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# Abstract

The ethnic Loba people of Mustang are experiencing climate vulnerability in terms of adaptation in agropastoral livelihood. They have adjusted their agropastoral living with what nature has provided and are coping to the changing climate with customary adaptive measures which includes traditional system of landholding, collective labour and irrigation management, seasonal migration, spiritual connectivity and out-migration for the collective survival of the community amidst the threats of becoming a climate refugee. Anthropologically climate effects are not just about human capacity to adapt and exercise resilience it is furthermore about their altering sociocultural institutions to readjust and to muddle through with its implications. Such readjustment requires repositioning of intimate human-environment relationships that not only ground and substantiate indigenous worldviews, but also work to maintain and safeguard local landscapes and ethos.

Keywords: Climate refugee, Community-based, Hidden-hunger

## Introduction

As a phenomenon of climate change, global warming is the sturdy intensification in the average temperature of earth's atmosphere because of an amplified quantity of heat striking the earth from the sun which is being trapped in atmosphere. A two-degree raise in temperature threatens 25 percent of all plant and animal species on the planet with extinction (Rodenberg, 2009). Cook (2013) argues that while climate change is not solely destructive, the negative impacts of global warming on health and agriculture are greater than the benefits for the majority of the world. According to UNDP Report (2008) climate change cause the most harm to the most vulnerable populations or those who lack the ability to cope with and adapt to climate change because of a lack of access to essential resources. Dankelman (2011) has noted that marginalized inhabitants of remote regions like women, children, the elderly, and the impoverished have less access to and control over resources and therefore are more negatively impacted by climate change. Upadhyay (2015) argues that the variation in climatic parameters are attributed directly or indirectly

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to human activities which are increasing the hazard of deforestation, flooding, storms, desertification, soil erosion and the melting glaciers in the Himalayas. Barnett et al. (2005) state that with higher temperatures the runoff peak will shift to winter and early spring, away from summer and autumn when the demand is greatest. Dessler and Parson (2006) squabble that the impact of climate change is not consistent across the globe, and considerable differences can be perceived between different regions, places and communities but the potential risk of vulnerability to climate change is expected to be high in remote mountains.

In an elevation ranging from 1,372 to 8,167 meters and with several high peaks, Mustang District, bordered by Tibetan plateau, is one of the remotest, protected, isolated and sparsely populated districts of Nepal with an area of 3,573 km<sup>2</sup> and a population of 13,452 (CBS, 2012). With a population of 3843 in 1104 households (1.49 persons per km<sup>2</sup>), the population of Upper Mustang has decreased significantly at the decadal ratio of 1.40; similarly, number of households is decreasing by 1.14 decadal ratios (CBS, 2012). The study area Lomanthang is a rural municipality situated in Upper Mustang inhabited by indigenous Loba community with a total population of 569 – Male 276, Female 293 in total 172 households (CBS, 2012). The household size is 3.30 which are lower than the national average of 4.9 persons (CBS, 2012). The proportion of dependent population is relatively high: 18.6% of the total population is children and 9.7% are aged above 80 years. This population statistic has close relationship with migration rate (19%) from mountain region of Nepal (Suwal, 2014).

Loba people are the followers of Tibetan Buddhism, and are culturally and ethnically of Tibetan origin closely identified with their socio-economic, cultural, linguistic, geographical and historical context with Tibet--a unique example of Tibetan culture (Selter, 2007). The Loba livelihood is based on agropastoral system, seasonal migration, trade and controlled tourism. But the existing rangeland is not sufficient for livestock because majority of the area is barren and cold desert like. Overgrazing is the main factor causing deterioration of rangelands (Schaller and Gu 1994). Declining rainfall has resulted in decline in crop production, crop failure, and more insect attack. But vegetables like string beans, spinach, cauliflower, cabbages which grow at lower elevations with higher temperatures, were growing faster (Bhandari et al. 2015). The ever increasing scarcity of drinking and irrigation water, rising temperatures and desertification in mountains has forced a historically and culturally rich subsistence-agriculture and livestock dependent Lobas to migrate to new places for a better life (Shahi, 2013). Low and erratic rainfall pattern, shifting snowfall, decreasing humidity, and increasing air temperature has created water crisis, drying spring and declining soil moisture with a direct negative impact on plant and animals' growth depicting a direct link between the changes in climate parameters and its consequences on agriculture and livelihood (Prasain, 2018). Given this predicament, the key objective of this paper is to assess the climate vulnerability of Loba community of Upper Mustang in terms of their experiences and adaptation in agropastoral livelihood.

The sample of this study includes randomly selected 75 households of Loba farmers with a population of 256 (female 132 and male 124). One household head each from 75 households were selected for the study on the ground that as elderly they are the decision makers in household activities and have good understanding of climate change impacts and adaptation experiences. Survey method was used to collect information on the impact of climate change on crop production and adaptation strategies which supplemented the qualitative ethnographic information collected through observations, interviews and case studies on personal experiences, valuation and responses on climate change impact and adaptation in agriculture and livestock. For primary data collection, fieldwork was carried out from March 11 to April 9, 2019.

# **Climate Change Impact and Information Sources**

According to Department of Hydrology and Meteorology (DHM) Mustang Station, the minimum annual average temperature of Upper Mustang is increasing at a rate of 0.048°C per year. Summer temperature is increasing at a rate of 0.024°C per year. In contrast, winter temperature is escalating at a rate of 0.115°C per year. Autumn average temperature is increasing at a rate of 0.026°C per year. Spring average temperature is fairly increasing at a rate of 0.032°C per year. Broadly, the minimum temperature is escalating in all season. The maximum annual average temperature of Upper Mustang is moderately increasing at a rate of 0.0139°C per year. In contrast winter season's maximum temperature is increasing at a nanual rate of 0.139°C. Autumn seasons' maximum average temperature is increasing at a rate of 0.049°C per year. Average annual temperature of spring season is fairly escalating at a rate of 0.0673°C. In general, the maximum temperature is increasing in average in each season.

Escalation of temperature has created diverse problems on ecosystem and biological behaviors of flora and fauna in Lomanthang. Melting glaciers, fluctuations in weather patterns, increasing temperature frequency and intensity of extreme weather events has caused negativity on agriculture and livestock. Accordingly, it has caused more harm to most helpless population or those who lack the ability to cope with and adapt to climate change. Over the last many decades Lobas witnessed environmental changes such as warming, intensified natural disasters and declining precipitation patterns. These have been conflicting with their knowledge and seasonal agricultural schedule.

In addition to natural climate variability, mass deforestation for the construction of new houses and hotels resulted in serious ecological disturbance, accordingly climatic change and its impacts were experienced harshly that forced Lobas attuned to adaptation in agropastoral livelihood system. The situational trauma of climate change influenced the customary ways of living; livelihood efforts were being harder, perceived and experienced in daily life and there were few sources of information on climate change. About 32.5% information on climate change and its impacts were obtained by local people's own observation of variations in climatic phenomenon.

## **Agropastoral Adaptation and Food Sovereignty**

MacDonald (1998) affirms that mountain farming systems are often characterized by diversified practices, a feature which distinguishes them from the standardized and often highly specialized practice of modern agriculture. For the people living in mountains, diversification is a rational strategy for risk reduction (MacDonald 1998, Mishra et al. 2003). Many mountain farming systems are highly flexible in response to environmental as well as socio-economic changes (Bishop 1998, Mishra et al. 2003, Aase et al. 2010). Trans-Himalayan region Lomanthang has limited arable land as well as limited growing season characterized by high levels of risk and vulnerability associated with geographical process causing the lowest per unit of agricultural and livestock production. In a flexible community level unity of agropastoral production system, subsistence agriculture and livestock are the main bases of Loba economy and livelihood which are sturdily associated with factors like accessibility of irrigation water, seed/manure, soil nutrients, human labour and livestock, pasture land, land holding, fuel, food consumption pattern, migration, goods exchange system, services and resources distribution prototype. Recently traditional agropastoral system has incorporated some modern tools/technologies in order to cope with changing climate. Challenges like early ripening of crops, dryness, and scarcity of irrigation water is rampant. In the process of adaptation, they are cultivating several varieties of vegetables and fruits. The altering environment and agriculture system nexus can be comprehended via human ecological analysis that focuses not only on one aspect but on *holism* and all-inclusive way. Kassam (2001) asserts that such correlation can be observed at the relations between humans, and other animals, plants and their habitats.

Nyeleni (2007) state that food sovereignty is the right of people to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. Agriculture production, consumption, conservation and sustainable use of local varieties embedded in Loba food sovereignty affirms that those who produce, distribute, and consume food should control the mechanisms of food production and distribution encompassing the rights to healthy and culturally appropriate food. For Lobas there is a biological and cultural significance of food. It is a medium for social interaction; production, processing, preparation and consumption are *community-based*. Active participation of male and female, elderly people, children, relatives and neighbors is imperative during cultivation, harvesting, processing and consumption. The agriculture season begins with a ritual called Sakaluka in which women plough agriculture field in order to appease the Snake God and to get blessings for good weather and harvest. Sakaluka is a collective action with social, spiritual and material dimensions to prevent extreme weather events and to express collective solidarity of the community, bringing them together, reaffirming collectivism, promoting solidarity to cope and reconcile with natural phenomena.

Ingrained in local ecology Loba food sovereignty system anticipates providing healthy and culturally appropriate food to community in a harsh climate. In a high mountain ecosystem amidst changing climate, agriculture/livestock system has sustained in relation to local livelihood and food sovereignty. Womenfolk make use of the food primarily to fulfill family and livestock's nutritional needs which constitutes grain, meat, milk and butter containing large proportion of dietary requirement with a conviction that meat generates heat to cope with severe cold. Tsampa (barley flour) is used widely used as medicine with buttered tea and Chhurpi (dried cheese) for pregnant women, sick, old and children. But in the last few decades, Lobas are gradually losing their food sovereignty. Loba heritage and capacities to produce healthy, high-quality abundant food are being threatened and undermined by neo-liberal market capitalism. Previously, food autonomy had provided them the hope and power to preserve, recover and build on their food producing indigenous knowledge and capacity. But due to alternative income sources from tourism, now, Lobas buy food and drinks imported from Tibet and India. Due to emerging markets, Lobas have started consuming high quality imported rice that has threatened indigenously produced crops and consumption pattern. Previously Loba had the practice of bartering grain with Tibetan salt. But with the decline in grain production and the availability of imported salt in the market, Lobas lost their sovereignty over salt and grain trade in which livestock played a crucial role for carrying loads.

The traditional polyandry system facilitated and organized the family and had supported cultivation and familial barter business. Polyandrous marriage had been a tool for managing the inherited property, livestock and grazing land/forest that had assisted in keeping the paternal property indivisible, maintaining agricultural sustainability and hence keeping vibrant the concept of food sovereignty. But currently, polyandry is on the verge of extinction owing to which the whole sociocultural and economic fabric of the family life is altering. The forces eroding polyandry are modernization, increasing education, weak social bonds, alternative income sources from tourism, and the changing life style.

Aase *et al.* (2010) affirms that Trans-Himalayan farming system constitutes variables such as labour, cultivated fields, domesticated animals, forest and pastures. The Loba people are adapting and integrated in large scale processes such as agriculture and livestock rearing, trade, migration and tourism. Different varieties of crops like buckwheat, naked barley, mustard, potatoes etc have developed social, cultural, commercial, nutritional, and medicinal as well as adaptability to changing ecological system. Few years back there was a high priority to produce cereal crops but now Lobas have become more selective of crops. The value of crops differs according to household demand, changes in consumption pattern and livestock population.

Yak, sheep, goat, horse, mules are the part of pastoral livelihood used for nutritious food items as milk, yogurt, fat, butter, cheese and meat, manure, fuel and for carrying goods. Prior to the development of roadways and modern transportation, Lobas maintained a large number of horses as a means of transportation. But currently goods are

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transported by truck and tractors. Change in the pattern of transportation and travel has reduced the quantity of food items for livestock consumption. Previously pea and wheat were the major productions, but nowadays buckwheat and potato are the high valued crops meant for export. Pea and wheat were the popular crop items to feed livestock when the Lobas kept large number of horses, mules, and donkey. But currently pea and wheat consuming animals are diminishing which make a little demand of pea and it is not popular item. Further, the increase in temperature, changes in precipitation patterns, changes in weather events, and reductions in water availability have resulted in reduced agricultural productivity of pea and wheat.

Severely extreme weather events have interrupted food delivery and resulted in price hikes in food prices after extreme events which are expected to be more frequent in future. Brown *et al.* (2015) has stated that productivity depends upon the weather condition and insects attack. Productivity is also sensitive to frost and hailstone. These natural occurrences have challenged Loba peoples' indigenous knowledge on weather that has threatened their food sovereignty due to their marginal geo-climatic situation. Barley is valuable locally due to its high value consumption as *Tsampa* the local staple nutritional food item. Potatoes and Turnip are grown in a significant amount. Rice is not grown locally; imported rice is available in same price as wheat is in Lomanthang. The most overlooked crop in Lomanthang is wheat. Foremost reason is that those people who were buying wheat for daily consumption have shifted to rice which is easily available in market. Adopting the rice as a conspicuous food, young people overlook locally available food which is a course of action towards losing food sovereignty.

The local distribution system of food has changed due to the availability of new food items, changing food habits, changes in economic value of different varieties of grains and the livestock production system. With the arrival of foreign tourists, most food items are served to tourists but the productivity of crops is not high in relation to inputs due to poor soil, inadequate manure and water, low temperature and extreme weather events. More seeds are needed and harvest proportion is also low. The seed has to be very much concentrated while broadcasting, but due to extreme cold winters, seed germination is extremely low. Seeds are also destroyed by birds, rats and insects. Organic pesticide was the first preference of Lobas but climate change generated effects and appearance of new pests on crops and decline in routine crops has forced the farmers to use inorganic pesticides in crops and vegetables. Rise in summer temperature has obligated the Lobas to follow yearly crop rotation to improve soil fertility and to avoid insect. Their responses to climate variability consisted of iterative sequence of improvised strategic adjustments. Based on their expectations of what the climate might be, Loba farmers proceed to carry out agricultural practices based on a well-established crop rotation pattern called Kar-Nak. If wheat or naked barley is grown in Kar (the previous year), Nak crops peas, mustard, or buckwheat is cultivated the next year. Fallow land can be seen all over the place in the lack of irrigation water.

Previously Lobas were not much cautious about grass collection since they had enough winter grazing access for their livestock in Tibet. But, this has halted nowadays due to Chinese government policy to restrict the entry of Loba people's livestock in Tibet. Similarly, owing to decline in food production, food supply to Tibet has stopped. Previously crops and livestock were much valued because they were used for trade in Tibet. But nowadays, the worth of local crops has changed because of the construction of new roads that has made easy access of imported goods. Nevertheless, Lobas have continued practicing agro-pastoralism as their traditional occupational identity, holding land as their ancestral property and gender participation for mobilizing the agropastoral system of subsistence amidst the changing climate. Both women and men are affected by and vulnerable to climate change and global warming, but women often bear more of the burden (UNDP, 2010). Amid patriarchic norms, gender participation in agriculture and livestock rearing is imperative for the Lobas. With heavy work burden, women have higher social status in community, domestic and public spheres.

Beforehand, Lobas lacked the habit of consuming green leafy vegetables. But now in the process of climatic adaptation, varieties of green vegetables are cultivated and consumed. Until few years back asparagus was grown at the altitude of 2200 meters but now it is grown at an altitude of 3750 meters. Now Lobas have started growing courgette, cauliflower, cabbage, carrots, coriander, string bean, bean, turnip as the main vegetable items. Until 2009 courgette could be grown only inside the greenhouse, but nowadays it is grown outside the greenhouse. Cucumber, chili, tomatoes, bitter gourd is grown inside greenhouse. The varieties of crops which were grown during winter are now cultivated during summer season which is due to climate change adaptation. Until few years ago, it took two years to grow big-sized onion but nowadays within a year it grows outside the greenhouse. Previously apples were not grown, but nowadays high quality apples are grown in orchards. Growing reliance on chemical fertilizers has facilitated the growth of apples. Apricot, peach, plum, pear, walnut, grapes are grown, widely consumed locally and sold to tourist resorts during tourist season. Less rainfall resulted in less crop production, crop failure, and more insects attack but had less effect on fruit farming.

The Loba cultural tradition of *Lakti-Chikula* a customary form of labour group rotation is under threat owing to the scarcity of human-resource during the harvest time. Under this customary system of labour exchange, labourers are used in the field to plough, collecting manure, to make canals etc. Seed broadcasting is done by well experienced person of *Lakti-Chikula* group organized in a group and they work in each and every individual household who have participated in the group. This group goes turn by turn to each household based on the arrangement of time. But nowadays, due to the acute shortage of labourers, the Lobas are hiring wage labourers from other districts of Nepal during the harvest season. Since the fast rate of Lobas out-migration amidst the intimidation of becoming a climate refugee, the wage of hired labourer is rising fast which costs more expensive for the farmers to cultivate crops. It is cheaper to buy crops from nearby shop rather than paying wages to farm labourers. This tendency is challenging the agropastoral practices of Lobas.

## Water Resource Management

Chaulane (2009) argues that irrigation water management is complex because of its attributes, such as the nature of public goods and the lack of properly defined rights for its use. The collective maintenance of irrigation system in Lomanthang is the continuity of customary norms of adaptation system for water management. But currently due to the scarcity of water, extreme weather events, melting glacier and pollution, the availability of irrigation/drinking water has become problematic. Lobas have a customary system to distribute water at the head-end and tail-end. The Lobas have developed village head system which is to mobilize obligatory labour support from the people who owns land and use water for irrigation and household. Village head take the responsibilities of clans, lineage and kin groups. Labour contribution for irrigation canal maintenance is fixed proportionately on the basis of land holding. Such determination is done on the basis of seed required for cultivable land. If there are households who own less or abundant land they are required to contribute proportionally in the maintenance of irrigation canal. Those houses who even do not own land have to contribute single day labour as they drink water. This indigenously managed irrigation system is the manifestation of local kinship, village headmanship, institution of polyandry, property inheritance system, access to land and agro-pastoral system that give nativity to age old indigenously managed irrigation system ultimately manufactured and protected by wider social structure.

Diminishing polyandry and fragmentation of paternal landholdings has affected the traditional water management practices. Currently as river beds have become deeper through erosion due to frequent Glacial Lake Outburst Flood (GLOF) hence Lobas could not build/repair canals with their technology to bring water up the level to irrigate the field. Irrigation along with agriculture has been affected not only by global warming and extreme weather events, but also by changing sociocultural institutions as polyandry, transformation effects, migration, tourism, Chinese and Nepali governments' policy, road construction and transportation facilities.

## Seasonal Migration and Resource Mobilization in a Changing Climate

Seasonal migration during extreme freezing cold season is an apparatus which is due to high altitude, snow fall and severe cold during winter season. Seasonal migration has helped Loba people to mobilize resources other than their cultivated field. Seasonal migration is imperative from religious, economic, and social point of view and has huge impact on agropastoral production and food consumption. Lobas migrate during winter after the end of harvest season. They trade local craft items, herbal medicines in cities of Nepal and India, visit relatives, pay pilgrimage to religious sites, treat sick family members and relatives. Since livestock is a significant link in the agropastoral farming system, during the seasonal migration, livestock is stall-fed (with leaves, grass and crop wastes) by few left-over elderly people at home.

Owing to the absence of family members at home, they save food at home and earn cash by trading goods and services and they buy items such as food, drinks, and clothes. Seasonal migration during winter season is the local strategy to cope with hardship with cold, food and other necessary items. The seasonal migration has implications on traditional joint family structure and polyandry. But the alterations in traditional polyandry marriage and family relationship have caused severe consequences on resources mobilization in agriculture, livestock, and human labour. Owing to the vigor of environmental stressors, Lobas seasonal migration is the needs of livelihood-distressed households. From anthropological perspective, in a warming world amidst altering sociocultural institutions, such migration may alter or fade away completely in the long run.

## Conclusion

Even though having contributed the least to greenhouse gas emissions, Lobas are the one most at risk from its consequences due to their close relationship with the fragile ecosystem. Climate change ramifications embedded with altering sociocultural institutions has brought different kinds of risks and prospects, threatened the agropastoral livelihood system, cultural and economic survival, and indigenous knowledge in relation to local habitat and food sovereignty. This connotes that climate change is not something that has come in isolation but amplification of the existing problems of geographical marginalization and the emerging trend of modernization. The adaptation strategies are alternatives such as seasonal migration, value focused agricultural production, seasonal and permanent migration and involvement in tourism.

Climate change is more about human-environment and nurture-nature relations. Managing climate-related risks to agropastoral livelihood requires new information, skills and technologies such as seasonal forecasts, risk analysis and water saving agricultural practices. With supports from related organizations, adaptation can be utilized as good opportunities to avert *climate refugee* predicament and the threat of *hidden-hunger* which is lowering Lobas essential nutrient contents. There is a need of impact identification and to understand changes that have occurred due to changing climate, adapt to them, and make the most of the new-fangled opportunities, while addressing upstream-downstream issues. From anthropological perspective, the effects of climate change are not just about local populations' capacity to adapt and exercise their resilience in the face of exceptional change, it is also about their changing sociocultural institutions to readjust to change and to muddle through with its implications. Such readjustment, necessitate a repositioning of intimate human- environment relationships that not only ground and substantiate indigenous worldviews, but also work to maintain and preserve local landscapes and culture. Adaptation is management smart dexterity hence climate adaptation necessitates adaptive progression to effectively manage biodiversity under climate change by expanding adaptive capacity as close to its theoretical, fundamental and practical limits as possible. There is the need for policy interventions at the community level. Community knowledge and participation are keys to make certain the success of such measures.

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