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REVIEW ARTICLE

Local Perception and Adoption to climate Change: A review of Agricultural perspective

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Abstract: The main objectives of the research is to understand the perception of the local people on climate change and examine the impact of such change on agriculture and livestock management practices among the people. Moreover the research also attempted to analyze the present adaptive strategies of the local people which ultimately increase their adaptive capacity and resilience in the face of change. The framework of cognitive anthropology and human ecology helped to compare and analyze the difference in the perception about change in climatic variables and climate related risk and disasters, their impact on agriculture and livestock management practices and present coping and adaptive strategies followed by the people in their respective surroundings. Furthermore, the study also used the sustainable livelihood framework to assess the climate change impacts on agriculture and livestock systems of the studied communities. It attempts to understand the perception of the people on climate change through the change in the climate related parameters such as precipitation, temperature, and mist and dews and climate related extremes and disasters such as the long drought, heavy rainfall, landslide and soil erosion, windstorms and hailstorms.
Keywords: Perception, Local People, Climate change, Agriculture and livestock, Communities.

INTRODUCTION

'Climate change is defined as a statistically significant modification in either the mean state of climate or variability that lasts for an extended period of time, generally a decade or more. Climate change can be caused by natural internal processes, external forces, or persistent human changes in the composition of the atmosphere' (Twecan et al., 2022). According to the Intergovernmental Panel on Climate Change (IPCC, 2021), climate change is "any change in climate over time caused by natural variability or as a result of human activity." The term "climate change" is now commonly used to refer to the change in our climate that has been observed since the early mid-nineteenth century. Greenhouse effect is a natural phenomenon existing in the earth only. Natural greenhouse system becomes a boon to the inhabitants of the earth because by this effect the earth atmosphere traps heat energy from the Sun just like a greenhouse, and supports life on the earth. Without this heat trapping system, the earth temperature would be about 15^0C less than the present one (Aftab et al., 2021). But now this system is heavily disturbed causing serious alterations in the climatic condition which ultimately have a multi-faced impact on the environmental and human system.

The discourse of climate change is widely being discussed throughout the different disciplines around the world. In the initial time, climate change was only taken as a global environmental problem. But due to its multi-faced impacts, the United Nation Security Council in 2007 held its first debate on the implication of climate change for international security. The United Nation also estimated that all but one of its emergency appeals for humanitarian aid that year were climate related (Forum, 2022). This signifies climate change becoming a social, cultural, economic and environmental trend, problems, issue, tension and challenge (UN, 2022). Likewise, the response of the European Union in this issue. Meanwhile, the issue of climate change was increasingly raised in every national and international talks and negotiations (Pandit & Bevilacqua, 2011). Therefore, climate change is no longer viewed as an environmental issue only, but it is taken as one of the social, cultural and humanitarian issues. From the social science perspective, the dominant factors shaping climate change are societal in nature, and are equally important aspects of the understanding (Aivazidou & Tsolakis, 2021; B. Paudel et al., 2014; G. S. Paudel & Thapa, 2004). Climate change-related hazards such as excessive rainfall, extended drought spells, landslides, and floods are rising in both severity and frequency. Such disasters immediately endanger people's livelihoods, particularly those who rely totally on nature and live in a fragile ecosystem. 'The cultural implication [of climate change] might be the confusion, alienation, and loss of life's meaning that occurs when people are separated from their environment.'

Natural and human systems of different regions respond to the change in climate differently according to the geography, social structure and economy of the region (Tosun & Howlett, 2021). We can expect this difference in response at regional, national, community and even at individual level. People perceive their environment through culture, and their cognition determines what constitutes dangerous climate change, and flexibility will specify limits to the adaptation beyond which community responses are no longer able to maintain acceptable goals. The experiences and observation of individuals throughout their life along with the socio-cultural and environmental condition is responsible for framing the perception about climate change. Moreover the local people are not only keen observers of the impending climate change; rather they have unique flexible adaptive strategies on the basis of their indigenous and traditional knowledge infiltrated from generations to cope with changing climate (Paudyal et al., 2018; Rai et al., 2018; Trotter et al., 2022).

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Keeping this in mind, here two study sites at Chitwan district was selected on the basis of different ecological and socio- cultural settings. Therefore the perception of the people on climate change may be different due to the variation in the ecological and socio-cultural setting (Rawal et al., 2021).

Nepal has already suffered from the hazards associated with the increasing global temperature (6th risk country in the world) for example, glacial retreats, Glacial Outburst Flood (GLOF), long drought, erratic heavy rainfalls, landslide, flood, declining groundwater, outbreaks of different vector born disease, which are triggering serious environmental and societal disruptions in spite of its least contributions to greenhouse gas emission (0.025% of global emission). Here the changes in climatic conditions along with the other factors may have affected the livelihood assets of the local people. So it is important to understand how much the changing climatic condition impacted on these assets especially in agriculture and livestock farming, a major way of making a living for the people of both the sites (Sharma et al., 2021). Furthermore, the community at different locations are affected differently through the hazards associated with the changing climate hence the society may develop specific coping and adaptive strategies in the face of change (Twecan et al., 2022).

2. METHODS

This study basically focused on the local perception, impacts and coping and adaptive strategies followed by the communities to climate change in the two VDCs of Chitwan district. This section concerns the rationale of selecting study sites, unit of study and technique of selecting respondents, data and data collection techniques and data analysis.

2.1 STUDY AREA

This study was conducted in socio-culturally and ecologically different two communities of Chitwan district. So this chapter deals with the geography and people of the study sites. It begins with the general information of Chitwan district which is followed by the information about Kaule VDC, Hattibang village, Gitanagar VDC and Kesharbag Village. Personal information of the respondents is placed at the end of particular Village information followed by the photos of respective study sites. Chitwan district (83^0 55″ - 85^0 10″ East Longitude and 27^0 46″ North Latitude) is located in the Inner Terai of central Nepal about 146 kilometers southwest of Katmandu. The district covers an area of 2,218 square kilometers. The district demonstrates good altitudinal variation having highest point at 1946 meter and lowest point at about 150 meter from the mean sea level. Therefore, a variety of climates is available including tropical, subtropical and moist temperate types. The district has two hill ranges – The Mahabharat hill (2000m) and the Chure hills (900m) which has a wide tract of flat land, called Dun valleys (Inner Terai). This valley has occupied about three fourth of the District and has average elevation 244 m above the mean Sea level. The annual rainfall is 1900 mm, which is quite higher than the national average which is 1800mm. The average maximum temperature ranges between 28^0 C and 32^0 C and the minimum temperature between 15^0 C and 20^0 C.

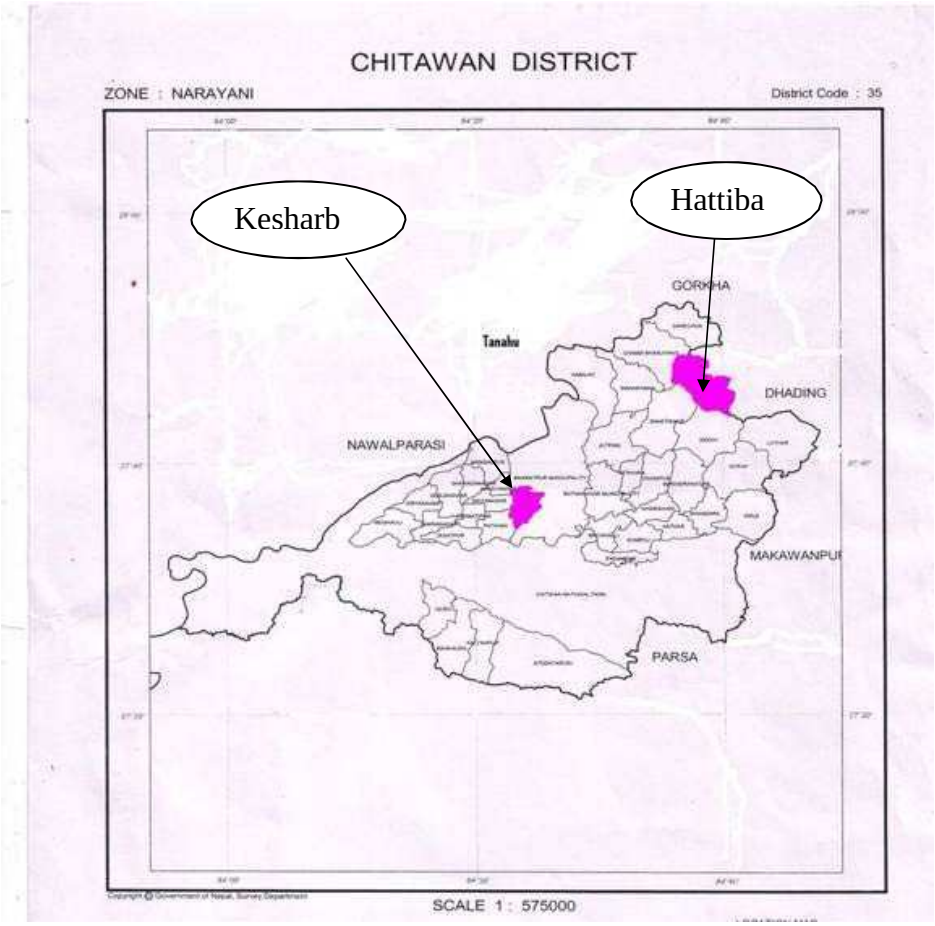

Figure 1. Map showing the study sites

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2.2 RATIONALE OF SELECTING STUDY SITES

One of the most critical issues of the fieldwork is the selection of the study area. The effect of changing climate is experienced almost all over the country with different rates. However, natural and human system in different region may respond differently according to the geography, social structure and economy of the region. This can expect at the community and even at the individual level. Taking consideration to this, the researcher selected two VDCs of Chitwan for this research purpose. Even within the short distance it was possible to explore two different ecological and social setting in the research sites having individually separate settings. One of the communities lies in the hilly region while the other lies in Tarai region. Moreover, the study sites have primarily depended on the agriculture and livestock for the subsistence. So, it would be easier for the researcher to compare the differences in the perception, impact and adaptive measures followed by the communities in response to the ongoing climatic change.

2.3 UNIT OF THE STUDY AND PROCESS OF RESPONDENT SELECTION

The two communities selected for the purpose study are the broader unit of the study. Due to the nature of my study, the researcher chose the elder member of the community purposely (Thompson et al., 2020). This research focuses on how local people see the changes in climate through different climatic parameters and climate related risk and disaster near their vicinity in order to find out the local people's perception on climate change and how this variation affects the entire agriculture and livestock system of the community. Finally the researcher paid attention to how local people cope with such unprecedented change through various adaptive strategies. So the researcher paid special attention in selecting the respondents of the study area (Subedi et al., 2022). For this the researcher selected the elder members of the community, assuming that they are the witness of the ongoing change and have gained valuable information and experience about the changing pattern of the climatic regime of their locality during their lifespan.

2.4 PRIMARY DATA AND SECONDARY DATA COLLECTION

The field work for this research was carried out first in December, 2018 at Kesharbag and in March 2019 at Hattibang. During the last week of March, the researcher had again visited Kesharbag to get some additional information that felt necessary after starting writing this paper. It was in regular contact with the local people through telephone also. In the field, the researcher conducted ethnographic interviews with 37 local people (21 at Kesharbag, Gitanagar and 16 at Hattibang Kaule) at both study areas. Respondent comprises mainly agriculture and livestock farmers along with ex-army men, and teachers. People were asked about change in their social and natural environment during the last 30- 40 years. Subsequently they were asked about what, in their view, explained the changing situation. If they mentioned climate as one of the variables, they were then questioned about the ways in which they perceive change in climatic parameters (temperature, precipitation, mist and dews). During the course of the interview with the local people, primarily taken the reference of some climatic indicator like temperature, precipitation, mist and dew and some climatic risk and disaster like drought, landslide, hailstorms and windstorms, which were happening during their lifetime providing important generalization about the changing situation of climatic regime. One of the goals was to elicit, in an open-ended manner, information related to how people perceive local change in climatic conditions. The researcher focused on the relatively clear and shared perceptions of climate and associated risks and the subsequent response to the impact of the ongoing change to the social wellbeing (agriculture and livestock) of the people, which was also the other goal of this study. Finally, after knowing the perception and impact, that focused my attention on how people respond to such change through various coping and adaptive strategies. Observation is a major technique of data collection in anthropology. Mainly, observed the techniques and practices of crop and livestock farming in the respective sites. Furthermore, also carefully observed the impact of climatic extremes such as the disease on plants, effect of drought and hailstorm on maize plantation fields. In addition, they also observed the present coping and adaptive alternatives of the people, for example, the weaving of bamboo baskets in Hattibang and wheat fields and the shallow deep tube well in Kesharbag.

Relevant books and journals, magazine, articles, website, internet research/seminars papers, thesis, reports, government policy and act have been collected and studied. Some have been accessed through the internet while others have been collected from the relevant libraries. The socio-demographic information regarding study sites were collected from Central Bureau of Statistics (CBS) records. Moreover**,** researchers visited the official webpage of Chitwan district for geographic and social data.

2.5 DATA ANALYSIS

The data obtained from the field was further categorized for easy data analysis and interpretation (Rudge, 2021) and simple statistics like sum, average and graphs were used for descriptive analysis using MS Excel. Moreover, the researcher developed various themes from the interviews that have been taken with different individuals and analyzed accordingly. The research has adopted a cultural model approach to analyze the knowledge, beliefs and attitude of different individuals towards change in climatic parameters and climate related risk and disasters. The opinions and experiences of people are quoted in their own words. The real name of the respondent was listed here after taking their permission.

3. RESULTS

3.1 PERCEPTION ON CLIMATE CHANGE AND CLIMATIC PARAMETERS

The main objective of the research was to understand the perception of the local people on climate change. So this chapter is basically concerned with the perception of the people (Mahmood et al., 2021). In this research perception of climate change is divided into major sections. At first the perception of the elder members of the respective communities on the change in the major climatic parameter was noted and tally available meteorological data of the nearest meteorological station (Chimi et al., 2022). In the second section the perception about climate related risk and disasters on the basis of risk ranking was presented which was important to understand how local people frame their perception on changing climate change on the basis of their lifelong experiences. People think that climate has an indispensable role in the entire livelihood system of the community (Wale et al., 2022). When asked about the change in climate, respondents most often began their response by describing the changed pattern in the local climatic condition particularly with respect to the change in precipitation, temperature and mist and dew pattern during their lifetimes as well as the impact due climatic related risk and disaster. Recollection of memorable events, like the largest disaster and event during the entire course of the time, was the most common method individuals used to discuss the change in the climatic variable. These salient events were almost always recalled and described in conjunction with other meaningful activities and occurrences, typically journeys undertaken, family affairs, and individual life history.

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3.2 PRECIPITATION

From the interviews with the respondents it has been generalized that the rainfall has decreased in amount and it has also displaced in time. People compare the frequencies and amount of the rainfall they have noticed during the course of their lifetime. One of the respondent of 90 years, a local resident of Kesharbag, shares his experience as follows:

"I came here from Myagdi district and have been continuously living here since 2076 B.S. Enough rainfall (in winter/summer) used to be prevailing in this place. Since 10 years' time, the winter rainfall is almost rare whereas the summer monsoon is also uncertain and is decreasing. During my whole life span, I never experienced such a drought as in 2018. During winter we did not receive enough rain and even the monsoon started late so we faced problems in cropping. Our winter crops almost fail, which is the only means for us to earn cash. In addition, due to the late monsoon, the production of rice was reduced to half in amount. Moreover we also faced a similar situation in the year 1969, 1991 and 2016 A.D. and that year many water wells were dried along with the failure of pre-monsoon and monsoon crops."

In this context, another respondent of 83 years old, a local resident of Hattibang has never heard about climate change or global warming but he knows something has been going wrong with the rainfall that everyone in the Chitwan hill depends on.

"We either get too much or too little rain these days," he says. "It rains when we want dryness and it's dry when we want rain. If our crops do not grow, we do not have food, so that means we die. Moreover sources of drinking water were going to vanish, forcing our life in deep thrust."

His reasoning underlines the seriousness of the situation facing all smallholders and marginalized people of the hill region. About 67% of the informants (*n*=37) felt that the amount of rainfall per month had decreased and 24% of them felt that the amount and time of the rainfall had changed.

3.3 TEMPERATURE

Like changes in the rainfall pattern, people of the study area, the elder people in particular, mentioned that they have noticed a significant change in the temperature regime of their area. Among the two field sites, Hattibang and Kesharbag lie at the altitude of 1400m and 220m respectively from the sea level so there is wide variation in temperature regime. Respondents from both sides claimed that the place is getting warmer in comparison to the past days. According to them, the days and nights in the winter seasons used to be very chilled in the past. But during recent years, they are experiencing less chilled winter days and nights. Similarly during the summer season, the days are becoming hotter. One of the interesting cases happened while a researcher was interviewing a respondent, the ex-chairperson of Kaule VDC. He was arguing that there is no significant variation in the temperature. His wife, working in the courtyard explains her observation about the temperature in contrast to him like this;

"This place used to be so cold that we could not avoid quilts (Sirak) at night throughout the year. We used to go to the nearby forest (Ban) in order to gather fodder and firewood. The winter mornings were so chilled that working outside the house before sunrise was quite difficult. But now, we quit blankets during summer night (Garmi masa). In the daytime of summer we feel more heat even staying inside the house. Similarly, winters are not cold as before. We did not experience the presence of mosquitoes here; it's been only 5/6 years that they are now playing around."

From the above mentioned story it has been clear that local people perceive their change in their environment through what they observe and experience while inhabiting the particular place during the entire course of the time. In this context Sertse et al., (2021) argues that the perception of local people about their environment—experienced through inhabiting particular places—are bound in a mutually constitutive relationship through the simultaneous inscription of a set of meanings in the bodies of the inhabitants and the places they inhabit. The process of perception is also a process of action: we perceive the world as, and because we act in it. In Kesharbag, Sanumaya Khati, 55, shared a similar experience about the changing climate.

"Generally, in the past the winter season lasted with the start of March (2nd week of the falgun), but now days become hotter after the second week of February the (end of the Magh). It creates difficulty in working in the field during the harvesting of Mustard and other winter crops. So since past 10-12 years, we change our working time, we prefer to work in the morning and evening instead of the daytime which we used do in past"

From the above two illustrations it has been clear that people have their own way of understanding about the phenomena happening in their surroundings. They frame their understanding in relation to the activities they have performed during the course of their existence. The local observation on the temperature is also supported by the average minimum temperature records of the Department of Hydrology and Meteorology, Rampur station. The available data showed a clear increase in mean minimum temperature for the months January (the coldest month of the year), March (the transitional month between winter and summer), and October (the starting month of winter). If we compare the mean minimum temperature of above -mentioned months of the year 1970 and 2019, we can see an increase of 2.2^{0}C (in January), 1.6^{0}C (in March), and 1.5^{0}C (in October). This data supports the local perception of being less chilled mornings and nights of those months. From the presented data we can generalize that there is an increase in mean minimum temperature of winter months.

3.4 MIST AND DEWS

Like temperature and precipitation, mist has its own role in the climate of any area. While conducting the interviews with the local people of the study area, it became clear that the mist and dew pattern in both of the study area has changed in comparisons to the past (Kenawy & Elkadi, 2021). In Kesharbag, local people consider mist and dew to be crucial for the maintenance of proper levels of soil moisture and humidity in the winter season – essential for the better yielding of the winter crops. They showed their concern about the uncertainty in mist instances. About 52% of respondents felt that the pattern of mist and dew are fluctuating, at the meantime around 42% do not see any significant decrease in most instances. One of the respondent, 93years old, resident of the Kesharbag Chitwan shares his experience about the mist pattern of this place in this manner:

"During December and January, dense mist used to prevail till 12 of the noon; it settled down in the form of the dew then after the days remained sunny. For 10 years, the thick and dense mist that used to recharge soil moisture no longer occurs…insufficient moisture prevents the proper growth and the production of winter crops especially the mustard (Tori). Moreover, the uncertain day-long mist with low humidity, continuing 3-4 days causes various fungal diseases to potatoes and mustard (lie) for 10-12 years. So, the use of the pesticide is increasing these days, which makes winter cropping difficult and costly."

Agreeing with another respondent, a 38 years old beekeeper of the same place argues,*"Although the density and frequency of the misty days had been reduced, the mist with low moisture prevailed all over the day, preventing honeybees going for the nectar collection which lowers the production of honey and ultimately reduces the production of mustard causing problem in the pollination of the flowers."*

The response of people about mist in the Hattibang is somehow different from the people of the Kesharbag. Around 50% of respondents noticed that the pattern of mist was stationary; whereas 25% perceived a slight decrease in mist occurrence. Difference in people's perception among these two research

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sites may be because of the geographical location of the place or due to the lesser impact of the phenomenon to the entire socio-cultural and environmental system.

3.5 PERCEPTION ON CLIMATIC RISK AND DISASTER

The global and national data clearly indicates an increase in frequency of natural disasters for the last few decades. Socioeconomic and environmental losses caused by these natural disasters are increasing (Graveline & Grémont, 2021). Different analyses revealed that weather/climate (hydro-meteorological) induced disasters are the principal contributors to the present increasing trend of natural disasters. Showing conformity to this global trend in the last two decades, Nepal has experienced an increase in the frequency and the severity of weather related disasters, particularly heavy rains resulting in floods and riverbank erosion in the Terai, and landslide, soil erosion and debris flow in the mountainous area. Hailstorm, windstorm and long drought are other weather related disasters significantly interfering with the natural and human system. Such an increase in weather/climate related disasters might be correlated with change in climatic system and human activities.

Local people classify and understand the climate related disaster according to the hazards that affect the existing human environmental relationship and as well to the socio- cultural environment. Since risk is a culturally defined notion. Therefore the perception about the risk is determined through how it hit the existing system (Takakura et al., 2021).

During the research period local people of both study sites categorized the risk according to the impact affecting them. When respondents were asked to classify the hazards in terms of the severity and risk they are experiencing, in Kesharbag majority of respondents considered drought as one of the most significantly affecting hazards, whereas landslide was recognized in Hattibang. This indicates that these disasters are the most significant and trouble creating hazards of the respective community. But in the case of Kesharbag, the landslide was not considered as a risk to the local livelihood. This indicates that different geographical regions have different climate induced hazards and the people's perceptions also vary accordingly. Though to some extent geography and place of residence determines the type and intensity of risk, how people perceive it also plays a significant role in classifying hazard. In Hattibang 12 out of 16 perceive hail storms as the major threats for them which destroy their orange and pear garden whereas those who don't have the pear and orange garden were less affected by the same risk.

TABLE: 1 RESPONDENTS CLASSIFICATION OF THE CLIMATE RELATED RISK

Categories of climatic risk and disaster	Kesharbag (No. of respondent)			Hattibang (No. of respondent)		
	Rank I	Rank II	Rank III	Rank I	Rank II	Rank III
Drought	11	6	4	10	5	1
Landslide/Soil Erosion	N/A	N/A	N/A	14	2	0
Heavy Rain	5	7	4	9	4	1
Hailstorm	2	4	9	12	2	2
Windstorm	3	8	5	12	3	1
Forest Fire	N/A	2	5	8	4	2

(Field Survey: 2018/2019)

During the field study the respondents expressed their grave concern over the increasing frequency of the natural disasters in the village. The majority of them responded that the frequency of natural disasters is increasing. According to the elders members of the community not only has the frequency of these disasters has increased but associated risk and loss have also increased significantly. In Kesharbag, 57% of total respondents think that there is an increasing trend of occurrence of natural disasters, while 23% disagreed on this. Similarly, in Hattibang, 68% respondents agreed and 12% did not support the idea.

The natural disaster caused significant damage to the socio-economic and environmental assets of the community. Nearly half of the interviewed respondents have mentioned that the loss of the agriculture land and crops are the major impacts. Other repercussions include economic and social loss in terms of properties, human social – cultural life and animals.

For the rural peoples, agriculture and livestock farming are the major livelihood options. Landslide, soil erosion, erratic rainfall and prolonged drought days are threatening the agricultural systems. On the one hand peoples do not have sufficient landholdings and on the other hand they are out of the new technological advancement for the betterment of farming as well as to minimize the impact of changing environment. Moreover, prevalence of adverse conditions during planting, growing and harvesting of agricultural products practiced on available landholding is reducing crop productivity. These all have a cumulative negative impact on their livelihood (Dendir & Simane, 2021). As a result of disrupted income sources, losing of lands, properties, animals and even family members, people are migrating to new places searching for better options. Some have chosen to go abroad in search of high income jobs. This is – in my view – a strategy to cope against the present changing environment. Therefore the climatic risk and disaster like drought, landslide, soil erosion, hailstorm and windstorms that were happening during the course of an individual's lifetime provides the important generalization about the changing situation of climatic regime and perception of the people and the impact of such unprecedented changes (Ali et al., 2021). In addition, it helps to elicit the information on how people observe these phenomena and ultimately help to trace the people's perception on the ongoing climatic events.

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3.6 IMPACTS ON AGRICULTURE AND LIVESTOCK

The agricultural system is highly dependent on the climatic factors (such as rainfall, temperature, humidity, radiation and so on), intrinsic factors (such as soil texture, soil nutrients, and soil moisture) and living organisms (such as the soil microorganism, pest and animals). Besides these many extrinsic factors such as fertilizers, human labor, pesticides, market, road, and irrigation facilities also play vital roles. So any change in the agricultural system is the sum total of change in all these factors. Present study is mainly focused on the impact of different climate induced factors in the community and based on local people's perception and researcher's field observations. More than 90% of the population of both of the research sites directly or indirectly depends on agriculture for livelihood subsistence. They follow traditional cultivation practices that rely on seasonal rainfall. So, any change in climatic factors causes adverse impacts on people's livelihood, thus increasing risk to food insecurity. Thus climate change has a direct impact on the economic well-being of the community. According to the people of Kesharbag, the unprecedented rainfall pattern (in timing and frequency) severely affected and caused shifts in the agricultural calendar. Moreover, the increasing temperature and long drought caused reduction in the soil moisture and increased desiccation; causing problems in germination and survival rates after planting crops. Respondents have observed the significant decline in production of the crops over the past 15 years or more. The principal matter of concern is that the seasonal calendar of both research sites has been changed due to the change in the climatic parameters and increased frequency of disasters. Different types of diseases and the pest outbreaks and fungal diseases to the potato and mustard plant are the main problems faced by the people these days. Although the use of the chemical fertilizer and pesticide is increasing day by day, the production of all crops is decreasing.

TABLE: 2. PEOPLES OBSERVATION OF THE IMPACTS ON AGRICULTURE

Impacts	**Peoples Observation by Area**	
	Kesharbag	**Hattibang**
Loss of local variety of crop	Maize (*Local Pahalo*) Wheat, Rice (*Manshara ,Dudhraj, Asnhame Masino, Aapjhutte*)	Maize*(Local Seto*) Wheat,Millet (*Dalle Kodo*) cucumber
Loss of production of key crops	Maize, Rice and Mustard	Maize and Pepper
Change in cropping pattern due to climate related extremes	Change in cropping calendar (maize and rice plantation) Difficult to grow local crop variety,	Change in cropping calendar (shift in the plantation and harvest of maize because of reduced in number of days to mature)
Paste and disease	Increasing *Gabaro* disease in Maize), Aphid(*Lie*) in Mustard and Rice (*Rate, Seto Putali)*	Increasing more to wheat (*Kalo Poke*) and Maize
Input of production	Costly due to use of pesticides and chemical fertilizer	Started using pesticide since a couple of years back
Emergence crops of new	Wide use of genetically modified crops especially more on rice and maize	Relatively lower use of genetically modified crops. But start of cropping new cash crops like Beans(*Ghyau seemi*, hybrid cucumber, new varieties of maize etc.
Fruits and Vegetables	N/A	Started cropping cauliflower, new varieties of pepper as local seemed really vulnerable to present conditions.

(Field Survey, 2018/2019)

Similarly, in Hattibang people believe that the agricultural system is subject to various changes in comparison to the past. People observed that some varieties of local crops, especially maize (*local Seto*) and millet (*dale kodo*) are about to vanish from the area. The productivity of major crops is declining every year. Several new disease and pest problems are being reported these days. Moreover, production of fruits (orange and pear) is decreasing both qualitatively and quantitatively. Erratic hailstorm and strong windstorms during the time of flowering and fruiting of these fruits are the major climate induced hazards reducing the net yield hence threatening local economy. In addition, various diseases to the orange plant affect plant health causing immature ripping of the fruits and even dying out plants.

3.7 IMPACT ON LIVESTOCK

Livestock is an integral component of the farming system in Nepal. It plays a pivotal role in the process of the intensification of Nepalese agriculture (Sharma et al., 2021). In the hills and mountains it is one of the important adaptive responses of the people to their environment which is generally known as the *mountain specification* of their livelihoods. Moreover, livestock production is integrated with the production of the staple crops like paddy, maize millet, wheat and pulses as well as fruit and vegetables (Subedi et al., 2022). Livestock recycles the nutrients on the farm, supplying drought power, manure, milk and meat, while crops supply food and fodder. The most common livestock species found in mixed crop farming are cattle, buffalo, and goats. Nearly half of the animal feed comes from the crop residues (Tulachan 2001). Livestock contribute close to 50 % of the household cash income in mountains, 36% in hills, and 20% in the plain (ibid 2001). Availability of fodder, grazing land, forest, water and manpower are the necessary prerequisites for livestock farming.

Like agriculture, the livestock system is also dependent on the natural resource and the local climatic condition. This fact is also supported by Molnar in her study about the four communities of Kham Magar in western hill of Nepal. Crop by products like straw and natural products like water, fodder and grass from forest, livestock rearing in pasture land plays an important role in livestock farming. Any changes in these systems directly or indirectly pose threats to the livestock system.

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Livestock keeping is one of the important livelihood strategies for both the people of Hattibang and Kesharbag. The respondents of both study sites argue that the entire livestock farming system has undergone change during the past 15-20 years. They have pointed out various natural causes like change in climatic parameters, climatic extreme events that directly affects the availability of fodder, water, forest and grazing land disease to animals. In addition to this, various economic and socio-cultural causes like changing meaning of livestock rearing, changing land use practices, availability of manpower, and alternative source of income, education and technology for the change in the livestock system over the past 15-20 years.

Besides these various causes for the change in the livestock practices, almost all the respondents of both the study areas argue that the change in climatic parameters and climate related risk and disasters have significant impact on the livestock system in their areas (Zhang et al., 2022). People frequently raise the issue about the change in the productivity of livestock and changing fodder management practices while talking about the changing climatic parameters and the climate related risk and disasters.

Better environmental conditions, good quality of feeds and forage and hygienic sheds along with proper health care of the livestock are the basic elements for the good livestock productivity. The respondents of both studies argue that the overall productivity of livestock is changing. According to respondents of Hattibang the increasing temperature causes thermal stress to the animal especially for cow and goat causing reduction in the milking capacity, increasing fever and even death of the livestock. Oxen are the main source of the power for ploughing, in that hill village the elders' members of the community noticed that the stamina of oxen is decreasing these days in comparison to the past days. They relate it to the loss of hygienic grass in the forest and reduction in grazing land that the livestock used to graze in the past because of long drought, soil erosion and forest fire.

In Kesharbag cows and goats are the major livestock. All animals were stall fed and needed plenty of stored feeds. So, livestock rearing is highly associated with crop farming. Rice straw is the main livestock feed throughout the year except June and July. In these two months farmers' feed maize stovers, green grasses grown in paddy fields. They don't get permits to enter into the forest for fodder and foliage collection.

The respondent at Kesharbag felt that the cattle were maturing and breeding earlier than in the past. Previously, cows usually mate only after two years; but now they give birth within two and half years. Similarly goats used to mate only after one whole year; nowadays they mate much earlier (within 8-10 month). Farmers also points out that although the maturation and first breeding time for the cattle is shortened but the overall fertility of the cattle was decreasing due to increase in the duration sterility and miscarriage. There used to be a regular breeding and calving season; for example most cows used to breed during July to October but now this cycle is no longer applicable for them. Similarly, the appearance of new disease and shift in the timing of the endemic disease is another important problem faced by the local residents. According to the farmers the foot and mouth disease (*Khoret rog*) used to prevail in the summer season; becoming one of the important causes for the reduction of milking capacity of cows and even the loss of animals in the winter in the last 4-5 years. One of the members of the cooperatives has lost his 4 cows due to foot and mouth disease. The officials of the milk producing Co- operatives, Annapurna Milk producers co-operative - one of the leading diaries in Chitwan, used to collect around 4000 liters of milk per day, argue that the amount of milk production is decreasing these days.

Furthermore, the scarcity of the quality fodders also adds to the burden of farmers in animal husbandry. The increasing trend of hybrid paddy plantation, due to the change in climatic condition, reduces the fodder yields. In addition, with the change in the climatic parameters and increase in climatic related risk and disasters, the outbreaks of various new diseases to crop also increased (Pandit, 2018). So, the increasing intensive use of the pesticides these days directly affects fodder hygiene and nutritional quality of the fodder than the local landrace crops. Local people have various explanations about the cause for the above mentioned change and challenge to the livestock system. But some elder respondents connect it as a consequence of the ongoing increase in the temperature and long drought which they were experiencing in the last few decades.

4. CONCLUSION

The communities are already experiencing the change in temperature, precipitation and mist and dew patterns since the past 15-20 years. This was supported by a number of indicators such as decrease in rainfall, shifting of monsoon, warmer winters, and increased rainfall intensity within short duration, long drought, landslides, soil erosion and outbreaks of pests and diseases. The impact of such change in climatic conditions is seen in the present and may cause severe impact on the livelihood of the communities especially on agriculture and livestock in future. Though the people of both communities had not heard the term 'climate change', they were quite aware of the phenomena. They had felt significant change in climatic parameters such as temperature, precipitation, mist and dews throughout their life experiences over the period. The perception of climatic risk and disasters depend on how it hits them, the existing socio-cultural and economic system and ecological setting they are residing in. For example, people of Hattibang perceive landslide and soil erosion as a major risk but this was not true for the people of Kesharbag. It is because landslides and soil erosion are major risks of the hill area which is not found in the plain. In this context, the perception of the people about the environment and environmental risks depend on where they live and how they act on the system. In addition to this, the perception also varies from individual to individual within the same geographical and social settings. Therefore the climatic risk and disasters like drought, landslide, soil erosion, hailstorm, windstorms that were happening during the course of an individual's lifetime provide the important generalization about the changing situation of climatic regime and perception of the people and the impact of such unprecedented change. In addition, it helps to elicit the information on how people observe these phenomena and ultimately help to trace the people's perception on the ongoing climatic events.

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CONFLICTS OF INTEREST

"The authors declare no conflict of interest".