



**PEOPLE'S PERCEPTION ON IMPACT OF CLIMATE CHANGE IN PASCHIM
AMAWA AND TIKULIGADH VILLAGE DEVELOPMENT COMMITTEE (VDC)
OF RUPANDEHI DISTRICT, NEPAL**

Khet Raj Dahal^{1*}, Manju Manandhar², Chhatra Mani Sharma³

¹Kantipur Engineering College, Nepal

²Shanti Janadarsha Service Centre, Dhulikhel, Nepal

³Kathmandu University, Nepal

*Corresponding author: dahal.khetraj@gmail.com

Abstract

The issue of climate change is one of the global challenges and great concerns to humanity. Although Nepal has a negligible share in the global emissions of greenhouse gases, it is more vulnerable to climate change impact due to its fragile mountain ecosystems. A study was carried out to assess people's understanding on climate change, identify its impacts on their communities and document how they are coping with those impacts. Descriptive and explorative research designs with purposive sampling method were used to collect data from the field. The study showed that more than 50% respondents were familiar with the concepts of climate change and remaining had no idea. Those who were familiar with climate change got knowledge about it from mass media. The result of this study showed that the climate change has several impacts on the study area such as decrease in agricultural production, loss in biodiversity, decrease in water resources and increase in health hazards. During field survey, people suggested that the Government of Nepal must have effective plan, policy and program for holistic approach and develop low cost technology for adaptation to climate change impact and improve livelihood.

Key words: Livelihood, Climate change, Adaptation, Nepal, Amawa and Tikuligadh

Introduction

Climate change (CC) is the global challenge of our country for sustainable development whose impact is of great concern to humanity. Climate is commonly defined as the weather averaged over a long period of time (**Thara et al., 2009**). The standard averaging period of climate change is 30 years (**BMO, 2009**). CC includes increase in temperature, change in rainfall patterns, sea level rise, salt water intrusion and a higher probability of extreme weather events such as flooding and droughts, is recognized as a global issue (**Bates et al., 2008**). IPCC Report (**2007**) states that CC is already having discernible impacts particularly in least developed countries like Nepal which are more vulnerable from the impacts because of their inability to cope with these climatic shocks. CC is expected to have serious environmental, economic, and social impacts in South Asia in particular, where rural farmers „livelihoods based on the use of natural resources are likely to bear the brunt of its adverse impacts (**ICIMOD, 2009**). The region is also confronted with issues like poverty, environmental degradation, and natural resources depletion, shrinking water resources, desertification and CC (**Schild, 2008; UNEP, 2002**). Climatic variability in this fragile ecosystem and livelihood system of the communities has further threatened the livelihood of the local people.

Countries like Nepal where more than 80 % population depends on agriculture and whose livelihood depends on climate sensitive resources are the most vulnerable to CC. It is reported that Nepal is ranked and listed as one of the most climate vulnerable countries in the world (**GON, 2011**). The situation is made worse by poverty, population pressures, land degradation, food insecurity and deforestation. In order to improve the ability of communities and households to adjust to ongoing and future CC, we need to improve the understanding of the risk they are facing (**Heltberg et al., 2009**).

There is an erratic distribution of monsoon rainfall combined with geological formations; flash floods are common in the Tinau basin. Furthermore, human activities like cultivation of marginal land, mining of riverbed materials, large scale deforestation, unplanned systems and construction of physical infrastructures such as roads, in hazardous mountain region and cultivation on steep slopes have increased the incidence of floods in various places. There are such effects with the Tinau River too. Sedimentation, bank erosion, flooding over farm land and wash out of settlements are the major types of disasters in the Tinau basin (**DWIDP, 2011; Guragain, 2012**). Tinau River has high socio economic values for the local

people of that area in terms of drinking water, irrigation, fishing, cleaning, washing, bathing and extraction of sand and stones etc. Thus, the study was focused on the impact of climate change and adaptation of people living along the bank of Tinau River.

Rupandehi district lies in Terai (southern plain) part of Western Development Region of Nepal. It consists of 1360 Sq. Km area. Most of the area is flat belt having fertile alluvial soils up to an elevation of 100m (DOI, 2014). However, the district also has mountainous forest and rangelands in the northern side reaching an elevation of about 1300 meters (DWIDP, 2011; Guragain, 2012; Dahal et al., 2013). Temperature in Rupandehi ranges from 8.75⁰C to 42.4⁰C and average rainfall is 1391mm (DHM, 2012). Total arable land (cultivated land) is about 85,122 ha. Among them, only 3387 ha land is fully irrigated round the year. Seasonal irrigated land is 47667 ha. There are few major rivers like Tinau and Rohini flowing across the district (DADO, 2012).

Rice-wheat is common crops followed with legumes in crop rotation. However in recent years, vegetables and banana fruit crops, sunflower, fish farming, organic vegetable farming, cereal seed production have also been added in agricultural system. Tinau and Rohini are two rivers provide basis of livelihood and water resource for surface irrigation. However, only 8% land of the district is irrigated through surface irrigation (DADO, 2012). In fact, large area of lands is irrigated through ground water sources. Tinau River which is largest river of Rupandehi passes through Paschim Amawa and Tikuligadh VDC.

Materials and Methods

The research was carried out during the period of January-April, 2014, on the bank of Tinau River especially in the areas of Paschim Amawa and Tikuligadh Village Development Committee (VDC), Rupandehi District, Western Development Region of Nepal (Fig.1). Semi-structured questionnaire was prepared for field survey. The questions such as “Do you have any idea/ knowledge of climate change? How did you get this knowledge? How long have you been staying in this place? What is the major impact of climate change in this area, etc.?” were asked to the people living along the bank of Tinau River. Household survey was done for gathering necessary data, which involved the use of key informant interview and observation. A total of 100 household samples (50 from Paschim Amawa and 50 from

Tikuligadh VDC) were taken for this study. Households were chosen mostly which were located on the bank of Tinau River from the different cross-sections of the communities so as to ensure the representative opinions of the study area. Interview, observation, informal discussions were the tools and techniques used for data collection in the field. The interviews were taken with the respondents having age above 35 years. Data were analyzed by both qualitatively and quantitatively. The qualitative data collected were analyzed by organizing them thematically and perusing the original descriptions of the field notes and developing generalizations. The result was logically interpreted along with simple tables, charts, and graphs using SPSS-15.

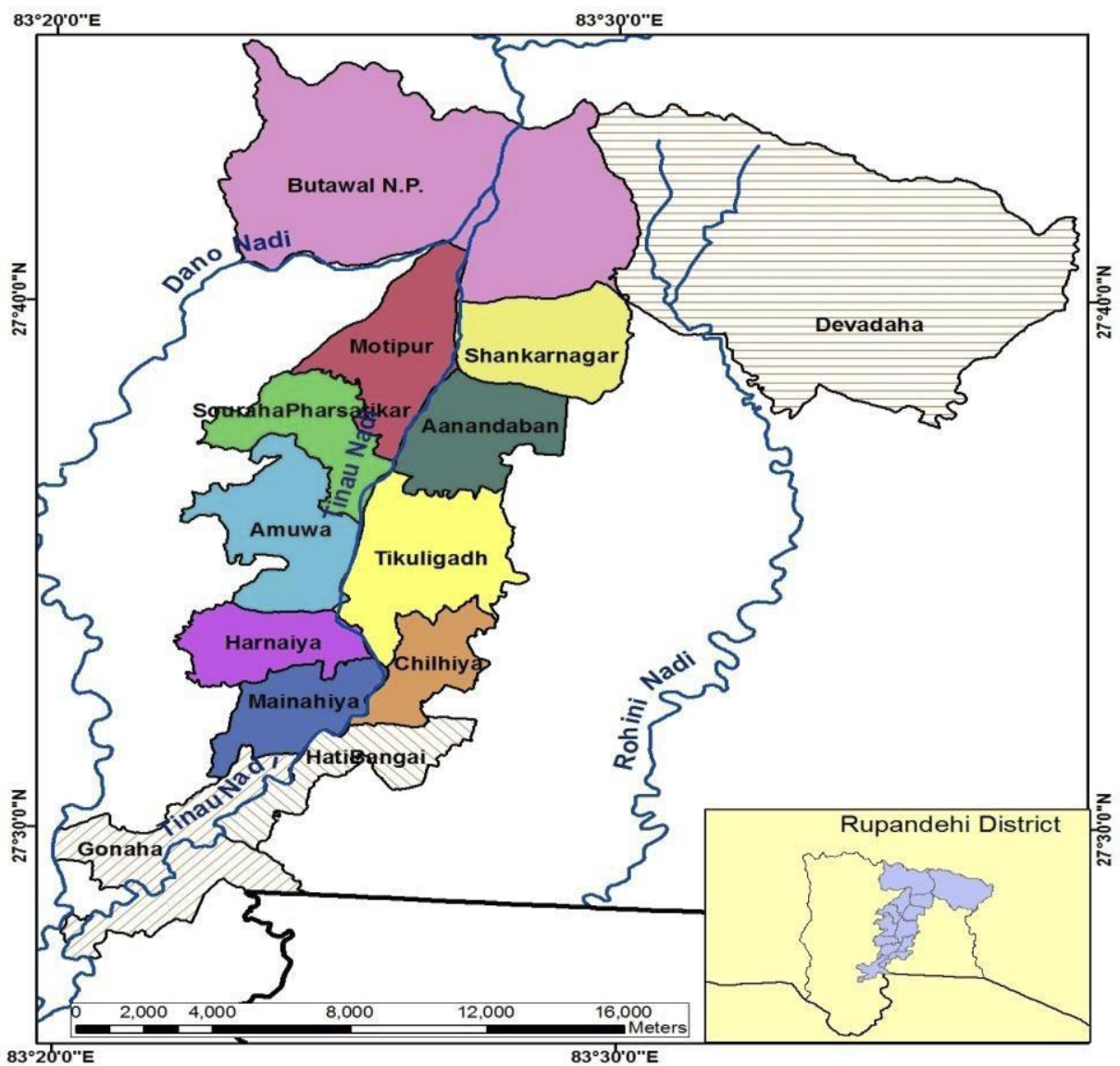


Fig. 1: Map showing study areas (Source: DOI 2014)

Results and Discussion

Socio-economic characteristics of the respondents

Gender

During survey, it was found that females were dominated by males in both VDCs. In Paschim Amawa VDC, 80% of the total respondents were males. Similarly, 56% of the total respondents were male in Tikuligadh VDC. It might be due to giving more preference to male even in presence of both male and female. Only in case where male members were absent during interview period, household as female member involved in interview.

Age structure, caste and ethnicity

Although the survey was targeted to the household heads who were supposed to be adults and elderly, the adults (35-55 years) and elder (>55 years) share 66% and 34% respectively in Amawa VDC. Similarly, adults (35-55 years) and elder (>55 years) share 52% and 48% respectively in Tikuligadh VDC. Six percent of the respondents were Tharu, 32% Madeshi and 62% Pahadi in Amawa VDC. In the same way 26% of the respondents were Tharu, 6% Madeshi and 58% Pahadi in Tikuligadh VDC (Table 1).

Table 1: Age group of respondents

Age group	Amawa (%)	Tikuligadh (%)
Adult(35-55 years)	66	52
Elderly(>55 years)	34	48

(Source: Field Survey, 2014)

Mixed caste group of Madhesi (Yadav, Kewat, Murau, Anasari, Kahara, Saheynea, Mallaha, etc)community was dominant ethnic setting followed by Tharu and Chaudhary and hill migrants (Bhramin, Chhetri and Magars). It comprises of religious diversity of Hindu, Muslim. Multi caste group of Madhesi community along with Chaudhary and Tharu and hill migrants were seen in this village consisting of multilingual, multiethnic and multi religious society (Table 2). However, we observed overall dominance of Pahadi community in both VDCs.

Table 2: Social composition

Ethnicity	Amawa (%)	Tikuligadh (%)
Tharu	6	36
Madeshi	32	6
Pahadi	62	58

(Source: Field Survey, 2014)

Education Status

The literacy rate was very low in both the study area. The literacy rate of Pahadi was found to be more than other ethnic group (Table 3). This implies that large numbers of farmers cannot easily go through reading materials published by agriculture extension office.

Table 3: Educational status in the study area

Ethnic group	Amawa(%)				Tiluligadh(%)			
	Illiterate	Primary	Under SLC	Above SLC	Illiterate	Primary	Under SLC	Above SLC
Tharu		6			24	10	2	
Madeshi	16	10	6		6			
Pahadi	20	18	14	10	30	10	4	14
Total	36	34	20	10	60	20	6	14

(Source: Field Survey, 2014)

Family Size

Most of the household of the study area had medium (6-10) household member. In Amawa 38% had less (up to 5), 46% had medium (6-10) and 16% had more (more than 10) family members. Similarly, in Tikuligadh 42% had less (up to 5), 48% had medium (6-10) and 10% had high (more than 10) family member.

Occupation

Most of the farmers reported that they were engaged in agriculture. Beside this, respondents of the study area were also involved in jobs/service, trade/business, foreign jobs, labor/daily wages (Table 4). From agriculture to other occupation was probably due to the lack of irrigation, less yielding from agriculture, extra earnings from business, etc.

Table 4: Occupation followed by sample respondents in the study area

Primary livelihood option	Amawa (%)	Tikuligadh (%)
Agriculture	12	90
Agri+Jobs	26	4
Agari+Business	14	2
Agri+Foreign job	12	
Agri+labour	6	4
Agri+jobs+Foreign+Business	2	-
Agri+jobs+Foreign	4	-
Agri+jobs+Business	8	-
Agri+Business+labour	4	-
Agri+jobs+labour	6	-
Agri+Foreign+labour	6	-

(Source: field survey, 2014)

Food sufficiency

Most of the farmers have engaged in services and small enterprise (such as mills, shop) which shows their multiple livelihood strategies. As agriculture is not the sole source or their livelihood, markets play a vital role for their food security. The food produced from agriculture production was not completely sufficient. In Amawa 19% of the responded had less than 3 month food sufficiency, 11% of the respondents had 3-6 months, 21% of the respondent had 6-9 months ,17% of the respondents had 9-12 months and 32% of the respondents had more than 12 month food sufficiency. Similarly in Tikuligadh 4% of the responded had less than 3 month food sufficiency, 4% of the respondent had 6-9 months , 25% of the respondents had 9-12 months and 67% of the respondents had more than 12 month food sufficiency.

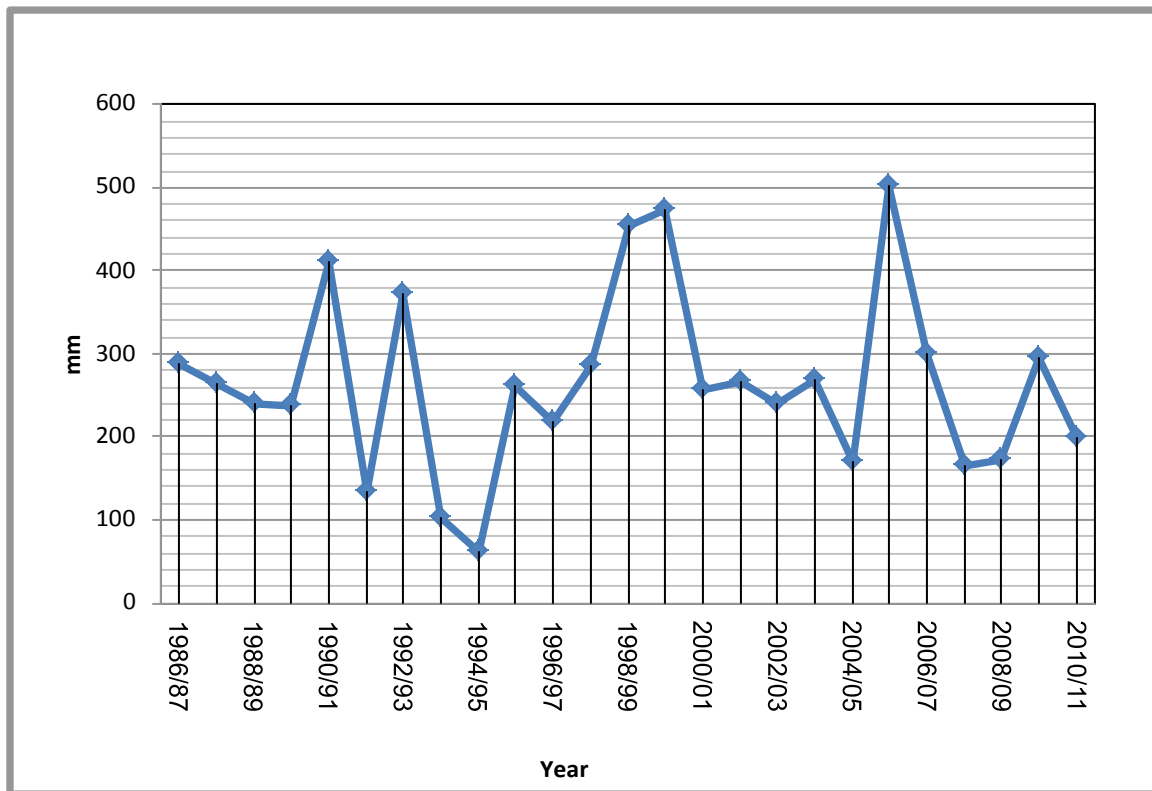
Climate Change Issue in the Study Area

Understanding of People on Climate Change

Perception or understanding of people about ongoing climate change in the surrounding area is discussed under this section. For this, understanding of people regarding change in climate factors, water resources and biodiversity were selected for analysis.

Understanding of Change in Climatic Factors

Most of the respondents have perceived differences in rainfall pattern, occurrence of drought, and change in temperature, dew and fog formation. Regarding precipitation pattern, respondents revealed that the time of rainfall, amount and intensity of rainfall have changed. Analysis of 30 years climate data showed the evidence of climate change in the study area. Monsoon precipitation anomaly generated from 30 years monthly rainfall data from the nearest meteorological station (Bhairahawa airport) highlighted the decreasing trend of precipitation in the area. The highest rainfall records in 1981, 1984, 1989 and 1998 matched with the flood events reported by the locals in the study area. The analysis of 30 years of temperature data showed the increase in minimum temperatures while maximum temperatures have remained the same (Manandhar et al., 2011).



Source: DHM (2012)

Figure 2: Rainfall pattern of the study area (Bhairahawa airport) from October to May (1986-2011)

Irrigation Facility in the Study Area

The available irrigation facility in the study area is presented in the table (Table 5).

Table 5: Available irrigation facility in the study area

S.N.	Type of irrigation	Name of VDC	
		Amawa	Tikuligadh
1	Irrigated	46.80%	100%
2	Rain-fed	8.51%	0%
3	Irrigated-rain- fed	2.21%	0%
4	Seasonal-Rain- fed	10.63%	0%
5	Irrigated- Seasonal-Rain- fed	31.91%	0%

(Source: DAO, 2012)

People's Perception on Precipitation Pattern

During survey, different respondents of the study area reported about the rainfall differently. Some people claimed that the rainfall has increased; some claimed it has decreased and some were unknown about it (Figure 3).

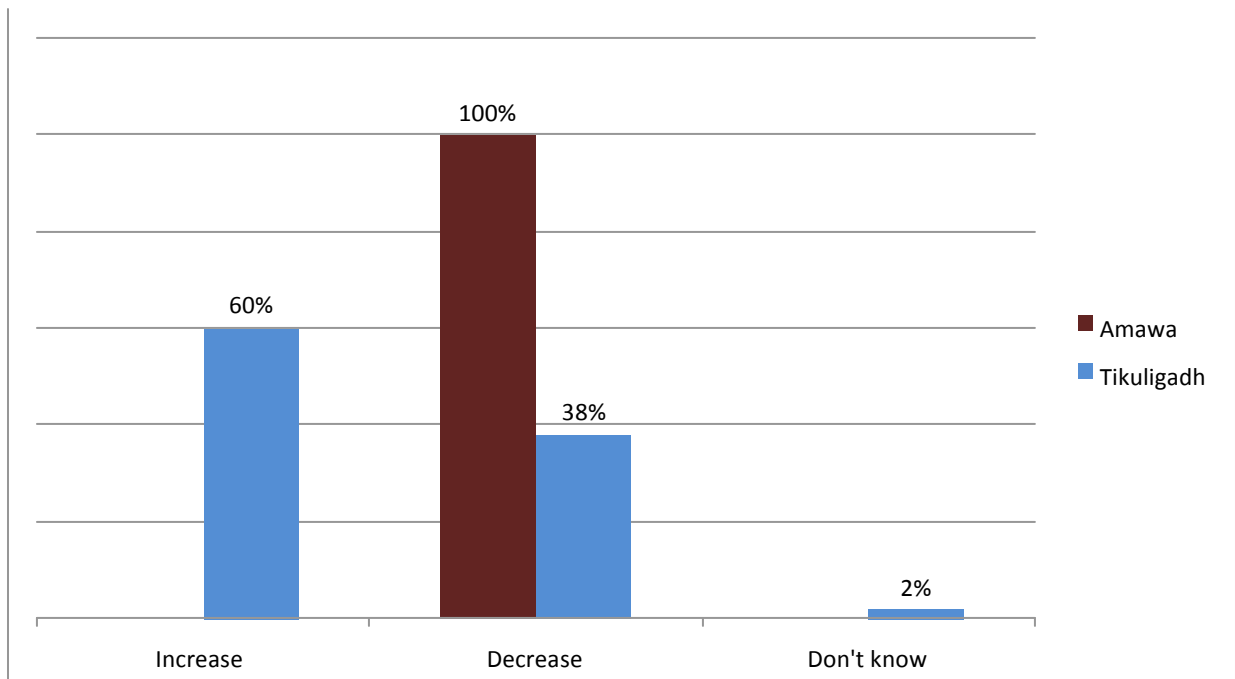


Figure 3: Perception of Respondents Regarding Change in Rainfall Pattern

Source: Field Survey (2014)

Similarly, people in the study area have different opinions for the amount of rainfall. Thus they responded differently (Figure 4).

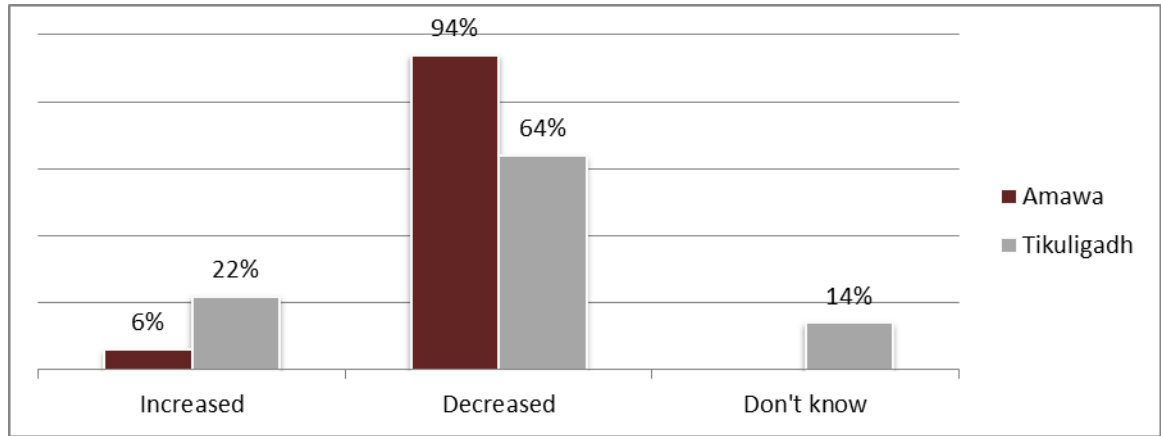


Figure 4: Perception of respondents regarding change in amount of rain

Source: Field Survey (2014)

Respondents have perceived that intensity and amount of rainfall has changed. According to respondents, recent rainfall occurs with high intensity for the short duration. There were variations on the response of local people for the temporal aspect of changes in precipitation. In Amawa VDC they perceived the change since 6-7 year, whereas it was 10-12 years in Tikuligadh VDC. In Amawa VDC, 6% of the respondents reported that the amount and intensity of rainfall increased during past decade, 94% reported that it was decreased. Similarly in Tikuligadh VDC 22% of the respondent reported that the amount and intensity of rain increased, 64% respondents reported that it was decreased and 14% reported that they have no any idea about change in amount of rain (Fig. 4).

Most of the local people agreed that there have been changes in the winter precipitation events. In Amawa VDC 98% of the respondents perceived that the rainfall pattern in winter has decreased. However, respondents from Tikuligadh VDC has some different perception because 48% of them answered that the rainfall has decreased, 24% of the respondents perceived increased rainfall and remaining 28% of the respondents didn't know about change (Figure 5).

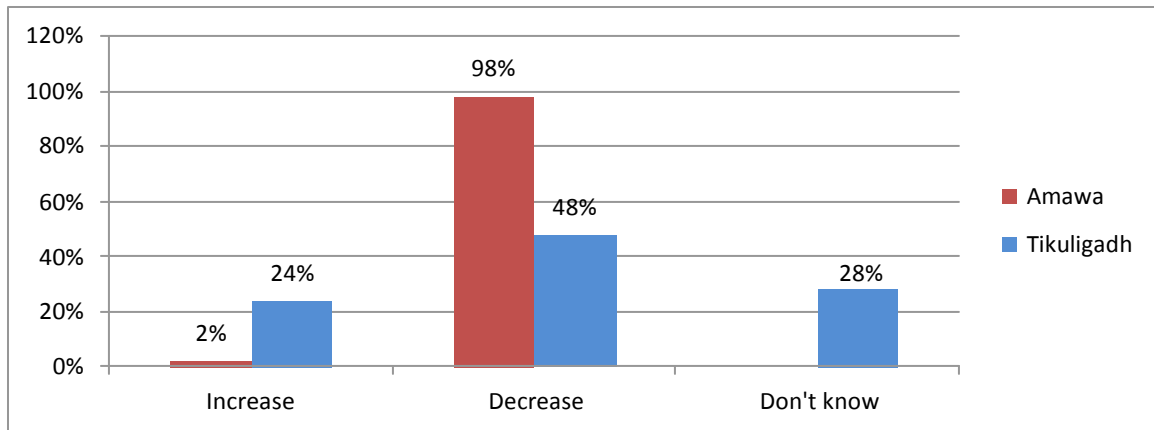


Figure 5: Perception of respondents regarding change in rainfall pattern in winter
(Source: Field Survey, 2014)

Drought

Almost all the respondents agreed that drought pattern has changed in recent years and they have been facing long drought periods. In Amawa VDC 98% of the respondents perceived that the drought pattern has increased, 2% said that they didn't know about change in drought pattern. Similarly in Tikuligadh VDC 88% responded that the drought pattern had increased, 12% claimed that it has decreased (Fig. 6).

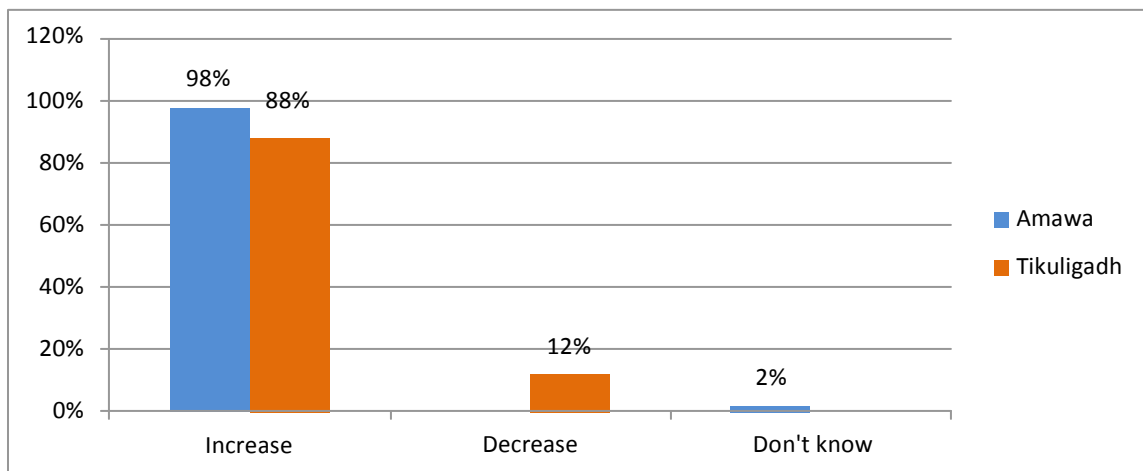


Fig.6: Perception of respondents regarding change in drought pattern
(Source: Field Survey, 2014)

Locals said that they have been facing long drought period for some years. In the past drought used to be at most two months long after which they used to get rain. However, in the past decades there was no winter rainfall from October 2008 to April 2009.

Temperature (summer hotness and winter coldness)

All the respondents with the single voice said that temperature has changed. The temperature in the summer season has gone up and winter has become warm. This shows that temperature has increased in recent years. In Amawa VDC, 96% of the respondents claimed that there was increase in summer hotness and 84% claimed that it was decreased in winter coldness. Similarly, in Tikuligadh VDC, 96% of the respondents reported that there was an increase in summer hotness and 90% reported that there was decrease in winter coldness (Figure 7 and 8).

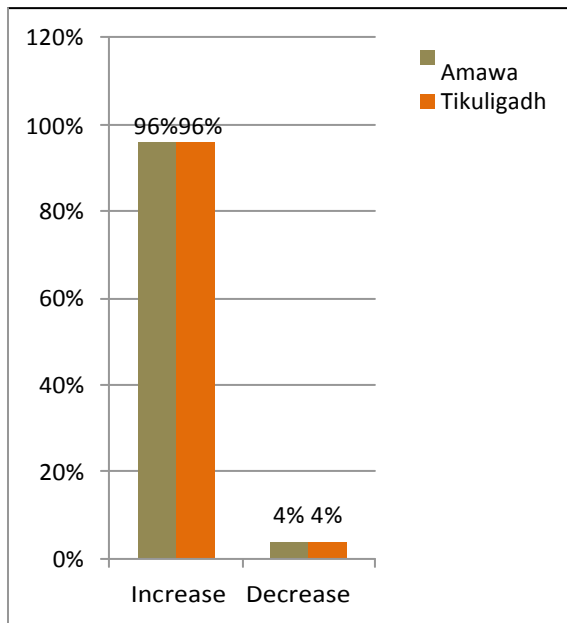


Fig 7: Perception of respondents regarding coldness (Source: field survey, 2014)

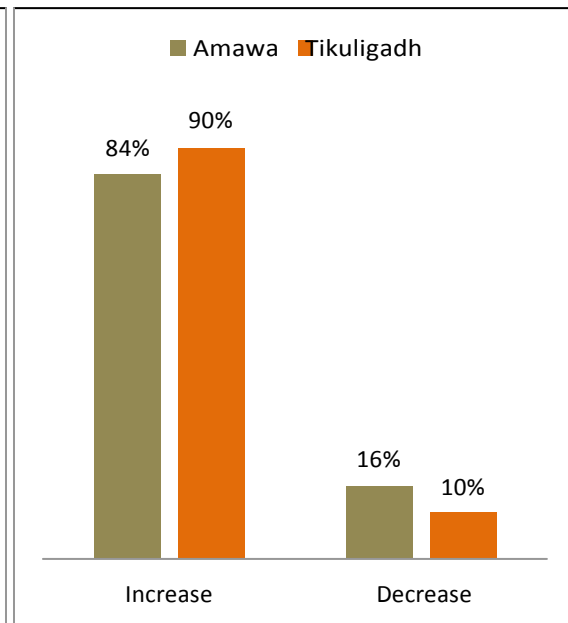


Fig 8: Perception of respondents regarding less summer hotness (Source: field survey, 2014)

Furthermore, they added that temperature has increased and mosquitoes had emerged as a problem in the study area. And it also supports local people's views with the temperature increased by 0.8°C from the beginning for the last 25 years compared to the average temperature during the last five years.

Other climatic factors

While asking in other climatic factors, most of the respondents agreed that storm, flood, hail storm, fog formation have changed. According to them, storm, fog formation, dew formation, hailstorm were not observed there (In the past decades) but now they have been observing it. Such incidents of hailstorm is damaging agriculture crops in recent years (Baral

et al., 2010) but it needs further investigation in the study area. Climatic factors such as temperature and rainfall directly affects the production of all most all the cereal crops except wheat (Bhandari, 2013). However, the scientific proof of the statement in the context of Tikuligadh and Amawa VDCs are lacking.

Understanding of climate change in water resources

The results of the survey showed that almost all the respondents have noticed decrease in water resources in recent years. According to the respondents, they could observe an increase in depth of well, reduction in stream flow, and reduced water levels in pond in recent years. The key informants mentioned that they used to have sources of drinking water nearby the villages. People have noticed change in their surroundings in the last couple of decades. Stream flow and spring characteristics have changed dramatically in recent years, making it challenging to manage water supplies (Tiwari *et al.*, 2010). Regarding the responses on knowledge of climate change more than 50% respondents reported that they were familiar with the concepts and remaining said they have not got any idea on climate change. People’s perception on climate change is presented in table (Table 6).

Table 6: Knowledge on climate change

S.N.	VDC	Perception of Climate Change	
		Yes	No
1	Amawa	52%	48%
2	Tikuligadh	72%	28%

(Source: field survey, 2014)

Those who were familiar with climate change got knowledge about it from mass media (i.e. radio, television, newspapers and magazines). According to them, causes of climate change in the study area were due to increase in population, deforestation, extraction of river bed materials, use of chemical fertilizer etc. Although 48% from Amawa VDC and 28% from Tikuligadh VDC reported that they had not heard or learnt of climate change, they understood that their local climate was changing in one or the other way. Climate change is proportionate to the literacy of the respondents. Positive (yes) response is an example of knowledge on climate change. It means if literacy rate increases then perception will also increase and vice-versa.

Impacts of climate change

Climate change is a burning issue in the study area. Locals have perceived changes in their surroundings. Most importantly the impacts have been seen in agriculture, water resource, health and biodiversity. Impacts on various fields have been discussed in subsequent paragraphs.

Agriculture

The main agriculture production of the study area is presented in table (Table 7). Locals have noticed decrease in agricultural production in recent year in comparison to the last 25 years. In Amawa VDC, 72% of the respondents reported that the agriculture production has reduced. Among them, 59% reported that crop production has gone down slightly and 13% claimed that it has reduced highly. in Amawa VDC, in case of summer crop (rice, maize, pulses etc), 60% claimed that summer production has slightly decreased, 11% claimed highly decreased, 6% reported same as before and 23% claimed increase. Whereas as in case of winter crop (wheat, barley, vegetables, pulses etc), 62% claimed that the winter production has slightly decreased, 8% claimed highly decrease, 15% reported same as before, and 15% claimed increased in the same VDC.

Table 7: Agriculture production in the study area

S.N.	Agriculture Production	Name of VDC	
		Amawa	Tikuligadh
1	Highly decreased	13%	0%
2	Slightly decreased	59%	0%
3	same as before	11%	0%
4	Increased	17%	100%

(Source: field survey, 2014)

Main reasons for decrease in production are untimely/ill -timed rainfall and increased drought period. According to respondents, the time of rainfall changed because of which they couldn't plant rice in the month of June. With the delay in rice plantation time the season of other agriculture crops also delayed.

In the same way in Tikuligadh VDC, locals have noticed increase in agricultural production in recent years in comparison to the last 25 years. In case of summer crop (rice, maize, pulses, etc.), 98% claimed that summer production has increased and 2% claimed

same as before. Whereas in case of winter crop (wheat, barley, vegetables, pulses etc) 100% claimed that the winter production has increased. Main reason in increase in production was the use of hybrid seeds, organic fertilizers and irrigation. Similarly, while asked about production of fruits, the time and productivity has changed. According to respondents, ripening of fruits has been some two weeks earlier than before.

Similar type of study done by **Malla (2008)**, in Rupandehi district, reported that fruits and vegetables are grown in 255 thousand hectares. Furthermore, he stated that climate change effects on horticultural crops are speedily becoming issues in the present situation. Tropical fruits; banana (*Musa acuminata*), mango (*Mangifera indica*), papaya (*Carica papaya*) and other crop like croton (*Codiaeum variegatum*) have been adopted in mid hills and observed off-season flowering in high altitudes crops like peach (*Prunus persica*), pear (*Pyrus communis*) and apple (*Malus domestica*).

Water resources

All of the respondents agreed that most of the water resources had decreased in the study area. As already discussed, ponds and streams have dried. This decrease in water has significantly affected irrigation in the local area. **Baral et al. (2010)** found that landslides and floods directly affected the drinking water, and low rainfall affected the water resources; in the study area 20% household said that CC had directly affected the drinking water system and also damaged the pipeline. In the past, the sources of drinking water were surface water/wells for 31.4%; ponds for 41.2% near the village and modern water tap for 15.7% only. However, at present there was a facility of drinking water either from pipe lines or from shallow/deep tube wells.

Health

Household survey revealed that health hazards have increased in the study area. According to them, frequency of disease like cholera, malaria, diarrhoea, typhoid, fever, jaundice, dengue, etc. have increased. One of the main reasons for the increase in health hazard was the increase in mosquito population. Respondents claimed that the population of mosquitoes has highly increased in the area owing to the rise in temperature of the local area. As already discussed above, the temperature has increased notably for the last few years.

Pollution like dust, smoke and sound affected the people who are close to the riverbed mining sites. Of course, the people living on the bank of Tinau River are close and they could

be more affected by such pollution. The study showed that the effect of pollution caused various diseases on human health especially to those who are living on the banks and flood plains of the Tinau River. In many households there were patients of eye irritation, skin disease, throat pain or respiratory infections. In the past there were no toilets and open defecation was practiced. However, now- a -days all the houses have toilets which help to make its environment clean and protect them from various illnesses.

Baral et al. (2010) stated that diarrhoea is observed as major health problem, and its causes have increased in current years. Thirty seven percent (37%) respondents said that frequency of cold due to the high fluctuation in weather was seen as major problem, while 18% said that people have suffered from the fever but the reason was unknown. Some (5%) mentioned that they didn't find any change.

Biodiversity

Most of the respondents have perceived that wildlife population has decreased. In Amawa VDC 68% reported that wildlife population has decreased, 30% claimed that wildlife population has not changed and 2% shared that wildlife population has slightly gone up. Similarly, in Tikuligadh VDC 62% of the respondents claimed decreased in wildlife population, 22% reported highly increased, 14% shared same as before and 2% reported slightly increased in wildlife population. According to the locals, with the change in climate, drought increased, temperature raised and decreased water resources. With increase in such incidents, the habitat for the wildlife population decreased along with decrease in population. Local people noticed different types of invasive weeds in the agriculture field like *Gandhe* (*Ageratum spp.*) plants with bluish flower have found in abundance and covered all the area but before 25 years they were observed rarely. The main reason for their adaptation might be an increase in temperature in recent years.

Human assets

Weather related disasters like drought; floods mostly destroyed human property like house and agriculture land in recent years. In Amawa VDC, 60% respondents agreed that intensity of damage in physical asset was same as before, 29% claimed slightly increased, 9% reported decreased, 2% shared highly increased. Similarly, in Tikuligadh VDC, 70% of the respondents claimed that intensity of damage in physical asset was decreased, 16% reported highly increased and 17% shared same as before.

Adaptation strategies at local level (in the study area)

For adaptation to climate change impact, people have developed some adaptation strategies to overcome its impact to some extent. Some of the important strategies were change in crop planting times, change in types of crops, plantation of various plants in home garden, use of water from deep tube wells for irrigation and drinking purposes. Some of them have changed their occupation. In these days they engage not only in agriculture but also in other jobs such as trade/business, foreign employment, daily wages labor, etc. The communities have switched to the crops, which could be cultivated with low water, such as maize (*Zea mays*), wheats (*Triticum aestivum*), mustard (*Mustard album*) and barley (*Hordeum vulgare*) instead of rice (*Oryza sativa*). In addition, they have started to grow short-term high value vegetables such as cauliflower (*Brassica oleracea*), cucumber (*Cucumis sativus*), spinach (*Sponaciao leracia*), brinjal (*Solanum melongena*) and potato (*Solanum tuberosum*) to overcome the low productivity problem (**Baral et al., 2010**). The same case was found in the study area too. **Tiwari et al. (2010)** stated that due to degradation of the grassland and low grass production, farmer had reduced the livestock number as well as practiced rotational grazing. In this study, some of the respondents reported that hardship of the livestock and agriculture farming forced them either to change their occupation to business such as running hotel or to migrate to some other places. According to **Gauchan (2009)**, the uses of chemical fertilizers are high in recent years. Many agricultural diseases have been emerged thereby affecting the crop production. In such condition, chemical fertilizers in fixed proportion with organic fertilizers have been recommended and some farmers have started adding such fertilizers to increase their production and combat with the losses.

The local people residing in the study area have used deep tube well to irrigate their agricultural crops during insurgency periods to cope with the less rainfall. This adaptation technique has helped to recover the less productivity due to insufficient and untimely rainfall to some extent. **Tiwari et al. (2010)** stated that indigenous settlements are generally located near the water sources. Thus, these people apply stream water for irrigation purpose to cultivate their crops. Similar type of adaptation measures were in practice to combat with drought period was observed during this study in Paschim Amawa and Tikuligadh VDC of Rupandehi district.

Conclusion

Climate change has affected on livelihood of the people living along the bank of Tinau River. But people in that locality were less aware. In the study area, drought, flood, along with hailstorms and storms were the main weather related disasters realized by the people. And such disasters have affected on the livelihood of the people living in that area. The change in production and productivity of fruits were also observed. Other impacts of climate change were decline in water level of ponds, wells and streams. Similarly, frequencies of diseases such as cholera, malaria, diarrhoea, typhoid, jaundice, dengue along with increase in number of mosquitoes were found to be increased. To adapt with climate change, most of the people have changed crop sowing and planting time. Similarly, they have used deep tube wells for irrigation instead of shallow tube wells and have maintained the greenery with plantation in their garden. Farmers have also been practicing hybrid seeds, organic and inorganic fertilizers to cope with climate change. The study recommends carrying out more research at local level as the generalized information is not applicable for all situations. In fact, the complex topography and micro-climates in Nepal make the understanding of climate change more complicated. Thus, further studies are required on climate science as there are opposite trends in temperatures within short geographic region which is important to understand.

Acknowledgement

We would like to acknowledge all respondents of Tikuligadh and Amawa VDC. Similarly, Mrs. Amrita Gurung and Mrs. Anita Tuladhar have assisted a lot during field survey and writing this paper and are acknowledged for their contribution.

References

- Baral, S.R., Gauli, K., Paudek, A., and Karna, Y.K., 2010. Vulnerability of Indigenous Mountains Communities to Climate Change and Their Coping Strategies. Forest-People Interaction (Proceedings of a National Conference. 230 pp. Pokhara, Nepal, June 7 and 8, 2010). Institute of Forestry, Pokhara, Nepal.

- Bates, B.C., Kundzewicz, Z.W., Wu, S, and Palutikof, J.P., 2008. Climate Change and Water. IPCC Technical Paper VI, Geneva, 210 pp.
- Bhandari, G., 2013. Trends in Seasonal Precipitation and Temperature: A Review in Doti and Surkhet Districts of Nepal. *International Journal of Environment* 2(1): 269-279.
- BMO, 2009. British Meteorological Office <<http://metoffice.gov.uk>> 2010, December 15.
- Dahal, K.R., Poudyal, C.P., and Guragain, H.P., 2013. Quantification of Riverbed Extraction and Morphometric Characterization of Tinau River, Nepal. *International Journal of Engineering, Sciences and Management* 3(2): 97-108.
- District Agriculture Development Office (DADO), 2012. Annual Progress Report, District Agriculture Development Office. Rupandehi, Nepal: DADO.
- DHM, 2012. Meteorological records of Rupandehi District, Department of Hydrology and Meteorology, Government of Nepal, Kathmandu.
- DOI, 2014. GIS map of Tinau River. Department of Irrigation, Nepal.
- DWIDP, 2011. Feasibility Study for Tinau Integrated Development Project. Report Prepared by Environment and Resource Management Consultant (ERMC) and Submitted to the Department of Water Induced Disaster Prevention, Kathmandu, Nepal.
- Gauchan, A., 2009. “Household Level Adaptation Strategies to Climate Change Impact in Mustang District: A Case Study from VDC, Mustang District”. A M.Sc. Forestry Research Thesis, Tribhuvan University/Institution of Forestry, Pokhara, Nepal.
- GON, 2011. Status of Climate Change in Nepal, Ministry of Environment (MOE), Government of Nepal, Kathmandu.
- Guragain, H., 2012. Impacts on Hydraulic Structure due to Riverbed Extraction. Thesis Submitted to Lumbini Engineering, Management and Science College, Pokhara University, Nepal.

- Heltberg, R., Siegel, P.B., and Jorgensen, S.L., 2009. Addressing Human Vulnerability to CC: Toward a “No-regrets” Approach. *Global Environmental Change* 19:89-99.
- ICIMOD, 2009. Potential for Carbon Finance in the Land Use Sector of the Hindu Kush-Himalayan Region. ICIMOD, Kathmandu.
- IPCC. 2007. Climate Change 2007. Adaptation and Vulnerability, Summary for Policymakers, Intergovernmental Panel on Climate Change, Geneva, Switzerland.
- Malla, G., 2008. Climate Change and its Impact on Nepalese Agriculture. *The Journal of Agriculture and Environment* 9:62-71.
- Manandhar, S., Vogt, D.S., Perret, S.R., and Kazama, F., 2011. Adapting Cropping Systems to Climate Change in Nepal: A Cross-regional Study of Farmers' Perception and Practices. *Regional Environmental Change* 11:335-348.
- Schild, A., 2008. ICIMOD's Position on CC and Mountain System: The case of the Hindu Kush-Himalayas. *Mountain Research and Development* 28:329-331.
- Thara, C., Kushnir, Y., and Cane, M.A., 2009. Climate Change over the Equatorial Indo-Pacific in Global Warming. *Journal of American Meteorological Society* 22(10):2678-2693.
- Tiwari, K.R., Balla, M.K., Awasthi, K.D., Bhusal, Y.R., and Sitaula, B.K., 2010. Local Peoples' Perception of Climate Change, its Impact and Adaptation in Trans-Himalayan Region of Nepal. *Forest-People Interaction (Proceeding of a National Conference, 251 pp, Pokhara, Nepal, June 7 and 8, 2010)*. Institute of Forestry, Pokhara, Nepal.
- UNEP, 2002. *Global Environment Outlook 3*. United Nations Environment Program (UNEP), Nairobi, Kenya.