and use of improved crop varieties, early planting and mixed cropping to reduce the risks of crop failure. Careful storage of grains, alternative irrigation methods, gulley control, contouring/terracing, bonding through bioengineering techniques, and community plantations are also practiced widely. For effective

implementation of these measures, communities need access to information and skills (RCRRP, 2012)

.MOAD's later TYIP (2010/2011–2012/2013) emphasizes the transformation of subsistence into competitive agriculture. Major objectives are ensuring food and nutrition security; making the agriculture sector competitive and business-oriented with increased production and productivity; reducing poverty by increasing employment and income-generating opportunities; minimizing the adverse effects of environment and climate change on the agriculture sector; developing cooperatives to support agricultural development; and enhancing human resources for the sustainable agricultural development process. The TYIP emphasizes the need to carry out climate change impact assessment, awareness raising, dissemination of climate friendly technologies, and promote the conservation, promotion and sustainable utilization of agricultural biodiversity.

The National Agriculture Sector Development Priority (NASDP) for the Medium-Term (2010/11–2014/15) (Government of Nepal, 2010c) highlights the limited capacity for adaptation to climate change effects. Awareness rising at different levels and the need for location-specific adaptation strategies to manage risks are clear priorities.

2.2 Climate Change Impacts on Agricultural Systems

Practical Action (2009), the effects of CC on agriculture in Nepal can be divided between systems that are dependent on thesummer monsoon and those that are dependent on snow, ice and glacial melt. Agricultural systems dependent on water sourced from snow, ice and glacial melt will see an immediate increase in water supply, but will also be in greater danger of GLOFs that threaten crops, water infrastructure, and mountain livelihoods, in general. Whether such an increase will consequently increase productivity in the short term is unknown, as very little exists in terms of water storage in Nepal, however primitive, to harvest such an excess of water supply. Long term, the effects of reduced water storage and variability of supply from earlier thawing of the snowpack and deglaciation have the potential to be significant, with glacial melt accounting for 30% of per capita consumption in some lowland regions and increases in temperature causing consequent increases in agricultural water demand. Unfortunately, because these effects are not likely to be

felt for decades, the short-term benefits of increased runoff will likely delay any comprehensive long-term proactive management plans or systems dependent on the summer monsoon, multiple scenarios are possible due to the pervasive uncertainty in the models and lack of data, including the 'roller coaster' discussed previously, where the monsoon could abruptly transition between 'dry' and 'wet' states.

In the short term, however, when taking into account the effects of increased aerosol production and ABCs, there is more certainty that less precipitation is likely to occur during the summer months as the number of rainy days decreases, even though the frequency of intense rainfall events will increase. Increasing variability of precipitation patterns will have a significant effect on crop productivity, as farmers will have to adapt to changing onset and termination dates of the monsoon. Later start dates significantly impacted rice crops in 2009, as many seedlings were lost use to the delay in rainfall, and many did not have enough time to mature enough for a viable yield.

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 yields, 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 intensity from east to west.

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 malnourishment 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.

There are two main branches of adaptation commonly cited in the literature: autonomous andstrategic. Autonomous adaptation refers to the actions of individuals taken at the household level to make changes that reduce vulnerability to a changing climate, regardless of planning, policies and strategies implemented at the national level. For instance, agricultural households can apply different management techniques that involve less water use, greater cropping intensity, crop diversification, micro-irrigation and small-scale storage, or anything that improves the resilience of the income base during fluctuating conditions.

In the near-term, autonomous adaptations in agro-economies, such as Nepal, will focus on shifts in agricultural and water management; however, income diversification is likely to become the primary autonomous adaptation strategy in the long term. Major changes like migration to urban centers, off-farm employment, remittances from abroad, or new businesses that capitalize on greater access to markets provided by advances in information technology and other infrastructure are already used as a means of adapting to changing circumstances.

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 in water resources, in both developed and developing countries, strategic adaptation planning is fundamentally about water management. 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 agricultural techniques that are less water intensive, refocused efforts on the rehabilitation of water infrastructure and development via expansions in storage and irrigation, and reevaluating water management within the context of the impacts of CC.

Though the majority of CC impacts will be felt in water resources, understanding how they are connected to basic development and poverty alleviation at the household level is also a crucial part of any strategic adaptation planning. In a broad lesson from water resources development in the past, such planning should not be limited solely to water resource issues, but should also focus on “enabling autonomous adaptation

processes by supporting the development of flexible, resilient, and accessible social and physical infrastructure systems. This means that many of the current projects and avenues for expanding development and improving the livelihoods of the millions of poor in South Asia through the creation of greater access to markets via infrastructure like roads, electricity and telecommunications would also be included in the strategic adaptation process.

Malla, G. (2008), there are also hundreds of NGOs active at the local level in Nepal working directly with local populations on a spate of issues and projects, but often with little coordination with government programs. The reasons for this are numerous, but most directly due to the lack of transparency, oversight and effectiveness in government institutions that have provided enough incentive for INGOs to avoid the government. Unfortunately, this has sometimes led to a mutual feeling of mistrust between the two sides, and a sense of resentment from government officials that the NGOs are turning local populations against them by creating impossible expectations of the local government. Based on observations in the Salleri region and conversations held with locals, NGOs seem to have been more effective in implementing projects and improving the livelihoods of local populations, especially in remote areas, than local level government institutions.

2.3 Review of Past Study

Malla, G. (2008) The severity of impact of climate change was out of the communities' capacity and coping ability. Findings of the household survey, carried out during the research in two VDCs of Pyuthan, also found the limitation of traditional adaptation practices. Respondents reported that many of the adopted traditional practices were ineffective. Almost 89.1% of the respondents in both the VDCs perceived that the existing adaptation options were ineffective and could not address the climate risk and impact. Similarly, the focus group discussion with local government officials, communities and civil society revealed that there was lack of information and technology to deal with extreme climatic events and uncertainties. Findings also showed that there was also a lack of government support and flow of resources on adaptation. Furthermore, government service providers were not confident about the technology needed to respond to the extreme events and impacts generated by climate change.

Khadka, R. B., (2012) in climate change adaptation, the institutional architecture and governance is studied mostly from development assistance perspective. Bringing the institutional governance issues from developing country's perspective and experiences will add value to the debate and discussion going on at both national and international level. Both the institutional and financial mechanisms are important pillar of governance, so they should be analysed together. This is largely shaped in by policy. Adaptive polices can only be effective if they are integrated. The following sections will outline the major issues and challenges related to climate change governance in Nepal.

Regmi, B. R. (2004) Climate change financing is recently in the spotlight and debate at national level. In his recent newspaper article described the debate saying the fundamental debate in adaptation financing, at national level, is the notion of implementing under aid umbrella or separate financial umbrella as currently agreed and debated under UNFCCC. There are principle differences in aid money and adaptation resources. Aid money is donors' voluntary commitment to help developing countries to progress development, whereas the adaptation resources is a moral responsibility and compensation from developed countries and the right of least developed countries to have access to resources. Climate change is a new area of research and policy in Nepal. There were very few institutions involved in climate change debate and discussion; practical interventions are rare. Government capacity in climate change was very weak. This has also affected the understanding and awareness among government line agencies about the urgency of climate change problem. The political parties and government leadership were busy in messy politics and has little time to think about climate change.

National Climate Vulnerabilty Study Team (2009),Climate change affects almost every phenomenon on the earth, climate change adaptation demands a system of effectively functional institutions and networks involving local to national and international actors. These institutions can bring comparative advantages and add value to foster adaptive capacity and community resilience. The purposeful participation and engagement of stakeholders can be both in terms of management as well as service delivery. The mix of local and national capacity in forging meaningful dialogue and delivery is important in an adaptation context. There is also argument that the important way of achieving collaboration will be establishing principles of

adaptive and collaborative management within and between national and local institutions. The multi-stakeholder forum at national and local level is meaningful to forge consensus on the governance mechanism and delivery options.

Biodiversity loss is also occurring and is expected to continue if the effects of climate change intensify. Since different plant and animal species are suitable to specific ecosystems, changes in soil, temperature, humidity, sunshine, and water availab ility will alter a particular specie's ability to survive in its environment. Additi onally, modern and hybrid seed varieties are increasingly replacing local traditiona l varieties as they often provide greater drought resistance or higher Yields. Col d-water fish, herbs, pasture lands; apple trees and livestock are expected
to be most at risk in Nepal. (Subedi, J. 2010)

Poverty and a lack of purchasing power limit the poor's ability to access food. Even if the poor are able to consume enough calories, diseases and a lack of micronutr ients may compromise their bodies' ability to absorb and synthesize nutrients.

Climate change will affect people of different genders, ethnicities, caste, and geograp hical regions differently. Rising temperatures, unpredictable precipitation patterns, and an increase in extremeeather events will have a disproportionate impact on women who depend on subsistence farming for their livelihoods. In a traditionally patriarchal 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.

The stresses to agriculture and food and nutrition security that have accompani ed changing weather patterns in recent years have necessitated that men and women a dopt different methods of coping. Many men and boys are migrating seasonally in search of off and on farm work. Migration is typically. Migration is typically scheduled around agricultural patterns, with men departing after planting season and returning in time for the harvest. In the Terai, men are able to remain closer to home, as there is an abundance of agricultural work in neighboring India and other parts of Nepal. Conversely, men residing in the hills are obligate to migrate for longer periods of time because of the greater distance they need to travel in search of work.

Climate Change Adaptation

Climate change adaptation strategies can be autonomous or planned, anticipatory or reactionary. Autonomous adaptation draws on existing knowledge and technology to respond to climate variability whereas planned adaptation mobilizes institutions and policies in order to increase adaptive capacity and invest in new technologies and infrastructure ministry.

Such as wealth, equality, political and social stability, infrastructure, access to natural resources, and social capital determine a person's or a community's adapti ve capacity. Developing countries have limited faculty to implement comprehensive climate change adaptation initiatives. Policies and funding are often inadequate to allow for early warning of oncoming threats and disasters, or alleviation after impact.

Left largely to their own devices, impoverished people try to minimize irrevers ible losses of livelihood by devising their own means of survival. These coping mechanisms, however, are often reactionary and insufficient. Climate change discussion formally entered in Nepal in 1992, when Nepal became a party of the United National Framework Convention ofClimate Change (UNFCCC) at the Rio Convention, 1992. However, Nepal and theHimalayan region were already in the academic radar of the emerging debate of climate change. For example, based on entries in this bibliography, Nakajima talked about the climate change in South Asia in 1976. Inthe late 1980s, when human induced climate change was getting academic recognition globally, Nepal and Himalayan region also got some attention, as shown here by Shah (1985–1986) and Gleick (1989), who, however, focused mainly on security and conflict aspects of GHGs effect and climate change. These were the initial academic concerns of climate change in the region.

He introduction of new technologies for irrigation, water and soil conservation, and new seed varieties, can allow farmers to adapt to climate stresses.

The United Mission to Nepal (UMN), in collaboration with the Nepal Agricult ural Research Council (NARC), is currently working with farmers to experiment with different varieties of seeds, particularly rice, that require varying amounts of water or that can be sown at myriad dates according to shifts in precipitation patterns.Farmers are testing new varieties for characteristics such as drought tol

erance, suitability of grains for specific purposes, and insect and pest resistance. It should be noted, however, that replacing traditional varieties with modern or external varieties may threaten biodiversity by replacing local species of plants and changing the pollinating behavior of local insect.Over the long term, this could potentially decrease yields. It is therefore essential to balance potential innovations for addressing food insecurity and climate change with critical analysis of potential harm to long term agro ecological stability in order to find solutions which enable adaptation without undermining the inherent resilience of food production systems.

Such strategies might be as diverse as improving water management, diversifying cropping strategies, improving access to markets, or developing community insur ance schemes. This section will explore several options for adaptation. These options have either been adapted from countries with simila contextual environments to Nepal, have potential for adoption in Nepal, or are already being experimented with in Nepal.

Agroecology is the sustainable management of agricultural systems through the applic ation of ecological principles. It is premised on the idea that ecosystem services can be improved through an understanding of ecological relationships and processes while fewer external inputs and causing fewer negative environmental or social impacts. An agrological approach attempts to replicate the structure and function of natural ecosystems and function of natural ecosystems so the plants and animals may coexist in harmony with local ecosystems and thrive accordingly.

Farms that incorporate both livestock and crops into the same system can recycle a great proportion of nutrients. Vegetative biomass can be converted into plant derived products such as building materials, paper, fuels, animal fodder, or fire wood. If animals are include in the farming system, biomass is cycled back into the system when they excrete the phosphorous, potassium, and nitrogen contained in their feed. Animal excrement not only fertilizes the soil, it can serve energy purposes as well.

At present, firewood accounts for approximately 90 percent of the biomass enery consumed in Nepal. Firewood is not a sustainable source of energy because once it is burned, it cannot by cycled back into the farming system.

Methane digesters that convert animal dung into biogas, offer a more sustainable substituteBiogas can serve the cooking and lighting purposes of rural families oncethe gas is consumed, the slurry used to fuel the digesters can be reused as a natural fertilizer andbe cycled back into the farming system.Efficient recycling depends upon minimal losses of nutrients. Farming practices that support development of healthy, vigorous root systems result in more efficient uptake and use of available nutrients. Farming practices that help minimize nutrient losses while building up root systems include crop rotations, reduced tillage, maintaining crop residue, growing cover crops, composting.

M soil evaporation, the roots increase water infiltration in the soil, building up the water table and protecting crops from low Precipitation.Trees also actas a defense in harsh climates, shield crops from the wind, sun, and rain. Micro fauna and micro florain the soil flourish as soil organic matter from tree litter and dead roots becomes enriched. As a whole, agroforestry systems are less susceptible to weather fluctuations and weather extremes such as Access to information on water resources, agricultural markets, and weather forecasting has helped farmers across the world adapt to rainfall and temperature variability. Accurate, timely, and location specific forecasts give farmers greater capacity to make decisions that will reduce their vulnerability to unfavorable climate conditions. (Cheetri, R.P. 2011)

Rai, J. K. (2011) the effects of the changes in precipitation and temperature are expected to change the balance between ‘green water’ and ‘blue water’. ‘Green’ water is the water that is used or lost in catchments before it reaches the rivers, while ‘blue’ water is the runoff that reaches the rivers. Glacial melting and retreat, rapidly thawing permafrost and continually melting frozen soils in higher elevations is already being observed. In the subbasins dominated by glaciers, this will mean increased downstream flows in the short term, but in the long term, runoff is expected to decrease with the retreating glaciers, causing major reductions in flow and significantly affecting downstream livelihoods and ecosystems. In the winter months, more precipitation is falling as rain, which also accelerates deglaciation, and in turn means a shorter winter and earlier snowmelt, ultimately affecting river basins and agricultural systems dependant on surface water diversions for the summer growing season.

CHAPTER-III

RESEARCH METHODOLOGY

The selection of methodology is one of the most important parts of any research. A systematic research study needs to follow a proper methodology to achieve the predetermined objectives. Research methodology is a sequential procedure and methods to be adopted in a systematic study.

3.1 An Overview of Study Area

3.1.1 Rupandehi District

Among the six districts of Lumbini Zone, Rupandehi (27°20' to 27°45' N latitude, 83°10' to 83°30' E longitudes, elevation 100-1229 m above sea level (asl), total surface area 1360 sq. km.), a Terai district, lies in the Western development region according to political division of Nepal and falls under central Nepal according to ecological division proposed by Stern (1960). Land use pattern of the district is as follows: 52.13% agricultural land, 20.87% urban area and roads; 24% (32006 ha) forests; water resources cover approx. 4%. Total number of the community forests (CFs) was 55 with a total of 8,094 ha area benefited by 32,099 HH until 2006 (DFO Rupandehi 2006) in Rupandehi district. The total population of the Rupandehi district was 708,419 (CBS 2011).

The study area lies in Churia range of Rupandehi district at Parroha Village Development Committee (VDC) area within the range of 27°41.5' to 27°45' N latitude, 83°20.4' to 83°22.3' E longitude and elevation 250 to 719 m asl The area lies about 10km west on the Churiya range from Dovan bottleneck area of TAL in Palpa district. Majority of study area comprises south facing slope with several micro aspect ranging from South-East to South- West. Two sites (SE slope: South-East facing slope and SW slope: South-West facing slope) lying between 250 and 550 m asl were selected for the present study. Ghamaha khola, a perennial river, passes through mid of two aspects. The Parroha Community Forest has an area of 633 ha with 1,267 households (HH) and 8,849 members are involved as a forest user's group (FUGs) in this community forest. For management purposes the Parroha Community Forest has been divided into three blocks. Present study was carried out mainly in Rani block (SE slope) and Kapase block (SW slope) of PCF separated by a Ghamaha Khola.

Climate

Since the study area lies in Churia range (Siwalik), the climate of the study area is typically tropical, dominated by South east monsoon. The climate of the study area has three distinct seasons: rainy monsoon (June - September), cool and dry winter (October-February) and hot dry summer (March - May). The nearest weather station, Butwal lies to the east of studied forest and is 16 km. far from it. The monthly average minimum temperature of the year 2009 to 2013 was 11.36°C and maximum 36.48°C (Figure 1) and average annual rainfall recorded during 2009 to 2013 was 1899.68 mm.

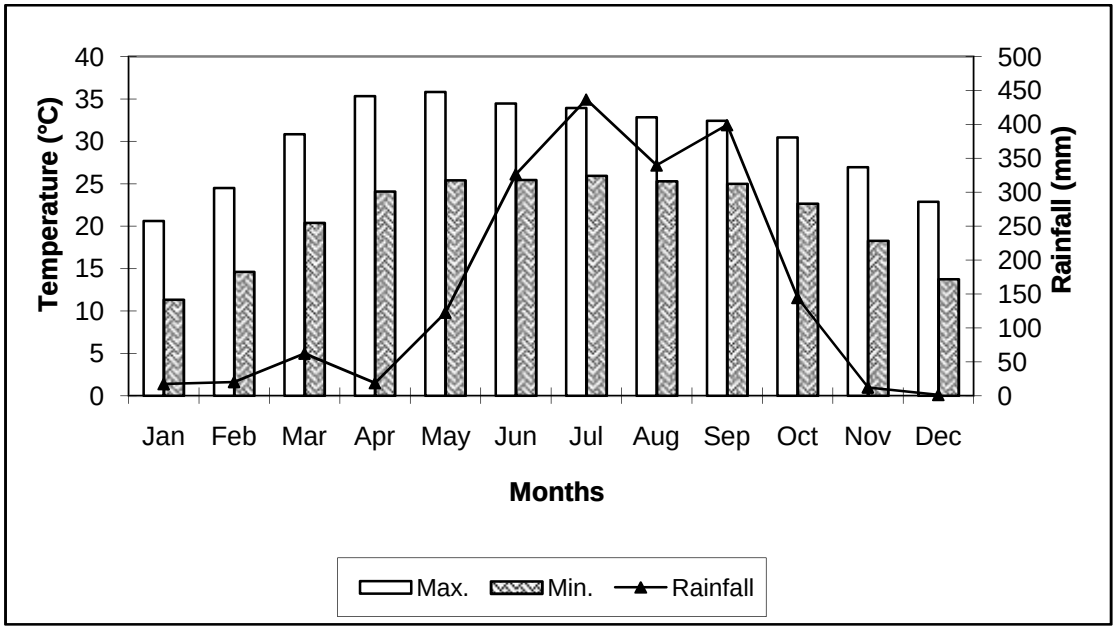


Figure 1. Monthly average maximum and minimum temperature, and monthly rainfall in the study area (2009 to 2013) recorded at Butwal Weather Station (27°42' N, 83°28' E, elevation 205 m asl)

(Source: Department of Hydrology and Meteorology, Government of Nepal).

Vegetation

The forest of the study area has tropical vegetation. The forest is hill sal (Shorea robusta) forest with sal as a dominant tree species. Other associated species are Saj (Terminalia alata), Banjhi(Anogeissus latifolia), Pyari(Buchanania latifolia), Botdhayaro (Lagerstroemia parviflora), Karma (Adina cordifolia), Bhalayo (Semecarpus anacardium) and shrub species as Bharlo (Bauhinia vahlii), Thakal (Phoenix humilis), Gaujo (Millettia extensa), Galeno (Leea macrophylla), etc. Among

the herbs, Aakhle (Eranthemum ciliatum), Musli (Curculigo orchioides), Pani sara (Globba racemosa), etc. and grasses like mothe (Carex cruciata), priya khar (Cymbopogon pendulus), sabai (Eulaliopsis binnata), etc. dominated the forest floor. These forests are green throughout the year except in summer season due to leaf fall in deciduous species.

Wildlife

The wild animals commonly found in this forest are tiger (*Panthera tigris*), leopard (*Panthera pardus*), spotted deer (*Axis axis*), jungle cat*(Felis chaus)*, jackle *(Vulpes sp.)*, pigmy hog (*Sus* sp.), etc. Among the birds, the notable birds found in this forest are jungle fowl (*Gallus-gallus mungi*), common koel (*Eudynamus scolopacea*), red-vented bulbul (*Pycnonotus jocosus*), asian paradise flycatcher (*Terpisphone paradise*), dove (*Streptopelia* sp.) and peafowl (*Pavo cristatus*), etc.

Soil

The Siwalik Zone is composed of unstable soil with sand stone, shale and boulders. The soil in Churiya hills (Siwalik) is mixed with stones and is unsuitable for cultivation. The soil in the Siwalik varies from loamy sand to silty clay loam and sandy clay loam while it is alluvial in the Terai (Shah 1999). Soil of the study area was sandy loam to sandy clay and black- grey- yellow in colour.

3.1.2 Kavre District

Kavrepalanchok District is a part of Bagmati Zone, is one of the seventy-five districts of Nepal, a landlocked country of South Asia. The district, with Dhulikhel as its district headquarters, covers an area of 1,396 km² and has a population of 385,672.

Physical Setting of Panchkhal VDC

Kavrepalanchok district covers 87 VDCs and 3 Municipalities lies in the Bagmati zone having 85°49' east longitude and 27°20' to 27°85' north latitude is in 31 km towards east from Kathmandu. The elevation of land is 350m (Dolalghat) to 3018m (Bethanchok Narayan Danda) from the mean see level.

The main trade road to Tibet, Araniko highway passes through this district. The historical cities in this district were Banepa, Dhulikhel, Panauti and Khopasi. The main occupations of people of the district were agriculture and animal husbandry whereas the city people had their owned trade business.

In Kavre district there are many basins like Panchkhal, Sunkhosi, Indrawati, Dapcha, Khopasi, Panauti and Bhakunde Besi. These basins are the granaries of the district.

There are variation on annual precipitation in this district. For example below 1300mm in Sunkosi, 1300-2000 mm in Roshi area and more than 2000mm in Bagmati watershed area (Metereological record, 1971-1984). Panchkhal VDC, the study area, is located to the middle part of northern side, is one of the 87 VDC of Kavre district.

There are different opinions in the forming of this VDC. Prsence of five different settlements of the people and five flat lands in this VDC is the main cause of naming 'Panchkhal' itself.

It has now developing in its infrastructure such as irrigation, health, education, electricity, communication and agriculture as well as market access. Since, the VDC is near to the city a lot of INGOs were working here. The program implemented by those INGOs along with government has played a significant role to change the life standard, attitude and behaviour of Danuwar in this VDC.

Location and Climate

Panchkhal VDC is situated at 85°38' east longitude to 27°741' north latitude towards north east of Kathmandu in the distance of 40km. Araniko highway, the trade road to Tibet in the boarder of neighbouring country China has passes through this VDC, touches the all nine wards and covers about 13km of the distance within this VC. The elevation of this VDC is 937m to 1219m from the mean sea level having annual precipitation more than 1200mm.

The structure of land pattern in this VDC is not uniform that is higher in northwest part and lower in southest part. The average maximum and minimum temperature of Panchkhal VDC is 30° and 16°c. Because of the hot climate and the malaria epidemics, there were only the Danuwars living in the Besi from their generations. But right after the eradication of malaria in the 1960 other non-Danuwar began to migrate in this place. Now the place has become a home of many ethnic groups such as Magar, Tamang, Newar, Brahmin and Chhetri.

Panchkhal VDC is surrounded by many other VDCs and municipality. They were Hokse and Devbhumi Baluwa VDCs in east, Dhulikhel municipality and Kavre VDC

in west, Anaikot, Jyamdi and Jaishithok VDCs in the north and Patlekhet and Fulbari VDCs in south. The natural boarder of Panchkhal VDC is rivers and the hills.

The Danuwar people of the study area also live in dune region on the bank of Bagmati River. Nowadays, Danuwar people are found all over the country because of their migration and travelling from one place to another in course of searching for jobs.

Population Distribution of Panchkhal VDC

Different kinds of caste/ ethnic people are distributed in Panchkhal VDC. The total household is 2364 and the total population of Panchkhal VDC is 11872, where, 5753 male and 6119 female. The population distribution is within nine wards. Among nine wards, no. of household and population in ward no. six is large and ward no. three is small. In totality, the no. of female is more than male.

Social Profile

The total population of Kavre district is 3,85,672 whereas male is 1889747 and female is 196725. There are 70,503 households.

This district is inhabited by various ethnic groups such as Bahmins, Chhetri, Newar, Tamang, Gurung, Rai, Limbu, Thakali, Magar, Bhujel, Gharti, Danuwar, Jirel, Majhi, Craine, Sunuwar, Chepang, Kumal, Bote, Lepcha, Route, Raji, Dhami, Kami, Sarki, Badi, Sherpa, Bhote, Pahari, Hayu etc

Natural Resources

Flora and Fauna

Forest is the main natural of Panchakhal VDC. There are two types of forest, government forest and community forest. The forests have cover about 36.52%area of the VDC, in which 17.90% area covered by governmental and left 18.62%area is covered by community forest. The government forest has occupied 387.09 hectare of land having the major forest were Panchakhal, Lamidanda and Thumka forest. Those governmental forests were not well managed and supervised with relative to the community forest. The name of the community forest are Thuli community forest, Dhaireni community forest, Kajiko community forest, Kolako Dando community forest, Ratmate community forest. These forests have covered 372.16 hector land of Panchkhal VDC.

Climate contrasts are reflected in natural vegetation. Sal (Shorea robusta), Bakaino, Chilaune (Schiima Walichii), Banyan tree, Bo tree, Harro, Panauri, Sallo, Champ, Koiralo, Eucalyptus, Sisso. Badahar, Sugandhakokila, Camphor, Simal, Sirnatara etc are the main flora found in these forest. Some of the species such as Camphor, Yellowsandalwood, Eucalyptus, Silky oak tree, Sisoo (Dalbergia sisoo), Sugandakokila, Badahar, Ultra sambaed tree were introduced in this VDC by some I/NGOs.

Besides this, various fruit plant are found in this VDC. Since the soil condition of this VDCC is mostly laterite and dry, the fruits plant like Guava, orange, lemon, sweet orange, pears, mango, Jackfruit, banana, papaya etc are found both in forest and public land.

Water Resources

Though the study area has been facing the problem of scare water resources, Jhikhu Khola, Danfe Khola and Chakhola are the main permanent source of water. Jhikhu Khola flows through middle of VDC, Danfe Khola flows through eastern boarder and Chakhola flows through northern boarder of the VDC. Those Kholas are not sufficient for irrigation of whole land of the VDC.

People have built a Rayale irrigation canal about 10 km length in 200. The canal has its initial point in the river of another VDC, by which people can now able to using their agricultural land in dry season. This helped the farmers to cultivate their land during the year. There has been not found any study on the access of ground water.

For drinking water, people use to collect water from natural water sources (kunwa) found throughout the VDC along with the drinking water taps which were jointly made by District irrigation office and drinking water authority. Some of the drinking water taps in this VDC were made by Nepal Red Cross Society with providing pure drinking water to keep people healthy. They have formed a user's group in every reservoir who has to pay a certain amount of money in other to use the drinking water.

Agricultural Land

The land of panchakhal VDC can be divided into three categories khet land which have well irrigation facility and cultivated during the year, Bari or pakho which have not irrigation facility and have to depend on mansoon for cultivation having only once

cultivation during the year. The land near the bank of river is known as khet whereas the having a sloppy step hill and somewhere- flat dry land is known as bari or pakho.

The VDC has contains a suitable land for agricultural purpose is 1,287.30 hectare which is 56.81 of total land. In this agricultural land, 24.51% is irrigated and lift 32.30° is not irrigated. The left land of VDC is covered by forest and grazing land having 810.40 hectare and 29.80 hectare respectively. Deforestation has been a matter of major ecological concern in recent years. Increasing need for agricultural land to feed a growing population and livestock which the land resource system cannot sustain excessive grazing, the annually increasing need for domestic fuel, and wanton felling trees for short-term gains have all contributed to a rapid rate of destoration. Ninety- eight percent of rural and 83% of urban energy consumption is derived from fuel wood.

The major food crop cultivated is paddy, maize, wheat, buckwheat, millet etc and the cash crops which are the main income generating from agriculture are potato, tomato and vegetable farming. They use more chemical fertilizer, insecticide and pesticide in their field which causes the finding of various unknown disease among them. Therefore, some of the farmers who were serious on their valuable life have now initiating their farming system in organic way.

3.2 Selection of Study Area

The researcher visited the fields of Rupandehi and kavre districts villages. As researcher belongs to Rupandehi district and few relatives belong to kavre district have been observed many farmers and own family facing the problem of climatic changes in harvesting, during the visit about few years ago. But scientifically, most of the agricultural activities done in hill and terai so researcher would like to focus on these two districts one from hill and other from terai. To observe the exact changes happened by climate change. In this regard researcher met the formers on their fields during they were forming their crops. Mostly, female respondents for the study. Mathematically, responded were in the ratio of 5:3 female to male. It is because most of the male have gone to abroad or out of village area. During study researcher found that respondents have changed their previous crops because of low productivity than before. Few were previously cropping rice, wheat and pulses but now they were engaged in cropping vegetables. The vast changes in seasonal rain fall and frequent

floods during rainy seasons and long drought as well force them to bear heavy losses.As there is no proper government policy or any kind of insurance policies to compensate them.Sopoor farmer diverted their traditional harvesting to modern vegetables harvesting.

3.3 Research Design

This research is designed to analyze the impacts of climate change and local adaptation in agriculture in Kavre and Rupandehi district hance to fulfill the objectives of the study .the nature of the study is descriptive and the study is totally based on primary data.

3.4 Sources of Data

The study base on the primary source of information for the source from different techniques such as face to face interview, group discussion, and informal interaction were used. Hydrological and meteorological data were collected from deportment of Hydrology and Meteorology (DHM), Government of Nepal and analyzed. The climate variables such as temperature and rainfall are utilized to explore the relation of climate of the paddy, maize and wheat where used and analyzed, taken from Ministry of agriculture (MOA). Relevant study reports, publications and maps were also collected and reviewed from various governmental and nongovernmental organizations.

3.5 Data Collection Technique

This study is based on primary data. This study analyzes the impacts of climate change and local adaptation in agriculture in Kavre and Rupandehi District.The main objective of the field study was to verify the collected data during the desk study stage, seek additional data and collect on the spot data. Walkover surveys were done using the structure questionnaire to collect the primary information, which is attaché in the annex. For the primary data collection, a total of 40 households (20 from Rupandehi and 20 from Kavre districts) were selected randomly for thepropose of household survey. Household level survey was carried out with list of structured and closed-ended questionnaires. The personal interviews conducted in cropping different aspects of climate change water resources, agricultural production and socio-diversity. As the research is focus on impact of climate change and local adaptation pattern were also included in the questionnaire. Thus the selection of the respondents were done

randomly, focus was given to the statement with form based-economy and elderly people. (For this propose different techniques such as face to face interview, group discussion, and informal interaction is used).

3.6 Primary Data

Interview: Twenty-twenty people with the 5:3 ratio of male and female different caste and status with different techniques such as face to face interview done.

Group discussion:

Sample Primary data from the study site are collected through structured interview, interview with key informants, and field observation. To ensure well-distributed representation, information on perception and awareness of climate change, vulnerability induced by climate change and adaptation measures of local communities to minimize such impacts and applies to understand the perceptions, attitudes and practices. Socio-Economic Vulnerability Assessment of each settlement is also calculated.

3.7 Data Processing

The data collected from above mentioned various sources have been tabulated so as to obtain desired outcome. The collected information has compiled and tabulated in different headings. Hence the data are processed by using relevant information.

3.8 Data Analysis

The collected data were analyzed using both descriptive tools like mean, standard deviation,percentage etc. and inferential statistical tools. Overall analysis was carried out by using Statistical Package for Social Science(SPSS) and Microsoft -Excel program wherever necessary.

CHAPTER-IV

AN OVERVIEW OF STUDY AREA

4.1Socio Economic Characteristics of the Respondents

In this sub-section socio economic characteristic such as age, education occupation annual income etc is presented in this chapter.

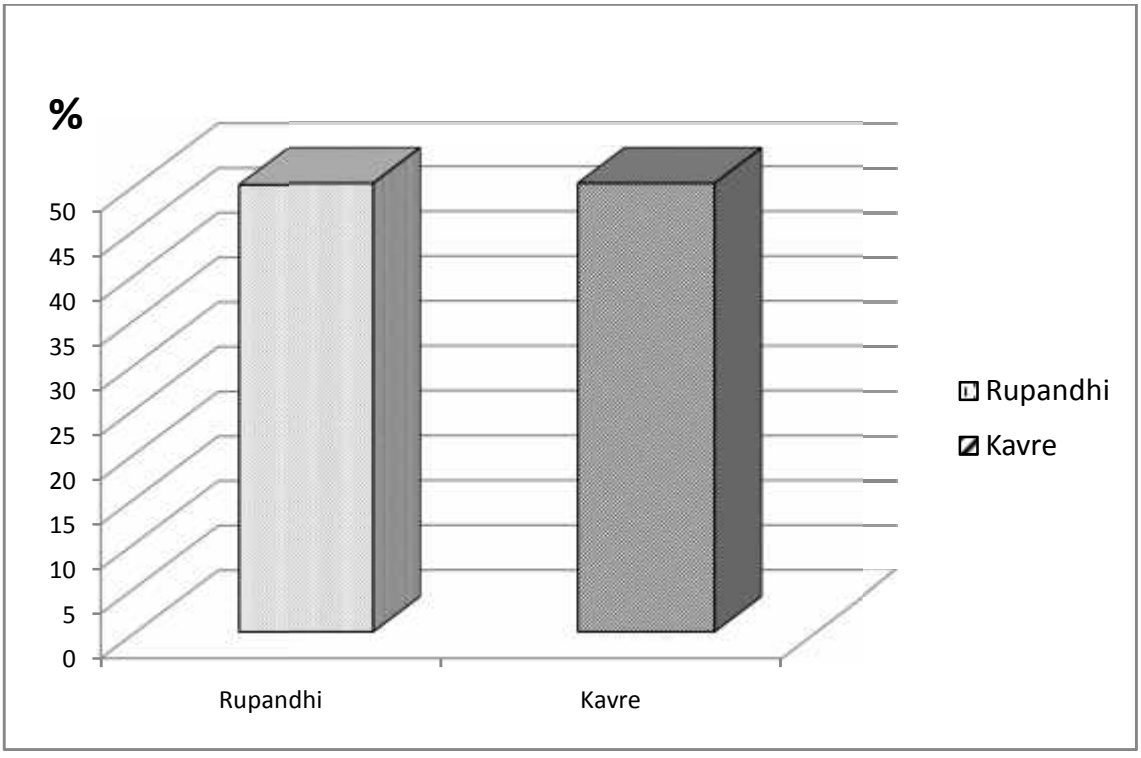
4.1.1 Respondents by Study Area

Table 4.1.1: Respondents by Study Area

Study Area	No.	Percentage
Rupandhi	20	50
Kavre	20	50
Total	40	100

(Sources: Field Survey, 2014)

Figure 4.1.1: Respondents by Study Area



Above table and figure show the respondents by study area. Out of the 40 respondents 50% are taken from Rupandehi and 50% from Kavre. Equal respondents are taken from both places.

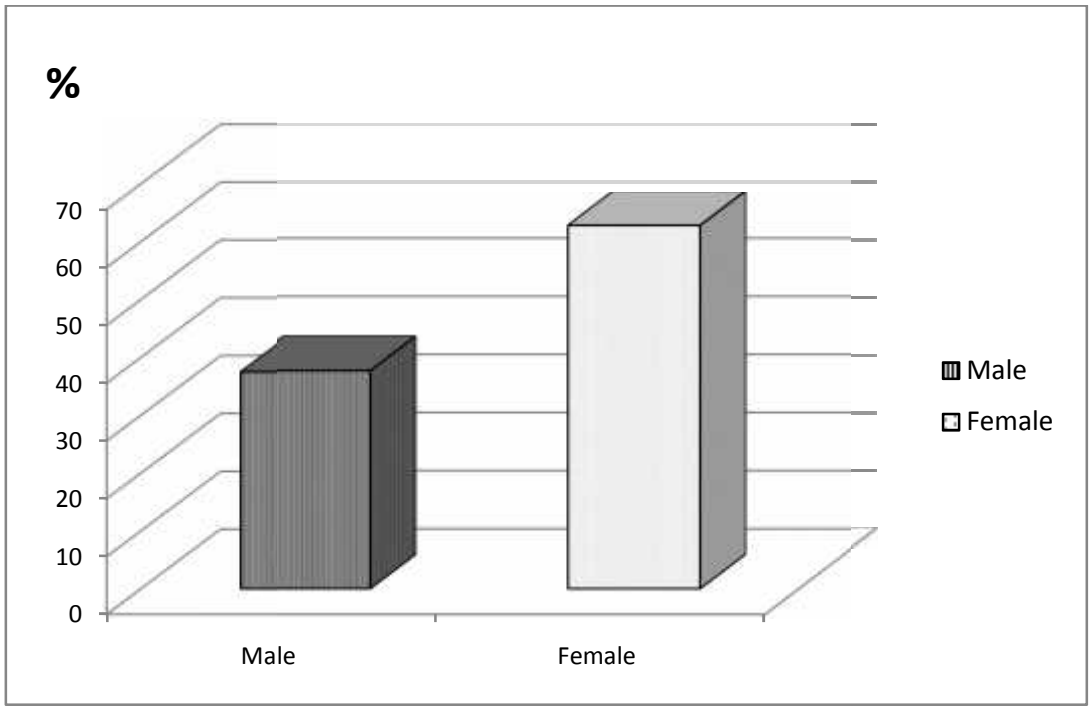
4.1.2 Respondents by Sex

Table 4.1.2: Respondents by Sex

Sex	No.	Percentage
Male	15	37.5
Female	25	62.5
Total	40	100

(Sources: Field Survey, 2014)

Figure 4.1.2: Respondents by Sex



The beyond table and figure explain the respondents by sex composition. Out of the 40 respondents 37.5% are mal and 62.5% are female. According to data female respondents are more than male. In those study area most of the male are out of house for job so female respondents are higher than male.

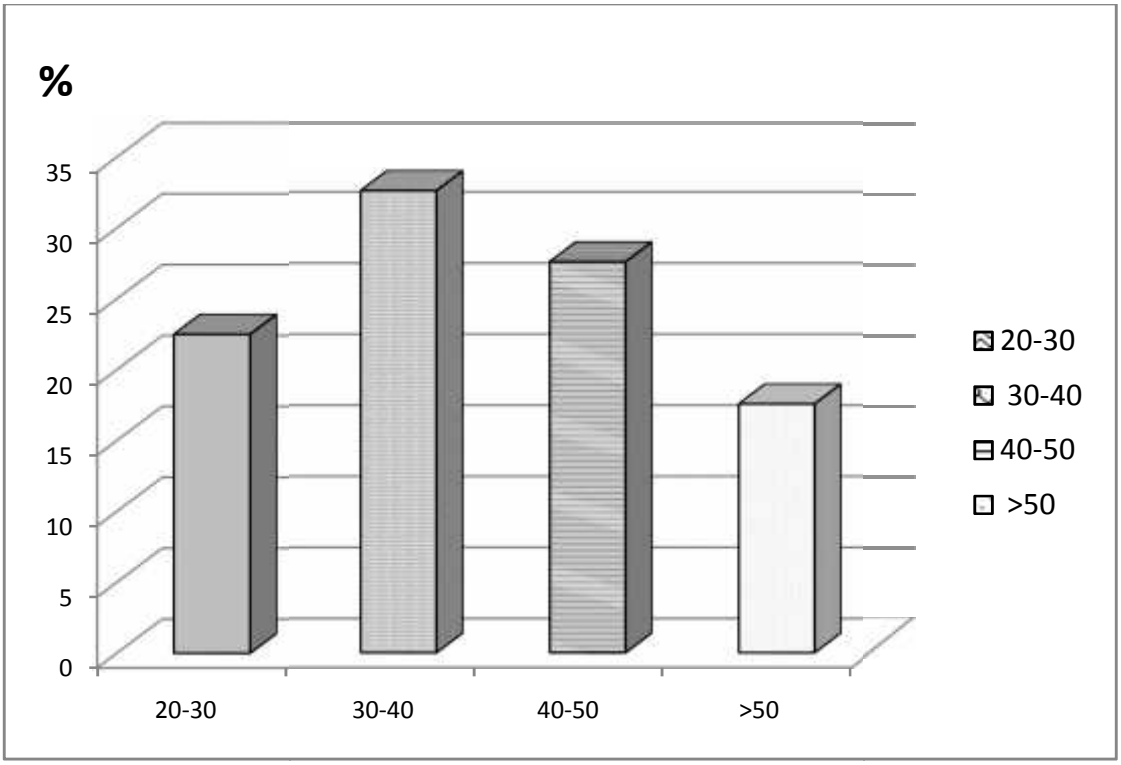
4.4.3 Respondents by Age

Table 4.1.3: Respondents by Age

Age	No.	Percentage
20-30	9	22.5
30-40	13	32.5
40-50	11	27.5
>50	7	17.5
Total	40	100

(Sources: Field Survey, 2014)

Figure 4.1.3: Respondents by Age



Above table and figure demonstrate the respondents by age group. Data show that 22.5% are between 20 to 30 years old, similarly 32.5% are between 30 to 40 years old, 27.5% are between 40 to years old and remaining 17.5% respondents are more

than 50 years old. High number of respondents is between 30 to 40 years old and low number of respondents is more than 50 years old.

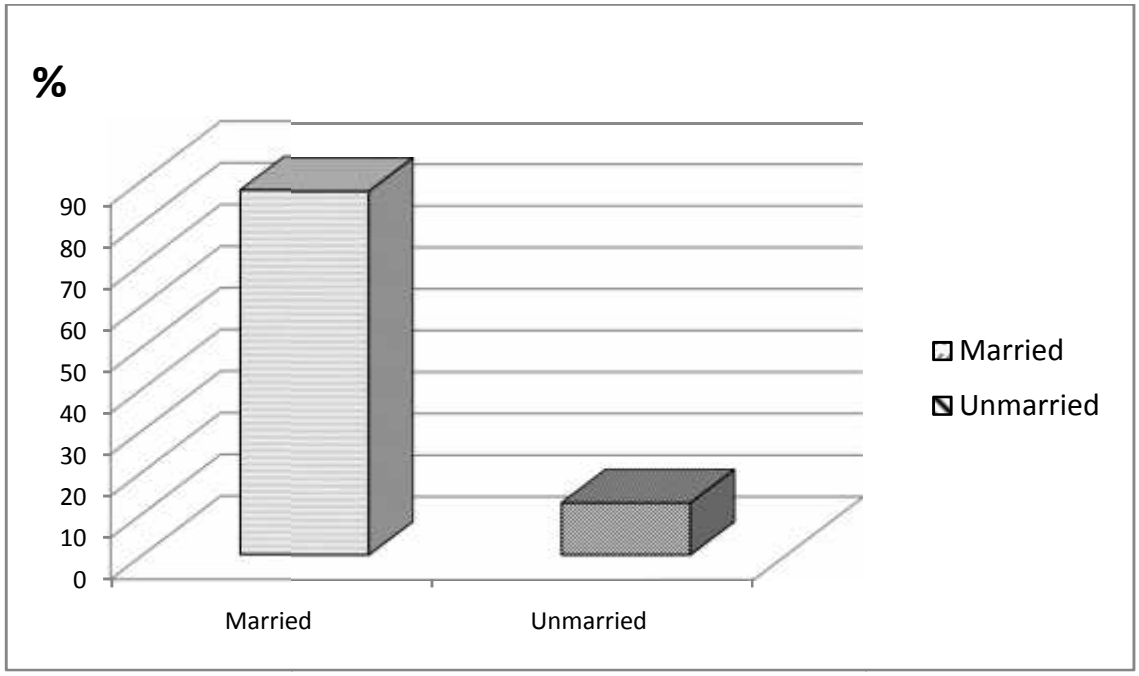
4.1.4 Respondents by Marital Status

Table4.1.4: Respondents by Marital Status

Marital status	No.	Percentage
Married	35	87.5
Unmarried	5	12.5
Total	40	100

(Sources: Field Survey, 2014)

Figure 4.1.4: Respondents by Marital Status



Above table and figure present the respondents by marital status. Out of the 40 respondents 87.5% are married and remaining 12.5% are unmarried. In those study area most of the respondents are married.

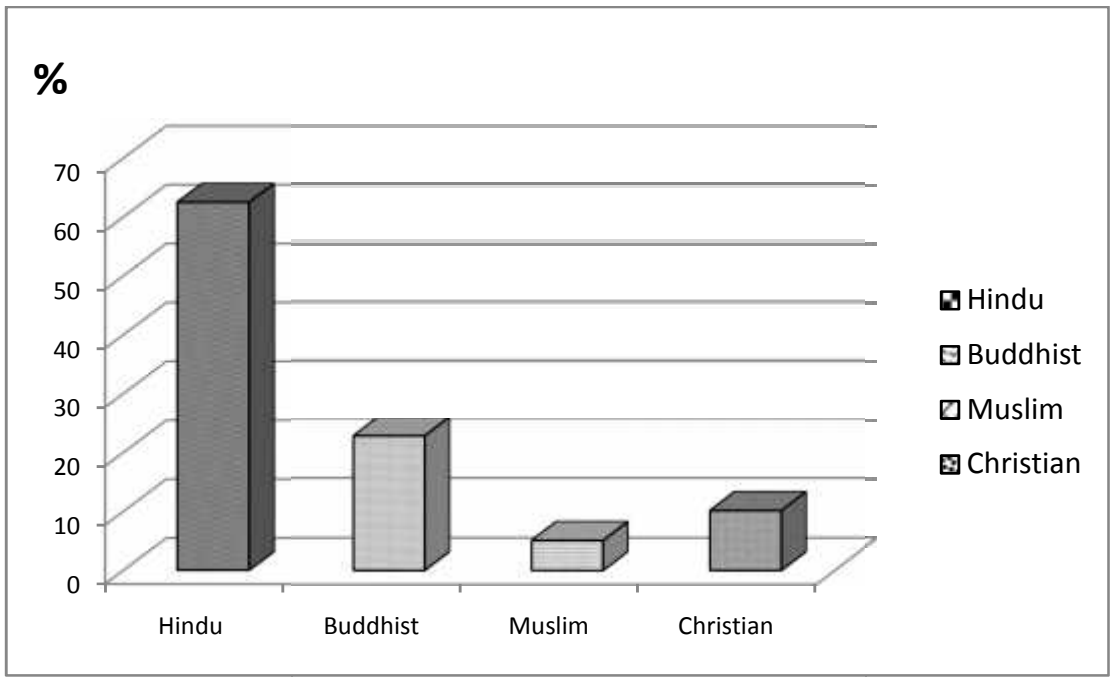
4.1.5 Respondents by Religion

Table: 4.1.5: Respondents by Religion

Religion	No.	Percentage
Hindu	25	62.5
Buddhist	9	22.5
Muslim	2	5
Christian	4	10
Total	40	100

(Sources: Field Survey, 2014)

Figure 4.1.5: Respondents by Religion



Above table and figure show the respondents by religious. Data show that 62.5% respondents are Hindus, 22.5% are Buddhist, 5% are Muslim and remaining 10% are Christian. Among those respondents Hindus are more than others and Muslim are less than others religious.

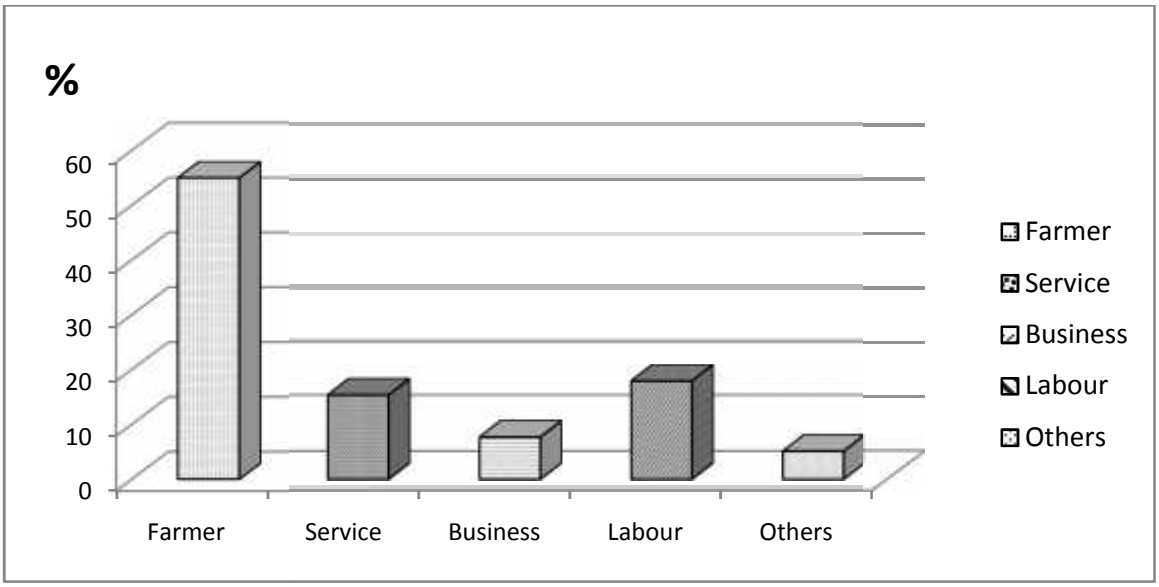
4.1.6 Respondents by Occupation

Table 4.1.6: Respondents by Occupation

Occupation	**No.**	Percentage
Farmer	22	55
Service	6	15
Business	3	7.5
Labour	7	17.5
Others	2	5
Total	40	100

(Sources: Field Survey, 2014)

Figure4.1.6: Respondents by Occupation



Above table and figure explain the respondents by occupation. Data show that 55% respondents are farmer, 15% are involve in service sectors, 7.5% are involved in business likewise 17.5% are labour and remaining 5% are involved in other sectors.

4.2 Impact of Climate Change

Climate change is a burning issue of recent time. It affect overall life of universe plant and animals are highly affected by climate change. In the contest of Nepal, there has seen defect effect in agriculture and farming system that has one of the important syndrome of climate change. In this study it analysis impact on climate change and local adoption in agriculture sector in Panchkhal VDC of Kavre ditrict and Porroha VDC of Rupandehi district.

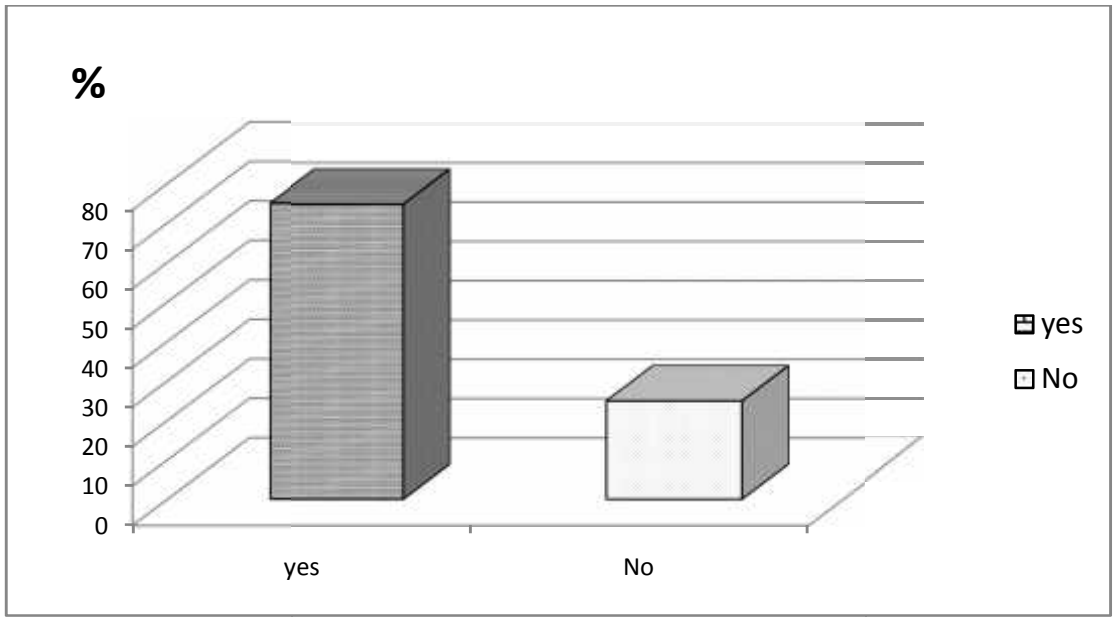
4.2.1 Do you have any idea about climate change?

Table4.2.1: Do you have any idea about climate Change?

Idea about climate change	No.	Percentage
yes	30	75
No	10	25
Total	40	100

(Sources: Field Survey, 2014)

Figure 4.2.1: Do you have any idea about climate Change?



Above table and figure show the respondents by know about climate change. Out of the 40 respondents 75% have knowledge about climate change and remaining 25%

have no knowledge about climate change. Most of the respondents have knowledge about climate change.

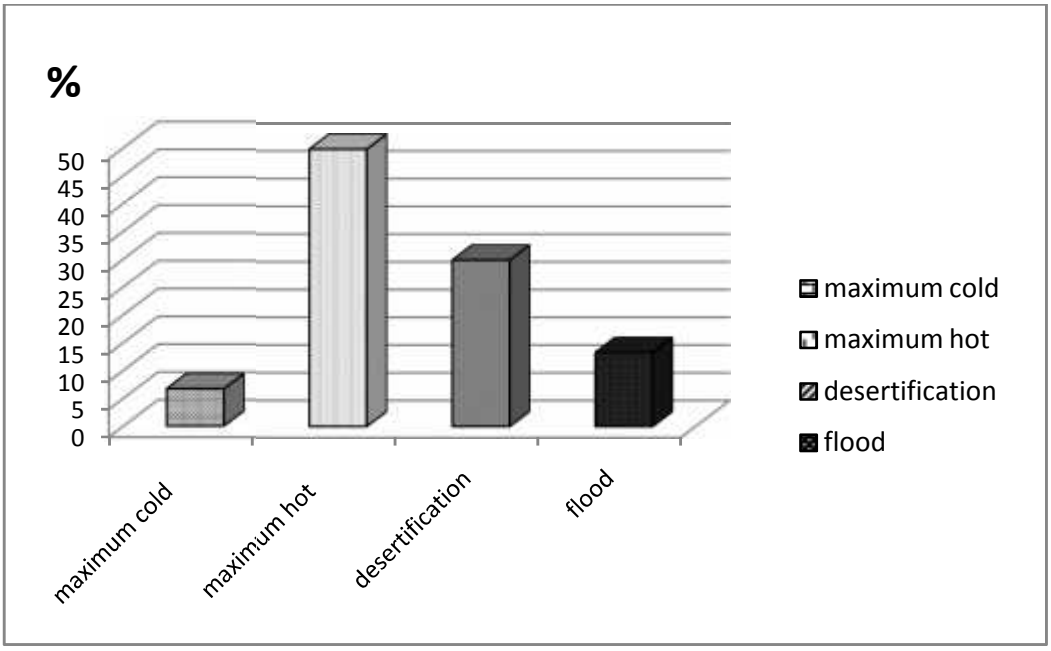
4.2.2 If yes, what feeling of climate change?

Table4.2.2: Feeling of Climate Change

Feeling of climate change	No.	Percentage
maximum cold	2	6.67
maximum hot	15	50
desertification	9	30
flood	4	13.33
Total	30	100

(Sources: Field Survey, 2014)

Figure4.2.2: Feeling of Climate Change



Above table and figure explain the respondents by feeling of climate change. According to data 6.67% respondents feeling maximum cold, 50% are feeling maximum hot and 30% feeling desertification and remaining 13.33% are feeling flood. Among those respondents most of the respondents are feeling maximum hot.

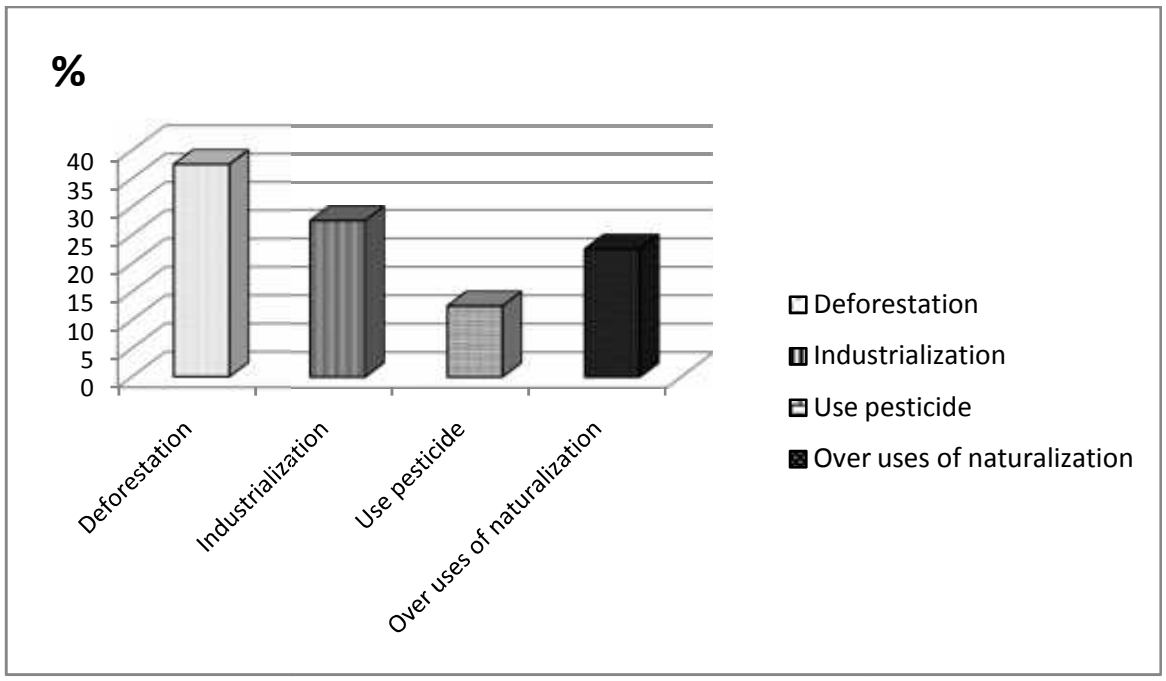
4.2.3 Cause of climate change

Table 4.2.3: Causes of climate Change

Causes of Climate Change	No.	Percentage
Deforestation	15	37.5
Industrialization	11	27.5
Use pesticide	5	12.5
Over uses of naturalization	9	22.5
Total	40	100

(Sources: Field Survey, 2014)

Figure4.2.3: Causes of climate Change



Above table and figure show the respondents by know causes of climate change. Out of the 40 respondents 37.5% say that deforestation is main cause of climate change, 27.5% say that industrialization is the main cause of climate change. Similarly 12.5% say that use of pesticide is the main cause of climate change and remaining 22.5% claim that over uses of naturalization is the main cause of climate change. Most of the respondents are say that deforestation is the main cause of climate change.

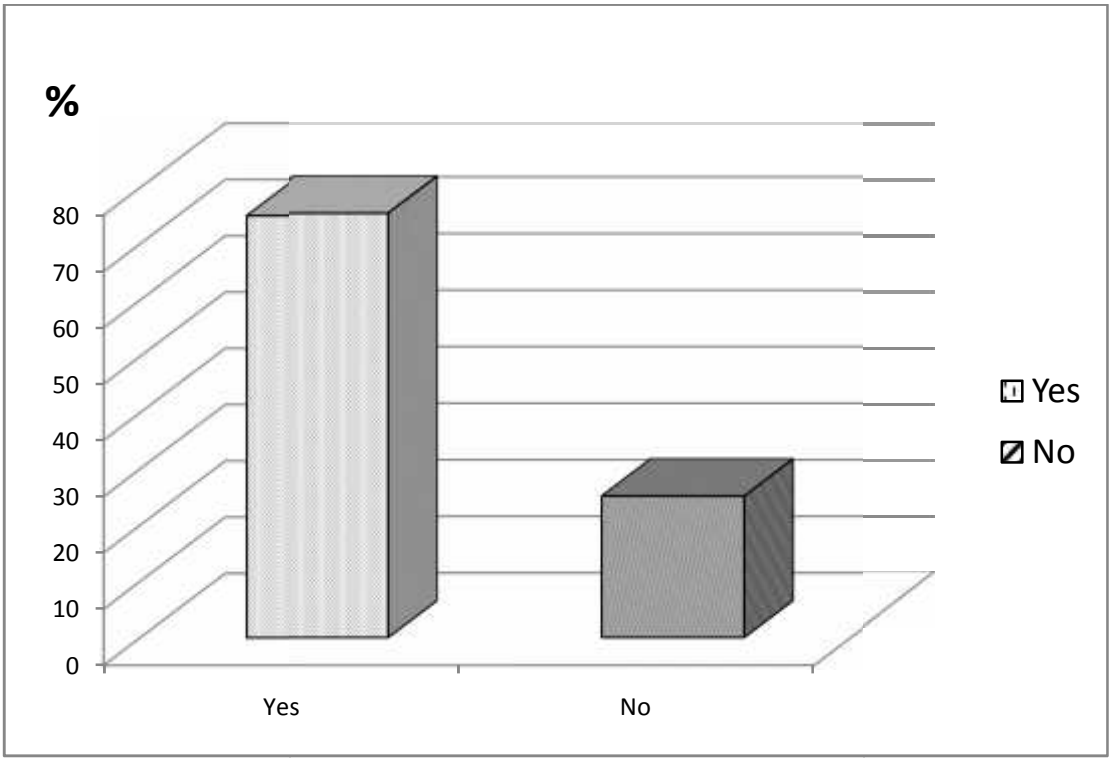
4.2.4 Feel any effect on climate change in agriculture

Table4.2.4: Feel any effect on climate change in agriculture

Effect on climate change	No.	Percentage
Yes	30	75
No	10	25
Total	40	100

(Sources: Field Survey, 2014)

Figure4.2.4: Feel any effect on climate change in agriculture



Above table and figure present the respondents by feel any effect on climate change in agriculture. Data show that 75% feeling affect on climate change in agriculture sector and other 25% do not feeling effect on climate change in agriculture. Most of the respondents are feeling effect on climate change in agriculture.

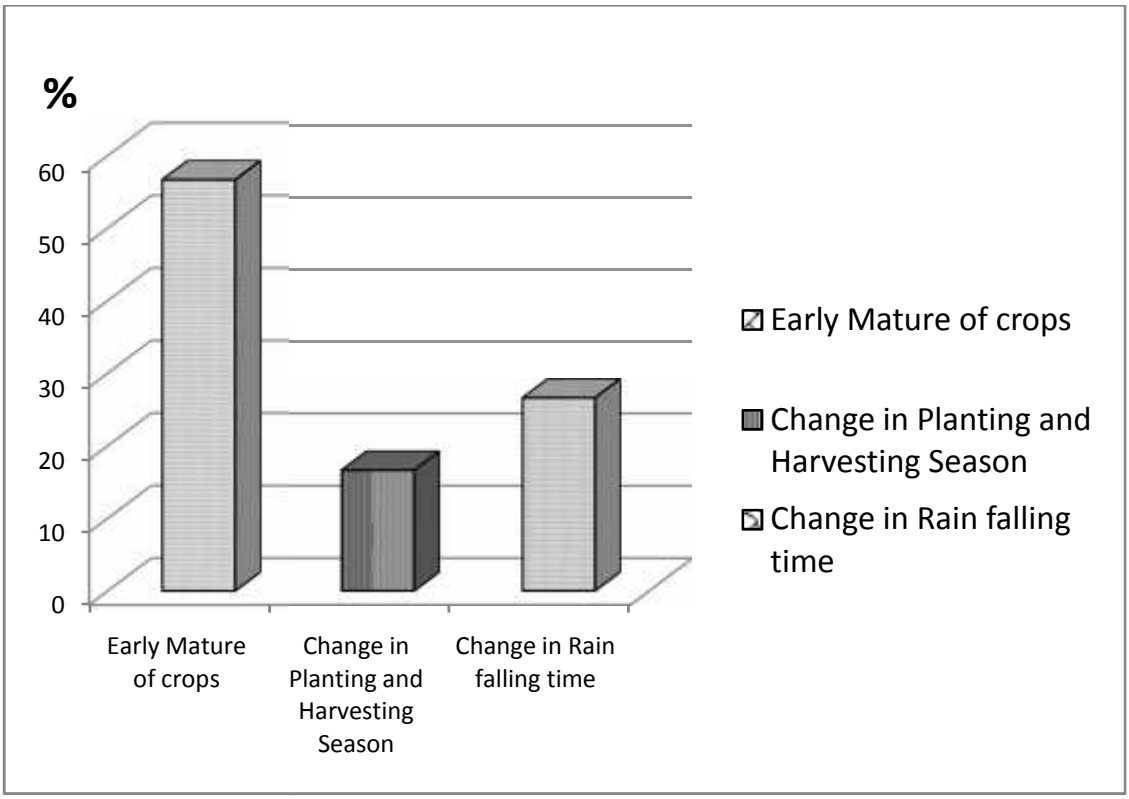
4.2.5 Effect of Climate Change on Agriculture

Table4.2.5: Effect of Climate Change on Agriculture

Effect of Climate Change on Agriculture	No.	Percentage
Early Mature of crops	17	56.67
Change in Planting and Harvesting Season	5	16.67
Change in Rain falling time	8	26.67
Total	30	100

(Sources: Field Survey, 2014)

Figure4.2.5: Effect of Climate Change on Agriculture



Above table and figure explain the effect of climate change on agriculture. Data show that 56.67% respondents feeling early mature of crops, 16.67% respondents feeling change in planting and harvesting season and 26.67% feeling change in rain falling time, those are the effect on climate change in agriculture. In those study area most of the respondents feeling early mature of crops.

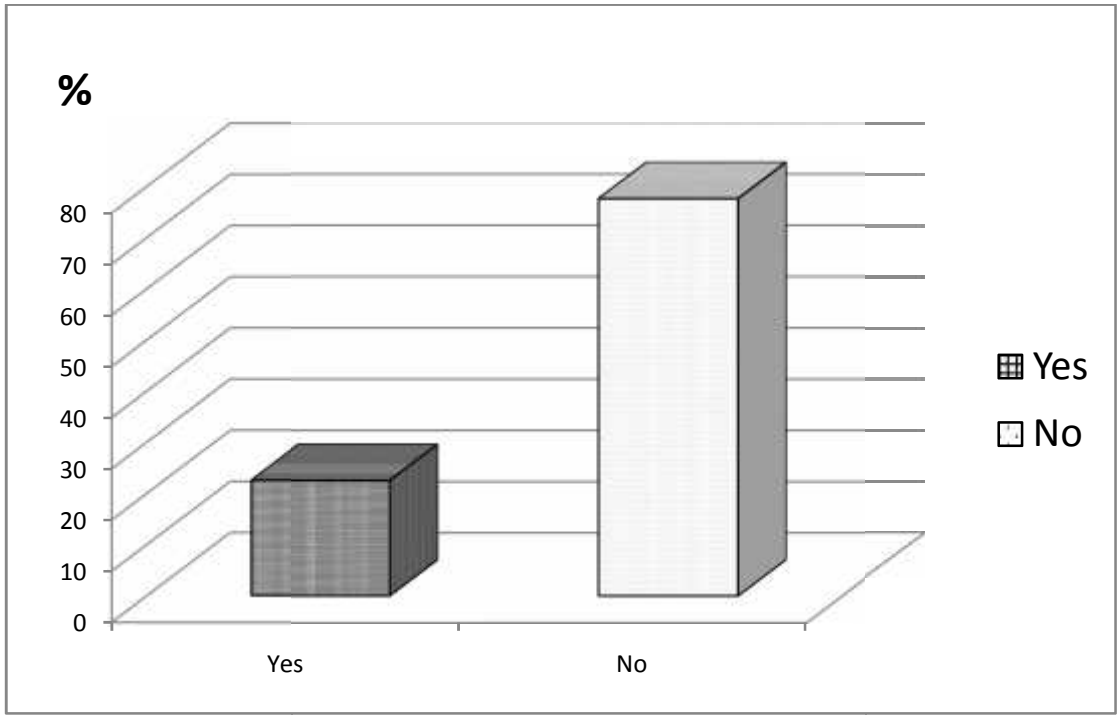
4.2.6 Feel Advantage from Climate Change in Agriculture

Table4.2.6: Feel advantage from Climate Change in Agriculture

Feel advantage from climate change in agriculture	No.	Percentage
Yes	9	22.5
No	31	77.5
Total	40	100

(Sources: Field Survey, 2014)

Figure:4.2.6Feel Advantage from Climate Change in Agriculture



Above table and figure show the respondents by feel advantage from climate change in agriculture. Out of the 40 respondents 22.5% are felling advantage from climate change in agriculture and 77.5% are not felling advantage from climate change in agriculture. Among those respondents most of the respondents are not feeling advantage from climate change in agriculture.

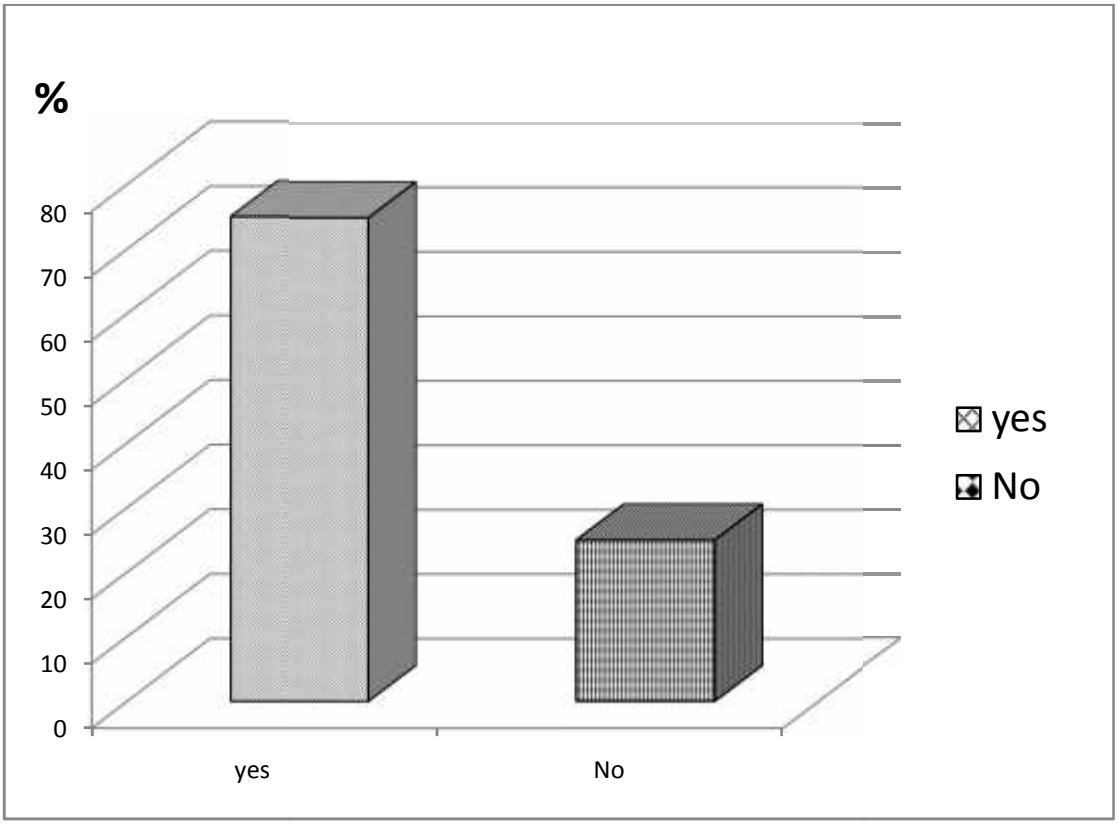
4.2.7 Feel Adaptation Problem after Climate Change

Table4.2.7: Feel Adaptation Problem after Climate Change

Feel adaptation problem after climate change	No.	Percentage
yes	30	75
No	10	25
Total	40	100

(Sources: Field Survey, 2014)

Figure4.2.7: Feel Adaptation Problem after Climate Change



Above table and figure demonstrate the respondent by feel adaption problem after climate change. Out of the 40 respondents 75% feel adaption problem after climate change and 25% are not feeling adaption problem after climate change. Most of the respondents feel adaption problem after climate change.

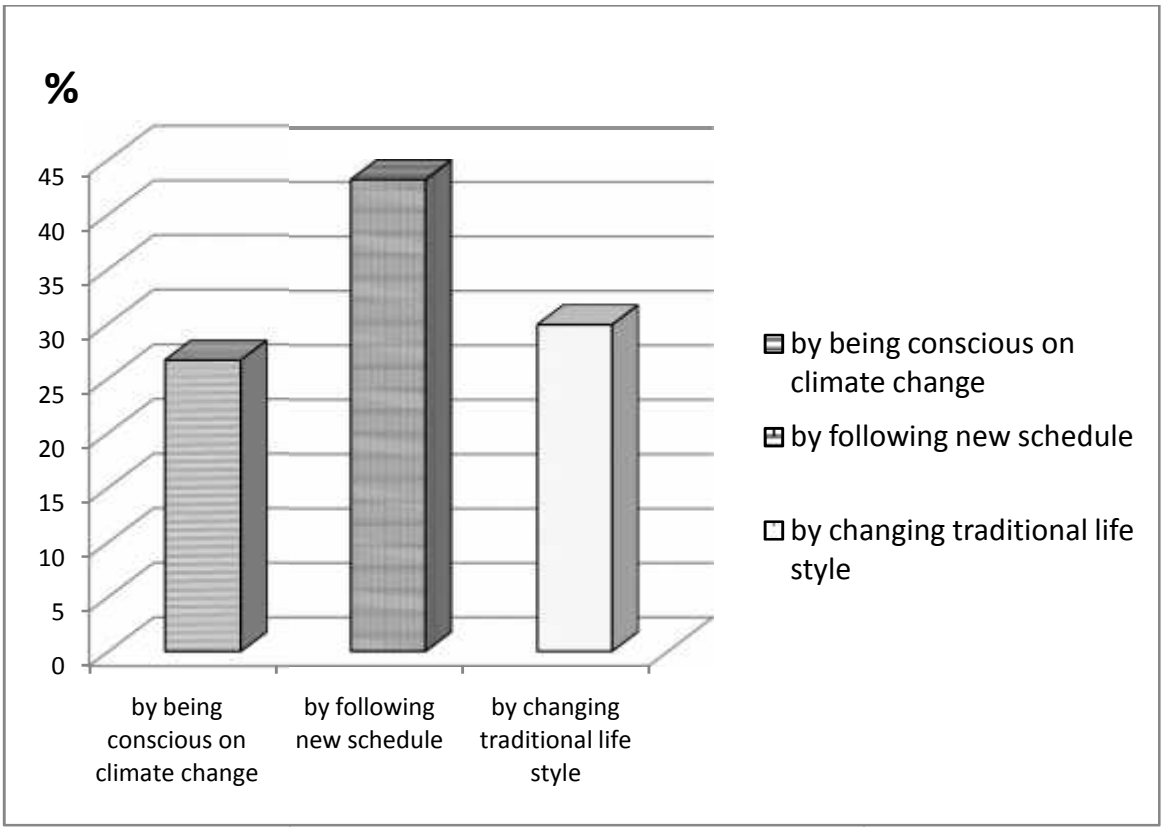
4.2.8 Adopt in Climate Change

Table4.2.8: Adopt in climate change

Way of adopt in climate change	No.	Percentage
by being conscious on climate change	8	26.67
by following new schedule	13	43.33
by changing traditional life style	9	30
Total	30	100

(Sources: Field Survey, 2014)

Figure4.2.8: Adopt in Climate Change



Above table and figure illustrate the respondents by adopt in climate change. Data show that 26.67% adopt climate change by being conscious on climate change, 43.33% adopt in climate change by following new schedule, and 30% adopt climate change by changing traditional life style.

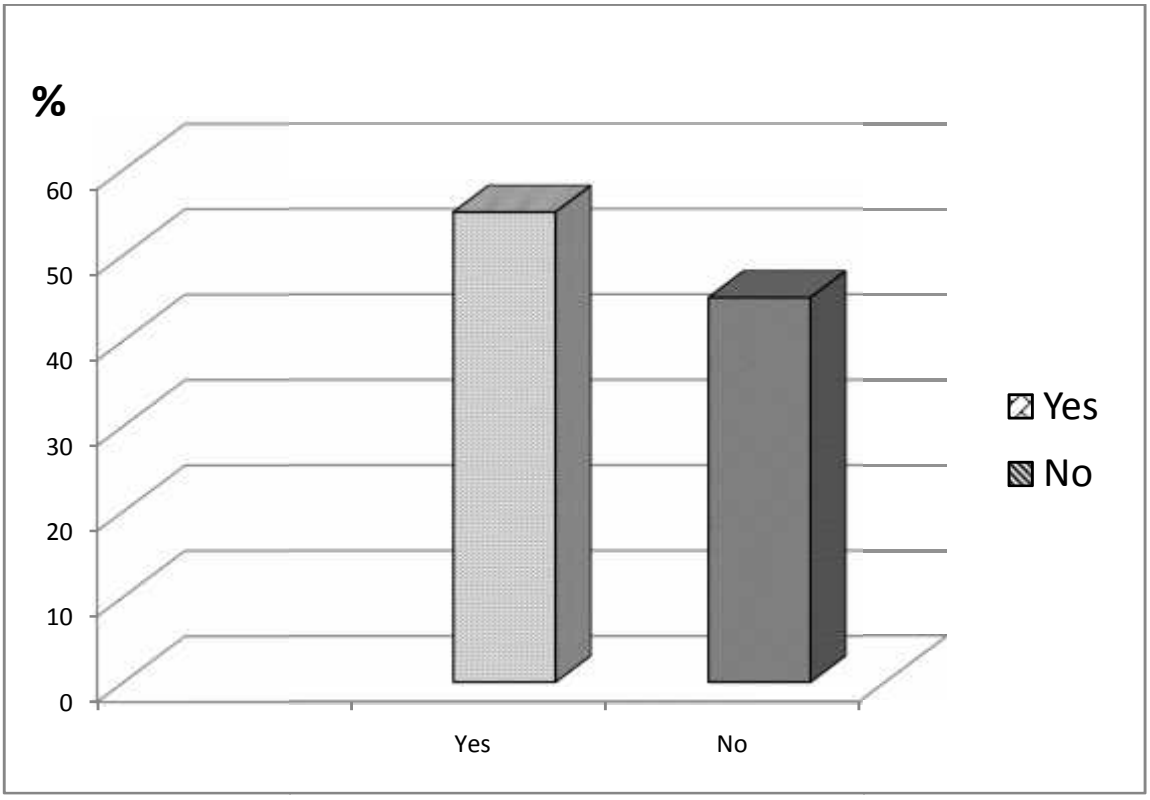
4.2.9 Idea to Save Earth from Climate Change

Table4.2.9: Idea to save earth from climate change

Idea to save earth from climate change	No.	Percentage
Yes	22	55
No	18	45
Total	40	100

(Sources: Field Survey 2014)

Figure 4.2.9: Idea to save earth from climate change



Above table and figure explain the respondents by any idea to save earth from climate change. Out of the 40 respondents 55% have idea to save the earth from climate change and 45% have not any idea to save earth from climate change. Among those respondents most of the respondents have idea to save earth from climate.

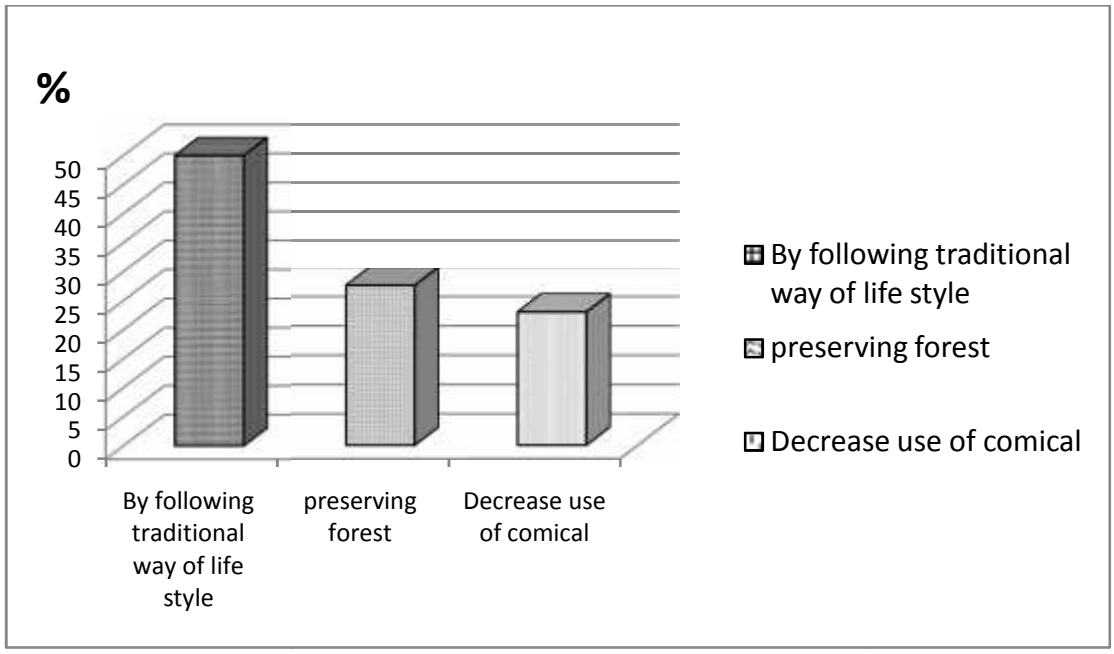
4.2.10 How Can Save Earth from Climate Change?

Table4.2.10: Save Earth from Climate Change

save earth from climate change	No.	Percentage
By following traditional way of life style	11	50
preserving forest	6	27.27
Decrease use of comical	5	22.72
Total	22	100

(Sources: Field Survey 2014)

Figure4.2.10: Save Earth from Climate Change



Above table and figure explain the respondents by save earth from climate change. Data show that 50% save the earth from climate change by following traditional way of life style, 27.27% say that preserving forest save earth from climate change and 22.72% say that decrease use of comical to save earth from climate change.

4.3Expert View about Climate Change

Whole discussion on water resources related problem, expert sug

gested that since few years water resources are going to day and there has problem of drinking water in Kavre district. In the same way in Rupandehi district early monsoon begin and discontinuation on rain falling and dryness season.

Climate change is one of the main causes of natural disaster because over rain fall, landslide and earth are the outcomes of climate change. Climate change bring various problem in Rupandehi like flood and in Kavre landslide thunder create problem in people life.

After discontinuation in rainfall, small water resources had dry and farmer, mainly vegetable farmers face problem in daily life. They have shifted from land and adopt new farming system that has seen in kavre district. Kavre district Panchkhal area there has been effect of climate change.

Nepal government had begun various programs to control climate change though it is difficult task. From the government side there has been lunch awareness program for the adaptation of climate changes. Green house effect is the main causes of climate change. Government discourage farmer to produce greenhouse effect such as using pesticide and other chemicals.

There are various factors to lunch the program on the adoption of climate change. Farmer need more production for that they use pesticide and chemical that play important role on climate change. In the same way, industries and deforestation also main cause of climate change.

In our view Nepalese government should conscious about climate change and encourage people to save forest, and discourage to produce greenhouse gas more than that it should be conscious about ecosystem and nature.

The effect of climate change fall both urban and rural area. Urban people are more responsible to destroy the environment so government should lunch program in urban area as well as rural area. Rural people become more victimized by climate change basically agriculture sector is highly affected by climate change so farmer should be conscious on climate change and make pain for the adoption of climate change.

4.4 Local Adoption Measures by the Communities Kavre and Rupandehi District

This study is concentrated on one hilly area Kavre district of Panchkhal area and Rupandehi district Porroha VDC. InPanchkhal area there has big problem of water after climate change. The problem becomes more serious than the past. Due to changing on rain falling season water reservation become less than the past in local sources. In this critical situation, people use life system for water. Causes of lack of water they migrated low land because there has no water in high land.

In Rupandehi district Porroha VDC, local water resources is going to dry before begin dry season. Swallow tubwell and underground water resources also dry and create problem of water. To fulfill the problem of water they follow deep tubwell.

Kavre district there has been problem of landslide during the rainy season. Since few years landslide and thunder aprear as problem deforestation is going in the area.

Rupandehi district Porroha VDC has faced the problem of flood and sink. During rainy season most part of the VDC becomes water fall. Over rain create problem in day to day life which is cases of climate change.

To adopt such impact of climate change people construct building rather than hut. Make ditch near house to pass rain water. Adaptation way is different in hill and Terai. Hill people migrate save place and adopt them by landslide as well as Terai people also adopt with climate change by saving there.

CHAPTER-V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This thesis in title impact of climate change and local adoption in agriculture sector: case study of Kavre and Rupandehi district highlights local adoption of climate change in agriculture sector. The objectives of this study are study the changing farming system and yields in a changing climate in Kavre and Rupandehi District and study the local adaptation measures adopted by the communities in kavre and Rupandehi District.

The study base on the primary source of information for the source from different techniques such as face to face interview, group discussion, and informal interaction were used. Hydrological and meteorological data were collected from deportment of Hydrology and Meteorology (DHM), Government of Nepal and analyzed. The climate variables such as temperature and rainfall are utilized to explore the relation of climate of the paddy, maize and wheat where used and analyzed, taken from Ministry of agriculture (MOA). Relevant study reports, publications and maps were also collected and reviewed from various governmental and nongovernmental organizations.Sample Primary data from the study site are collected through structured interview, interview with key informants, and field observation. To ensure well-distributed representation, information on perception and awareness of climate change, vulnerability induced by climate change and adaptation measures of local communities to minimize such impacts and applies to understand the perceptions, attitudes and practices. Socio-economic Vulnerability Assessment of each settlement is also calculated. The data collected from above mentioned various sources have been tabulated so as to obtain desired outcome. The collected information has compiled and tabulated in different headings. Hence the data are processed by using relevant information. The collected data were analyzed using both descriptive tools like mean, standard deviation,percentage etc. and inferential statistical tools. Overall analysis was carried out by using Statistical Package for Social Science(SPSS) and Microsoft -Excel program wherever necessary.

Agriculture is the largest sector and backbone of Nepalese economy and more than 76% of population depends on this sector (NPC-2010). agriculture sector contributes

about 36% of the total GDP of the country , thus Nepalese economy depends heaving on agriculture .agriculture is very much sensitive to climate change causes the extreme impacts on agricultural production and the adaptation measures in these remote areas of Nepal. In context of Nepal lack of research and credible evidence is the major challenge for fighting with impact of climate change. Nepal has very diverse microclimatic and geophysical conditions within small areas. So the best way to measure the impact of climate change would be conduct researches at the community level. 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 adaptation measures adopted by the local people in the Kaver and Rupandehi District of Nepal. In such a situation study is quite significant.

5.2 Findings and Conclusion

This study has been based mainly primary data. While analyzing the data following Finding conclusion has been drowning. While analyzing the respondents by study area out of the 40 respondents 50% are taken from Rupandehi and 50% from Kavre. Equal respondents are taken from both places. From analysis of respondents by sex out of the 40 respondents 37.5% are mal and 62.5% are female. According to data female respondents are more than male. In those study area most of the male are out of house for job so female respondents are higher than male. When analysis of respondents by age group 22.5% are between 20 to 30 years old, similarly 32.5% are between 30 to 40 years old, 27.5% are between 40 to years old and remaining 17.5% respondents are more than 50 years old. High number of respondents is between 30 to 40 years old and low number of respondents is more than 50 years old. Analysis from marital status of respondents there found 87.5% are married and remaining 12.5% are unmarried. In those study area most of the respondents are married. From the analysis of respondents by religion 62.5% respondents are Hindus, 22.5% are Buddhist, 5% are Muslim and remaining 10% are Christian. Among those respondents Hindus are more than others and Muslim are less than others religious. From the analysis of occupation status of respondents there found that 55% respondents are farmer, 15% are involve in service sectors, 7.5% are involved in business likewise 17.5% are labour and remaining 5% are involved in other sectors. 75% have knowledge about

climate change and remaining 25% have no knowledge about climate change. Most of the respondents have knowledge about climate change.6.67% respondents feeling maximum cold, 50% are feeling maximum hot and 30% feeling desertification and remaining 13.33% are feeling flood. Among those respondents most of the respondents are feeling maximum hot. When the analysis of causes of climate change 37.5% say that deforestation is main cause of climate change, 27.5% say that industrialization is the main cause of climate change. Similarly 12.5% say that use of pesticide is the main cause of climate change and remaining 22.5% claim that over uses of naturalization is the main cause of climate change. Most of the respondents are say that deforestation is the main cause of climate change. 75% feeling affect on climate change in agriculture sector and other 25% do not feeling effect on climate change in agriculture. Most of the respondents are feeling effect on climate change in agriculture. 56.67% respondents feeling early mature of crops, 16.67% respondents feeling change in planting and harvesting season and 26.67% feeling change in rain falling time, those are the effect on climate change in agriculture. In those study area most of the respondents feeling early mature of crops.22.5% are felling advantage from climate change in agriculture and 77.5% are not felling advantage from climate change in agriculture. Among those respondents most of the respondents are not feeling advantage from climate change in agriculture. 75% feel adaption problem after climate change and 25% are not feeling adaption problem after climate change. Most of the respondents feel adaption problem after climate change. 26.67% adopt climate change by being conscious on climate change, 43.33% adopt in climate change by following new schedule, and 30% adopt climate change by changing traditional life style. 55% have idea to save the earth from climate change and 45% have not any idea to save earth from climate change. Among those respondents most of the respondents have idea to save earth from climate. 50% save the earth from climate change by following traditional way of life style, 27.27% say that preserving forest save earth from climate change and 22.72% say that decrease use of comical to save earth from climate change.

5.3 Recommendations

Through analysis overall objective of this study the following recommendations have given as follows:

- Most of the cases deforestation is main cause of climate change it should be stopped and preserve the forest.
- Farmer highly use fertilizer and chemical that create problem in environment and climate change it should be stopped and began organic farming.
- Greenhouse effect should be control.
- Air pollution and water is increasing day by day it is necessary to control.
- Government should lunch awareness program about climate change and way of adoption.
- Farmer use traditional way to kill insets rather than use pesticide.
- Off seasons vegetable farming should be control and follow seasonal farming.
- Government allocate budget to control climate change and local adaptation.
- It should be encourage farmer to follow organic farming.
- NGO/INGO should work on controlling climate change.

ANNEX

QUESTIONNAIRE

1. Name: Address:

2. Sex:

   a. Male b. Female

3. Age:

   a. 20-30 b. 30-40 c. 40-50 d. >50

4. Marital Status:

   a. Married b. Unmarried

5. Religious status:

   a. Hindu b. Buddhist

   c. Muslim d. Christian

6. Occupation :

   a. Farmer b. Service c. Business

   d. Labour e. Others

7. What is the cause of climate change?

   a) Deforestation b)industrialization

   c) Use pesticide d) Over uses of naturalization

8. Do you have any idea about climate change?

   a)Yes b) No

9. If yes, what is climate change?

   a) Maximum cold b) Maximum hot

   c) Desertification d) Flood

10. Do you feel any effect on climate change in agriculture?

    Yes / No

11. If yes what effect do you feel?

    a) Early mature of seed b) Change in planting and harvesting season

    c)Rainfall season

12. What kind of effect do you realizes in recent year?

    a) Over flood b) long time coldness c) very hot

    d) Traditional crops production reduce

13. Do you feel advantage from climate change in agriculture?

    a) yes/No

14. Do you feel adaptation problem after climate change?

    a)Yes b) No

15. If yes, how can you adopt in climate change?

    a) By being conscious on climate change b) by following new schedule

    c) By changing traditional life style

16) Have any idea to save earth from climate change?

    a. Yes b. No

17. If yes how can save earth from climate change?

    a) By following traditional way of life style b) Preserving forest

    c) I don’t know

REFERENCES

Aerts, J. C. J. H. (2006: 49-63). *Financing climate change adaptation*, Disasters-Special issues on climate change and disasters, Vol. 30.

AFDB,ADB,DFID,EC,BMZ,DECD,UNDP,UNEP and the World Bank,2003: *Poverty and climate change: reducing the vulnerability of the poor through adaptation* [sperling. F. (ed)], p.p 43

Agrawal, A. (2008). *The role of local institutions in adaptation to climate change*,International Forestry Research and Institutions Program (IFRI), Working Paper No.08I-3. School of Natural Resources and Environment, University of Michigan, Michigan, USA.

Anderson, S. (2011). *Negotiating climate resilience in Nepal*: Institute for development studies, Sussex, UK.

Bird, N. (2011). *The future for climate finance in Nepal*, Overseas Development Institute,London.

Brandt, Us, S., and Gert Tinggaard, S. (2003). *The Political economy of climate changepolicy in the EU: Auction and Grandfathering, a Counter-Intuitive Result'*. IME Working Paper No. 51/03. Department of Environmental and Business Economics,University of Southern Denmark, Esbjerg.

Chhetri, R. P. (2011). *Minding the money: Governance of climate change adaptation finance in Nepal,* Oxfam, Country Programmme Office, Nepal.

Dahal, N., (2008). *Understanding climate change adaptation issues in Nepal*, The Initiation, Vol. 2.

Dalfelt, Arne and Dinar Arie (July 12, 2000) "*Climate change impacts on African agriculture" (…..)*Robert Mendelsohn, Yale University

Garcia,K. (2009: 130-146). *Mainstreaming adaptation in developing countries*: The case of the Philippines, Climate and Development, Vol. 1, No. 2. Pp. 130-146.

Governance Post (2012). *Architecture, Agency and Adaptation*, Cambridge University Press, London.

Government of Nepal. 2015. *Economic survey* .Kathmandu, ministory of finance

Government of Nepal. 2010c. *National Agricultural Sector Development Priority (NASDP) for the Medium-Term (2010/11–2014/15)* Kathmandu, Ministry ofAgriculture and Cooperative.

Gupta, J., Persson, A., Olsson, L., Linnerooth-Bayer, J., van der Grijp, N., Jerneck, A., Patt, A. (2010). *Mainstreaming climate change in development cooperation policy*: conditions for success in M. and H. Neufeldt (eds.), *Making Climate Change Work for Us: European Perspectives on Adaptation and Mitigation Strategies* Cambridge University Press, Cambridge. Pp. 319-339.

Hardin, G. (2000), The Tragedy of the commons, *Science*, Vol. 162 (1968), pp. 12431248.

Helvitas (2011), *Nepal's climate change policies and plans: local communities' Perspective*, *Environment and climate series 2011/1*. The Rights and Resources Initiative (RRI). Helvitas- Swiss Inter-corporation Nepal, Kathmandu.

Huq, S. (2009). *Adaptation in a Post-2012 Regime:* Means to integrate and strengthen policies and programmes for equity-based climate change cooperation in Biermann, F., Pattberg, P. and Zelli, F. (eds.), *Global Climate.*

Huq, S., Rahman, A., Konate, M., Sokona, Y. and Reid, H. (2003), *Mainstreaming adaptation to climate change in least developed countries* (LDCs). International Institute for Environment and Development, London.

IIASA, 2002: *Climate change and agriculture vulnerability*, International Institute for Applied systems Analysis, Vienna.

Institute of Development Studies and International Insitute for Environment and Development (2011), *The Pilot programme for climate resilience in Nepal*, Institute of Development Studies, Brighton, UK.

IPCC, 2001b: Climate *Change 2001: Impacts, adaptation, and vulnerability. C*ontribution of WG II to TAR of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge.

Khadka, R. B., (2012), *Safeguarding the future, securing Shangri-La–Integrating environment and development in Nepal:* TMC Academic Journal, 2012, 7(1): 40-55 52.

Malla, G. (2008). *Climate change and its impact on Nepalese agriculture*, *The Journalof Agriculture and Environment*, Vol. 9. Pp. 62-71.

Malla,G. (2008). *Climate change and its impact on Nepalese agriculture*. The Journal of Agriculture and Environment, VOL: 9, Jun. 2008 Review paper.62

Maraseni, T. N. (2012). *Climate change, poverty and livelihoods*: adaptation practices by rural mountain communities in Nepal, *EnvironmentalScience and Policy*, Vol.21. pp.: 24-34.

Ministry of Environment (2010). *National adaptation programme of action*, Ministry ofEnvironment, Kathmandu, Nepal.

Ministry of Environment (2011). *Status of climate change in Nepa*l, Ministry ofEnvironment, Kathmandu, Nepal.

MOAD. 2012. *Statistical information on Nepalese agriculture 2011/2012 (2068/069)*. Kathmandu, MOAD Agribusiness Promotion and Statistics Division, Statistics Section.

MOEnv, 2010: National *adaptation programme of action to climate change*, NAPA/TWG, 2010: Stocktaking *Report*, Thematic working group: NAPA Agriculture and Food Security, Ministry of environment, Nepal.

National Climate Vulnerabilty Study Team (2009). *Vulnerability Through the eyes of vulnerable:* climate change induced uncertainties and Nepal's development predicaments. Institute for social and environmental transition-Nepal (ISET-N, Kathmandu) and Institute for Social and Environmental Transition (ISET, Boulder, Colorado) for Nepal ClimateVulnerability Study Team (NCVST), Kathmandu.

Ngigi Stephen N.(2009) *"Climate change adaptation strategies:Water Resources Management Options for Smallholder Farming Systems in Sub-Saharan Africa"*The MDG Centre for East and Southern Africa of the Earth Institute at Columbia University, New York.

NPC, 2010: The *food security atlas of Nepal*, Food Security Monitoring Task Force, National planning Commission, Government of Nepal

O'Brien, K. L. (2007). *Portfolio screening to support the mainstreaming of adaptation to climate change into development assistanceClimate change*, Vol. 84.pp. 23-44.

Oxfam (2011). *Minding the money:* governance of climate change adaptation finance in Nepal, Oxfam, Nepal.

Practical Action (2009). *Promoting adaptation to climate change in Nepal*: Practical Action, Kathmandu.

Rai, J. K. (2011). *Global and local discourses on climate change*: A perspective from the concept of embededness, Dhaulagiri journal of sociology and anthropology,Vol. 4. Pp. 143-180.

RCRRP. 2012. *Managing climate risks in the Himalayas. A community-centric approach*. New York, Regional Climate Risk Reduction Project (RCRRP),UNDP-ECHO.

Regmi K. (2010). *Climate change governance and funding dilemma in Nepal achievements, challenges and next steps*, International Institute for Environment andDevelopment, UK.

Regmi, B. (2011). *Shocked and stressed, The Kathmandu Post*, 5 July, 2011, pp. 4, Column.

Regmi, B. R. (2004). *Adverse impacts of climate change on development of Nepal: Integrating adaptation into policies and activities*, CLACC Working Paper No. 3, Bangladesh Centre for Advanced Studies, Dhaka.

Senaratne, A., Perera, N., & Wickramasinghe, K. (2009). *Mainstreaming climate change for sustainable development in Sri Lanka: Towards a national agenda for action,* Institute of Policy Studies, Colombo.

Shrestha, U. B., Gautam, S., and Bawa, K. S. (2012). *Widespread Climate Change in the Himalayas and Associated Changes in Local Ecosystems, PLoS ONE,* Vol. 7. Pp. 36741.

Sietz, D., Boschutz, M., Klein, R. J. T. and Lotsch, A., (2008). *Mainstreaming climate Adaptation into development assistance in Mozambique: Institutional barriers and opportunities*', The World Bank, Washington DC.

Subedi, J. (2010). *Climate change adaptation in Nepal*: Issues and strategies, in Pereira J.J., *Community, Environment and DisasterRisk Management*, Vol. 5, pp.: 169-196, Emerald Group Publishing Limited, London.

Tanner, T. and Allouche, J. (2011). *Towards a New Political Economy of Climate Change and Development, IDS Bulletin*, Vol. 42. Pp.: 1-14

Tearfund (2006). *Overcoming the barriers: Mainstreaming Climate change adapatation in developing countries ', In* Mitchell,T. and Thomas, T. (eds.), *Tearfund Climate Change Briefing paper,*Tearfund, UK.

Thapa, Kamal(2011) *Effect of climate change in highland agriculture and local adaptive strategies: Case Study of Timure VDC, Rasuwa"*, an Unpublished Master Degree Dissertation, CDES, T.U., Kathmandu

United Nations Development Programme (2009). *Nepal Country Report, Global Assessment of Risk. United Nations Development Programme*, NDP,Kathmandu.

United Nations Framework Convention on Climate Change (2011), *Report of the Conference of the Parties on its sixteenth session*, United Nations Framework Convention on Climate Change, Bonn.

Watmough, G. R. (2012). A community-level assessment of factors affecting livelihoods in Nawalparasi District, Nepal, *Journal of International Development***,** Vol. 24. Pp.: 255-263.

West, S. (2012). *Redd and adaptation in Nepal*, REDD NET, Overseas Development Institute, London.

Yates, J. S. (2012) 323-558). *Uneven interventions and the scalar politics of governing livelihood adaptation in rural Nepal*, *Global environmental change*, Vol. 22, pp. 323-558.

www.encyclopedia.com

www.fao.com

www.google.com

www.sandee.com