

## Research Article



# Impacts of Climate Change on Livestock and Livestock Produces: A Case Study of Banke District, Nepal

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**Abstract** | Climate change is one of the most complex challenges that humankind has to face in the coming decades. The threat and vulnerability are catastrophic mainly to marginal and remote areas. No sector, person or region is free from impacts of climate change and neither is livestock sector. This study was carried in Banke district to find out impacts of climate change on livestock and its productivities. Result showed that farmers perceived the climate change as change in rainfall pattern, rainfall duration, onset of the monsoon, and changes from summer and winter etc. Some farmers realized the change in climate and its impact on their usual farming practices. But, majority of farmers (57.88%) are still unaware about climate change and how to deal with it. Among total respondent, only 15% of them stated that their source of awareness about climate change was extension worker, which indicates very minimal interaction between farmers and extension worker. Most significant impacts of the climate change were increased disease pest infestation, loss of appetite and decreased milk production. Vulnerability index of the area found to be 4.29, indicating higher vulnerability of the research area to climate change. Study concluded that impact of climate change in livestock sector is significant and means of dealing with climate change must be identified soon for the betterment of farmers' economy and insuring food security.

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## Introduction

Earth's climate keeps changing over the time, which can be imposed by any natural causes or due to human activities. With ever increasing population and never meeting demands of whooping amount of population, demands is increasing very rapidly causing unsustainable use of resources along with unsupervised industrialization and development of infrastructure leading to deterioration of the environment resulting into climate change (Kumar, 2014). Generally, Climate change is the deviation of the existing weather pattern which extends over very long period of time. It can be simply referred as the change in average weather condition. Climate change

is becoming greater threat to agriculture sustainability and food security along with the livelihood that depends upon it along. The threat and vulnerability are catastrophic mainly to marginal and remote areas. It is one of the most complex challenges that humankind has to face in the coming decades (Shrestha and Baral, 2018). Due to climate change, various sectors of human life are affected. Effects are seen in various aspects such as Agricultural sector, forestry, glacier, fresh water and biodiversity. Today climate change is the pressing issues of 21st century due to its impact on global ecosystem. Not a single individual, country or place in the world is free from the challenges of climate change (Kumar, 2014). Temperature of Nepal has risen by 1.7<sup>0</sup> C in past 30 years (1975 to 2005),

and the average temperature increased as 0.06 °C per year and in particular, 0.04°C per year in plain area and 0.08 °C per year in Himalayas (Shrestha et al., 1999). Agriculture is the backbone of country and main economic activity of majority of Nepalese people (Shrestha, 2018). Agriculture and Forestry sector contribute 38.1% to National Gross Domestic Product (GDP) and provide employment opportunity to 65.6% of a total employed population (MoAD, 2012). Livestock is and has always been integral part of Agriculture in our nation. Still to the date Livestock alone contributes 25.68% of Agriculture Gross Domestic Product and about 9% of national GDP (Basnet and Pandey, 2018). With such a huge contribution on economy, it can't be over looked in anyway. Elements of weather such as temperature, precipitation, humidity, wind speed and other climate factors directly or indirectly affect the growth and production of livestock (Houghton et al., 2001). Directly on the front or acting behind climate change and climate hazards are the leading contributor of livestock losses (Sharma, 2009). Smallholder farmers, which include majority of Nepalese farmer, do not have adequate resources for effectively responding to the impacts of climate change (Shrestha and Shrestha, 2017), and are highly vulnerable to its negative consequences. This study was conducted to understand the level of awareness among people about climate change, major impacts of climate change in livestock and vulnerability of the area from the view point of livestock production.

## Materials and Methods

### *Study area*

This study was conducted in the Banke district, lying on western plain area of Nepal. The study focuses to explore the perception of farmers of Bageshwori Village Development Committee (VDC) on climate change, its impact on livestock and livestock productivities.

### *Sample size, sampling procedure and selection of the respondent*

All the farmers from Bageshwori VDC were the target population for this study. During the selection of the respondent only age of above 30 years and at least 10 years of settlements within this locale were included in the sample, because they provide valuable and useful information regarding the past trends on climatic variables. Careful attention was paid to make the sample more inclusive as possible (*i.e.* inclusions of farmers from different wealth categories, different

ethnic groups). Ninety households were selected as sampling respondents for this study.

### *Source of information*

For the primary data, the pre-tested systematic semi structured questionnaire was used for face to face interview and key informant interview. Secondary information was mainly collected through reviewing different publications published by Ministry of Agriculture Development (MoAD), Department of Livestock Service (DOLS), Department of Hydrology and Meteorology (DHM), Central Bureau of Statistics (CBS), Nepalese Agriculture Research Council (NARC), District Agriculture Development Office. Other than those, published materials from different NGOs and INGOs, individual research and scholar research articles concerning climate change and its impact were considered.

### *Survey design and data collection*

For the collection of primary data two sets of interview schedule were prepared, one set to collect the information from farmers another set to collect the information from key informants (Shrestha et al., 2018). Different variables were identified and interview schedules were prepared accordingly. The field survey was conducted in January, 2017. The respondents were interviewed using face to face method by visiting their homes. Key informants were interviewed in the same manner. Information obtained from the interview was crosschecked during the focus group discussion. Additional information on various communities-based adaptation strategies; difference observed in the present and past regarding the livestock raising was collected through focus group discussions.

### *Data analysis*

Primary data collected from the field survey and secondary data collected from other means were coded, tabulated and analyzed using Microsoft Excel. Qualitative data obtained during survey are studied and presented as tables or lists. And, obtained quantitative data are presented using simple descriptive statistics like frequency count, percentage, mean etc. Impacts and perception of farmers on the change of climatic variables over the time and their adaptation strategies were studied by estimating frequency, percentage, charts and diagrams.

### *Vulnerability index assessment*

Vulnerability of livestock based research area to the

impacts of climate change estimated using principle component analysis and integrated vulnerability approach. The integrated vulnerability approach is simpler, appropriate and easier to interpret and implement as well (Deressa et al., 2008). Vulnerability score was estimated using three components, namely adaptive capacity, sensitivity and exposure. Principal Component Analysis (PCA) was performed to estimate the score of vulnerability components. Vulnerability was calculated as defined by IPCC (2001).

$$Vulnerability = Adaptive\ capacity - Sensitivity - Exposure$$

$$V_k = \sum_{i=1}^n W_{ki} A_{ki} - \left( \sum_{i=1}^n W_{ki} S_{ki} - \sum_{i=1}^n W_{ki} E_{ki} \right)$$

Where;

$i = 1, 2, 3, \dots, n$  Households;  $K=1, 2, 3, 4$  and  $5$  representing research fields;  $V_k =$  Vulnerability index for  $k^{th}$  field;  $W_{ki}$  = Weight obtained from first PC scores of  $i^{th}$  variable for  $k^{th}$  field;  $A_{ki}$  = Adaptive  $i^{th}$  for  $k^{th}$  field;  $S_{ki}$  = Sensitivity  $i^{th}$  for  $k^{th}$  field;  $E_{ki}$  = Exposure  $i^{th}$  for  $k^{th}$  field.

For the calculation of direction and magnitude of vulnerability index, negative sign was assigned to sensitivity and exposure, while positive sign was assigned to adaptive capacity. Higher vulnerability index score indicates less vulnerability and vice versa (Madu, 2012).

## Results and Discussion

### Study area

Banke district lies in the western plain part of Nepal which covers an area of 2,337 km. Altitude of the district is 127 m to 1236 m from the mean sea level. Among the total area, 57,252 (23.4%) ha of land is suitable for agriculture, among which 37838 ha is occupied by lowland and 15000 ha by upland (DADO, 2018). Total population of Banke district is 491,313, in which males are 244255 (49.71%) and females are 247,058 (50.29%). There are 46 VDCs in Banke district besides Bageshowri VDC. There are total nine wards in Bageshowri VDC with the household number of 2840 and average household size of 4.49 (CBS, 2011). Among total population within the study area (including family member of respondents), males comprised 45.3% and females comprised 54.7% of total population, whereas male and female population of the Bageshowri VDC is 44.2% and 55.8% of total population respectively (CBS, 2011).

### Population of livestock

The average family seems to rear higher number of compared to any other livestock followed by goat and cattle. Further detail has been shown in Table 1. Most of the animals found to be of local origin rather than any hybrid species, which might be due to the fact that this study only included regular farmers rather than high scale commercial farmers.

**Table 1:** Population of livestock in the study area.

Livestock	Average Population (No.)
Cattle	2.9
Buffalo	1.4
Goat	3.4
Poultry	5.8

### Information gain about climate change by the respondents

The study showed that 42.22% of the respondents know about climate change, which is very low compared to similar study of Kenya *i.e.* 96.47% of population were aware about climate change (Adebayo et al., 2012). Out of 38 respondents who were aware about climate change only 18.3% of them knew climate change clearly, 33.1% knew ambiguously and majority of respondents 48.6% of them knew climate change a little bit. Such lower awareness about climate change might be the outcome of lack of access and interaction with extension officers, poor government awareness activities, lack of information about climate change in media etc. The study revealed that 35% of the respondents know about climate change through their self-experiences by comparing the past and present events of climatic parameters such as change in temperature, rainfall pattern etc., 27% through media such as local FM, 23% of the respondents said that they know about climate change through social organization working in that area, their relatives, neighbors and local leaders and only 15% of them got the information from extension agents which is very low compared to what Yohanna et al. (2014) reported and shows dire need of extension agents to focus on this issue.

### Major climate change impacts on livestock perceived by respondents

There are many known and unknown, direct or indirect and felt or unfelt impacts and effects on climate

change on livestock, livestock system and livestock production. After, focus group discussion, key informant interview and literature review, mainly six major impacts were identified, which are shown in Figure 1. Among six identified impacts, increase in disease pest incidence was found to be the most significant impact. Similar result was reported by Dhakal et al. (2013) who stated that the incidence of diseases and external parasites in animal, loss of forages and fodders, heat stress, water scarcity, infertility, decline in the milk yield and lactation period were climate induced impact of on livestock production.

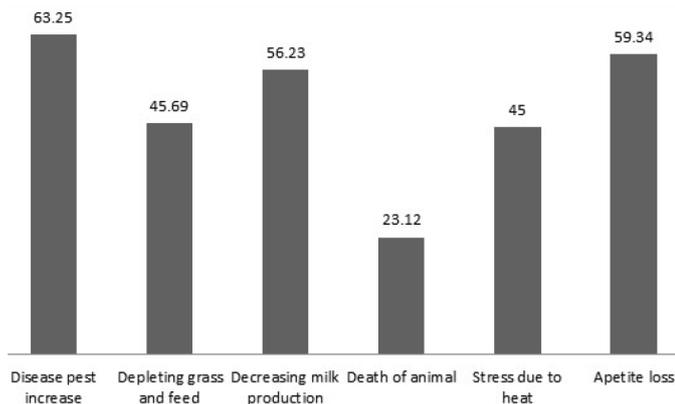


Figure 1: Negative impact of climate change in Livestock.

#### Increase in disease and parasite infestation

Livestock disease and parasite infestation can be dependent of and the outcome of several factors such as geographical location, animal vigor, disease characteristics, livestock management and other environmental factors (Thorton and Herrero, 2010). With the change in weather pattern and climatic elements disease and parasites infestation are increasing (Thorton et al., 2009). Among them, 63.25% of farmers believed that incidence of several diseases and parasites are increasing. Increased temperature and variability of climate pattern directly or indirectly increases susceptibility of livestock to pathogens while at the same time it also enhances pathogenicity of pathogens, which results into increased incidence of disease and parasites (Nardone et al., 2009).

#### Decreasing feed and grass availability

Quality and quantity of feeds and grasses are depleting in the study area, which can be the result of climate change, lack of forest, unable to produce fodder and forage in their own land. Among all the respondents, 45.69% of farmers believe that quality and quantity of feed and grass for livestock production are depleting. There are several reports and publication which sup-

ports farmers' perception and beliefs in this matter. Chapman et al. (2012) states with the climate change and its impact in temperature, quantity and quality of feeds are being affected.

#### Impacts in milk production

In the study area, 56.23% farmers believe that with change in climatic pattern milk production has been decrease significantly even though there is use of improved breed and some adaptation strategies. Similar ratio of people found to be suggesting the reduction of milk production in findings of Dhakal et al. (2013) as well. Several direct and indirect influence of climate change such as increasing disease and parasites infestation, environmental stress and lack of appropriate quality and quantity of feed and grass can be the main actor for such impact (Nardone et al., 2010). This is further supported by Houghton et al. (2001) who stated that temperature, humidity and other climatic factors directly and indirectly effects animal growth and milk production. Similarly, Aydinalp and Cresser (2008) reported that higher temperatures induce significant decline in milk production along with slower weight gain and lower feed conversion efficiency.

#### Death of animal in study area

Baumgard et al. (2012) suggests that climate change influence several factors such as temperature increase, livestock and pathogen interaction, farming system and many other environmental factors resulting to higher incidence of diseases, poor feed and grass availability, environmental stress, poor growth and vigor resulting to higher death rate of animal. About 23.12% of respondents believes that death rate of animal is increasing with the climate change. Farmers stated that not only death rate is increasing, susceptibility of livestock towards stress and health issues are also rising.

#### Animal affected by heat stress

Heat stress generally means impact of abnormal temperature to animal. Occurrence and extent of heat stress is influence by temperature and humidity level along with species and their genetic potential as well growth stage and ultimately nutrition level of animal (Downing et al., 2017). Among them, 45 of the respondent believed that animal are being affected to the heat stress. Chauhan and Ghosh (2014) stated that with global warming and climate change incidence of heat stress on livestock has been increasing which causes decrease in estrus expression, lower milk

production and reduces conception rate as well.

### Livestock loss of appetite

The majority of 59.34% respondents said that animal affected from heat stress which shows that there are many animals affected from heat stress. Farmers stated that due to appetite loss and lower consumption, growth and milk production is negatively influenced. Loss of appetite can be due to the heat stress, disease and parasites or abnormal metabolism due to changing climate and weather pattern. With the rise in temperature and humidity, growth and development has been heavily affected. Specially, higher temperatures are very detrimental to livestock because other than causing heat stress and other health issues it also causes suppressing effect on appetite of livestock appetite (Henry et al., 2012).

**Table 2:** Component scores of coefficient for component first through PCA

Indicators	Types of variables	Component scores
Age of household head	Sensitivity	-0.5018
Household education	Adaptive capacity	0.2378
Family size	Sensitivity	-0.1859
Gender of household head	Sensitivity	-0.1134
Food security	Sensitivity	-0.2384
Owned land	Sensitivity	-0.0134
Saving amount	Adaptive capacity	0.0127
Irrigation facility	Adaptive capacity	0.2163
Credit facility	Adaptive capacity	0.2231
Availability of information	Adaptive capacity	0.4126
Primary Occupation as agriculture	Adaptive capacity	0.4016
Extension service	Adaptive capacity	0.2038
Training received	Adaptive capacity	0.2978
Drought rank	Exposure	-0.1572
Dry spring rank	Exposure	-0.0486
Disease outbreak	Exposure	-0.1583
Vulnerability index		4.29

### Vulnerability analysis

Vulnerability index of the study area was found to be 4.29 (Table 2). Higher vulnerability index represents stability of the area and less sensitivity toward climate change. Such lower vulnerability index represents higher vulnerability toward climate change. Similar vulnerability status was also reported by Dev (2014). Such vulnerability score indicates the seriousness of impacts of climate change in rural areas and at the

same time shows need of concern and works from all the concerned sectors to combat with the climate change. Education of household head, involvement in agriculture, information availability, credit and irrigation facility, extension service and trainings contributes toward decreasing vulnerability of the area. It shows that to combat and mitigate climate change impacts strategies such as training and awareness camp, better interaction and access to extension worker, irrigation and credit facility must be implemented. Disease outbreak and higher aged household head are two important characteristics that which contributes to increase vulnerability of the area.

### Conclusions and Recommendations

Climate change is not a new concept or new idea to anyone at this stage. As human civilization is moving forward, more and more we are moving on the direction of doomsday. Climate change is the result of our cynical and irresponsible acts. Impact of climate change has started to affect more and more people and more and more region of the world. Livestock sector is one good example to study the impact of climate change. Study showed that only 42.22% of the population is aware about climate change and within those population only 18.33% of population knows clearly what climate change is exactly. This study identified six major impacts of climate change on livestock, which are; increased disease pest infestation, depleting grass and feed level, decreasing milk production, death of animal, heat stress and appetite loss. Among those six issues increased disease and pest infestation found to be most important followed by appetite loss and decreased milk production. Vulnerability index of the study area was estimated to be 4.29, which index higher vulnerability or climate change sensitivity of the study area. It shows that study area is in dire need of climate change adoption strategies. We need to better understand those impacts of climate changes, and find strategies to solve them, avoid them, adopt them and try to make earth more prosperous from our place as much we can.

### Author's Contribution

Anish Shrestha designed and supervised this research study and collected the data. Samata Baral carried literature review and collected other secondary information needed. Anish Shrestha and Samata Baral both participated in data analysis and manuscript

preparation.

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