

Pond Becomes a Lake: Challenges Posed by Climate Change in the Trans-Himalayan Regions of Nepal

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Abstract

Satellite images, repeated photography, temperature and precipitation data, and other proxy scientific evidences support the claim that climate is changing rapidly in Nepal, including in the Trans-Himalayan regions of the country. Climate change in the Trans-Himalayan region of Nepal is altering the existing relations of functional socio-ecological system for generations. This ethnographic assessment of Nhāson village looks at the disturbance posed by climate change to the social and ecological relationship in reference to livestock management practices. It focuses on two thematic areas of communities' verbalisation of issues and challenges faced by the mountain herders in the climate change context. This paper is the product of ethnographic study between the years 2012 and 2014 in Nhāson. The locals' attachment to environment and witnesses of change is capable of telling the story on the disturbance of climate change in the social and ecological systems, contextually. The stories gathered during walking, herding, travelling, watching and observing of the places are "real stories" with insights into the past climate variability and fluctuation which is critically valuable to understand the environmental phenomena at times when scientific evidences are not sufficient. Ethnographic study can contribute in documenting the place and cultural specific stories as a powerful evidence to climate change and its impact on grounded social and ecological systems.

Key words: Community story, climate change, livestock, socio-ecology, Trans-Himalayan region

INTRODUCTION

Upon analysing the precipitation data from 1977 to 1994, Shrestha *et al.* (1999) found that the mean annual temperature in the Himalayan region of Nepal had risen by 0.6°C per year. Shrestha and Aryal (2011) also analysed the temperature data by using modern measurement techniques, and reported the continuation in rise of temperature. Likewise, Baidhya *et al.* (2008) stated that the number of cool days and nights during winter had decreased by about 5 and 9 days respectively, and that the incidence of hot days and nights had increased by about 16 and 7 days, respectively. The same paper analyses the precipitation data from 1974 to 2005, and show that the number of rainy days in a year had slightly decreased while the days with

heavy rainfall (i.e. more than 100 mm per day) had increased during the same period. The analysis of snow cover, precipitation and temperature data by using Moderate Resolution Imaging Spectrometer also showed that the snowfall pattern shifted beyond the actual time, i.e. from January to March; moreover, the growing season had prolonged along with the increase of temperature in the Trans-Himalayan regions of Nepal (Paudel and Anderson 2013). These temperature and precipitation data analysis and evidences combined with the satellite images, repeated photography, and other proxy scientific evidences show that the climate in the Himalayas of Nepal including the Trans-Himalayan regions is changing.

Scholars and organisations have carried out comparative studies of photos, maps and satellite images of the Himalayan region of Nepal (Vetaas 2007; GoN 2010; Shrestha and Aryal 2011; ICIMOD 2002, 2011). Vetaas (2007) compared two photos of the Gangapurna Lake located in the upper Manang – taken in 1952 by Tony Hegan and another one taken in 2005 by the author. A closer comparison of these photo imageries of the Lake reveals that the glacier is melting very rapidly. Likewise, the International Center for Integrated Mountain Development (ICIMOD) compared three satellite images of the Thulagilake (locally known as *Dona Taal*) located in the highland pasture of the lower Manang. The first image was taken in 1962 by an Indian Survey Team, the second one in 1992 by the Water and Energy Commission Secretariat, and the third one in 2005 by ICIMOD. The first survey reported that the size of the lake was 0.22 sq. km with 0.6 km in length. The size of the lake had increased by 2.45 times (0.76 sq. km with 1.97 km length) in 1992. The natural enlarging process of the lake has not stopped. In 2005, its size was measured to be 0.94 sq. km with 2.54 km length (ICIMOD 2011). These comparative analysis of the images or photos reveal the alarming impact of climate change in the Trans-Himalayan region of Nepal, including Manang. Natural science-based literature largely overlooked place-specific and culture-specific aspects of climate change that limits our way of understanding how culture and place-specific communities actually narrate and respond to climate change (Vedwan and Rhoades 2001; Crate *et al.* 2009; Carey 2010; Crate 2011; Poudel 2016a).

Farming, herding and trading are the traditional sources of livelihood for the people of Nhāson. Because of the geographical condition or topography, the inhabitants of Nhāson depend on precipitation, especially on winter snowfall, for subsistence. Furthermore, suitable or arable land for farming is limited¹ and, the time span to carry out agricultural activities is short. Hence, the people of Nhāson undertake livestock activities as an alternative source of income. Nhāson valley's altitude ranges from 1,645 to 8,125 meters from the sea level (HMG/N 2000) and comprises of diverse flora and fauna. This range of geographical variation facilitates transhumance and allows the locals to keep and rear different types of livestock including Zebu cattle to yak, low dwelling goats and sheep, to high altitude adapted goats and sheep. Moreover, the geographical variation allows the herders of Nhāson to move between high and low altitudes in search of pasturelands, which has been the case for generations. This has helped them to amass knowledge about the local environment and, in particular, about the availability of water and ground grasses in the pasturelands for livestock. However, the knowledge on the environment, in case of the herders of Manang, seems to have resulted from their actual practices of inhabiting and engaging with the landscape rather than genealogically or through primordialism (Ingold and Kurtilla 2000). The narratives and knowledge of the locals about the environmental process and change in itself is a powerful evidence of climate ethnography (Ingold and Krutilla 2000;

¹ Out of 470446.7 hectares (ha) of total land area of the district, farming land attributes to merely 2178 ha, which is less than 0.5 per cent of the total land area of the district.

Vedwan and Rhoades 2001; Cruickshank 2001, 2005; Crate 2008; Rhoades *et al.* 2008; Carey 2010; Poudel 2012, 2016a).

For the people of Nhāson, climate change is not just about hotter temperatures, shifting rainfall patterns, melting of glaciers, or darkening peaks. It is also about the stories, myths, realities, loss of indigenous knowledge and breaking of structurally cognised knowledge about seasonality, shifting habitats of flora and fauna, change in mating and breeding calendars of livestock among others. It is indeed the nexus of society and nature, between humans and their environment, culture and nature, and global and local (Vedwan and Rhoades 2001; Cruickshank 2005; Orlove *et al.* 2008; Rhoades *et al.* 2008; Crate and Nuttall 2009, 2016; Barnes and Dove 2015; Poudel 2016a). Moreover, the rhythmic routine between social systems (human annual activities and customary laws) and ecological systems (annual climatic calendars), which had functionally operated in the area over many generations, is gradually being disrupted and finally breaking up due to the changing climate, which has unfortunately received very little attention from scholars.

I argue that the disturbance in the prevailing harmonious relationships within a given calendar of human annual activities and climatic annual calendars is against the will of the local people. Indeed, it is forced by an external agency (here, by climate change), which is producing and reproducing a situation characterised by conflict in rhythmic cycle between the social and ecological systems in the Trans-Himalayan region of Nepal. This paper explores how the herders of Nhāson make sense of climate change by conducting

climate ethnography in a specific place despite multi-sited approach proposed by the anthropologists (Crate 2011; Sherpa 2014). Geographically, climatologically, culturally and economically, Nhāson is a powerful context for climate ethnography (Poudel 2016a). Located in the mountain region of Nepal, Manang is one of the highly vulnerable places in terms of climate change (GoN 2010) where the maximum temperature has increased by three degrees over the last three and half decades (Poudel 2016a). The impacts of climate change are noticeable and experienced in agriculture, forests and biodiversity, water resources and energy (GoN 2011; CBS 2016). In recent years, the snow covered mountains are turning dark, and glacier lakes are gradually expanding - phenomena that are noticed by the local people very clearly (Poudel 2016a). The multiple and diverse issues embedded within climate change are apparent. The paper focuses on the local's articulation and verbalisation with regard to climate change and its impacts, and how they narrate change in climatic variables. Finally, the paper presents the future trajectories pertaining to livestock management to highlight the challenges faced by locals in the region due to climate change.

METHODS

Fieldwork at Nhāson was undertaken for seven months between 2012 and 2014. The fieldwork focused on collecting data related to the local knowledge on, and perceptions and responses to, climate change. Ethnography is regarded as a 'thick description' (Geertz 1973) of people's behavior and social relations in the cultural and ecological contexts in which they live (Barnes and Dove

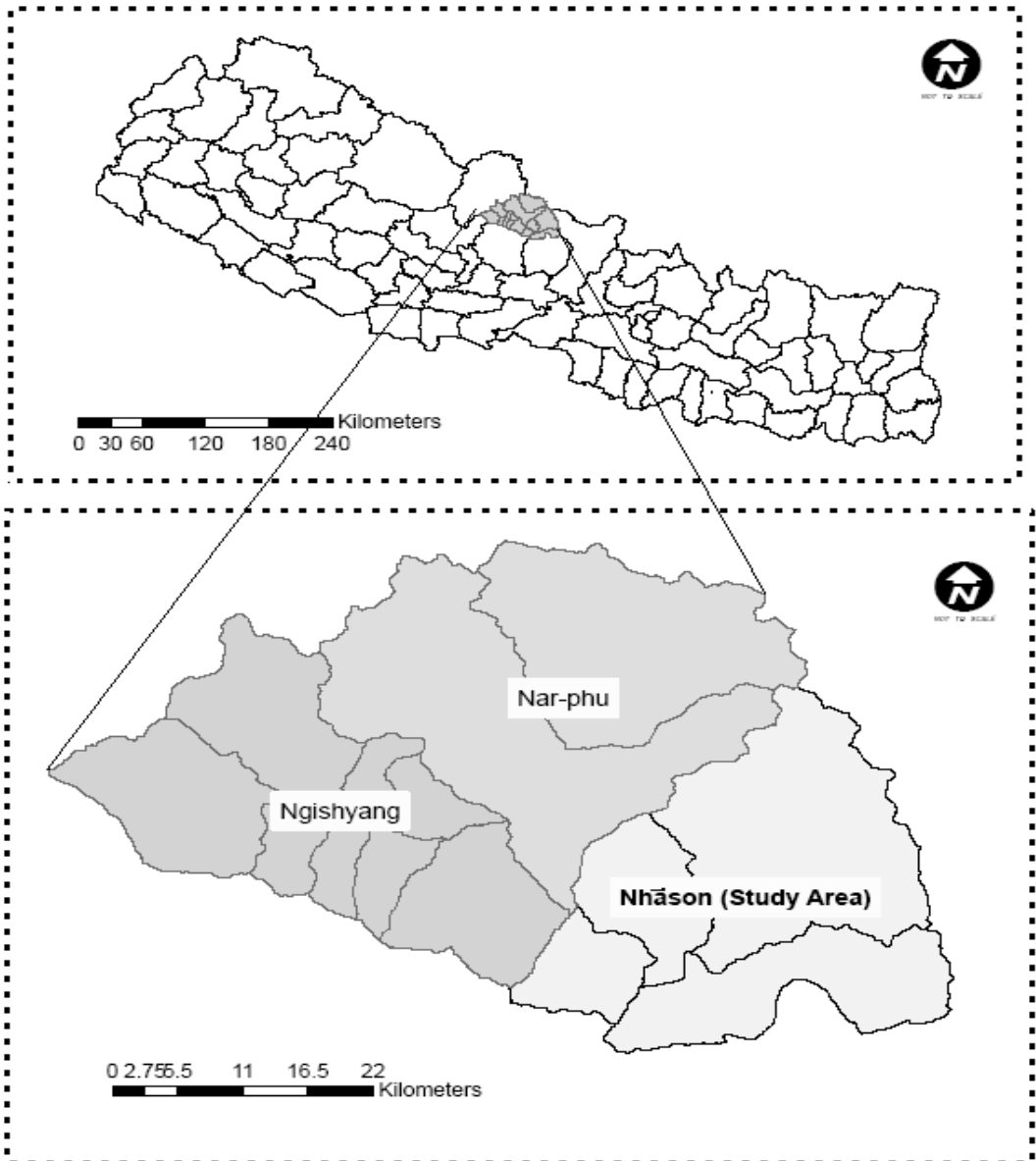
2015). To understand the relationship between the herders of Nhāson with their environments, information on the herders' annual activities was collected. For this purpose, the author accompanied the local herders – moving across their pasturelands and collected narratives and stories, and observed the natural settings and their everyday behaviors. This helped to contextualise the impacts of climate change. The *Kurakani* – informal conversations – with the local elders and herders led to a broad understanding about the change in climate and livestock management in the region. Key informants involved five elderly and informed locals. These individuals have inhabited in the region for long and have specialised their knowledge on various aspects such as herding, culture and environment, and other related issues. During the study, several informal discussions in groups and also with individuals were undertaken. These informal discussions involved varied categories of people like young and old, men and women, herders and farmers, business-persons, shamans and likewise. Such informal discussions were held mostly in the evenings when the villagers sat around their hearths and discussed about their day's events and made plans for the following day.

THE SETTING

Nhāson is located in the southeast of Manang district which is divided into three micro-ecological zones, viz. Gyasumdo (Nhāson), Nar-Phu and Nisyhang (Gurung 1976). It covers a wide vertical zone from 1,645 meters to 8,125 meters from the sea level (HMG/N 2000). According

to the Department of Hydrology and Meteorology (DHM 2010), the maximum temperature recorded at the Chame station, nearby state of Nhāson, was 22°C and the minimum temperature was -4°C with annual precipitation amounting to 1235 mm. The data recorded by the Government of Nepal shows that a large proportion of the land is barren (44.18%), the second largest is mountain and rock land (39.60%) followed by grazing land, forest land, bush land and agricultural land each accounting to 8.23 per cent, 5.42 per cent, 2.09 per cent and 0.46 per cent respectively (GoN 2001).

'Nhāson', which comprises of several villages today, is derived from the combination of two words in Gurung language, viz. '*nha*' (villages) and '*son*' (three) – literally meaning 'three villages'. Nhāson, therefore, traditionally denotes three villages namely Tache, Nache and Tilche. In 2014, there were 16 settlements in this area. A few of these settlements had formed after the arrival of new groups over the last one and half century while some settlements emerged after the expansion of tourism in and along the corridor of the Annapurna mountain range in the late 1970s (Poudel 2016a). All the settlements are located along the banks of Marsyandi river and its tributary, the Dudh-Khola. The settlements are dispersed in a wider geographical area from about 1,645 (Taal village) to 3,700 (Bimthang) meters from the sea level. However, people living in the settlements, located along the trekking routes, are largely involved in business whilst off-route villages still largely rely on agro-pastoralism as means of livelihood.



Map 1: The Study Area

FINDINGS

Livestock Management in Nhāson

Livestock in Nhāson is an integral part of subsistence agricultural system and trade. Agriculture, therefore, would be impossible without livestock. Like other

mountain regions of Nepal, Yak, *Nak* (female Yak), *Cho* (male cross breeding of Yak and Zebu cow), *Cho-aama* (female cross breeds of Yak and Zebu

cow), cow, ox, goat, sheep, horse, and mule are common livestock raised for different purposes such as draft energy, manure, wool, meat, dairy products, and transportation. Besides material use, some livestock are essential for them to perform rituals and religious activities. Sheep, for example, are not only of material value for the people of Nhāson, but they are needed to make sacrificial offerings to the local deities during various rituals celebrated to maintain relations between cosmology and the living world. However, these perspectives are not fully sufficient to understand about livestock management in Nhāson. Livestock management in Nhāson has been producing and reproducing through a wider political and economic process over the last six decades (Poudel 2016a).

In 2012, there were 40 herds in 6 settlements in Nhāson. Now there are 13 herds of cow, and the same number of sheep and goat herds, 7 herds of Yaks, 3 herds of *Choaama*, and 3 herds of mules and 1 herd of horses. In Nhāson, herd structures vary in terms of livestock composition. Some of them comprise of a single specimen while others have two or more species². It depends on climate, grasses or availability of grazing lands, human resources and economic status of household and so on. For instance, the locals cannot keep Yak and cow together in a single herd due to the variation in physiological characteristics to sustain in a particular climatic condition. Thus, a household maintains separate herd for Yaks and cows which is not possible without potential human resources in a household.

Local Narratives and Experiences on Climate Change

It was on November 5, 2012. I was at Tek Bahadur's house at Unash. Tek Bahadur Gurung, his wife, his youngest daughter and I were sitting around the hearth having tea and some snacks. There was an informal chatting about the way of lives of people in the past and present. We also conversed about the environment and the changes that have occurred with time. Tek Bahadur began to talk about the change in the glacier that he noticed in his lifetime as follows;

In 1955, I was 16 years old. My father and I were in the goth (temporary shed for herders) at Wagreche pastureland. That was my first visit to a herd and the area. There was a small pond known as 'Dona Pokhari' above Wagreche grazing land. As I recall, Dona pokhari was small and occupied space that would be occupied by a house in the village (he was referring to the space occupied by his house). In 1959, I enrolled myself in the Indian Army and did not have time to visit the pokhari anymore for a long time. In 1981, I retired from the army service and returned to live here. Soon thereafter, I started with sheep herding. In the summer of that year, I visited Wagreche and its surroundings again with my herd. At that time, I was surprised to see that the small pokhari I had seen many years ago had turned into a Taal (lake).

Tek Bahadur's narrative - 'the small Pokhari had turned into a Taal'- implies that climate change is strikingly affecting

² Single species composite herd structure means Zebu cattle specific only or Yak only or goat only or sheep only herd.

the hydrological and environmental processes in the local surroundings. In the general discussion with the villagers, a comment about the erratic weather pattern especially in the last few years was made. This was supported by an event that I encountered on the evening of 17 August, 2012. On the day, Sol Bahadur, a young man of Tache village and I were talking about the livelihood of the people in the village. Suddenly, it started raining heavily outside. “Oh! What kind of rain! It looks like ‘*Lamjunge-rain*’! Seems like the *Lamjunge-rain* has started in our village. I have not seen such rain in the village before!” Sol Bahadur exclaimed. I understood the literal meaning of the ‘*Lamjunge-rain*’, but could not contextualise the reality. Therefore, I tried to contextualise it in changing rainfall patterns in the village. “What is *Lamjunge-rain*?” I asked him. “It is a low altitude rain”, he replied.

Indeed, misty rain and rainfall without thunder and lightning was a common feature of the monsoon rain - what is locally referred to as *Asarpyagi*. The

villagers had felt changes in that pattern of rainfall since last few years. Regarding this, an informant Komal Ghale (67 years old) said;

When I was little, our elders used to say that there were no thunder showers in areas above Chyamche, the southern border of the Nhāson village. I had also never heard thunder before rains until 2008. Now, thunder and lightning are common in Asarpyagi (monsoon rain)

The recorded meteorological data since 1976 to 2010 at Chame, a nearby station, also support the local experiences and narratives (see Figure 1), although the indigenous ways of interpreting the change in rainfall pattern is not quantitative unlike the data provided by meteorological station. It is linked with environmental signals or language like ‘rain with or without thunder and lightning’ and ‘*Lamjunge-rain*’ which are indeed qualitative measurements that tell us about increasing intensity of precipitation in the Trans-Himalayan region and in particular, at Nhāson.

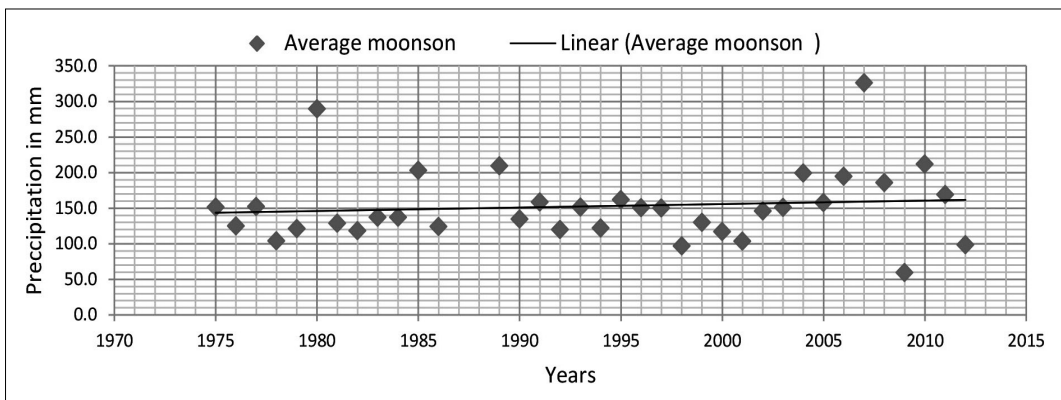


Figure 1: Average Monsoon Rainfall from 1975 to 2012 in Nhāson

Source: DHM (2012)

Making Sense of Change in the Temperature

The meteorological data shows that the maximum temperature in Nhāson has increased by about 3°C over the last three decades or so (see Figure 2). One degree Celsius increment in the mean

temperature can cause an isotherm shift of 150-200 meters (Meyer-Abech 1993). The evidences of climate change in isotherm shift are clearly noticed in Nhāson. For example, apple, maize and green vegetables and trees are now found in areas where people usually did not grow anything until the late 1970s (Poudel 2016a).

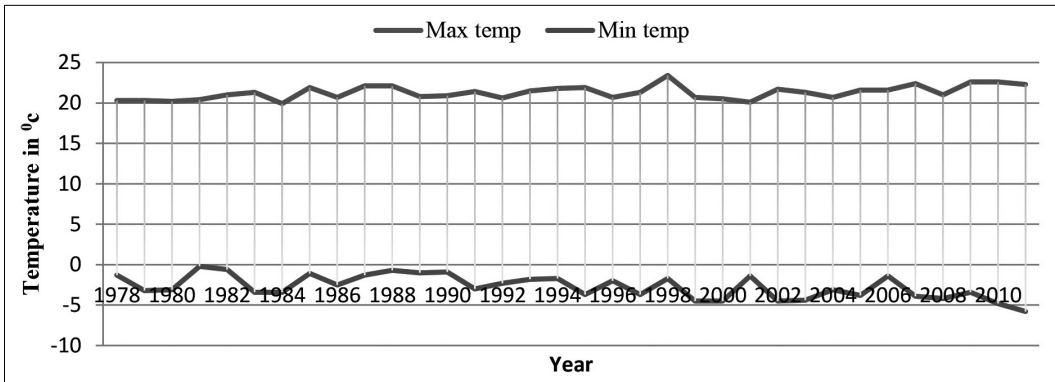


Figure 2: Maximum-Minimum Temperature from 1978 to 2011 in Nhāson

Source: DHM (2011)

Climate change is not just about high temperature and melting of ice (Barnes and Dove 2015). It is different things for different people. For the herders of Nhāson, it is about the loss of grasses on meadows, lack of availability of grasses and water for their livestock when needed, shift in habitat of livestock, shift in vegetation landscape, change in the breeding calendar of livestock, and difficulty in cross-breeding Yak-bull with cows for hybrids production. Hence, it is not the change in a single variable, but rather a complex phenomenon which is interlocked with diverse aspects of social and ecological systems.

In May 2013, I was talking with some herders at Nache village about the impact of climate change on livestock management practices. One of the informants, Mangal Bahadur Gurung (68 years old), narrated

the impacts of climate change that he has noticed in their pasturelands as;

There were a few species of rhododendron and other thorny trees at Kromche pastureland, and most of the lands were covered with grasses. Snow used to cover the land for a longer period during winter. However, the weather and vegetation landscape have been changing a lot since few decades. There is a very little snowfall during winter, and now it does not remain on the ground for long as it did before. The decrease in snowfall made it possible for new vegetation to grow at Kromche grazing land. The rapidly growing and increasing of trees, especially thorny species, have made the grazing spaces smaller.

On September 28, 2012, I was going to Dona Lake and its surroundings. It was

a high pastureland of Nache herders. Meghalal Gurung (52 years old) was with me. We were about to reach Kromche (3000-3200 meters), and there was a big tree with a cut-mark. He stopped there and talked about the cut-mark. "This cut-mark is the sign of heavy snow deposit on the ground which our ancestors made," said Meghalal. Then we went ahead and reached Kromche pasture. There was a shelter and we sat there to rest. At that time, he told me a story about a Yak-bull that went missing due to heavy snowfall.

In our village, there was a Yak-bull raised for cross breeding. One particular winter, a Yak-bull was left at Kromche (I could not recall the date). During that winter, there was a heavy snowfall which continued for several days and remained frozen on the ground. The Yak-bull could not get anything to eat due to the thick layers of snow and it died of hunger eventually. Today, the event, which was a reality in the past, has become like a fairy tale. The place where we lost the Yak-bull due to heavy snowfall in the past, at the same place we lost our six Yak-bulls due to low altitude sickness in the 21st century when we kept them for mating with cow for cross-breeding. Today, we do not move yak herds down from Wagreche (3,700 meters) throughout the year.

These narratives from the local herders tell us about the changes in their environment including the shifting of snowfall and increased temperature from their own experiences of herding, hunting, watching, walking and living there for almost a half century or more. Indeed, local people telling about the change in environment is largely rooted in orally narrated

stories which provides an alternative set of principles for thinking about current events (Cruickshank 2005:57)

Challenges in Livestock Management in Trans-Himalayan Region

In my discussion with the local herders, they felt that climate change poses challenges to manage livestock. One of the challenges is to continue the practice of hybrid production (*Cho* for male and *Cho-aama* for female) which is an integral part of livestock management in Nhāson. In Nhāson, the villagers produce cross-breeds by crossing between Yak-bull and cows. In this regard, Bishop (1998) writes;

Hybrid should be impossible, however, some species are sufficiently close either due to recent domestication or because of insufficient time or selection pressure for differentiation, that their chromosomes will match up and produce a viable offspring, especially with human assistance in the mating process itself (Bishop 1998: 31).

Hybrid production is a complex phenomenon in the sense that herders should have sound knowledge about the ecological system, temperature, mating seasons of livestock, geographical location and human resources available at household as well as suitable climate and enough grass for livestock. This shows that there is a close connection between human and ecological systems regarding livestock management, in particular, hybrid production in Nhāson. During the discussions with the villagers, it was reported that climate change has threatened the rhythm of natural system that is ultimately breaking up the relations

between the social and ecological system. For instance, Kromche, one of the pasturelands of Nache village, was the place for cross-breeding between Yaks and cows. In the beginning of May, the villagers began to move their cow herds towards Kromche. They reached there by mid-May. At that place, they would keep Yak-bull and cows together for cross breeding by separating *Nak* and bulls from each herd. They would keep Yak-bull and cows together from mid-May until mid-July. Thereafter, they would move the Yak-bull to higher altitude because they cannot live in lower altitudes due to its physiological characteristics³. Therefore, knowledge about the ecological system – when to keep Yaks and cows together and when the bull moves to a higher altitude – is essential. This is gradually disrupted by climate change in Nhāson which is narrated by a herder as;

Since the last decade, the weather has changed a lot. It is less cold and there are no heavy snows in the winter season as it used to be in the past. Now, Kromche is not a suitable place for keeping Yak-bull from mid-May to mid-July for cross breeding with cows which was not the case until the end of 20th century (Suljung Gurung, 52 years).

Indeed, traditional knowledge and practices of hybrid production are built upon interaction with the ecological system. The social system (traditional knowledge and practices of hybrid production) and ecological systems are not separate entities as Berkes and Folke (2000) argue. They are interlocked with each other in terms of being threatened due to change in temperature and snowfall

pattern at Nhāson. In other words, the herders had a cognised structure with regard to the movement of livestock and their management which was closely interwoven with the climatic calendar which is gradually being disrupted due to climate change. This means climate change appears as a driving force in breaking the linkage between the human and ecological systems in the region.

Shifting Snowfall and Losing Ground Grasses

'Hiun-pagladai-janchha, ghans-palaudai-aauchha' (as the snow melts, the grasses grow), was a frequently heard statement during my fieldwork. This is not a general statement, but is a time tested and empirically grounded knowledge about the relationship between snowfall and the onset of germination of grasses in the area. Moreover, the statement tells us about the importance of snow and snowfall in the life of the herders in Nhāson. It is because the growth of grasses is largely dependent on the intensity and duration of snowfall. This is proven by statement of Guptaman Gurung (73 years old), a herder of Unash, who answered to me when I asked him about the onset of grass growing on pasturelands. He opines;

I cannot say exactly about the onset of grass growing on pasturelands. It depends on the intensity and the duration of snowfall in winter. If we get more than five times heavy snowfall in winter, there will be a lot of grass to feed the livestock during the spring. Grass grow immediately after the snow melts; otherwise it begins to grow only after rainfall.

³ An annual movement of Yak herds is from about 3,000 meters to 5,000 meters and above, and Zebu cattle move from about 1,600 in winter to 4,200 meters in summer in Nhāson

Local people have been noticing the change in duration and intensity of snowfall over the last three decades. As per the local experiences, timing for the onset of snowfall has shifted from mid-December to late February and early April which is also reported by western science based studies of the area (Paudel and Andersen 2013). The most visual impact of currently changing snowfall pattern was noticed by the herders on the duration of the growth of grasses and the availability of water resources.

In the past, it would snow heavily on time and grass would also grow on time. But, nowadays it snows less and it occurs later. Consequently, grass has almost stopped to grow and the quality of ground grasses is not as good as it used to be in the past. (Guptaman Gurung, 73 years old)

This statement signifies the importance of timely snowfall which are crucial for the availability of grasses and water resources in pasturelands. If snowfall gradually becomes thin, the herders will lose the ground grasses and water which are essential for feeding the livestock. I frequently came across the statement about losing ground grasses along with the shifting of tree lines in the higher altitude over the last three decades. Regarding the shifting of vegetation landscape, one of the informants Lal Bahadur Gurung (54), a local forest guard and former herder, narrated;

My father was in the Indian army. After retiring from his service, he invested all of his savings to buy a sheep herd. I spent my early life (age between 14-24 years) as a shepherd. Even today,

my family does not separate from this traditional occupation. These days, I still occasionally visit the herds. Prochha, Timle and Yoba grazing lands are the summer pasturelands for our herds. In my early herder life, I did not notice a single tree at these pasturelands. As I recall those days, we had to go down to collect firewood. Today, these are gradually covered with pine trees. It makes us easy to collect firewood on the one hand, but on the other, we are losing our ground grass.

This statement illustrates the multiple emerging issues faced by the locals due to climate change. Indeed, the statement tells us about the process of environmental changes, opportunities and threats posed by climate change in the mountain regions which herders are experiencing in their everyday lives. The statement tells us that climate change is not only a matter of change in the vegetation landscape for the mountain dwellers, but also poses a risk leading to shortage of ground grasses without which their livestock cannot survive. In other words, climate change will lead to the scarcity of grasses on pasturelands. In the long run, this scarcity will threaten the social system which is the governing factor of the ecological system in the mountain region (Jhoda 2000; Rhoades 1997)⁴.

Climate Change, Water Scarcity and Yak

The herders have faced water scarcity in the springs and rivulets during the grazing season in the highland grazing areas, in particular, for their yaks along with the decreased intensity and duration of snowfall in winter. During my discussion with the

⁴ Here social system means thiti system (customary rules/regulations) which regulates the behavior of members in a society.

people, I found that scarcity of water on pasturelands vary in terms of geographical locations. It was higher in Unash than Nache, Tilche and Tache. Hence, the Yak herders of Unash faced higher scarcity of water resources than others due to lack of springs and rivulets in the area. However, they described the changes in the water resources in pasturelands by linking it with the movement of herds;

In the past, water was never scarce in our grazing lands. Springs would start to sprout during March/April along with the melting of the snow and would remain intact until mid-November. Thus, we neither had to wait for more days to move our livestock up to the grazing lands nor hurry to move the herds down. Nowadays there is no water for our livestock. It only begins to regenerate after the onset of monsoon in mid-June and almost dries up by the end of September or early October. We have to wait for more days to move the livestock up to the pasturelands and hurry to bring them down. (Krishna Gurung, 46 years old)

The herders told me that water scarcity in high range meadows affected livestock like Yaks and *Naks*, *Cho/aama*, oxen and cows and sheep and goats differently. As compared to other livestock, the herders reported that Yaks and *Naks* are more vulnerable to the ongoing climate change – in particular shortage of water in the pasturelands and increasing temperature. Regarding the effects of increased temperature and shortage of water in pasturelands, Krishna Gurung (46 years old) commented;

Today, we are in dilemma. Yaks will die of low altitude sickness if they are

kept at lower altitude pasturelands during spring, and they will also die of dehydration if they move up to the higher pasturelands.

Krishna's statement illustrates that Yak herding is at more risk in the mountain regions in the context of increased temperature. The risk is multifaceted and connected with livelihood and culture, ecological knowledge and practices. Thus, Yak herding is not just a matter of economy; it is a matter of culture, ecological knowledge and practices. The threat to Yak herding is, therefore, also a threat to the mountain culture, ecological knowledge and practices.

In Nhāson, it was found that the upward shifting of the Yak habitat is taken as a coping or adaptive strategy against the risks created by climate change. In winter, for instance, Nache herders used to keep their Yak at Nache village and its surroundings (2,400 masl) until the late 1970s. Since then, they could not move their Yak down from Kromche (3,100-3,200 masl) due to increased temperature. Then they began to keep their Yak at Kromche from the late 1970s and this remained so until 2006. Since 2007, they could not move their Yak herds down from Wabu and Wagreche grazing lands (about 3,600 to 3,700 masl) during winter due to increase in the temperature. With each instances of increased temperature, the evidences show that Nache herders have been shifting the location of Yak herds towards higher altitudes to cope with the risk. In the Trans-Himalayan region, the shifting of location to higher altitude cannot be a long-term adaptive strategy for them and has limitations. Once the day will come where there will be no place to shift the Yak in the mountain region and there

will be no more Yaks, and there will be no more mountain culture associated with Yak and its herding.

Challenges to the Customary System

The people of Nhāson have been managing their agro-pastoral systems for many centuries through resource-use practices and the traditional institutional arrangements which are common in the mountain regions of Nepal (Brower 1991; Steven 1993; Gurung 1996; Bishop 1999; Jhoda 2000; Poudel 2016a). Rather than grazing their animals in a single pasture, the herders of Nhāson graze their livestock in a dozen or more pasturelands every year on a rotational basis. Each village has its own social system, i.e., institution that Ostrom (1991:23) defines 'as a set of rules' that govern the behavior of users. In case of Nhāson, each village has its own territorial boundary that defines the users' rights and governs the behavior which is historically and culturally constructed (Poudel 2016b). Members of the village do not have the rights to use resources available except on one's own territorial boundary. Breaking the rules is subjected to punishment. In addition to village territorial boundaries, they have made rules to protect the resources. This is called *riti-thiti* (customary rules), what Gurung (1996: 88) terms as 'adaptive behavior'. Indeed, it is the social system that regulates the behaviors of the villagers to thrive in their harsh environments (Poudel 2016a). In my discussion with the herders of Unash village, it was reported that spring water was drying up at the high grazing land during the spring season due to low

and delayed snowfall in the winter. If the scarcity of water increased in the current ratio, the *thiti* system, a linking mechanism between the human and environmental systems (the phrase is used by Berkes and Folke 2000), will not be functional to regulate human behavior in the future in Nhāson. Climate change is therefore not only threatening the physical system, it is gradually posing challenges to the existing *thiti* which is a governing institution in the local context⁵.

In Nhāson, *thiti* works as a social institution with regard to the management of resource-use practice. It is a rule for the villagers. In the context of herding, it manages the grazing lands by controlling free movement of livestock intra-village and inter-villages. The days for the opening and closing the fallow lands for grazing to livestock are decided collectively by *Bau-samuba*. It is announced publicly a few days before the opening and closing days. The day for opening grazing lands to livestock is called *narcha-piba*. *Bau-samiti* gives an order to *Syarphu* (village messenger) to notify the villagers about the days for the opening and closing of the grazing lands or fallow lands. The breaking of the *thiti* is subject to punishment or fine. The amount of the fine varies for different livestock in different villages (Poudel 2016a).

In Nhāson, *thiti* system is interconnected and operated based on the seasonality of the natural calendar. The days for closing and opening of pasturelands for livestock are fixed in four villages - Nache, Unash, Thanchok and Ghyalanchok. The ongoing climate change is adversely affecting physical seasonality, i.e. the timing of

5 By the late 1980s, the *thiti* system was governed by the *Jimmawal* system which was paralysed after state intervention. Today, it was reorganised under *bau-samuba*. In each village, there is a *bau-samuba* and each household is a part of it.

rainfall and snowfall, growing season of grasses, and regeneration of water in the springs. In this context, how the *thiti* system will function and operate in future can be a challenge for the mountain region.

CONCLUSION

The anecdotal information and herders story reveal that locals are key witnesses to the changes in environmental phenomena of the local ecosystem. The local knowledge is grounded in activities such as herding, hunting, walking, sitting and living with the environment and resources over a long period of time. Such attachment with the environment and resources provide an in-depth, cumulative, relational and diachronic set of information for the given area (Sillitoe 1999; Riedlinger and Berkes 2001; Berkes 2008; Chhetri 2008) and provides an alternative set of principles for thinking about current events including climate change (Cruickshank 2005).

Livestock management is at risk in the context of climate change in the Trans-Himalayan regions of Nepal. Scarcity of water in the grazing land and decline of grasses in pasturelands have put additional pressure on new areas that can exacerbate and break the existing social systems and capital, increase conflict among users, and force them to abandon their traditional occupations. The loss of traditional occupation, for example herding, will not only affect livelihood but degrade and detriment the cultural system and capital of the region and ecological knowledge embedded with the local landscape.

In the context of climate change, social and ecological systems in the Trans-Himalayan region of Nepal are disturbed from its past realities. The linkage between the social and ecological systems is gradually

disrupted, thus affecting communities who did not partake in the process of creating such anomalies. Hence, it is against the will of the local inhabitants. Such external imposition is caused by climate change. Therefore, it catalyses future incidents related to conflict between human annual activities and current annual climatic calendar.

Additionally, Nepal's insufficient and incoherent scientific records to understand climate change and variability through time and space (Shrestha and Aryal 2011) makes it difficult for further research. The local indigenous narratives provide insights into the past climate variability, and fluctuation which make them extremely valuable to understand about the environmental change and act locally which can be abetted by ethnographic methodology for documenting the place and cultural specific evidences of climate change.

ACKNOWLEDGEMENT

I acknowledge people of Nhāson, professor Ram B. Chhetri, socio-ecological specialist Dr. Naresh N. Rimal for feedback and insights.

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