

Climate Change Impacts and Adaptation Measures Practiced in Agriculture at Latikoili VDC of Surkhet District, Nepal

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Abstract. Limited understandings of the impacts of climate change and lack of local research have proven to be major challenges for the Nepalese agricultural sector. A study was carried out in Latikoili VDC of Surkhet district aiming to identify impacts of climate change, examine people's perception, and assess existing adaptation measures practiced on agriculture. Qualitative and quantitative analysis was done to the data collected from primary and secondary sources. The climatic data revealed; the trend of temperature has increased and rainfall has substantially decreased over past 29 years. The results showed most of the respondents perceived change in climate and farming system such as delay of monsoon, erratic rainfall pattern, increased temperature resulting drought associated with decrease in water sources, shifting cultivation, planting and flowering time. The adaptation measures such as adapting improved seed varieties with change in planting time, IPM practices, and plastic pond to store waste water have been practiced to combat climate change. Sharing information and raising awareness among people can be done to enhance livelihood.

Keywords: Climate change, agriculture, people's perception, adaptation measures

1 Introduction

Global warming and climate change are the great concern of today since they affect the ecosystem around world. Exponential growth of CO₂ and other green house gases in the atmosphere is causing climate change [1] affecting agriculture, forestry, human health, biodiversity, mountain to aquatic ecosystems. Climate is one of the main determinants of agricultural production [2]. Agriculture is the major land use across the globe. Approximately 65 % of arable land in Nepal is rain fed and only 24% has access to irrigation system making the sector highly vulnerable to climate variability [3]. Agricultural land is rain fed in our country and summer monsoon is the only source of water for irrigation [4]. Within agriculture, it is the rain fed agriculture that will be most impacted by climate change. Likewise, temperature and rainfall are the important weather parameters that affected productivity of rain fed crops [5]. Nepal's temperature is increasing at high rates 0.06⁰ Celsius per year compared to the global scenario [6]. Precipitation has become increasingly unpredictable; while biodiversity depletion, deforestation, increased frequency of extreme weather events have all negatively affected agricultural production. As the majority of Nepalese engage in smallholder farming which is susceptible to weather volatility, a greater portion of the population will be directly affected by climate change. High level of poverty will restrict the adaptive capacity of Nepalese farmers.

Nepal demonstrates a diverse geo-physical and climatic conditions within a relatively small area. It is, therefore, an ideal place to study climate change and its impact on nature and socioeconomic factors. In the present context, fluctuating weather and erratic pattern of rainfall has been a constant threat to the farmers leading to drought, flood, landslide, increase in pest number resulting decline in crop production. The resulting low yield of crop production has left Nepal highly vulnerable to climate change. The limited understanding of the impacts of climate change and lack of localized research have proved to be a major challenge for the Nepalese agricultural sector as it struggles to cope and adapt with the changing nature[7]. Surkhet is one of the districts practicing rain fed agriculture. The district experiences humid sub- tropical climatic regime as well as less rainfall and the onset of monsoon is later [8]. Varying temperature and precipitation affects the overall cultivation pattern. Thus, this study

assesses the trend of temperature and precipitation, people's perception on climate change and type of adjustments people have made to combat changing climate.

Taking Latikoili VDC of Surkhet district as reference [9] this study intends to study the perception of climate change among local farmers and the types of adjustments they have made in agricultural practices in response to the changing climate. The main objective of this research is to study the impacts of climate change on agriculture and adaptation measures practiced by farmers, using Latikoili VDC of Surkhet district as the case-study. The specific objectives were to analyze the trend of temperature and precipitation, to study people's perception on climate change and its impact on agriculture and to assess agricultural adaptive measures practiced to combat the effects of climate change.

2 Study Area

The study was carried out in Surkhet district of Bheri zone in the Mid-western Development region of Nepal. Surkhet Valley lies in the Inner Terai Valleys of Nepal. The study site was purposively selected because the district is also identified as one of the vulnerable site for the impacts of climate change by vulnerability assessment conducted by National Adaptation Programme of Action [10].

3 Methods

Both qualitative and quantitative analysis was done to the data collected from primary and secondary sources.

3.1 Primary Data

The methodology includes primary data collection through household survey with semi structured and open-ended questionnaire, key informant interview and focus group discussion within a selected VDC.

The majority of people residing were Bhramin, Chhetri, Newar, Magar, Tharu. Random sampling was selected to perceive people's perception regarding climate change as well as agricultural information. Key informants such as teachers, IPM trainers, agro vet, and aged people were considered. 12 key informants interview were taken with the datasheet and pre-tested semi structured questionnaire. Around 3% of the households were interviewed which covered 150 respondents. Female participants were interviewed mostly as females were highly involved in agricultural practices. Focus group discussion was applied to get the baseline information about the study area, to understand community perception as well as individual's perception on climate change, impacts on agriculture, agricultural practices and type of adjustment they have made to combat climate change. Informal discussions were done with farmers and local residents to obtain further more information.

3.2 Secondary Data

The secondary data with regard to temperature and precipitation of 29 years (1984-2013) were collected from Department of Hydrology and Meteorology, Babarmahal. Thus, secondary data with regard to agricultural productivity of 29 years were collected from District Agriculture Development Office, Surkhet and Central Bureau of Statistics, Thapathali, Kathmandu. This study was conducted to find out the trend of temperature and precipitation and correlate it with agricultural productivity.

3.3 Data Analysis

Data collected from household survey were compiled, tabulated and the data were statistically analyzed using SPSS tool, MS Excel to know about people's perception on climate change. The graphs were plotted using bar diagrams, pie charts. The adaptation measures were assessed from the information gathered from household survey, key informant interview and Focus Group Discussion.

4 Results and Discussion

4.1 Trend of Temperature

The annual mean temperature in Surkhet was found to be 21.89 °C. From 1984-2013, the mean temperature has increased by 0.034°C as shown in figure 1. Studies have also shown Nepal’s temperature increases 0.04-0.06°C annually [10]. Our result is in accordance with the study conducted by NAPA.

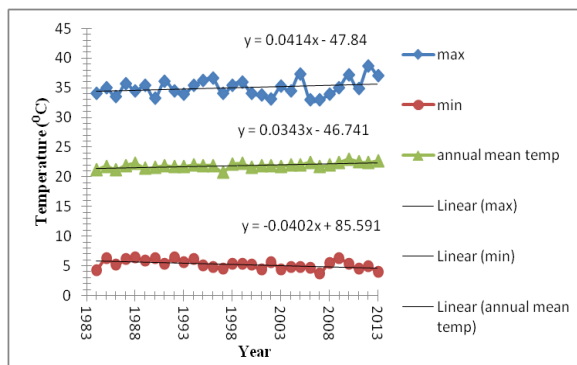


Figure 1: Temperature trend at Birendranagar airport station

4.2 Trend of Precipitation

In a study conducted by Chalise [11] on the meso-scale, the impact of climate is mainly due to local topographic characteristics with dry inner valleys receiving much less rainfall than the adjacent mountain slopes as a result of the lee effect. In our study, the trend analysis based on annual precipitation record of 1984-2013 at three meteorological stations clearly showed that Pusma camp has the highest precipitation trend of 3.964 mm per year compared to other two meteorological stations as shown in figure 2.

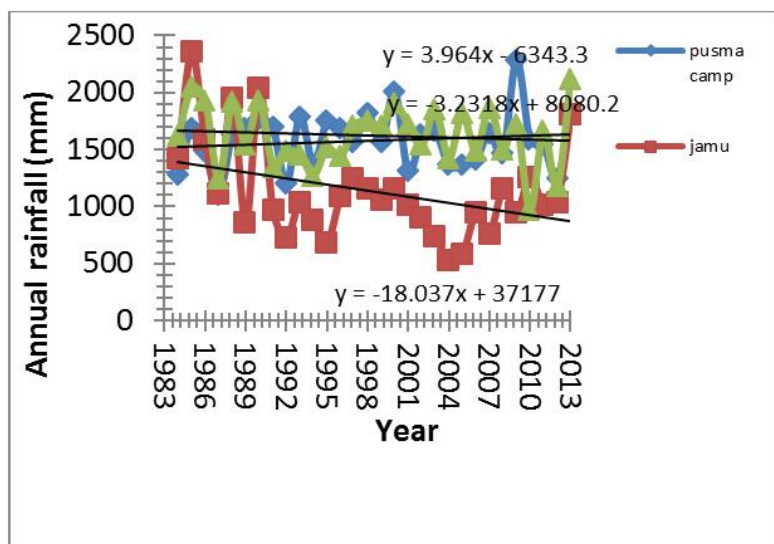


Figure 2: Precipitation trend in three stations of Surkhet

The precipitation data from three meteorological stations were averaged for average annual precipitation and it showed decreasing trend. The record of pre- monsoon, monsoon, post- monsoon from 1984-2013 showed a decreasing trend with large fluctuations. The annual mean rainfall is 1443 mm. From the figure 3, it has shown that from 1984-2013, the mean annual rainfall has decreased by 5.7 mm per year.

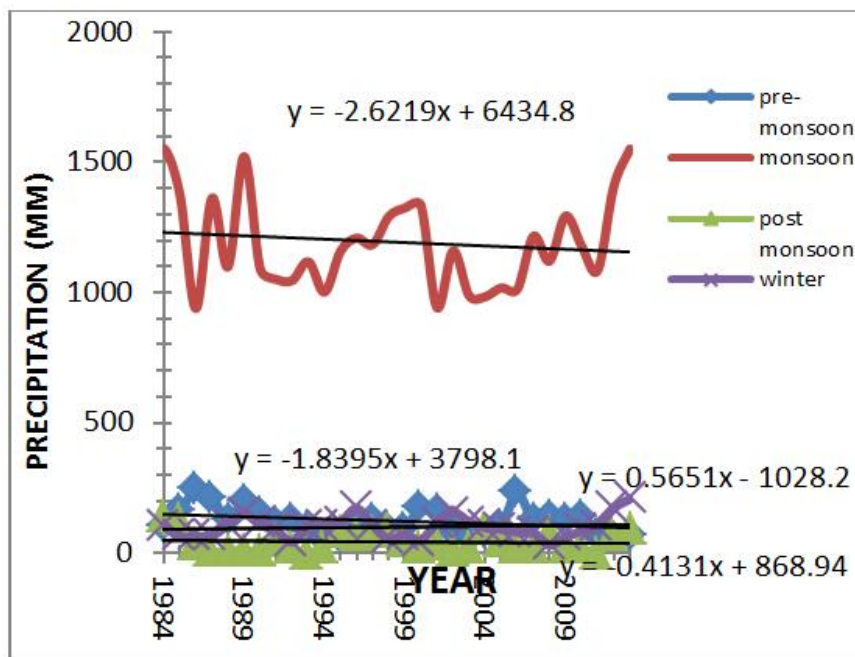


Figure 3: Precipitation trend in Surkhet

4.3 People's Perception on Climate Change

The study revealed that most of the respondents were residing in the study area for more than 25 years. The descriptive analysis showed that only 34.67% of the respondents were aware about the term “climate change” as they have heard it through television, radio and newspaper and 65.33 % were unaware of the term climate change though they have experienced the changes.

Table 1: People's perception on climate change

Responses	Increased (%)	Same (%)	Decreased (%)
Temperature	87.3	10	2.7
Precipitation	1.3	-	98.7
Length and duration of rainy days	1.3	-	98.7
Heavy rainfall events	34	12	54
Flood	29	20	51
Drought	89.3	8	2.7
Cold waves	90.7	2.7	6.7

The people's perception on climatic factors as temperature, precipitation, length and duration of rainy days, heavy rainfall events, flood, drought, cold waves are described in Table 1. Out of 150 respondents, about 90% perceived long term change in the temperature. Most of the respondents (87.3%) have perceived increase in temperature which is in accordance with the climatic data. The study revealed that 98.7% of total respondents noticed decrease in the amount and duration of rainfall. Similarly, respondent observed decrease in the number of rainy days. Almost 98% of the respondents noticed a change in the timing of rainfall, with rain coming either earlier or later than expected. 89.3% experienced increased in the occurrence of drought because of lack of rainfall and lack of irrigation. Almost all respondent found decrease in water sources in recent years which have become drier. 34% observed increased frequency of heavy rainfall in short periods. 51% mentioned about decreasing flood intensity and 29% experience increase in flood intensity while 20% experienced no changes. Respondents revealed that cold waves and frost have increased since past few years. Therefore, people's perception is in accordance to climatic data analysis. Farmers have experienced increasing temperature and the

rainfall pattern has changed. *Shrawan* (July-August) was known as *Kalo ratri* (Dark night) because of excessive and heavy rainfall in monsoon. Over the past few years, farmers used to carry *Syaku* (umbrella) with them while working in the field. They used to experience heavy and timely rainfall. At present, monsoon has been delayed and rainfall has become erratic and farmers no longer carry an umbrella with them while working in the field. Farmers' perceived prolonged drought associated with decrease in water sources. In the year 2028 B.S people had faced famine. Similarly people have experienced hailstone in 14th Mangsir 2041 B.S that have damaged the field declining rice production and vegetables. Due to the delay of monsoon in 2069 B.S. people were unable to transplant rice cultivation. People have suffered from frequent flooding in the past that used to wear away villages. But in the present context, flooding event has decreased. 2070 B.S had good rainfall in monsoon and the production was good.

4.4 Impacts of Climate Change on Agriculture

Farming being the major occupation of this region, locals feel themselves to be highly affected by the change. The impacts on agriculture due to climate change are as follows:

- Lengthening of drought period due to erratic pattern and decreasing rainfall have made farming activities difficult. Indeed, farmers mostly relied on rain water for agricultural practices.
- Some farmers have shifted transplanting date of rice due to the delayed monsoon. Similarly, sowing and harvesting periods of the crops have changed.
- Some farmers have given up wheat farming because of low germination of wheat seeds due to lack of adequate moisture. Similarly, frost damaged wheat in winter during its initial growth stages, leading to low yield in the study area.
- Local varieties of different crops have disappeared due to low productivity in recent years. Some crops like madaley kakro (cucumber) and kodo (millet) have disappeared due to lack of rainfall in Latikoili VDC. Farmers use chemical fertilizers for enhancing crop production leading to declining soil quality.
- Increased infestation of pest such as grasshoppers, fruit borer, caseworm, leaf roller, termites, and stink bugs.

4.5 Adaptation Measures

Most of the coping activities were based on local knowledge and innovations. The following adaptation measures were adapted by the farmers:

- Construction of local irrigation canal to irrigate agricultural land in dry periods.
- In place of wheat, other crops like lentil and mustard are planted which require less amount of water. Some have changed their cropping calendar, cropping pattern, and planting method. Multiple cropping systems are practiced such as rice- lentil, rice – lentil – potato
- Many farmers have shifted into subsistence vegetable farming instead of cultivating cereal crops. Many farmers have started practicing off seasonal vegetable farming.
- IPM techniques have been introduced and adapted in few areas. Very few farmers have practiced organic farming. Improved varieties of seed have been introduced to increase agricultural productivity.

5 Conclusion

The trend of temperature showed increasing trend and precipitation showed decreasing trend and the pattern of rainfall has become erratic. The study showed that the impacts of climate change were seen in agriculture. Disappearance of local varieties of crops, shift in planting time, increased frequency of plant diseases, lengthening of drought period showed the changing scenario of the study site. Therefore, it has forced local people to find measures to secure their livelihood. Raising awareness and sharing information among the locals can be done to adjust with climate change impact and enhance agricultural livelihood.

6 Recommendation

More research relating climate change and perception needs to be done, especially to aware local people about the impacts of the changing climate. Empowering communities, information, technological skills, education and employment are keys to addressing vulnerability. It is recommended to extend the action-research and to upscale adaptation strategies.

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