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Case Report

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CLIMATE CHANGE AND COMMUNITY FOREST IN NEPAL: LOCAL PEOPLE'S PERCEPTION A CASE STUDY FROM TWO COMMUNITY FOREST USER GROUPS OF MID-HILLS OF NEPAL

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ABSTRACT

Climate change is regarded as one of the most fundamental threats to sustainable livelihood and global development. There is growing a global concern in linking community-managed forests as potential climate change mitigation projects. This study was conducted to explore the local people's perception on climate change and the role of community forestry (CF) to combat climate change impacts. Two active community forest user groups (CFUGs) from Rukum West District in Nepal were selected as study sites, and various participatory tools were applied to collect primary data. Although most of the respondents were aware about the words "Climate Change" in study sites, they were more familiar with the irregularities in rainfall season and other weather extremities. The study focuses on perceptions of, and on adaptations to climate change by Community Forest User Groups. Information was collected from both primary and secondary data sources. Climate data were analyzed through trend analysis. Results show that most community forest users perceive climate change acutely and respond to it, based on their own indigenous knowledge and experiences, through both agricultural and non-agricultural adaptations at an individual level. 70% of the respondents had the idea that, due to increase in precipitation, there is a frequent occurrence of erosion, floods and landslide. Around 78% of the people agreed that community forests help in stabilizing soil, reducing the natural hazards like erosion, landslide. Biogas as an alternative source of cooking energy, and changes in crops and their varieties are the common adaptation measures that local people start practicing in both CFUGs in Nepal.

Keywords: Climate Change, Community Forestry, Local People's Perception, Global Warming, Adaptation, Nepal.

INTRODUCTION

Scientists believe on the climate is changing globally.

Recently, IPCC (2007) predicted that the temperature is likely to increase at 1.8º C to 4ºC by the end of the century. This prediction on temperature increase will be because of increase in the concentration of carbon dioxide (CO_2) in the atmosphere (Petit *et al.,* 1999). Temperature and rainfall are the two main element of climatic phenomenon. Study on these elements is crucial to know the trend of climate change. It is projected in Nepal that the climate change, especially temperature is realising on an average of 0.06 degree centigrade per annum whereas the rate is alarming in the case of Terai (about 0.04 degree centigrade per year).

People are the live evidence of experiencing environmental changes such as global warming and climate change. Human behaviour is integral not only to causing global climate change but also to responding and adapting to it (Clayton *et al.,* 2015). The study concluded that forest users' perceptions of climate change mirror meteorological analysis, though their perceptions were based on local climate parameters (Ayanlade *et al.,* 2017).

The results suggest that improving basic education, climate literacy, and public understanding of the local dimensions of climate change are vital to public engagement and support for climate action (Lee *et al.,* 2015). Similar studies are being conducted inside the country and globally. For example, in Ethiopia (Debela *et al.,* 2015) (Tesfaye and Seifu 2016), in Chile (Roco *et al.*, 2015), in South Africa (Elum *et al.,* 2017), in Switzerland (Shi *et al.,* 2015), in Nigeria (Ayanlade *et al.,* 2017), in Tanzania (Below *et al.,* 2015) and so on. In Nepal, different studies covers on climate change perception and adaptation strategies are being covered. Some of them are, in Budi Gandaki River Basin (Devkota *et al.,* 2017), Melamchi valley (Sujakhu *et al.,* 2016), (Khanal *et al.,* 2018) water source protection vanishing perception in mountains (Poudel and Duex 2017), perceptions of climate variability and human health risks in Tanahu district *(Mishra et al.,* 2015) and Kaski and Chitwan districts of Nepal (Khanal and Kattel 2017). However, the understanding of district level key stakeholders and forest users are largely lacking from rural mid hills district of Nepal. It is important to give all forest user groups information that will help them to adapt to climate change using appropriate farming technologies and practices. Projects and programs designed to enhance understanding of the consequences of climate change will help them to develop the management ability to cope with climate risk (Roco *et al.,* 2015). valuing local knowledge and experiences makes people more responsive to the intervention and backing up the perception results by scientific data analysis establishes a sense of legitimacy to what people have perceived (Devkota *et al.,* 2017) The effects of global warming are already being experienced by the most vulnerable-the world's poor countries including Nepal. Since it is exposed to all type of climatic conditions with steep topography and fragile geology, the impact of climate change is significantly serious in Nepal. The monsoon tends to begin later, the rainfall is more irregular and flash floods are more frequent. The winter rains are reduced, and people are noticing that summers are hotter and winters generally less cold. Mountain communities are receiving less snowfall and seeing glaciers retreat. In the mid-hills water sources are drying up and in the plains, people get realized greater flooding and unexpected cold waves (Regmi *et al.,* 2010). Rural communities live in close proximity of community forest, particularly in the mid-hills of Nepal. These people need regular supply of forest products and income from the forest to maintain their life perpetually. In a case study, Bhusal (2009) listed several impacts of climate change such as change in rainfall pattern, more frequent droughts, abnormal hail and

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thunderstorm, relatively warmer wind flow patterns, shifts in flowering and fruiting time etc. Local people have been observing these changes for years, although they have some ideas and understanding of the anthropogenic causes of these changes (Chapagain *et al.,* 2009). In order to cope with all kinds of climate hazards that are likely to occur due to climate change people should be made aware about different adoption strategies so that the forest dependent communities need not suffer in near future and also contribute in reducing carbon in the atmosphere (Gaire *et al.,* 2008). The conservation of forests is critical to balance Green House Gases in the atmosphere and minimize the impact of climate change. Previous research studies clarified that people's perception is very important in making people to adapt to climate change. However, a particular study focusing on the exploration of role of community forestry on climate change in proposed Districts has not been available. Therefore, this study explores the local people's perception on climate change and the role of CF to combat climate change impacts. Specifically, this study assesses the understanding of CFUG members on climate change and its impacts on overall environment, and documents the activities conducted by local people to adapt as well as mitigate the climate change impacts. This study contributes towards a better understanding of the intensity and impacts of climate change. The findings of the research are clear guidelines for future actions to effectively address the climate change issues in the study districts of Nepal.

STUDY AREA

Two active Community Forest User Groups with a heterogeneous mixture of societies from Rukum West District in Nepal were selected as study sites. Gairdamar CFUG from Bafikot rural municipality and Chitrepakha CUFG from Musikot municipality of district were selected with the help of Divisional Forest Office staffs, District disaster management committee, musikot, Rukumand corresponding CFUG operational plan and constitution. The data of Gairdamar CFUG were collected in 10th - 25th September, 2020 whereas data from Chitrepakha CFUG were obtained in 01 to 15th October, 2020. Both primary and secondary data were collected for the study. A total of 30 households were selected from the Gairdamar CFUG and 50 users were selected from the Chitrpakha CFUG. All together 80 questionnaire responses (individual/ household survey), at least five key informants survey from teachers, politicians, business personal, doctors and students in each group and at least a group discussion was performed for data collection. In both CFUGs, people around the CF are local people who are using the forest since long time back and are very well known about the changes that are taking place inside and around the forest. The Figure-1 presents the location map of study area and table-1 presents an overview of the demographic as well as socio-economic background of both CFUGs.

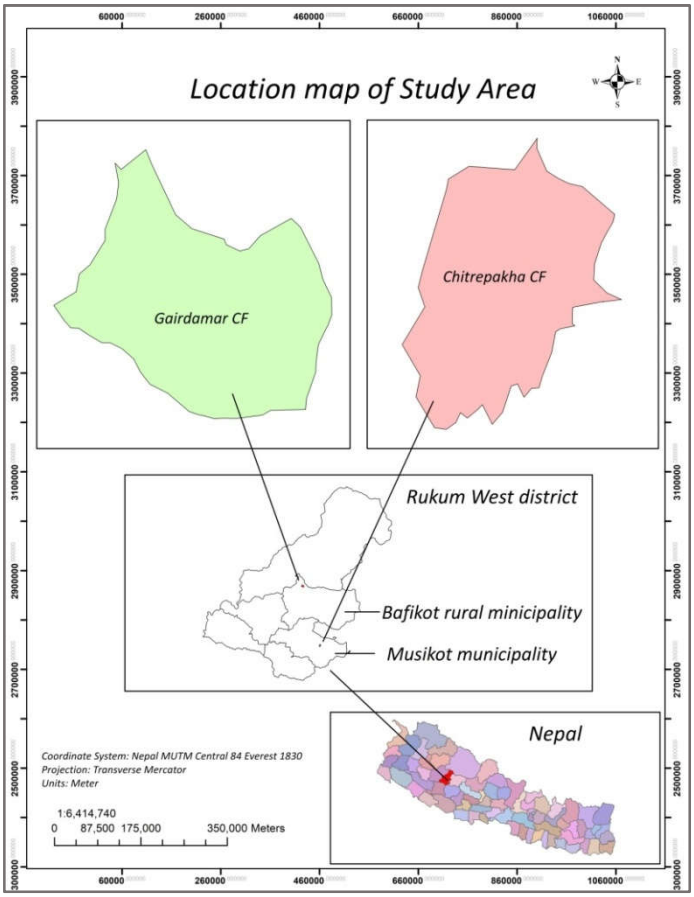

Figure-1: Location map of study area. (WWW. Dos.gov.np and Operational plan of CFUG)

Table-1: Background information of two selected CFUGs. (Source- Operational plan of Community forest user groups)

Attributes	Gairdamar CFUG	Chitrepakha CFUG
Handed over as CFUGs	10 years ago	20 years ago
Area	35.44 ha.	16.56 ha.
No. of households	37	186
Major forest species	*Pinus spp., Quercusspp.,Castanopsissp, Rhododendron arboretum*	*Pinus spp., Quercusspp.,Castanopsissp p, Rhododendron arboretum*
Elevation	1300m-1800m.	1452m- 1814m.

METHODS

Data Collection

Both qualitative and quantitative research techniques were employed to collect the data. Both the primary and secondary data were collected during the research. Primary data were collected through a Focus group discussion and Self-observation & Questionnaire survey while secondary data were collected through relevant sources.

Primary Data Collection

Primary data were collected through reconnaissance survey, questionnaire survey, focus group discussion and direct observation

Reconnaissance survey:

A reconnaissance survey was carried out to gain the knowledge on the socio-cultural and biophysical aspects of the site and to build the

trust with the local people so that they can involve willingly in the further research process in a participatory manner. Rapport building with forest user groups, government officers, students, farmers, CDG members, other concerned personnel and individuals was made and they were informed about the research to build the trust and to create a friendly environment for the study.

Questionnaire Survey:

The questionnaires were carried out in some households during the preliminary survey and were finalized by incorporating the feedback from local people. A structured questionnaire survey was carried out to gather the required information needed to fulfill objectives. 80 households, proportionally from each ethnic group or caste were interviewed to gather the basic data using questionnaire following a simple random sampling method. The survey represents *Brahmin/ Chettri (B/C)*, Janajati*/Adhibasi and Dalits* and male-female respondents. Head of the family and elderly individuals were interviewed. Information on the temperature and precipitation pattern, the damage done by various natural calamities and climate change mitigation practice adopted by people themselves and other concerned authority all-round the decades was also noted.

Focused group discussion:

Discussions were held with poor, men and women and disadvantaged groups to discuss the issues related to study background and also to triangulate the information obtained from the household survey.

Direct observation:

Direct observation was made to analyze the actual field situation. The climate change mitigation activities adapted by the community forest user groups such as water holding tanks for irrigation and to save crops from droughts (artificial irrigation practices), biogas, change in crops and varieties were observed and analyzed. The climate change pattern especially in rainfall change pattern and temperature pattern through more than two decades were analyzed and it is to be noticed that I am a local forest user too. The impacts of climate change in rural hilly region were observed in various natural sources and human daily activities.

Secondary Data Collection

Secondary data for the study were collected from different relevant sources like CFUGs operational plan of forest user groups, DFO, IOF library and various published & unpublished literature. Metrological data (precipitation, temperature, drought etc.) were collected from the Climate change knowledge portal and Data Access Viewer- NASA power whereas the natural disaster data were obtained from Nepal Disaster Report, 2019. Internet sources and different libraries were visited to collect related data and information. Operational Plan and other minute books of CFUGs were reviewed during discussion with committee.

Data Analysis

Household data analysis:

Primary data were analyzed quantitatively using descriptive statistics. Contingency tables and Chi-square tests were performed to investigate the correlation between forest users' perception of climate change and climatic factors. 30 samples from the Gairdamar community forestry user group and 50 samples from the Chitrepakha community forestry user group were used to perform Chi-square tests. Alongside with quantitative descriptive statistics, qualitative information in the form of narrative experiences and observations are provided in textboxes, bearing witness to the changing climate and increasing climatic variability in the study areas.

Climate data analysis:

Descriptive statistics such as sum, mean, relative frequency, and standard deviation as well as analytical tests such as student t-test was used in studying the trend of rainfall and temperature change. Trend analysis of long-term climate data was done to ascertain the changes in climate pattern and to analyze the match between forest users' perceptions and climatic facts. The stability of trend in rainfall and temperature changes was checked by performing t-test between different datasets with equal variances. The test, however, did not perform well due to the fact that the study did not cover more than 40 years of climate data. A total of 480 datasets for mean monthly temperature trend stability analysis over 40 years were used for the both Gairdamar CFUG and Chitrepakha CFUG. Similarly a total of 480 datasets were used for 40 years mean monthly rainfall trend stability analysis for both community forestry user groups as data obtained from the Climate change knowledge portal and Data Access Viewer- NASA power.

RESULT AND DISCUSSION

Socio-economic Status of the Respondents

Household survey was conducted in 46% (80 households) of the total CFUG members. Among them, 30 households from the Gairdamar community forestry user group, Bafikot rural municipality and 50 households from the Musikot municipality of Rukum district.

Gender Factor:

The household survey and individual survey was carried out in 46% male respondents and 54% female respondents. The survey was done with elderly people having age more than 35 years because they have more knowledge of climatic pattern as they faced during their earlier age and hence, it makes them easier to compare the climate change pattern from before to recent time periods. The more female respondents were taken, it is because of men are usually abroad country in searching for jobs and employment and to make better livelihood. Female are normally as hose wife and they work at home and directly or indirectly they are engaged with community forest and agriculture and hence, they face more impacts of climate change directly. That's why it becomes easy to study about the climate change pattern as their perception towards it.

Cast factor:

Household survey was conducted with all casts in the community. Three casts were found: Bramins/Chhetri, Dalits and Janajati. About 62% of the respondents were from Bramins/Chhetri followed by 24% of Janajati and remaining 14% of Dalits.

Occupation:

Different occupation provides different level of knowledge about the climate change and its impacts. Farmer face more impacts of climate change in agriculture field followed by other occupations. From the household survey, it is found that about 95% of respondents were directly engaged with farming as shown in Figure-4 whereas 2% people are engaged with business, about 2% engaged with jobs including private jobs and governmental jobs and remaining 1% includes people abroad the country, politics etc.

Perception of local people on climate change

More than two-thirds of the forest users of Gairdamar community forestry interviewed in Damar village during 10 to 25 September, 2020 and about one third of Chitrpakha community forestry users were interviewed in Sankh village during 1st to 15th October, 2020 as the study area. The interviews were taken on the basis of user personal experience and perceived changing climate knowledge. In addition to that, some users have heard about increasing global temperatures and erratic rainfall from mass media or through conversations with other local people. Forest users' in both community forest user groups have experienced changes in climate. They have perceived changes in intensity and timing of rainfall, and an unusual rise in both summer and winter temperatures. They observed that there were no mosquitoes in the past but that increasing temperatures have been favorable for mosquitoes and many other insects, and have also led to an increase in crop diseases. Most of the forest users interviewed in the Gairdamar Community forestry user group are unanimous about a decrease in the volume and a change in the timing of snowfall. Decreasing snowfall has been experienced along with increasing winter rain, and less snow cover has been noticed in the Bafikot area (Box-1). Besides temperature, rainfall, and snowfall changes, a distinct change has been noticed in the occurrence and timing of frost. People from both Gairdamar user group in Bafikot and Chitrepakha User group in Musikot reported that frost, which used to occur from the 2nd week of September onwards in past years, has now been delayed by 2 weeks and occurs only from October onwards. Farmers in both user groups have also complained about increasing rain and fog in their areas. Before, there used to be 2–3 days of fog; now fog may last for 15–20 days. Local people in both villages have experienced an increasing trend of untimely and erratic rainfall, and a decrease in the level of water in the nearby SankhKhola and Sanoveri rivers. People in Sankh village can still remember the severe drought that occurred in the year 1996 and 1998, which caused a big loss in rice production. Whereas people in both Bafikot village and Sankh village remember the severe floods that occurred in the years 2008 and 2014 in Sanoveririver and SankhKhola respectively.

Box-1: A report on decreasing snowfall in Bafikot rural municipality-10, Damar village (source: author's interview)

KarnaBahadurMalla, President of Gairdamar Community Forestry User Group, 59-year-old resident from Bafikot rural municipality-10, Damar village, still has a hazy memory of the winter of the year 1971. When he was a 10-year-old boy, snow cover in Damar village was one storey high. Due to heavy snowfall, people were not able to move around for sometimes up to 3/ 4 days. Everyone was confined to the house, eating stored food, drinking melted ice water and also using stored fire woods for cooking purposes. He said that in the past snow used to be thick on the hills till the month of May but that nowadays it melts earlier, exposing the black surface and giving a dirty appearance to the hilly slopes. He appeared to be very concerned about the changes that have been taking place

Precipitation:

Precipitation, as an indicator of climate change, includes four main sub-factors: shifting of the rainy season; decrease in winter rainfall and snow fall patterns; uncertainty of intensity of rainfall and snowfall; and change in rainfall and snow fall patterns. This study shows that 48% of the respondents perceived that there is increase in rainfall than before while 42% respondents responded as the rainfall is decreasing. 4% of the respondent said that the rainfall intensity hasn't changed much than before.

When asked about their view on occurrence of rainfall, almost all of the respondents were with the idea that the rainfall is very uncertain. Additionally all of the respondents reported rainfall and snowfall variability with untimely, late monsoon start, no winter rain and high intensity pattern with short periods as Figure-2.

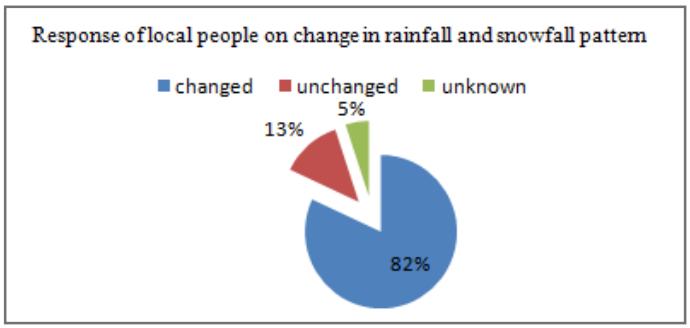

Figure-2: Response of local people on change in rainfall and snowfall pattern.

Temperature

Temperature is one of the main factors relevant to climate change impacts in the study area. It is found that respondents perceive climate change as a global issue due to increase in the average temperature of the earth's surface. Local people are experiencing the change in seasonal temperature compared to previous years. From the whole respondent perception analysis, it is found as follows:

perception category	percent
Increased	88%
Not changed	7%
Decreased	3%
Unknown	2%

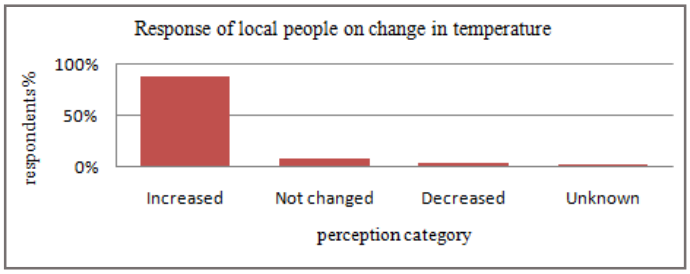

Figure-3: Response of local people on change in temperature.

88% of the respondents said that they have experienced a significant increase in temperature in recent years (Figure-3). Respondents said that the incidence of snowfall and rainfall pattern and intensity is changing and they feel less cold during the winter than they used to do. In the past, before the winter sun was experienced mild and they can stay outside all day, but they feel that sun is so scorching hot in recent years. They also said that the heat in summer is increasing and winter is warmer. This evidence revels that local people agree that there is an increase in seasonal temperatures in the study sites. There were 7% of the respondents who claim that the temperature is same as before and 2% respondents were uncertain about it.

Drought

Almost 70 % respondents said that the incidents of drought have been increasing due to which they are facing a lot of problem in cultivation of rice and other seasonal crops. While there were 25% of the respondents who said that the occurrence of drought was common in the past so there isn't much changed and remaining 2%

and 3% of the respondents were having the response as the drought is decreasing and no ideas about it respectively as shown in Figure-4.

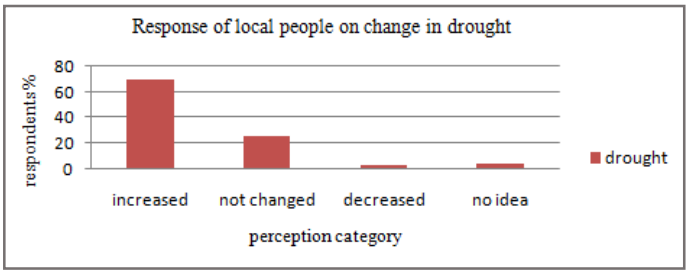

Figure-4: Response of local people on change in drought.

Climate data analysis:

The graph of seasonal rainfall patterns in Figure-5 shows an increasing trend in the last 40 years. Ichiyanagi *et al.,* (2007) found, too, that winter rainfall over western Nepal has increased. The graph of total rainfall shows that the rainfall is increasing in the last 40 years (Figure- 6). Manandhar and Perret (2010) have found the same result in climate trend analysis in Rupandehi and Mustang district of Nepal as the average annual rainfall in increasing whereas Dey and Kumar (1983) found an inverse relationship (negative correlation) between Indian Summer Monsoon (ISM) rainfall and the extent of snow cover in the Himalayas, which suggests that there might be a link between increasing rainfall and decreasing snowfall in the Rukum region. Arnell (1999) explained that a rise in temperature can lead to a general reduction in the proportion of precipitation falling as snow, and a consequent reduction in many areas in the duration of snow cover.

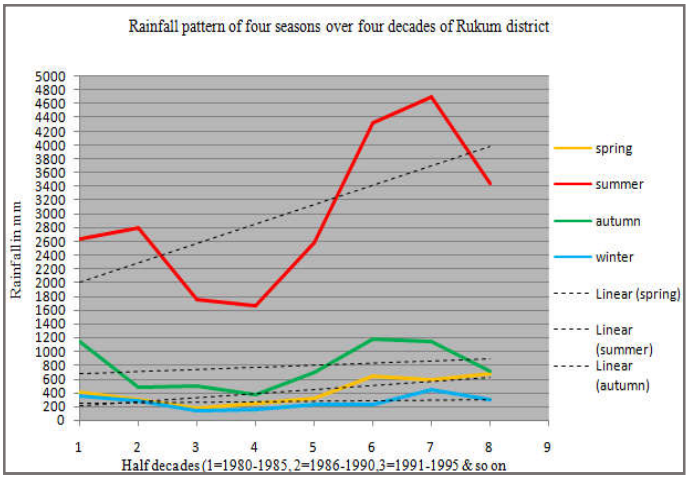

Figure-5: Seasonal rainfall analysis over four decades in study area.

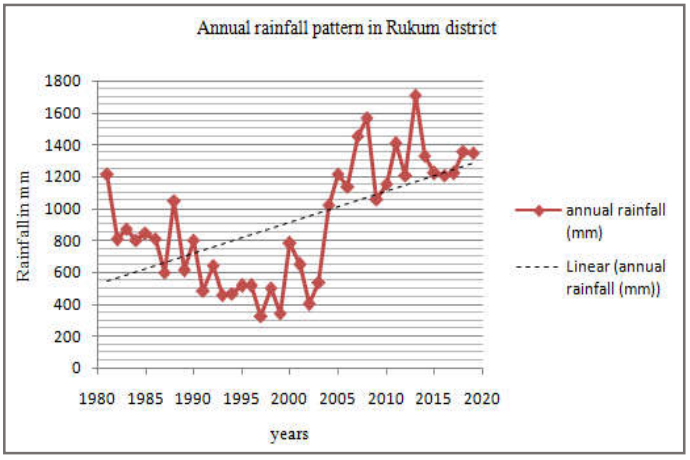

Figure-6: Average annual rainfall pattern of study area.

From the detail analysis of data it is concluded that the rainfall pattern over last 40 years is of largely fluctuated. During 1990 to 2000s, rainfall intensity was very low and from post 2000s the rainfall intensity became higher and higher till 2010s. This fluctuation in rainfall intensity is clearly stated in graph as Figure-7. While the rainfall pattern is highly fluctuated but the fact is that mean annual rainfall is increasing and till increasing. Average annual temperature data over a 40- year period have revealed a significant rise in temperature in study area (Figure-11), which supports both Arnell's statement concerning a link between rising temperatures and decreasing snowfall, and local community forestry users' perception of increasing temperatures in Rukum. Meanwhile there is large fluctuation in temperature, in some years the average annual temperature was much higher and in some years, annual temperature becomes reduced but the fact is that the mean annual temperature is increasing. Though this warming trend is in line with the average annual temperature increased calculated by Sharma *et al.,* (2004), it is more than global average increase given by IPCC(2007). Shrestha et al. (1999) stated that the analysis of maximum temperatures from 1971 to 1994 showed an increasing trend after 1977, ranging from 0.06 to 0.12C year-1 in the Middle Mountain and Himalayan regions, while the Siwalik (hills bordering the Gangetic plain with little potential for agricultural production) and Terai regions show a comparatively lower increase in temperature.

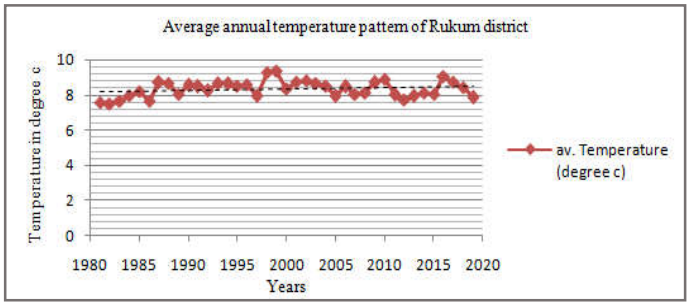

Figure-7: Average annual temperature pattern of Rukum district.

The seasonal temperature is also increasing throughout the all four seasons. The maximum temperature in Sankh village was noticed during 1996s, 1998s which caused drought and rice damage in agriculture field. It is a clear proof which proves that the seasonal temperature is in increasing way as Figure-8.

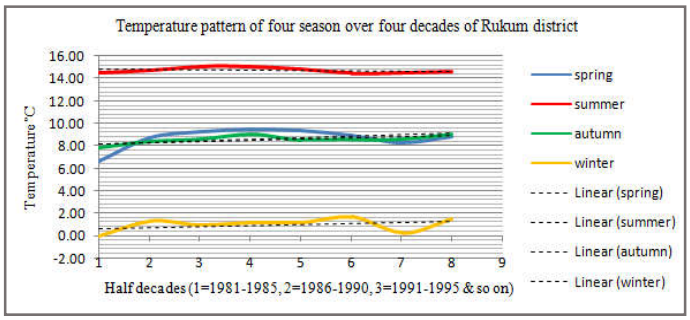

Figure-8: Seasonal temperature pattern of Rukum District.

The perception of local people in comparing with the seasonal precipitation as Figure-9 and seasonal temperature as Figure-8 provides a matching result. Precipitation during summer, winter and autumn season of last five years is gradually decreasing however the temperature over four seasons over this time is in increasing way. The decrease in precipitation during last five year and increasing in temperature over this time period proves that the drought is being increased in comparing with older climatic data. Hence, the local people perception in change in drought is in line with the actual drought trend in two community forest of Rukum district. The chi-

square test showed a significant match between actual changes in temperature and community forest user's perception towards it. Same results obtained in the actual rainfall pattern and drought in study area and community forestry user's perception in rainfall change and drought change too. Hence, the test for changes in temperature, rainfall and drought is significant (Table-2).

Table-2: Correlation between users' perception of climate change and climate change in study area.

Study area	PeopleÚsperceptio on climate change	Corelation with climate data	Chi square test statistics
Gairdamar CFUG	Change in rainfall	Positive	Significant
	Change in temperature	Positive	Significant
	Change in drought	Positive	Significant
Chitrepakha CFUG	Change in rainfall	Positive	Significant
	Change in temperature	Positive	Significant
	Change in drought	Positive	Significant

Chi square hypotheses were tested against P >0.05 error

The comparison of community forest users' perceptions and the climatic records has revealed a close match between both, and provided evidence for the ability of local people to accurately observe and recall climatic events. This proves that local people in both study areas are aware of climate change. This ability combined with adapting experience provides the basis for their various endeavors to adapt their land use to the increasing impacts of climate change.

Natural Hazards (Erosion, Landslides, Flooding)

Climatic hazards which are the harmful on livelihoods and ecosystems can be caused by gradual climate variability or extreme weather events. Some hazards are continuous phenomena that start slowly, such as the increasing unpredictability of temperatures and rainfall, and others are unexpected but relatively discrete events such as hot winds or floods (Regmi *et al.,* 2010). According to the study, 70 % of the respondents had the idea that, due to increase in precipitation during rainy season there is frequent occurrence of erosion, floods and landslide. 26% of the respondents stated that the frequency of natural hazard hasn't increased, while 4% of the respondents were unknown about this idea. Nepal disaster report 2019 shows that climate change has had a big impact on the range and intensity of disasters. The Figure-9 below shows that the occurrence of climate related disasters has soared around 9 times compared to geophysical disasters. Action should be made on the points identified in the Paris Agreement, to reduce the impact of climate change. Nepal and other countries in the Himalayas are particularly vulnerable to the global warming effects of climate change. Moreover, drought, epidemics, changes in the monsoon pattern, excessive rain, GLOFs, heat waves, and cold waves have a both primary and secondary impacts on agriculture, cause loss of life, and affect the economy at large.

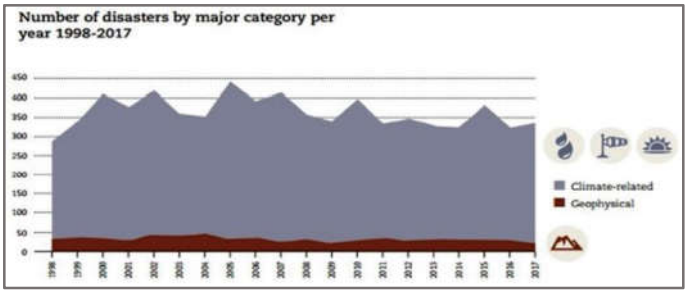

Figure-9: Number of disaster by major category per year 1998-2017 of Nepal (Source- Nepal disaster report, 2019).

The natural disaster in study area has the same occurrence pattern as the overall disaster occurrence pattern throughout the country. The landslides, floods, lightening, fire, heavy rainfall, snow storm, avalanches, hail storm, snake bite etc. in study area are compared as data obtained from local government and the analysis of data results increase in natural disaster. In comparing local people perception towards natural hazards with the Nepal disaster report, 2019 and with local governmental data, it is concluded that the perception is matching with the actual hazards pattern. According to local people, the natural hazards like landslides, fires, lightening events are increasing year by year and damage to various fields such as agriculture field, construction field, domestic property and human injury and deaths too. This perception is in line with the study 'Disasters in Nepal, 2015' by Subodh Dhakal and is also matching with the Nepal disaster report, 2019.

Major Areas Affected by Climate Change and People's Perception on These Impacts

According to the response of CFUGs people, 70% of the respondents stated that the soil moisture is depleting in their agricultural land (Table-3). Likewise, 80% of the respondents perceived that the wind pattern is getting warmer, which causes an increasing trend of species extinction in their forest and agricultural land.70% of the respondents said that there reported the more cases of forest fire than before. 70% of the respondents agreed that the flowering and fruiting time of the forest and agricultural species have changed.

Table-3: Major areas of climate change impacts and perception of local people on these impacts

Major area of impacts	Impacts	Response of local people %		
		Yes	NO	Don't know
Ecosystem function and process	Soil moisture depletion	70	5	25
	Wind pattern is getting warmer	80	10	10
	Water source availability decreased	90	7	3
	Extinct plant species	85	5	10
	Increase in forest fire	70	2	28
Biological system	Changes in flowering and fruiting time	70	20	10
	New diseases in Agriculture crops	80	15	5
	Invasive plant species seen in forest	90	5	5
	Decrease in grass production in forest	70	20	10
	Decrease in medicinal herb availability	80	10	10

Respondents of GairdamarCFUG of Bafikotrural municipality said that there has been disappearance of some local plant species in their CF and have also experienced decreases in wild animals like deer, bear and wild rabbit. Meanwhile people in the Chitrepakha CFUG of Musikot municipality said that the number of Jackal has been increasing since some years, and the species like wild he has disappeared. Based on the key informants' interview, it can be said that insects and pests are increasing in recent years. A few species of insects that were common to the area are gradually disappearing but new species of insects and pests are being observed. The planting time of rice, wheat and maize have shifted 15-20 days earlier than before. The main reason for this is the increase in drought and rainfall pattern. Respondents said that they have stopped planting some species like fapar (*Fagopyrumesculatum*), bodhi (*Vignaspps*), and peanuts (*Arachishypogae*) due to lengthening of the draught season. 90% of the respondent said that there is decrease in the water

sources. Likewise, Tiwari *et al.,* (2010) also reported that change in flowering and fruiting time in some species, increased invade species like *Agerativespp*, *Lantana camera* in the farm land as well as forest land have been realized by local people. An interesting fact found from the key informants is that invasive species are moving gradually to upper elevations (e.g., *Eupatorium odoratum*) which have been seen even at the elevation of 1,500 m (Bhusal, 2009). Scientific communities believe that changes in temperature and rainfall are creating favorable environments for pests, diseases and invasive species to emerge, spread and encroach on agriculture and forestlands (SAGUN 2009 cited in Bhusal 2009).

Role of Community Forestry to Combat Climate Change

Community forest had proliferated throughout the country, with over 22.37 million hectors of national forest land under the management of community forest user group in Nepal. Currently 22,266 community forest user groups are formed involving about 2.9 million households throughout the country. Community forest has contributed 37% relative reduction in deforestation and 4.3% reduction in poverty (FECOFUN, 2019). Many rural communities have a symbiotic bond with the forest, as it is a source of their daily livelihood requirement such as fuel wood, fodder and herbal medicines. Additionally rural people have religious beliefs associated with the forest, and have been using the forest as a means of economic development. The local dependency on the forest is making possible to protect the forest from total deforestation. 88% of the respondents agreed that community forest helps them by cooling the air in hot days, and maintaining the atmospheric temperature. 78% of the respondents said that community forest plays important role in stabilizing soil, reducing the natural hazards like erosion, landslide etc. 91% of the respondents have expressed the idea that community forest preserves the water sources, provides grass and firewood, and manure to the field. Moreover, 60% of the respondents perceived that forests sequester carbon, and maintain carbon dioxide level in the atmosphere.

Table-4: People's perception on the role of CF to combat impacts of climate change

Statements	Response %	
	Yes	No
CF provides cool air in hot days, maintain atmospheric temperature	88	12
CF helps in stabilizing soil, reducing the natural hazards like landslides, erosion	78	22
CF preserves water sources, provides grass and fire wood and manure to the field	91	9
CF sequesters carbon and maintain carbon dioxide level in atmosphere	60	40

Local Adaptation Strategies:

As explained in earlier topics, the potential impacts of climate change are distinctly observed, but local people are using very limited coping strategies to minimize the effect on their livelihood from climate change impact. However, local people have been using some traditional methods of adoption for generations based on indigenous knowledge and innovations. The practices like Biogas, change of crop varieties and artificial irrigation practices etc were reported from both CFUGs.

CONCLUSION

Although most of the respondents were unaware about the words "climate change" in study sites, they were quite familiar with the change in rainfall season and intensity, warmer weather, and some weather extremities. 88% of the respondents said that they have experienced a significant increase in temperature in recent years. Almost 70 % of the respondents said that the incidents of drought have been increasing due to which they are facing a lot of problem in cultivation of rice and other seasonal crops. Likewise, 70 % of the respondents had the idea that, due to increase in precipitation during rainy season there is a frequent occurrence of erosion, floods and landslide. Most of the respondents perceived that the changes in ecosystem functions such as soil moisture depletion, water source scarcity, are more frequent than twenty years ago. Similarly, alternation in biological system such as change in flowering and fruiting time of plants, dominance of new invasive species is also commonly observed. 80% of the respondent perceived that the wind pattern is getting warmer, which causes an increasing trend of species extinction in their forest and agricultural land. Respondents of Gairdamar CFUG said that there has been increasing of some plant species such as Kafal and Lapsi in their CFs and have experienced of disappearing animal species like deer, bear and wild rabbit. Even though, respondents failed to recognize the significant role of CF to combat climate change impacts, most of the respondents (78%) were agreed with the idea that CF helps in stabilizing soil, reducing the natural hazards like erosion, landslide. Just 60% of the respondents understood the CF sequesters carbon, and maintains carbon dioxide level in the atmosphere. Since local people in the study sites haven't faced the extreme impacts of climate change by far, they are using very limited mitigation as well as adaptation strategies to the climate change. Biogas is the common strategies the people of both CFUGs are commonly adapted these days as an alternative source of fuel wood. The new hybrid and productive species are gradually replacing indigenous species which are liable to the impacts of climate change. Around 80% of the respondents argued that they have made changes in the planting or tending or harvesting time of the agricultural and fodder crops.

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