

A research report


Impacts Assessment and Climate Change Adaptation Strategies in Makawanpur District, Nepal



An experience sharing on climate change among the local people in Makawanpur district (Hetauda Municipality-6 and Churiya VDC-9) of Nepal

Researcher

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Cover photo: Disaster risk area of Makawanpur district with local people.

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Abstract

Climate change affects the ability of developing countries to achieve their poverty reduction and sustainable development strategies. Projections of climate change point to increases in climate risks as a result of mid-continent drying increased frequency and severity of some climate extremes, and greater variability in rainfall. The effects of climate change are expected to deepen poverty and affect livelihoods, assets, infrastructure, environmental resources and economic growth. The current vulnerabilities and future risks warrant increased efforts to improve capacities, infrastructure, knowledge and partnerships related to climate risk management. Nepal is on the front line of climate change and variations on **Khetbari's experience** are now being recorded in communities from the freezing Himalayas of the north to the hot lowland plains of the south. Although emission of green house gas in Nepal is very negligible as compared to the developed countries, there are tremendous negative impacts of climate change in Nepal.

The study seeks to find out the impacts of climate change on livelihoods to enable and support effective adaptation decisions that would reduce vulnerability to climate and environmental change while also promoting sustainable development. The present study entitled “**Impacts Assessment and Climate Change Adaptation Strategies**” was carried out in Makawanpur district assessing the impacts of climate change on which local people have been facing since the past decades. Community-based climate change adaptation strategies were assessed as per the experience sharing of the local people. Nevertheless, local people have prepared the action plan in order to cope with against climate change on when, where and how they will apply in the future themselves in their own communities. Both primary and secondary data were used in order to find out the impacts and adopting strategy to fight against climate change in the study area. Focus groups discussion, key informants survey, PRA/RRA tools, workshop on climate change and trend analysis were used as a primary data collection whereas different published and unpublished literature review were used as a secondary data to accomplish this study. Drought and desertification are starting to spread and intensify while observing the past five decades in the study area. As a result, failing agriculture output that surely affects the poorest of the poor people in the community. Majority of the people in **Hetauda Municipality – 6 and Churiya VDC-9** are dependent on agriculture and this sector has adversely affected by the loss of the top fertile soil due to soil erosion, landslides and floods. Therefore, soil loss is one of the major causes of decline in agricultural production. The increase in temperature has adversely affected warmer environment crop.

Analysis of recent climatic trends reveals a significant warming trend in recent decades which has been pronounced by the indigenous people. As a result, trends of flooding have been gradually increasing in frequency and size in **1960 (2017 BS), 1967 (2024 BS), 1979 (2036 BS) , 1991 (2048 BS) , 1993 (2050 BS), 1995 (2052 BS) and 1997 (2054 BS) A.D.** Amongst all the years, year 052 BS was the largest flood as compare to other years and directly affected too many lives and property. As per the flooding trends, reveal that, there has been gradually increasing the size and frequency of floods since the last five decades.

People participation towards tree plantation and agriculture's role as a driving force for climate change can be condensed by taking measures that reduce the rate and volume of Greenhouse Gas emissions. By realizing, serious preparedness and actions should be taken that might hopefully impede the process of climate change and slowly but surely adapt to the rapidly changing climate. Capacity and knowledge need to be applied to better manage present risks adapt to changing future risks and integrate climate risk management into development strategies.

Key words: Climate change, Adoption, Strategy, Greenhouse gases, Floods

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INTRODUCTION

1.1 Background information

Nepal is a land-locked country located in South Asia between India and China. It contains 8 of the 10 highest mountain peaks in the world, including Mount Everest (at 8848 m), although some of its low lying areas are only about 80 m meters above sea level. There is therefore extreme spatial climate variation in Nepal – from a tropical to arctic climate within a span of only about 200 kilometers (the size of an average grid box in a climate model). Nepal is divided into five geographic regions: Terai plan, Siwalik hills, Middle Mountains, High Mountains (consisting of the Main Himalayas and the Inner Himalayan Valleys), and the High Himalayas .

The climate in Nepal varies from the tropical to the arctic within the 200 km span from south to north. Much of Nepal falls within the monsoon region, with regional climate variations largely being a function of elevation. National mean temperatures hover around 15 °C, and increase from north to south with the exception of mountain valleys. Average rainfall is 1,500 mm, with rainfall increasing from west to east. The northwest corner has the least rainfall, situated as it is in the rain shadow of the Himalayas. Rainfall also varies by altitude; areas over 3,000 m experience a lot of drizzle, while heavy downpours are common below 2,000 m (USCSP 1997). Although annual rainfall is abundant, its distribution is of great concern: flooding is frequent in the monsoon season during the summer, while droughts are not uncommon in certain regions in other parts of the year.

Temperature observations in Nepal from 1977-1994 show a general warming trend (Shreshtha et al. 1999). The temperature differences are most pronounced during the dry winter season, and least during the height of the monsoon. There is also significantly greater warming at higher

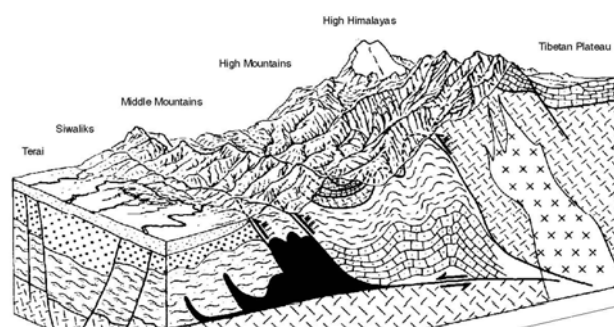


Fig: Geographical location and topography of Nepal

elevations in the northern part of the country than at lower elevations in the south. This finding is reinforced by observations by Liu and Chen (2000) on the other side of the Himalayas on the Tibetan Plateau. Significant glacier retreat as well as significant areal

expansion of several glacial lakes has also been documented in recent decades, with an extremely high likelihood that such impacts are linked to rising temperatures.

There are no definitive trends in aggregate precipitation, although there is some evidence of more intense precipitation events. A somewhat clearer picture emerges in stream flow patterns in certain rivers where there has been an increase in the number of flood days. Some rivers are also exhibiting a trend towards a reduction in dependable flows in the dry season, which has implications both for water supply and energy generation (**Shakya 2003**). Glacier retreats also contribute significantly to stream flow variability in the spring and summer, while glacial lake outbursts which are becoming more likely with rising temperatures, are an additional source of flooding risk.

Asia is the largest continent on Earth and spreads over four climatic zones (boreal, arid and semi-arid, tropical and temperate). The region faces formidable environmental and socio-economic challenges in its effort to protect valuable natural resources. Land and ecosystems are being degraded, threatening to undermine food security. In addition, water and air quality are deteriorating while continued increases in consumption and associated waste have contributed to the exponential growth in the region's existing environmental problems. Furthermore, the region is highly subject to natural hazards. There is evidence of prominent increases in the intensity and/or frequency of many extreme weather events such as heat waves, tropical cyclones, prolonged dry spells, intense rainfall, tornadoes, snow avalanches, thunderstorms, and severe dust storms in the region (**Cruz et al. 2007**). Impacts of such disasters range from hunger and susceptibility to disease, to loss of income and livelihoods, affecting human survival and well-being.

Global warming is causing the melting of glaciers in the Himalayas. In the short term, this means increased risk of flooding, erosion, mudslides and GLOF in Nepal, Bangladesh, Pakistan, and north India during the wet season. Because the melting of snow coincides with the summer monsoon season, any intensification of the monsoon and/or increase in melting is likely to contribute to flood disasters in Himalayan catchments. In the longer term, global warming could lead to a rise in the snowline and disappearance of many glaciers causing serious impacts on the populations relying on the 7 main rivers in Asia fed by melt water from the Himalayas. Throughout Asia one billion people could face water shortage leading to drought and land degradation by the 2050s (**Christensen et al. 2007, Cruz et al. 2007**).

In Asia, the principal impacts of climate change on health will be on epidemics of malaria, dengue, and other vector-borne diseases (**Martens et al. 1999**). The global burden of

climate change-attributable diarrhoea and malnutrition are already the largest in the world in Southeast Asian countries including Bangladesh, Bhutan, India, Maldives, Myanmar and Nepal in 2000. Illness and death are expected to increase from diarrhoeal diseases due to drought and flooding, and are also expected from increased amounts of cholera bacteria in coastal waters. An increase in the frequency and duration of severe heat waves and humid conditions during the summer is likely to increase the risk of mortality and morbidity, principally in the old and urban poor populations of temperate and tropical Asia (**Epstein et al. 1995**).

In recent years, enormous pressures have been put on Asia's ecosystems to support the ever growing demand for natural resources. The most affected areas are coastal and marine ecosystems, forests and mountainous regions and the flora and fauna within them. Climate change will have a profound effect on the future distribution, productivity, and health of forests throughout Asia, for example northeast China may become deprived of conifer forest. Grassland productivity is expected to decline by as much as 40 – 90 per cent for an increase in temperature of 2 – 3° C combined with reduced precipitation, in the semi-arid and arid regions of Asia.

Fisheries in both fresh water and sea water could be affected. Fisheries at higher elevations are likely to be adversely affected by lower availability of oxygen due to a rise in surface air temperatures. In the plains, the timing and amount of precipitation could also affect the migration of fish species from the river to the floodplains for spawning, dispersal, and growth (**FAO 2003**). Sea level rise and changes in sea water temperature, salinity, wind speed and direction, strength of upwelling, mixing layer thickness and predator response to climate change have the potential to substantially alter fish breeding habitats and food supply for fish and ultimately the abundance of fish populations in Asian waters with associated effects on coastal economies (**Cruz et al. 2007**).

Projected sea level rise could flood the residence of millions of people living in the low lying areas of South, Southeast and East Asia such as in Viet Nam, Bangladesh, India and China (**Wassmann et al. 2004, Stern 2006, Cruz et al. 2007**) and 30 percent of coral reefs could be lost in the next 10 years (**Cruz et al. 2007**). The loss may be as high as 88 per cent (59 per cent of global) in the next 30 years (**Sheppard 2003; Wilkinson 2004**).

1.2. Rational of the study

Due to climate change, agricultural sectors, forestry, glaciers, fresh water and biodiversity is facing various adverse impacts in Nepal but we still do not have clear idea of its impacts in Makawanpur district. Thus, there is strong need to enhance understanding on impact of climate change in all these sectors. There is need to verify impact of climate change in the area with some facts and figures. There was highly essential that we developed an adaptation strategy to reduce the threat from climate change. Implementing the adaptation strategy in these vulnerable sites need to be prioritize.

Climate change could bring unprecedented reversals in poverty reduction, nutrition, health and education. Fighting climate change: Human solidarity in a divided world, the 2007 Human Development report from the UN, argues that the world is drifting towards a “ tipping point “ that could lock the world’s poorest countries in a downward spiral, leaving hundreds of millions facing malnutrition, water scarcity, ecological threats, and a loss of livelihoods. Agricultural systems may break down as a result of increased exposure to drought, raising temperature, and more erratic rainfall, leaving up to 600 million more people facing malnutrition.

The increasing pace of climate change and its effects on human lives has been a very important issue of discussion and debate in recent years. Even though the degree of climate change and its temporal and spatial impacts are open to debate, a general consensus exists that the poorer countries will suffer more in an irony to their smaller roles in bringing about the current faster pace of climate change.

The Independent (**UK, 9 May 2007**) actually claims that the existing divisions between rich and poor countries will even be exacerbated by the pattern of climate-change impacts in the coming years. Since it has been realized that the human activities, especially of the more developed nations, have contributed greatly to the climate change, a positive change in those activities may somewhat retard the process though the climate change in the future is bound to be a lot faster than in the present or the past.

The Greenhouse Gases, containing mostly water vapour, carbon dioxide (CO₂), methane (CH₄), halocarbons, and nitrous oxide (N₂O), trap some of the energy received from the sun and thus act as a thermostat controlling the earth's climate. Without this natural greenhouse effect, the average temperature on earth would not be the current +15° Celsius but would be -18° C, making life impossible. Even though it has been scientifically accepted that the earth’s climate has always been constantly changing with a steady rise in average global temperature, modern lifestyles, and gas emissions from vehicles and industries, burning of fossil fuels and the destruction of forests.

Removals of The Greenhouse Gases have raised the levels of existing The Greenhouse Gases to alarming levels and rates, thus making the current rate of the climate change much more rapid than any time in the last 10,000 years. Global temperature has increased by 0.3 to 0.6°C over the past century with most of the rise occurring in the last 40 years. If no action at a global level is taken to curb this trend, then scientists predict that the average global temperature will increase by 1.4 to 5.8°C over the next hundred years, which may lead to consequences more drastic than all the natural calamities that have been documented over the last 100,000 years **(NRCS, 1995)**.

Intergovernmental Panel on Climate Change (IPCC) predicts that though Canada, northern Europe and some parts of the Soviet Union may benefit by the increased cereal productivity due to the climate change, sub-Saharan Africa, southern Europe and southern Asia could see widespread declines in the cropland productivity. IPCC further goes on to state that even though the regional, sub-regional and national impacts, magnitude and the rate of change is subject to discussion, it is generally accepted that: (a) the increase in the earth's overall temperature will alter precipitation patterns, trigger extreme weather conditions and may raise the sea level and threaten fresh water sources, (b) change delicate ecosystems, such as mountain flora and fauna, (c) disrupt farming, fishing, forestry and (d) directly or indirectly affect human health and endanger animal habitat. Agriculture and Climate Change Since activities related to agriculture also release the Greenhouse Gases agriculture could add to the trend of rising temperature. However, agriculture also plays an appreciative role of making positive contribution to climate change **(IISD & IES, March 1997)**.

Climate Change and Agriculture in Nepal It is quite amazing that within the span of 200 km from north to south, the climate of Nepal varies from arctic to tropical. Nepal also enjoys the four normal seasons: spring, summer, autumn and winter. The annual mean temperature is about 15°C and increases from the north to south with exceptions in valleys. The annual mean precipitation is around 1800 mm in Nepal but because of greatly diverse topography it ranges from more than 5000 mm in the south to less than 250 mm in the north. Spatial distribution of rainfall is also of great concern regarding the occurrence of floods, landslides and other extreme events. Most floods occur during the monsoon season when heavy precipitation coincides with snowmelt in the mountains. The agriculture sector provides employment to around 65% of the population but since it is mostly subsistence it contributes only about 38% to the total Gross Domestic Product. Because the Nepalese economy depends heavily on tourism and agriculture, it is very sensitive to climate variability. Hydro-power is the primary source of electricity and has a huge potential for growth but it is susceptible to glacier lake outbursts due to climate change. Nepal would be

affected by the climate change impacts at several fronts: *hydropower, irrigation, domestic water uses and disasters*.

Around 40% of the land resource in Nepal is covered by the forests. Agriculture stands second in terms of use of land as it covers around 27%. Because of the growing demands of the population, not so satisfactory land productivity and limited opportunities in non-farm activities, expansion of agricultural land continues with each passing year. The demand for water for irrigation in the agricultural sector has increased tremendously. The irrigated area expanded from 0.439 million hectares in 1984 to 0.88 million ha in 1998. According to studies done by the Department of Hydrology and Meteorology, the average temperature in Nepal is increasing at the rate of approximately 0.06 degrees Celsius per year. Nevertheless, the temperature in the Himalayas is increasing at a faster rate and this can have serious impacts on the country's glacial lakes. Although definitive trends in aggregate precipitation have not been determined, there are evidences of more intense precipitation events. Glacial lake outbursts could also destroy hydro-projects and cause floods and landslides. Contradictorily, glacier retreats have also been recorded which would lead to contracted flow of water during drier seasons. Therefore, because of climate change and the rising temperatures, Nepal could face drier phases during dry seasons with wetter monsoon (as much as three times the current level of rainfall) with chances of flooding and landslides during rainy seasons with subsequent impacts on agriculture and livelihoods **(Alan M, Regmi B.R., 2005)**.

About 80% of water in Nepal is used for irrigation. Vulnerability of rice yield showed that at 4°C increase in temperature and 20% increase in precipitation, there could be yield increase only from 0.09 to 5.5% and beyond that the yield would continue to decline. With maize, it was found that increased temperature would lead to decreased yield. However, the result was mixed in case of wheat. The changes in temperature and precipitation will also alter the hydrological cycle and the water resources. As mentioned earlier, since Nepalese agricultural sector is highly dependent on the weather, climate change has serious consequences. Glacier retreats combined with higher temperatures, increased evapo-transpiration, lower soil moisture levels and decreased winter precipitation may bring about droughts in Nepal from November to April. Such draughts or very low rainfall levels at critical points in the development phases of winter and spring crops can dramatically reduce crop yields and livestock numbers and productivity. Reduced precipitation and moisture availability could also hamper the grasslands, fodder and forage production and productivity and this accompanied by heat stress to livestock would mean decreased livestock production and productivity. Even though such fluctuations can be countered by investments in irrigation or by greater food imports, Nepal, a poor country, can probably take those measures effectively. Then on the other hand, monsoon

precipitation coinciding with snowmelt in the mountains could lead to floods during rainy seasons damaging not only agriculture and livestock but also the livelihoods of many people. All this would culminate to decreased crop yield and lower livestock productivity which if uncompensated by rising imports may threaten even the food security concerns **(Alan M, Regmi B.R., 2005)**.

A few emergency management items such as construction of emergency shelters and provision of housing for disaster-affected families have been proposed in the tenth plan but given the enormity of climate change, policies that help slow down the climate change and those that aid to adapt are also required **(Alan M, Regmi B.R., 2005)**.

Policies can be taken to impose environmental taxes on nitrogen fertilizers, promote better timing of fertilizer and manure applications, development of rice cultivars emitting less methane, better feed quality for livestock, improved livestock waste management and expansion of agro-forestry. On adaptive side, measures such as breeding of greater tolerance of crops, vegetables, livestock and fish to higher temperatures, development of low-cost water conservation technologies, development of early warning and drought and flood forecasting systems, preparedness plans for relief and rehabilitation, development and implementation of land use systems that stabilize slopes and reduce the risks of soil erosion and landslides, and construction of livestock shelters and food stores can be taken to alleviate the effects of extreme conditions affecting agriculture and livelihoods **(IISD & IES, 1997)**.

1.3. Objectives of the study

1. To enhance general understanding of the study area on impacts of climate change in agriculture, fresh water, biodiversity, and livelihood of the communities
2. To prepare adaptation strategies based on the vulnerability assessment
3. To organize Training cum workshop in order to aware local people and take information on climate change for research
4. To identify adaptation activities in the study area to build resilience of the community and ecosystem
5. To recommend the better mechanism for the future courses of action against climate change for sustainable livelihood in their communities.

METHODOLOGY

2.1 Site selection criteria

Among 22 highly disaster affected districts of Nepal, Makawanpur is one of them. That is why, Makawanpur district had been selected to carry out the research on climate change. Every year local people have been facing the flood –based disaster which is dangerous and there have been huge loss of life and property. Obviously, we selected the study area due to followings criteria:

1. Women and Child Development Forum (WCDF) is conducting the Disaster Risk Reduction School Program (DRRSP) in collaboration with Action Aid Nepal and DFID.
2. Impacts of climate change can be seen in both of areas.
3. Almost all the people were indigenous, dalits, underprivileged and deprived communities.
4. Climate change research had not been conducted before.
5. Not so far from Hetauda (Headquarter of Makawanpur district)

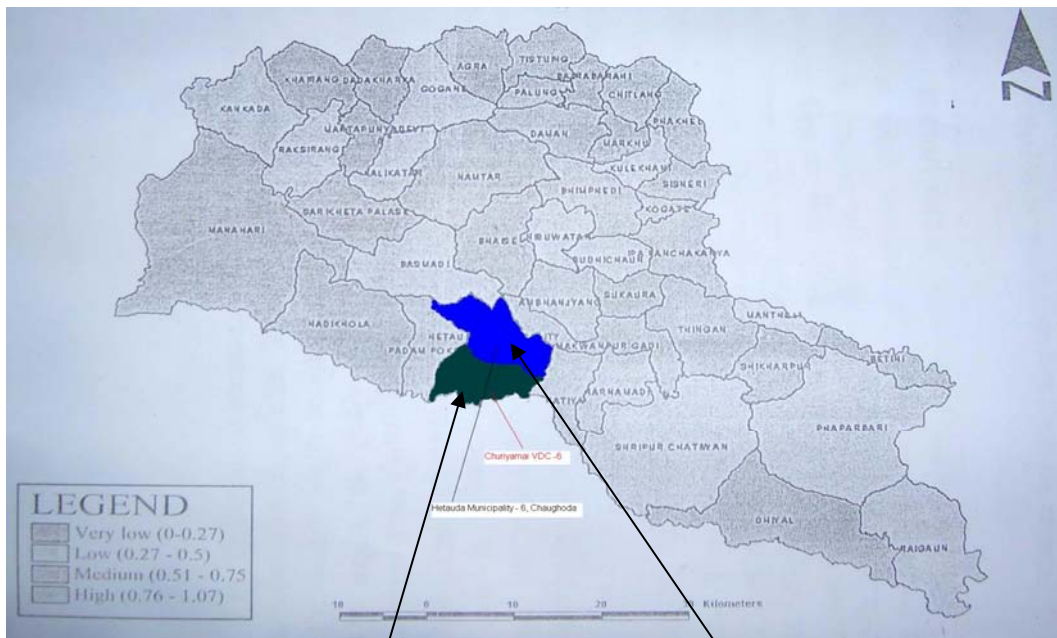
2.2 Study area description

Makawanpur district is in the churia foot hills locally known as Bhabar, is composed of relatively recent beds of boulders, gravel and silt, typically dry slopes makes the land unsuitable for cultivation. The undulating terrain of two distinct mountain range i.e. Churia in the south and Mahabharat range in the north is the result of tectonic uplift. Churia is composed of coarsely bedded boulders, crystalline rocks and conglomerates. There are two main perennial rivers namely Bagmati and Rapti, which flow from north to south and drain the district. Some common rivers are Lothar, Manahari, Samari and Carra. Based on 2001 population census, the population of Makawanpur district is 392604, out of which males are 199144 and females are 193460 where as annual growth rate is 2.2 %. Human development index of this district is 0.479. Moreover, major caste/ethnicity are Brahman/Chhetri Group (26.01%) , Advanced groups (6.89%), Marginalized group (1.13%), Highly marginalized group (4.48%), disadvantaged group (55.23%) , endangered group (0.02%) , dalits group (4.41%) and unidentified group (0.24%)

The climate is tropical in the south and the inner valley to temperature type in the north. Climatically there are cold, hot and rainy seasons. The average rainfall is 226.3 mm/year (CBS, 1998). Of the total annual precipitation more than 80% fall during June-September. April – May provides the highest temperature with maximum exceeding 40°C at low land.

For this study, two distinct study areas were selected in such a way that one from the Hetauda Municipality-6, Chaughada and other from Churiya VDC-9. Both of the study areas were in the tropical region and southern part of the district.

Map of the study area



Hetauda Municipality 6,
Chaughada

Churiya VDC- 9

2.3 Key methods

The selections of appropriate methods are to the most important part of any types of research. Participatory methods were used to collect data to share their experience and knowledge towards climate change. Various attempts and attendance of stakeholder meeting were organized in order to collect information regarding climate change on how climate change has affected in their



Photo: Focus group discussion in Hetauda Municipality -6,

communities. Both qualitative and quantitative research techniques were applied in this study, including observation, focus group discussion and questionnaire survey.

In order to conduct the study and fulfill the objective as outline above, Systematic and integrated methodologies were followed. The major elements of this methodology was included the use of primary and secondary information, field observation, key informant interviews workshop on climate change and formal questionnaire regarding the impact of climate change on their livelihood. Along with this information, focus group



Focus group discussion on climate change in Churiya VDC-9

discussion was carried out in order to find out the adoption strategy to fight against climate change. 2 days village level workshop was organized and conducted to train and share knowledge on climate change. Moreover, the aim of the workshop was to capture all the information which is intended for this research.

RESULT AND DISCUSSION

3.1 Impacts of climate change

Local people of Churiya VDC-6 and Hetauda Municipality-6 are facing an increasing risk from super disasters such as floods, drought and rise in infectious diseases, which has a host of increasing environmental, health, and economic impacts.

As per the field survey, impacts of climate change on both of Hetauda Municipality-6, Chaughoda and Churiya VDC-9 of Makawanpur district were successfully assessed during field trip whereas Disaster Risk Reduction through School Program has been implemented in coordination with Women and Child Development Forum (WCDF), Action Aid Nepal and DFID since the last two year. Details of impacts have been shown below:

3.1.1 Impacts of climate change on agriculture

Over two-third of Nepal's population depends on agriculture for a livelihood. Farmers follow a traditional set-planting pattern, relying on rainwater and the seasons. Now the old rhythms are upset by unpredictable rains or prolonged droughts. In the past four decades, the agricultural productivity of major grains in Nepal has gone from being the highest in South Asia to the lowest. Since 1960, the number of global Weather related disasters have increased four fold, real economic losses seven fold, and insured losses. A part of this rise in disaster losses can be attributed to rapid Weather changes. Developing countries are the most vulnerable to natural disasters that have serious economic impacts (**WWF Nepal, 2006**).

The impact on agriculture will directly affect the economy. In Nepal, agriculture is the backbone of the economy and accounts for 80% of the population's livelihood and contributes to 40% of the GDP. Likewise, more than 90% of people in the study area have primarily depended up on agriculture.

In the study area, impacts of climate change on agriculture were seriously assessed using focus group discussion and PRA/RRA methods. The following impacts were recorded during periods in both of the areas:

- 🌦️ Likely changes in the local and regional temperature, precipitation, rainfall pattern, soil moisture, sunshine and cloudiness, threatened the traditional agricultural practices (both of the study areas).

- ✚ Climatic change has brought in every year about extreme events like floods, drought, and hailstorms, affecting agriculture drastically in both of the study areas.
- ✚ Rising temperatures and increased rainfall has seriously led to more pests and weeds, as a result of, reduced productivity (both of the study areas).

3.1.2 Impacts of climate change on Forests

Forests cover almost 29% of Nepal, absorbing and storing carbon dioxide. Cutting and burning trees releases the gas back into the atmosphere. The conservation of forests is critical to balance GHGs in the atmosphere and minimize the impact of climate change. Nevertheless, following negative impacts have been experienced in both of the study areas

- ✚ The degradation of forests, accelerated from the 1950s (Hetauda Municipality-6, Chauthada) and 1975 (Churiya VDC- 9) with a rising demand for human settlements and forest products.
- ✚ Forests are unable to adapt to the rapidly changing conditions caused by climate change, making trees more vulnerable to diseases and pests that contribute to degradation and fragmentation.
- ✚ With a decrease in moisture levels due to climate change, forest fires are more likely (the biggest forest fire was experienced in 1993 AD in Hetauda Municipality-6, Chauthada, whereas such the largest fire was experienced in 1995 AD in Churiya - 6).
- ✚ Increased droughts, flooding, and changes in rainfall pattern were seriously affected in the study area.

3.1.3 Impacts of climate change on health

In the study area, impacts of climate change on health have been seemed as a minimal as compared to other sectors. There was reliable evidence that correlated climate change with health. However, impacts of climate change on health have been shown the following in the study area.

- ✚ An increase in malaria has been attributed to climate change. Water is the breeding ground for mosquitoes and warmer temperatures mean these disease-carrying pests now breed previously in cool areas. Breed
- ✚ According to the local people, outbreaks of Kalaazar and Japanese encephalitis are increasing which is definitely due to climate change in Terai (hot regions)
- ✚ Flooding and water contamination has surely heightened risk of water-borne diseases. Contagious outbreaks are more pronounced after floods that disrupt sewage systems in the study area.

Case Study

I do not want to remind my earlier days about cruel floods

Mr. Deep Prasad Dahal is residing in Churiyamai VDC- 9, Shikharpani of Makwanpur District at the moment. He had born in Bijulikot -5, Ratamata of Ramechhap District in 2014 B.S. He spent his childhood there. He said, "My father Tirtha Prasad Dahal used to cultivate some crops for livelihoods in the newly cultivated field (commonly known as Birauto in local language)". Unfortunately, this field was totally brush away by this hazardous flood. Then, it was very difficult for his family to survive there. When he was 14, his family settled down to Sarlahi, Hariwan in 2028 B.S. They lived there for 9 yrs. Sadly, cruel floods brushed away in their entire cropping fields. They couldn't face to the tremendous floods in their life. As a result, his family migrated to Makwanpur district in 2037 B.S. At that time they had only one hundred rupees. He faced many difficulties even for hand to mouth in Makawanpur. To solve these problems, he started to work in a pan factory as an unskilled labour. He worked there for one year but his office did not give a chance to be permanent. During period, Hetauda Textile Industry opened the vacancy. He applied and selected for the job by chance. He worked there for 19 years. Along with his job, he also started poultry farming in his area. He continued it for 4 years and left. His hard work helped him to improve his economic condition. In 2048, the Textile Industry collapsed so he returned back to agriculture. Till then he has bought 1.5 hectares of land. He says, "Because of continuous migration and poverty I couldn't study and had to face many difficulties." He has studied up to 3 classes. But his two daughters and two sons have just passed their graduate level. Now he is spending his retire life in home. He has two workmen. He has kept two milky cows. Sowing two tractors, I sometimes look after them. Now a day he has also involved in social service. He is the president of school building construction committee, Shree Churiya Mai Secondary School and treasurer of Hatemalo farmer group and Hatemalo farmer group main committee. He is an honorable and respectable person in his society. He satisfies with his name and fame. In his 44 years life he has felt that the temperature is going to be very in summer and too cold in the winter. Rain fall system has also changed. There is no rain in the right season. There is some times downpour in the up season. The production of agriculture is getting low. Frequencies and scale of floods are gradually increasing in every year. Floods have also brought many fatal diseases which made the vulnerable to human and livestock's health. He said, I have lots of such bitter experience in my life. Life is making a very struggle even for hand to mouth. It is due to climate change. He added, we have to initiate in village level in order to fight for climate change so that we can experience the very limited impacts in our community.

Climate change, in my own experience

I am Tirbikram Manandhar of 48 years. I have been residing since 2018 B.S. in Hetauda Manucipality – 6, Chaughoda, Makawanpur. I have faced ups and downs in my life. I had not heard the word of “Climate change” before. I have one wife, two daughters and two sons. I have been cultivating from my own private agricultural land with indigenous methods for 20 years. Nevertheless, I was satisfactory able to grow wheat, paddy and maize without using any chemical fertilizers and pesticides. In a gesture of time, I am facing many challenges to grow the agricultural crops. I have with the bitter experiences, he added, 10 to 15 years ago, sources of water was sufficient with the green forest near by village. Now sources of water have eliminated and going to be the drought. As a result of, we are facing many difficulties and challenges even in hand to mouth problems due to lack of productivity. So climate change has directly impacted in our livelihood too. I have more than 30 years of experience in this village. We realized, temperature is rising as compare to earlier years. It is due to higher deforestation rate in order to solve the problems for rapidly growing human population. Obviously, we are facing tremendous floods in every year. The trends of flooding are growing in increasing rate as compare to earlier floods. I had got a chance to view the different floods closely in 2018 BS, 2024 BS, 036 BS , 045 BS, 050 BS and 053 BS. The most hazardous flood was of 050 BS and 052 BS. So our village will also be the vulnerable for the future if we ignore to climate change.

Many wetlands in our village are becoming the drought. Production of agricultural crops has lowered due to climate change. He added, we have to initiate from our own community. Preparation of action plans to struggle aligned with climate change, should be implemented in order to adopt climate change by planting large scale plantation program in the bank of steam/river with community mobilization. So public awareness is the vehicle to change to cope and reduce the climate change.

We have no any alternatives for livelihoods

Man Kumari is 70, and lives on an old thatched house on Churiya VDC with her husband. Her family has fished for generation. Earlier, stream near by village was a nice place because the water from river used to flow in and a lot of fish would bread. We used to have a good living and our children would live in peace. But now our children remain hungry. Now, the water has become a poisonous. As a result of, we can not see any fishes in the river. She said, “I am afraid on how our generations survive, they have to shiftt their occupation”. Due to poverty, we have not any alternatives for livelihoods. Life is making struggles. All are due to climate change.....

Agricultural land is becoming a drought

Ram Bahadur is a 45 year-old indigenous people residing in Churiya Village Development Committee, word No: 6 of Makawanpur district. He said, “I have a bitter experience, he added “I used to cultivate paddy in my Gairi Khet. Due to become a drought in my Gairi Khet, I have imposed to cultivate millet and maize only. It is definitely due to lack of moisture in the field. Production of paddy is becoming the very low due to lack of moisture. Ram Bahadu, along with other small farmers have been suffering such type of problems. They surely guessed that it was the result of deforestation, global warming and use of chemical fertilizer.

3.1.4 Impacts of climate change on biodiversity

An impact on climate change in biodiversity is likely to have a number of impacts from ecosystem to species level. In both of the study area, impacts of climate change on biodiversity were clearly viewed according to the group discussion and key informants survey. As per their invoices, in one hand, birds diversity were decreased as compare to earlier years whereas in the other hand, introduction of new bird species were very few and going to be disappear day by day. The most obvious impact is the effect that flooding and temperature changes have definitely affected the ecosystem, allowing some ecosystems to expand into new areas, while others diminish in size. As well as shifting ecosystem boundaries, these changes will also cause changes in natural habitat an outcome which will have a knock-on effect on species survival.

A growing body of research indicates that, as a result, climate change may lead to a sharp increase in extinction rates. Mid-range predictions from one recent study suggest that 24 per cent of species in the five study regions will be on their way to extinction by 2050 due to climate change. The study indicates that for many species, climate change poses a greater threat to their survival than the destruction of their natural habitat. Obviously, impacts of climate change on biodiversity were clearly seen in the study area due to endanger and extinct of wild flora and fauna.

3.2 Ranking of impacts and vulnerabilities

The necessity of suitable responses to climate change not only relies on the degree of certainty associated with projections of various climate parameters, but also in the significance of any resulting impacts from these changes on natural and social systems. Further, development planners often require a ranking of impacts, as opposed to a catalog that is typical in many climate assessments, in order to make decisions with regard to how much they should invest in planning or mainstreaming particular response measures. Towards this goal, this section provides a subjective but reasonably transparent ranking of climate change impacts and vulnerabilities for particular sectors.

Vulnerability is a subjective concept that includes three dimensions: **exposure, sensitivity, and adaptive capacity** of the affected system (Smit et al. 2001). The sensitivity and adaptive capacity of the affected system in particular depend on a range of socio-economic characteristics of the system. Several measures of social well-being such as income and income inequality, nutritional status, access to lifelines such as insurance and social security, and so on can affect baseline vulnerability to a range of climatic risks. Other factors meanwhile might be risk specific – for example proportion of rainfed (as opposed to irrigated) agriculture might only be relevant for assessing vulnerability to drought. There are

no universally accepted, objective means for “measuring” vulnerability. This section instead subjectively ranks biophysical vulnerability based on the following dimensions 4:

A. Certainty of impact. This factor uses our knowledge of climate change to assess the likelihood of impacts. Temperatures and sea levels are highly likely to rise and some impacts can be projected based on this. Changes in regional precipitation are less certain. We use the MAGICC/SCENGEN outputs to address relative certainty about changes in direction of mean precipitation. Changes in climate variability are uncertain. The Intergovernmental Panel on Climate Change (**Houghton et al., 2001**) concluded that higher maximum and minimum temperatures are very likely, more intense precipitation is very likely over most areas, and that more intense droughts, increased cyclone wind speeds and precipitation are likely over some areas.

B. Timing. When are impacts in a particular sector likely to become severe or critical? Based on available information, we considered whether impacts are likely to become so in the first or second half of this century.

C. Severity of impact. How large could climate change impacts be? Essentially this factor considers the sensitivity of a sector to climate change. For the most part, we did not consider the ability of adaptation to cope with climate change impacts.

D. Importance of the sector. Is the sector particularly critical in terms of its size of economy, cultural or other importance, or its potential to affect other sectors? This factor considers exposure of the sector to climate change, that is, how many people, property, or other valuable assets could be affected by climate change.

A score of high, medium, or low for each factor is then assigned for each assessed sector. In ranking the risks from climate change, the scoring for all four factors was considered, but the most weight was placed on the certainty of impact. Impacts that are most certain, most severe, and most likely to become severe in the first half of the 21st century are ranked the highest.

3.2.1 Priorities ranking

In order to know the priorities ranking in the study area, first of all, carried out the likely impacts of climate change. We saw closely the impacts of climate change on agriculture, forestry, health and sanitation, hydrology and water, ecology and environment and biodiversity sectors. At a very glance, we had guessed the agriculture and forestry issues. According to the respondents, following result has been seen using priorities ranking table:

A. Hetauda Municipality - 6, Chaughoda

S.N.	Categories	Likely impacts (as per the respondent			
		High	Medium	low	Negligible
1	Agriculture	25	15	3	2
2	Forestry	24	16	2	3
3	Health and sanitation	10	12	20	8
4	Water and hydrology	22	15	3	4
5	Ecology and environment	16	2	5	8
6	Biodiversity	23	20	6	1

(Ref: According to the field survey, April, 2008)

During field survey, altogether 50 respondents were selected for the questionnaire survey. As per their perception towards climate change, they marked the different categories as high, medium, low and negligible respectively in the study area. Nevertheless, they felt too difficult to rank the categories because almost all the categories had some how negative impacts in the study area. As per respondents survey, agriculture has seen the highest impacts followed by forestry, biodiversity, water and hydrology, ecology and environment, and health and sanitation. In case of medium impacts, biodiversity has been seen the highest medium impacts followed by forestry, agriculture, water and hydrology, health and sanitation, and ecology and environment. In case of lower impacts, health and sanitation has been seen as the highest impact followed by biodiversity, ecology and environment, agriculture, water and hydrology, and forestry. Eventually, health and sanitation, and ecology and environment have been seemed the negligible impacts in the study area.

In a nutshell, local people marked the agriculture, forestry and sources of water as a priority lists to do something because local people have often thought on how to sustain and improve their livelihoods. Creating awareness rising on health and sanitation has been clearly seemed due to various NGOs/ INGOs working in this area.

B. Churiya VDC - 9

S.N.	Categories	Likely impacts (as per the respondent)			
		High	Medium	low	Negligible
1	Agriculture	24	20	2	2
2	Forestry	20	15	3	2
3	Health and sanitation	17	12	10	11
4	Water and hydrology	25	19	4	2
5	Ecology and environment	22	19	5	4
6	Biodiversity	24	15	8	3

(Ref. According to the field survey, April, 2008)

In Churiya VDC, questionnaire survey was carried out with 50 respondents. Respondents were selected in such a way that they represented inclusive approaches of women, dalits, old and indigenous people and marginalized people. As per the respondent questionnaire survey, almost all the categories have been marked as higher impacts on climate change. The table reveals that agriculture, water and hydrology, and biodiversity has more effected followed by ecology and environment, forestry and health and sanitation in churiya VDC.

3.3 Floods trend analysis

It is the best method to know and identify on how floods are increasing with increasing in time. About three decades of experience on floods have been analyzed in both of the study area. The study reveals that trend of floods are increasing which definitely prove the impacts of climate change in area.

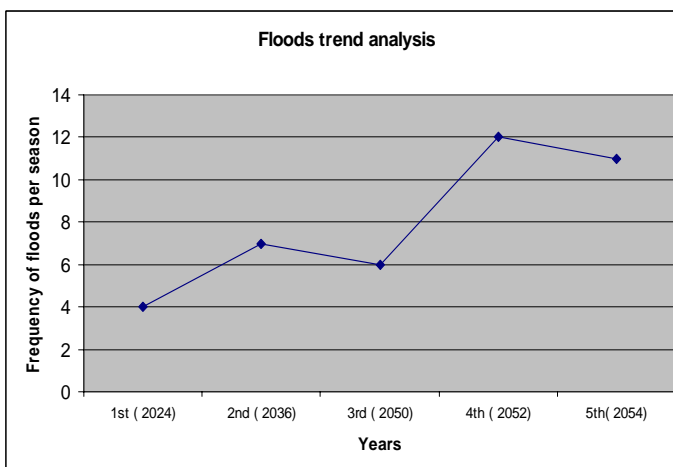


Fig: Flood trends analysis in Hetauda Municipality – 6, Chaughoda

In Hetauda Municipality – 6, Chaughoda, 2052 BS was the highest frequency of floods in viewing the last three decades. Moreover, frequency of floods has been increased with the increasing in years. This data was captured according to the focus group discussion with near about 50 participants.

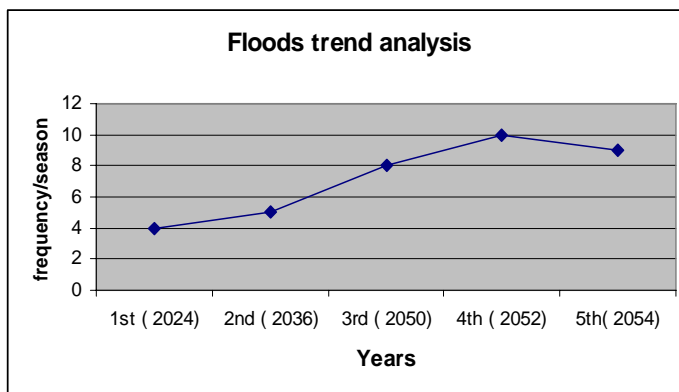


Fig: Floods trends analysis in Churiya – 9

Definitely, this result reveals that frequencies of floods are increasing in the near future if local people ignore the climate chance mitigation measures in their communities.

In Churiwamai VDC- 9, 2052 BS was the highest frequency of floods in observing the last three decades. Similarly, frequency of floods has increased with increased in time period which shows the impacts of climate change in this area.

3.4. Adaptation strategies

Climate change is considered to be one of the most serious threats to sustainable development, with adverse impacts expected on the environment, human health, food security, economic activity, natural resources and physical infrastructure. Global climate varies naturally, but scientists



Photo: Community-based adaptation strategies

agree that rising concentrations of anthropogenically produced greenhouse gases in the earth's atmosphere are leading to changes in the climate. According to the Intergovernmental Panel on Climate Change (IPCC), the effects of climate change have already been observed, and scientific findings indicate that precautionary and prompt action is necessary. While mitigation has traditionally been the pivotal issue for many climate change experts, adaptation to the effects of climate change is now acknowledged as necessary for responding effectively and equitably to the impacts of both climate change and climate variability. In recent years, adaptation has become a key focus of the scientific and policy-making communities and is now a major area of discussion in the multilateral climate change process. Adaptation has been implicitly and explicitly linked with development-focused action, particularly as the IPCC has underscored that developing countries are disproportionately vulnerable to climate change and lack adaptive capacity. Development processes and trajectories will be affected by the rate of climate change, and this is especially important for developing countries with growing economies. Particular attention will need to be paid to the management of water and other natural resources, agricultural activities, and the sources and generation of energy.








Local people impose to design the adoption strategies themselves if the climate change affects directly in their livelihoods. It is the universal true. Local people have carried out the different community level initiatives in order to fight from climate change. Formulation of the adoption strategies is the vehicle of change to cope with the adverse situations made by climate change. One year action plan has been formed in order to minimize the climate change in the local community.

Local perceptions on climate change and impacts, including emerging alien plant species, warmer winters, increased frequency of extreme events and increased vector-borne diseases were the serious in the study area. Adaptation responses, such as use of metal sheets to prevent rainwater leakage, alternative storage tanks or irrigation canals for rainwater collection, temporary migration, cultivating shorter span crops shows that local people have imposed to responses of climate change impact in the study area.

3.4.1 Adaptation activities

As per in the field, adaptation measures were grouped as sectoral (introduction of improved agricultural varieties), multi-sectoral (e.g., use of improved watershed) and cross-sectoral (e.g., promotion of public awareness, climate research, and data collection). Sectoral measures relate to specific adaptations for sectors that was directly affected by climate change. In agriculture, reduced rainfall and higher evaporation may call for the extension of irrigation. Local people have started to use hybrid seeds in order to cope with increasing climate change. Multi-sectoral measures relate to the management of natural resources that span sectors – e.g., water management or river basin management by using low cost technique. Local people have initiated to prepare embankments and promote bioengineering technique. The ecosystem approach to climate change adaptation involves the integrated management of land, water and other resources that promotes their conservation and sustainable use for the future. Cross-sectoral measures can span several sectors and include the following: Education and training: Introduction of climate change issues at different levels of the educational system is an ongoing process that can help to build capacity among stakeholders to support adaptation in the future, and can help to develop appropriate research activities and a greater awareness among citizens. Local people have initiated these activities form their community as a campaign.

In the grass roots level, people in the study area are organizing and implementing practices which definitely help towards climate change:

-  Minimum consumption of energy
-  Promotion of renewable energy
-  Be consensus on climate change
-  River courses protection
-  Watershed management
-  Bioengineering techniques
-  Plantation program

3.5 Action plan

Action plan for the communities (Hetauda Municipality - 6, Chaughoda)

S.N.	Activities	When	Where	Who is responsible?	Remarks
1	Group formation in the coordination with eco club members	Second week of May	Banshagopal Higher Secondary School	Principle of Banshagopal Higher Secondary School	
2	Speech competition program on climate , Climate change : Challenges for future	3 rd week of June	Banshagopal Higher secondary school	Group leader and school management committee	
3	Plantation program (Bamboo plantation, Eucalyptus species, Khair (<i>Acacia catechu</i>), <i>Beepal</i> (<i>ficus religiosa</i>)	2 nd week of July	South – east from the premise of school building	Group leader and school management committee	Suitable species will be planted at the boarder of streams.
4	Wire fence program	Commencing from August to september	Plantation area	School management committee /disaster management committee	
5	Embankment construction	2 nd week of September	South-east part of the Karra Khola	Management Committee	Coordination with
6	Awareness raising program on climate change	October to November	Chaughoda	Group (Formed by local people)
7	Improve stove program	December - January	Chaughoda	WCDF
8	Monitoring and evaluation of the progem	February /March	WCDF / Action Aid

Table: participatory action plant of Hetauda Municipality – 6, Chaughoda

Churiyamai VDC

S.N.	Activities	When	Where	Who is responsible?	Remarks
1	Plantation program	Within end of the June	In and around School ground	Principle of Churiyamai Higher Secondary School	- Bans - Khair - Sissoo - Peepal - Eucalyptus spesies
2.	Environment day celebration	June 5	School (Churiyamai Higher secondary School)	Principle of Churiyamai Higher Secondary School	Speech competition and Drawing competition
2	Embankment / dry wall construction , Gabion wall construction	Up to 2 nd week of July	Bank of stream, South-east of school area	Disaster management committee	Used locally available materials
3	Bio gas promotion program	Up to 2 nd week of August	Churiya VDC	Groups	After coordination with various

					line agencies
4	Coordination with different environment related organizations	August to September
5	Awareness raising program on climate change	December	School	Eco club (School)	Climate change, environmental conservation, green house gases, Global wawrming, UNFCCC

3.6. Workshop on climate change

Workshop on climate change was organized in Seema hotel, Makawanpur, Nepal realizing the fact that impact of climate change are tremendous. The main aim of the workshop is to create the community awareness on climate change among the indigenous local community. Almost all the participants had come from the disaster-prone areas named Hetauda Municipality -6, Chaughada and Churiyamai VDC-9. In this workshop, two management committee (Banshagopal disaster management committee and Churiyamai Disaster management committee) have eagerly involved in this esteemed workshop.



President of WCDE, welcomed to participants in climate change workshop

At a very glance, we had intended to know the expectation of all the participants through this workshop. Most of the participants had expected to know, share and building capacity from this workshop. In fact, participants are very curious and eager to know and share their experience regarding climate change. Impacts of climate change were discussed and realized through the group-based approaches by separating each group concerning the priority-wised impacts on agriculture, forestry, ecology, health, biodiversity and others. Obviously, this workshop was able to create the awareness for the community people in order to safeguard and fight against climate change. Nevertheless, people have designed the plan for the future courses of action in order to achieve the minimal impacts on climate change. Eventually, each group had presented their views and ideas regarding cause and mitigation measures on climate change.

Objectives

General objective

The main objective of the workshop was to create the public awareness, build capacity and adopt appropriate strategies against climate change in the community.

Specific objects

1. To share the knowledge and skills on climate change through focus group discussion.
2. To identify the roots cause of climate change in local level
3. To find out the role and responsibility towards climate change which is growing at the alarming rate
4. To discuss the relation between agriculture and climate change and its impacts
5. To recommend the better mechanism for the future courses of action.

Subject matter

Day one

1. Climate change and global warming

- What is Global Warming and Climate Change?
- What is the Greenhouse Effect?
- What are the impacts of Global Warming?
- Rapid changes in global temperature

2. Climate change, in context of Nepal

3. Impacts of climate change

- Agriculture
- Forestry
- Freshwater and hydropower
- Health and sanitation
- Biodiversity
- Ecosystem

4. Climate change on global (Different convention related to climate change)

- Rising Sea Levels
- Increase in Pests and Disease
- Failing Agricultural Output; Increase in World Hunger
- Greenhouse gases and emissions resulting from human activity
- Differences in Greenhouse Gas Emission Around the World
- The United States is the World's Largest Emitter of Greenhouse Gases
- The previously 15-member European Union is also large Emitter
- Stalling Kyoto Protocol Gets Push by Russia

6. The Kyoto Protocol

The Kyoto Protocol was the climate change treaty negotiated in 1997, setting targets for emissions of greenhouse gases.

7. Rich nation's emissions have been rising

The UNFCCC released greenhouse gas emissions data for the period 1990-2005. It showed that rich countries generally had rising emissions, not reductions as the Kyoto Protocol mandated.)

Day 2:

1. Community level adaptation strategies
2. Action plan for the future course
3. Group presentation
4. Video showing (Showing video named PRAKOP KO PIDA and MAUSAM PRIBRATAN SANDESH)
5. Closing session

Outputs of Workshop

(Focusing on impacts, mitigation measures and recommendation for the future).

Here, we have focused on agriculture sector on how its impacts for livelihood. During workshop, agricultural sector has been prioritized as the highest impacts realized by local people.

1. Causes of maximum impacts

- ✚ Low rainfall
- ✚ Insect pest in agriculture crops
- ✚ Loss of soil fertility
- ✚ Acid rainfall
- ✚ Precipitation

2. Mitigation measures

- ✚ Growing of crops as per the season
- ✚ Promoting Integrated Pest Management (IPM) technology for curing agriculture crops
- ✚ Using compost manure rather than chemical fertilizer
- ✚ Testing of soil PH
- ✚ Using some how hybrid seeds in order to secure from poverty

3. Recommendation

- ✚ Forest conservation and plantation program on denuded hills slope
- ✚ Control and management of poisonous gases
- ✚ Creation of community awareness
- ✚ Training and education
- ✚ Climate change as a campaign
- ✚ Policy making

Conclusion: *Outcome of the workshop was used in result and discussion part of the research on impacts of climate change especially for agriculture and livelihoods. Community level adaptation strategies and recommendations were identified and analyzed with the help of group discussion during workshop.*

CONCLUSION AND RECOMMENDATION

4.1 Conclusion

Nepal's share in climate change is negligibly small. The population of Nepal is less than 0.4% of the world population and is responsible for only about 0.025% of annual greenhouse gas emissions. However, Nepal is highly vulnerable to climate change impacts. Temperatures are likely to increase more in high mountain areas than elsewhere. Global climate change will also likely shift monsoon precipitation patterns in ways that will threaten Nepal's current agricultural practices, infrastructure, bio-diversity, especially in mountain regions where migration of species is physically restricted.

Awareness raising, capacity building and small scale mitigation works are gradually conducting in community level which was definitely the implications of various NGO/INGO implementing in this district on disaster risks reduction that will automatically help to fight against climate change for local people. Among 22 highly disaster affected districts of Nepal, Makawanpur is one of them. Every year local people have been facing the flood – based disaster which is dangerous and there have been huge loss of life and property. As per the present situations, local people said “ we can not eliminate natural disaster but can minimize being united “ added , we do not have any experience that governments has helped NGOs and community in the field. In above result and discussion, we have concluded the following points:

1. As per respondent's survey, agriculture has been seen the highest impacts followed by forestry, biodiversity, water and hydrology, ecology and environment, and health and sanitation in Hetauda Municipality -6, Chaughoda.
2. Almost all the categories have been marked as higher impacts on climate change in Churia VDC. Nevertheless, it reveals that agriculture, water and hydrology, and biodiversity have been the highest impacts followed by ecology and environment, forestry and health and sanitation.
3. As per the floods trend analysis, frequencies and scale of floods have gradually increased due to climate change in both of the study sites.
4. Local people have initiated to plant tree in the river banks, bamboo plantation, infrastructure development (roads repairing, gabion wall construction, embankments and bioengineering methods), change the cropping patterns, use hybrid seeds and initiate the community based disaster management in order to cope with the adverse situation of climate called as climate change.
5. 2-days Workshop on climate was organized and 52 local people had got a chance to share their experience, make action plan and select the appropriate recommendation for the future courses of action.

4.2 Recommendation

1. Awareness generation and advocacy

Creation of community awareness on climate change among the indigenous community (specially for poor, women, dalits and disadvantaged groups) should be focused in the future courses of action. Human interference/ disturbance on environment have been growing up rapidly as a result of adverse effect on climate change. In the study area, an impact of climate change was realized highly on agriculture and forestry so local people have been facing the disasters due to higher deforestation rate. Some of the major activities under this sector are education to teacher and students and parents intending to generate multiple effects on the communities about correct understanding and responding disasters should be implemented in local community where they have been facing the disasters (especially on floods) due to climate change. Awareness plays a vital role in sustainable disaster response and ensures protection of life and properties. Before mitigation measures, hazard mapping, research and documentation, vulnerability assessment, situation analysis, sharing meetings and mobilization of theatre and media for awareness rising among community people should be focused and implemented promptly in the near future in order to reduce disaster risks in the community level.

2. Capacity building

Capacity building intends working for enhanced capacities of communities and their support institutions so that they could plan and implement the planned in order to reduce the probable disaster risks and make some action towards climate change reduction The activities under capacity building mainly include training on planning and First Aid and naturally nurturing the DMCs and other stakeholders. Process as well as behavioral sustainability can be harnessed through building local capacities. Training to Youth Clubs, Eco-Clubs, Women CBOs, Dalit /ethnic organizations etc fall under this sector. Critical knowledge gaps that impede effective adaptation decisions should be identified and plans for new collaborations of stakeholder and scientific organizations that target the identified gaps should be developed and promoted for follow-up action;

3. Small scale Mitigation

Small scale mitigation should be prioritized in the community (both of Hetauda municipality – 6 and Churiya VDC- 9) which greatly contributes to minimizing the effects of disaster. Small –scale mitigation activities such as embankments, culverts, repair and maintenance of infrastructures should be initiated and implemented on which can reduce the loss. Training on these activities such as low cost measures should be focused on communities using local available resources. Eventually, use of safe route for evacuation and means of emergency transportation should be managed

4. Community-based Adaptation

To address the widespread climate change related hazard of flooding, effective community adaptation initiatives include early warning systems, design of structures to accommodate flooding and provide safe platforms, land use planning for water and exposure control, emergency preparedness systems, and watershed reforestation should be enforced and implemented for the future courses. Risk communication products designed to support adaptation decisions and targeted to decision-makers and vulnerable groups, should be developed, tested, and disseminated by each pilot action to engage civil society in the development of adaptation strategies. Recommendations for adaptation and integration of adaptation into development, environment and resource policies and programs should be produced and promoted by each pilot action and should be reflected in National Communications

5. Afforestation / Reforestation

Plantation programs should be focused and implemented in the disaster prone areas which ultimately help to reduce the climate change. Community- based action plan should be prepared in yearly basis so that local people could initiate the environment friendly activities.

7. Policy

Policy plays the vital role to reduce the adverse climate change in both local, district and national levels. Avoided deforestation, promoted afforestation and reforestation, biodiversity –friendly and climate-friendly energy, capacity building and community engagement and bio fuels and agro energy expansion should be considered and implemented as a policy level recommendation. Networks of institutions in developing country regions should be strengthened for leading south-south capacity building efforts related to the United Nations Framework Climate Change Convention and other Multilateral Environmental Agreements.

7. Research on climate change

There are very few research activities in Nepal concerning on climate change. Action research should be promoted and conducted in the future. Research and extension is the key methods to create the community awareness on climate change among the underprivileged and deprived communities.

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