

Climate Change and Community Forestry in Nepal: Local People's Perception

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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 Kaski and Syangja Districts in Nepal were selected as study sites, and various participatory tools were applied to collect primary data. Although most of the respondents were unaware about the words "Climate Change" in study sites, they were quite familiar with the irregularities in rainfall season and other weather extremities. 60% of the respondents had the idea that, due to increase in precipitation, there is a frequent occurrence of erosion, floods and landslide. Around 85% 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, global warming, adaptation, Nepal*

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1. Introduction

Climate change is caused by an increase in certain greenhouse gasses such as carbon dioxide and methane in the atmosphere. Climate change is considered to be one of the most serious concerns to sustainable development, with adverse impacts on environment, agriculture, economic activity, natural resources and physical infrastructures (ICAO 2012). Since 1750, the time of the industrial revolution, Carbon dioxide (CO₂) has increased by 31%, methane by 151% and nitrous oxide by 17% (Dahal 2009). Rising concentrations of the artificially produced Green House Gases (GHGs) are leading to changes in the climate. Though developed countries are mainly responsible for global warming and should take concrete actions to reduce their greenhouse gas emissions, the impact of changes will be felt by the entire global community. The poor country, like Nepal, is likely to suffer most due to limited resources to cope with and adapt to the effects of climate change (Regmi et al. 2010).

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).

Climate change and forests are inherently linked (FAO 2006). Changes in global climate are already influencing forests through higher temperatures, altered rainfall patterns and more frequent and extreme weather events. Forests sequester and store carbon dioxide, which play a major role in reducing global greenhouse gas emissions. However, deforestation and degradation can change the forests from a sink to a major emitter of the greenhouse gases. Trees general hold about 20% carbon in their biomass. Particularly in the tropics, where rapidly growing vegetation removes carbon from the atmosphere more quickly, planting trees can remove a large amount of carbon from the air within a relatively short time. The global carbon retention resulting from reduced deforestation, increased forest growth and more agro-forestry and plantations could make up for about 15 percent of carbon emissions from fossil fuels over the next 50 years (FAO 2006).

Community forestry is an institutional innovation of empowering local communities in managing forest

resources for their benefit in co-ordination with the government, although they do not own the forest or the forest product under the Forest Act and Regulations in Nepal. CFUGs¹ are typically socially heterogeneous with members from, both the wealthy class and the poorer segments of society (Parajuli et al. 2010). Every CFUG, according to the Forest Act 1993, is granted full authority to manage the forest. Awareness of local communities and stakeholders about climate change and its expected impact and their views on climate change were only related to their geographic boundaries. However the area of coverage of climate is wide and beyond the local environment (Gurung and Bhandari 2009). The important role played by forest in sequestering CO₂ from the atmosphere and the livelihood and environment benefits accruing to the local communities enable CF to meet the dual objectives of clean development mechanism (CDM) i.e., sustainable development and emissions reduction. Hence, there is growing interest in linking community-managed forests as a climate change project and there exists potential for more exploration on this linkage that provides local as well as global benefits (Sharma et al. 2004). Due to the slow but visible implications of the global warming, the pattern of weather seems to be gradually changing to affect the entire process of the agriculture and forest. As weather pattern changes, the lives of farmers, which depend on traditional subsistence-based agriculture, have become more vulnerable and difficult.

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 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 little 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 GHGs 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.

2. Methods

Two active CFUGs with a heterogeneous mixture of societies from Kaski and Syangja Districts in Nepal were selected as study sites. Kurchinikharka CFUG from Kaski district and Khanikhola-Charimara CFUG from Syangja district were selected with the help of DFO staffs and corresponding CFUG operational plan and constitution. 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 Table 1 presents an overview of the demographic as well as socio-economic background of both CFUGs.

Table 1. Background information of two selected CFUGs

Attributes	Kurchinikharka CFUG	Khanikhola-Charimara CFUG
Handed over as a CFUG	20 years ago	7 years ago
Area	22 ha.	11 ha.
No. of households	300	110
Major forest species	<i>Castanopsis-Schima</i>	<i>Castanopsis-Schima</i>

Both qualitative and quantitative research techniques were employed to collect the data. Different participatory tools such as focus group discussion (FGD), discussion with committee members, key informants' survey and semi-structured questionnaire survey were used to generate the primary data. After selecting the CFUGs with the pre-established criteria, preliminary field visits were conducted 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. The different activities (bio-physical and socio-economic) were directly observed in various places like respondents' home, farm, forest and surroundings. Direct observation helped to triangulate the information gathered during focus group discussion & questionnaire survey. FGD was conducted with groups of homogenous people to discuss the research issues and questions. The FGD provided a chance to disadvantage people and women to express and share their views more freely. Researcher at very beginning interacted with the committee members who are in key positions to inform about research and its objectives. They were again met at the end of survey to discuss about questions related to research and issues identified during data collection. The researcher deeply discussed with the committee chairperson, secretary and treasurer about activities conducted by CFUGs.

Household interview is the most crucial component of data collection process in this research, and that was conducted in all the sampled households using a pretested semi-structured questionnaire. Information was collected on climatic phenomena, its impacts in farming practices, forest condition and socioeconomic condition of the community. Detailed face-to-face semi structured

¹ CFUG is a group of local people who have common interest and access right to control, protection and management of public forest resources.

questionnaire survey were conducted to collect the data from the local inhabitants. 20% sampling intensity was considered in both CFUGs and household was selected following simple random sampling. Most of the interview was conducted with the household head, who is generally the oldest and the most experienced person in the household affairs. The questionnaire was pre-tested and some necessary changes were made before conducted the final interview. The purpose of pre-testing was to identify any ambiguity or errors in questions. Key informants like local leaders, teachers, government employers who are familiar with the proximity of the local area were interviewed during the field visit time. Using checklist, Open-ended questions were discussed with them about current practices and future strategies of CF. Secondary data for the study were collected from different relevant sources like CFUGs, DFO, IOF library and various published & unpublished literature. 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.

All collected data were analyzed by using qualitative and quantitative data analysis techniques. Most of the data were fed in to computer software programs i.e. SPSS and MS- Excel program. Using different statistics such as Percentage, Mean and graphics, both qualitative and quantitative data were interpreted. Qualitative data were presented by illustrating the categories, ranking and other descriptive manners.

3. Results and Discussion

3.1. Socio-economic Status of the Respondents

Household survey was conducted in 20% of the total CFUG members. Among them, 29% of the respondents were male and 71% of the respondents were female. Education is one of the major factors influencing people's knowledge and perception. The education level of respondent was broadly classified into 4 categories such as illiterate, under SLC, higher secondary (11-12), and higher studies (above 12). 67% of the respondents were illiterate and followed by 15% of under SLC, 13% higher secondary level and remaining 5% were from higher studies category.

3.2. Perception of Local People on Climate Change and Its Impacts

As Bhusal (2009) explains, most of the respondents were unaware about the climate change, but they were quite familiar with the change in rainfall season and intensity, warmer weather, and some other weather extremities. Below are the specific climate factors alternation and their impacts that the local people perceived.

3.2.1. 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.

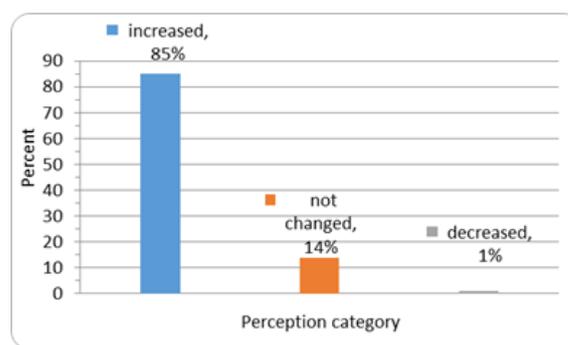


Figure 1. Response of local people on change in temperature

85% of the respondents said that they have experienced a significant increase in temperature in recent years (Figure 1). Respondents said that the incidence of snowfall and rainfall is decreasing 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 reveals that local people agree that there is an increase in seasonal temperatures in the study sites. There were 14% of the respondents who claim that the temperature is same as before and remaining 1% respondents were uncertain about it. 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).

3.2.2. 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 changing of rainfall and snow fall patterns. This study shows that 77% of the respondents perceived that there is increase in rainfall than before (Figure 2). When asked about their view on occurrence of rainfall, almost all of the respondents were with the idea that the rainfall is very uncertain. 23% of the respondent said that the rainfall intensity hasn't changed much than before. Additionally all respondents reported rainfall variability with untimely, late monsoon start, no winter rain and high intensity pattern with short periods. They agreed on the shifting of the rainy season with the rainfall now starting only during the first week of July while it should start from about the third week of June. Similarly they observed that the winter precipitation season in this area was from January to March. However, it has now stopped during this period and the number of days is decreasing and the intensity is unpredictable even if it does happen.

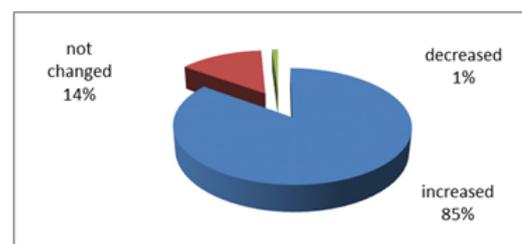


Figure 2. People's perception on change in precipitation

3.2.3. Drought

Almost 60 % 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 (Figure 3). While there were 40% of the respondents who said that the occurrence of drought was common in the past so there isn't much changed. According to the study conducted by Lamichhane and Awasthi (2009), annual precipitation is fluctuating every year, but the average (or five-year mean) shows that decreasing rainfall till the mid- 1980s and increasing rainfall during 1990-2004, which is again decreasing in recent years (2006/07). At the same time, although high annual precipitation is observed, very low and even decreasing precipitation in January, February and March indicates prolonged dry periods or droughts in recent years (1994-2006). Thus, there are more extreme events, both drought and short duration in the past drought used to be at most two months long after which there used to get rain.

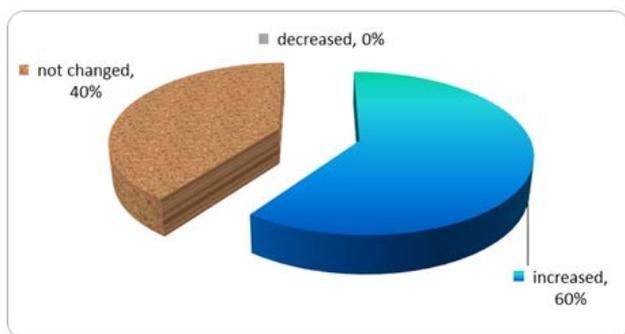


Figure 3. People's perception on change in drought

3.2.4. 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, 60 % of the respondents had the idea that, due to increase in precipitation there is frequent occurrence of erosion, floods and landslide (Figure 4). 34% of the respondents stated that the frequency of natural hazard hasn't increased, while 6% of the respondents were unknown about this idea.

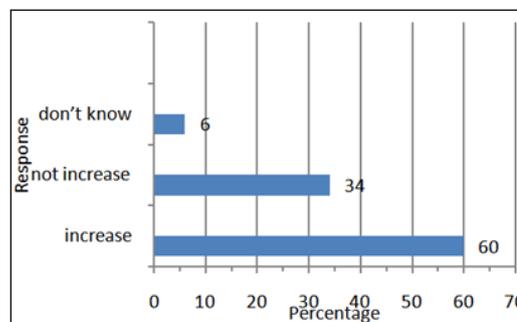


Figure 4. Local people's perception on the increase in frequency of natural hazards.

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

According to the response of CFUG people, 70% of the respondents stated that the soil moisture is depleting in their agricultural land (Table 2). Likewise, 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. 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 2. Major areas of climate change impacts and perception of local people on these impacts

Major areas of impact	Impacts	Responses of local peoples (%)		
		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 Kaski district said that there has been disappearance of some local plant species in their CF and have experienced increases in wild animals like deer, bear and wild rabbit. Meanwhile people in the Syangja district said that the Jackal has disappeared since some years, and the species like wild hen have increased a lot. 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. One typical example is that, even those areas where mosquitoes were not found until thirty years ago are severely being affected by mosquito.

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 (*Fagopyrum esculatum*), bodhi (*Vigna spp*), and peanuts (*Arachis hypogae*) 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 *Agerative spp*, *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).

3.4. Role of Community Forestry to Combat Climate Change

Community forest had proliferated throughout the country, with over 1.22 million hectares or 20.5% of national forest land now under the management of community forest user group in Nepal (Basnet 2009). 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.

44% of the respondents agreed that community forest helps them by cooling the air in hot days, and maintaining the atmospheric temperature (Table 3). 65% of the respondents said that community forest plays important role in stabilizing soil, reducing the natural hazards like erosion, landslide etc. 47% of the respondents have expressed the idea that community forest preserves the water sources, provides grass and firewood, and manure to the field. Moreover, 24% of the respondents perceived that forests sequester carbon, and maintain carbon dioxide level in the atmosphere.

Table 3. 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	44	56
CF helps in stabilizing soil, reducing the natural hazards like erosion, landslide.	65	35
CF preserves the water sources, provides grass and firewood, and manure to the field.	47	53
CF sequesters carbon, and maintains carbon dioxide level in the atmosphere.	24	76

3.5. 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 following practices were reported from both CFUGs.

Biogas: Using biogas as a source of cooking energy not only reduces indoor air pollution (fuel wood smoke), but also reduces the use of forest trees as firewood. Additionally, biogas slurry is useful as a bio-fertilizer which reduces the cost of mineral fertilizers and associated environmental hazards. Most of the respondents from both CFUGs are adopting the biogas as

an alternative to firewood. Some of the NGOs are providing financial support to construct the biogas plant in both Districts.

Changes of crops and varieties: Crop rotation is a practice of planting different crops in different season in a given unit of farm to avoid loss of crop from pests and climate hazards. In both CFUGs, local people found some indigenous species unproductive and liable to climate change, so they are planting different species as well as varieties. Local people have started to use hybrid seeds in order to cope with increasing climate change. For instance, in Kurchinikharka CFUG, people plant the different paddy species these days. They found the original species cannot adapt the current change in weather and rainfall. Likewise, in Khanikhola Charimara CFUG, people use Napier grass as a fodder species in place of Badahar (*Artocarpus spp.*). 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.

Artificial irrigation practices: Some of the respondents from both CFUGs stated that they are using artificial irrigation system to agricultural and less relying on the natural precipitation. However, this practice is just for rich people.

4. Conclusions

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. 85% of the respondents said that they have experienced a significant increase in temperature in recent years. Almost 60 % 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, 60 % of the respondents had the idea that, due to increase in precipitation 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 Kaski district said that there has been disappearance of some plant Spps such as Kafal and Lapsi in their CFs and have experienced an increase in the animal Spps 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 (85%) were agreed with the idea that CF helps in stabilizing soil, reducing the natural hazards like erosion, landslide. Just 24% 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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