Impact of Climate Change on Livestock Production in Himachal Pradesh: A Case Study of Hamirpur District of Himachal Pradesh

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ABSTRACT

Background: The present study was undertaken to understand the perceptions of farmers about climate change and its impacts on livestock production and also various adaptation strategies taken by them to deal with climate change in Hamirpur district of Himachal Pradesh.

Methods: For the selection of the respondents, the multistage random sampling technique was employed in which the selection of three blocks from Hamirpur district of Himachal Pradesh.

Result: As far as selected blocks were concerned, Nadaun faced the highest decline in milk production (-17.02%), whereas, meat production had a decline of 27.31 per cent in Bijhari. Majority of farmers had adopted strategies like use of improved breeds of livestock (23.15%), their vaccination (20.83%) and increasing their nutrition (19.17%) for improving milk production. New flexible techniques for improving the health of livestock like periodic vaccinations, finding cure to lethal diseases and ultimately their production should also be made available by state government.

Key words: Adaptive strategies, Climate change, Livestock production.

JEL: C1, P1, Q1, Q5.

INTRODUCTION

In Himachal Pradesh, raising animals is crucial to the growth of the agricultural industry. In hilly states, it is an essential component of the farming system. In addition to providing milk, meat, wool and manures, they are the primary energy source for transportation and ploughing. The farmers' secondary source of income is animal husbandry. Because dairy farming produces a valuable good for human health, it helps to preserve the ecological system (Varijakshapanicker *et al*., 2019; Bharti *et al*., 2017). In addition to giving a lot of people access to affordable, wholesome food, this industry contributes significantly to the creation of job possibilities in rural areas (Al-Sharafat, 2013). The application of FYM greatly increases crop productivity. But, dairy farmers has also confronted the impacts of climate change, therefore it's critical to assess their awareness of climate variability and how it affects livestock productivity and population (Rojas *et al*., 2017; Shivani *et al*., 2023). Because of its effects on water availability, animal and milk production, livestock diseases, animal reproduction and biodiversity, climate change poses a threat to the production of livestock. Dairy cattle's extreme sensitivity to changes in temperature, humidity and feed availability can be seen in how much feed they consume, which affects how much milk they produce during the production season (Allen *et al*., 2013; Suliman *et al*., 2025). Due to its effects on grasslands and range, climate change has an effect on the production of meat and dairy products (FAO, 2019; Gera *et al*., 2025). The state of Himachal Pradesh is experiencing the effects of climate change due to increasing temperatures, unpredictable rainfall and snowfall, which are having an impact on livelihoods, livestock, horticulture and agriculture (Rani and Prasher, 2020; Rani *et al*., 2024). Over the past ten years, the state's farming systems have undergone continual modifications due to the harmful effects of global climate change on prospective areas including livestock. Since, livestock is also a great source of income to the farmers apart from agriculture, so, an attempt has been made this study to analyse the impact of climate change on livestock production which is divided into 4 sections *i.e.* milk, meat, wool and egg production and adaptive strategies taken by farmers to deal with them.

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MATERIALS AND METHODS

For the selection of the respondents, the multistage random sampling technique was employed in which the selection of three blocks from Hamirpur district of Himachal Pradesh

(Bamson, Nadaun and Bijhari) was done and 120 respondents were selected. The respondents who were more than 30 years of age were chosen for the investigation as they had enough experience about the changes occurred/ occurring in the agro-climatic conditions of Hamirpur district (Manandhar *et al*., 2011). The respondents were interviewed through questionnaires, including perception about impact of climate change and collected primary data were analyzed through mathematical and statistical methods (Shukla *et al*., 2016).

Per cent change approach

Per cent change is defined as the extent to which a variable gains or loses a value.

$$\text{Per cent change (\%)} = \text{Base year's value-Past year's value Base year's value} \times 100$$

Where;
Base year is the year 2017-18 and Past year is the year 1987-88.

Chi square (χ^2) test

To test whether the problems faced by farmer are significant to all the categories or to the independent category only.

$$\chi^2 = i=1n(Oi-Ei)2Ei2\ \chi^2 = \Sigma\frac{(O - E)^2}{E}$$

Where;
Oi = Observed value.
Ei = Expected value.
i = 1,2,3,……,n.
where
n = No. of observations.

Garrett's method of ranking

A questionnaire regarding knowledge of various adaptation strategies to cope up with climate change was prepared and respondents were asked to rank the answers of a particular question (Rani, 2019). In order to rank the various responses made by the respondents, Garrett's method of ranking was used. The per cent position was calculated by using following formula:

$$\text{Per cent position} = 100*(Rij-0.5)Nj$$

Where;
Rij = Rank given to the i^{th} variable by j^{th} respondent.
Nj = No. of variables ranked by the j^{th} respondent.

The per cent position of each rank was converted into scores using Garrett's ranking conversion table given by Garrett and Woodworth (1969). For each factor (adaptation strategy), the rank frequency value calculated in the first step was further multiplied with the average percentile score calculated for respective factor. Further, the overall sum of each factor was calculated and then divided by the total number of items ranked by the respondents in order to obtain average score or Garrett score. The average scores were then arranged in descending order for each of the questions asked and ranked accordingly. The factor having highest mean value was considered to be the main factor.

RESULTS AND DISCUSSION

The negative effects of climate change on livestock industry have increased due to increase in global warming (Rani *et al*., 2021). Its direct effects include alternating post-absorptive metabolism, nutrient portioning and eventually affects production. Indirect effects include reduced feed intake, altered immune systems, reduced feed, water availability and quality and increased environmental interaction with disease causing parasites and vectors. So, the impact of climate change and adaptive strategies taken by farmers were discussed under following sub-heads.

Changes in livestock production over the last 30 years

Production of livestock had decreased over the last 30 years in which milk production declined by 11.57 per cent followed by meat production (-8.26%) whereas, wool production and egg production showed an increasing trend (Table 1). As far as selected blocks were concerned, Nadaun faced the highest decline in milk production (-17.02%), whereas, meat production had a decline of 27.31 per cent in Bijhari. So, it can be concluded that the livestock production is also sensitive towards climate change in the study area.

Farmer's perceptions on impact of climate change causing changes in livestock production

Livestock production is affected by various factors like fodder scarcity, grazing problems, short lactation period, feed scarcity *etc*. Scrutiny of the Table 2 revealed that in case of selected blocks, Nadaun was affected highest by various factors causing changes in milk production like fodder scarcity, grazing problems, short lactation period, feed scarcity and, increase in feed price according to season and infertility followed by Bamson and Bijhari. Grazing problems, increase in feed price according to season and fodder scarcity were found the most influential factors among all the factors causing changes in livestock production.

Table 1: Changes in livestock production over the last 30 years (Block-wise). (Per cent)

Particulars	Bamson	Nadaun	Bijhari	Overall
Milk production	-9.21	-17.02	-7.02	-11.57
Meat production	-5.98	5.43	-27.31	-8.26
Wool production	7.14	8.33	11.75	9.07
Egg production	5.49	0.93	3.83	3.17

Farmers' perceptions towards adoption of various adaptation strategies to improve livestock production in Hamirpur district

Livestock plays an important role in the sustainable livelihood of poor people because of inherent risk involved in the crop farming due to uncertainty of rainfall and occurrence of recurrent droughts. They provide income and increased economic stability of the households. So, from the scrutiny of the Table 3, it was revealed that the majority of farmers had adopted strategies like use of improved breeds of livestock (23.15%), their vaccination (20.83%) and increasing their nutrition (19.17%) for improving milk production. Somewhat similar trend was also seen in meat production too. While, most of the farmers had adopted

Table 2: Farmer's perceptions on impact of climate change causing changes in livestock production (Block-wise). (Per cent)

Particulars	Bamson	Nadaun	Bijhari	Overall
Milk production				
Fodder scarcity	57.14	87.23	81.58	76.66
Grazing problems	65.71	87.23	81.58	79.16
Short lactation period	31.43	51.06	31.58	39.17
Feed scarcity	65.71	82.98	81.58	77.50
Infertility	31.43	42.55	47.37	40.83
Increase in feed price according to season	62.86	68.09	81.58	70.83
Effect on milk yield	51.43	46.81	55.26	50.83
Reduction in livestock weight	40.00	27.66	31.58	32.50
Meat production				
Fodder scarcity	62.86	53.19	52.63	55.83
Grazing problems	57.14	51.06	55.26	54.17
Feed scarcity	60.00	55.32	57.89	57.50
Infertility	20.00	36.17	18.42	25.83
Increase in feed price according to season	45.71	40.43	50.00	45.00
Reduction in livestock weight	42.86	38.30	36.84	39.17
Wool production				
Fodder scarcity	62.86	53.19	52.63	55.83
Grazing problems	62.86	53.19	47.37	54.17
Feed scarcity	62.86	53.19	50.00	55.00
Infertility	20.00	36.17	18.42	25.83
Increase in feed price according to season	51.43	40.43	31.58	40.83
Reduction in livestock weight	42.86	29.79	34.21	35.00
Egg production				
Feed scarcity	17.14	10.64	18.42	15.00
Infertility	11.43	8.51	15.79	11.67
Increase in feed price according to season	31.43	25.53	34.21	30.00
Reduction in livestock weight	40.00	25.53	28.95	30.83

Table 3: Farmers' perceptions towards adoption of various adaptation strategies to improve livestock production.

Particulars		Yes (%)	No (%)	Don't know (%)	Chi-sq value
Milk production	1. Improved breed	23.15	55.83	20.83	3.09
	2. Vaccination	20.83	59.17	20.00	4.67
	3. Increasing nutrition	19.17	60.00	20.83	6.00*
Meat production	1. Improved breed	19.67	60.00	20.00	5.58
	2. Vaccination	12.50	68.33	19.17	12.99*
	3. Increasing nutrition	17.94	61.67	20.00	7.08*
Wool production	1. Improved breed	10.99	70.00	19.17	14.95*
	2. Vaccination	13.33	69.17	17.50	11.98*
	3. Increasing nutrition	15.83	70.00	14.17	9.17*
Egg production	1. Improved breed	5.21	77.50	17.50	23.70*
	2. Vaccination	2.50	81.67	15.83	28.49*
	3. Increasing nutrition	5.21	77.50	17.50	23.70*

*shows chi-sq values at 5 per cent level of significance.

Table 4: Farmers' perceptions towards adoption of various adaptation strategies to improve livestock production (Block-wise). (Per cent)

Particulars		Bamson	Nadaun	Bijhari	Overall	Garrett score	Rank
Milk production	1. Improved breed	17.14	38.30	10.53	23.15	69.45	2
	2. Vaccination	20.00	17.02	5.26	20.83	65.93	3
	3. Increasing nutrition	28.57	21.28	13.16	19.17	69.53	1
Meat production	1. Improved breed	17.14	21.28	21.05	19.67	68.42	1
	2. Vaccination	5.71	8.51	10.53	12.50	57.19	3
	3. Increasing nutrition	22.86	17.02	15.79	17.94	67.31	2
Wool production	1. Improved breed	14.29	10.64	7.89	10.99	61.29	1
	2. Vaccination	17.14	10.64	13.16	13.33	52.29	3
	3. Increasing nutrition	14.29	21.28	10.53	15.83	60.08	2
Egg production	1. Improved breed	5.71	4.26	5.26	5.21	51.97	1
	2. Vaccination	2.86	4.26	-	2.50	44.02	3
	3. Increasing nutrition	5.71	4.26	5.26	5.21	46.22	2

Rank is an absolute number.

strategies like vaccination and improving nutrition for livestock production as most of them were rearing them. Similarly, it is revealed that in case of milk production, increase in nutrition was the most significant strategy adopted by most of the farmers whereas, in case of meat production, use of improved breed was the most significant one whereas strategy of vaccination was the least significant one (Table 4).

CONCLUSION

The above discussion has led us to the conclusion that climate change has significantly impacted the livestock sector and farmers need to deal with this withbetter adaptable strategies. The educated farmers were more likely to perceive changes in the climate and might adapt mitigating procedures easily, improving farmers' education and offering free extension advice will be crucial in boosting their response to climate change and promoting adaptation, as well as improving livestock production. Farmers also think that cattle performance is affected by the harsh effects of climate change. Thus, attitudes of farmers towards climate change adaptation are associated with farm typology, with an emphasis on giving cattle access to more water and better housing in addition to providing fresh methods for evaluating programmes for adaptation to climate change. Further, the climate change adaptation strategies for livestock will be strengthened by increasing agricultural systems in conjunction with the development of new economic models. New flexible techniques for improving the health of livestock like periodic vaccinations, finding cure to lethal diseases and ultimately their production should also be made available by state government. Also, awareness towards adaptation to these harmful impact of climate change can be created through organising various veterinary camps is also the need of the hour. But people should shown their enthusiam in terms of their participation in these camps. Further, proper registration and timely checking of animals by veterinary doctors and use of protective measures can help in dealing with climate change.

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Conflict of interest

There is no conflict of interest between the authors.

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