

Assessment of Awareness about Climate Change among Dairy Farmers in Bundelkhand Region

Abstract

This study was designed to assess the awareness of dairy farmers towards climate change. 80 dairy farmers responded to a designed questionnaire that was developed to collect the data and covered farmer's socio economic status, source of awareness and their specific knowledge towards climate change. Most dairy farmers actively recognized the climate change effects on dairy animal's performance and health according to the study results. The relatively low awareness of causal factors and livestock-related consequences suggests the need for targeted educational interventions to bridge knowledge gaps, promote sustainable practices, and enhance climate resilience in the agricultural sector. The research proposed new policies to streamline processes of accessing financial support and dairy farm improvement grants to reduce climate change impacts on dairy cattle.

Key Words: Awareness, Climate change, Dairy farmers, Logistic Regression

INTRODUCTION

Farmers recognize climate change as an important enduring problem which affects them fundamentally. Multiple biological and physical ecosystems suffered from climate change impacts during recent years which led to significant alterations throughout the agricultural industry that supports local rural communities (Ado et al., 2018). The dairy farming in India are significantly supported by small-scale and marginal farmers for producing milk. The effects of climate change on livestock affect developing nations like India particularly hard due to their large population who make their living from agriculture. Water shortage emerges from climate change to create drought areas across many nations resulting in animal death and weight loss and increased livestock diseases until farmers experience income reduction and economic effects. The temperature of India has increased by 0.60 °C during the past hundred years. The IPCC forecast (2017) suggested that the global temperatures should increase between 1.5 °C to 2.5 °C until 2100. Dairy farmers experience climate change as a serious problem therefore their

Commenté [AZ1]: The study has certain limitations, including the small sample size (80 farmers), which restricts the extent to which the findings can be generalized. Additionally, the use of a declarative method (questionnaire) may introduce response biases, and the lack of longitudinal data limits the examination of changes over time. The analysis also does not take into account certain contextual factors that may influence awareness of climate change, such as local policies or institutional frameworks.

Commenté [AZ2]: The introduction lacks clarity and structure, mixing background information, statistics, and literature without clearly defining the research problem. Key terms like climate change awareness are mentioned but not properly explained. It also remains too broad, covering general issues without narrowing down to a specific objective or research gap. The logical flow is weak, and some sources are cited without clear integration into the argument.

Commenté [AZ3]: Use a bibliographic tool

understanding about climate volatility and its consequences for livestock and yields are most important aspect. Dairy farming in Bundelkhand is mostly small-scale and subsistence-based, facing challenges like water scarcity, low milk productivity, poor infrastructure, and limited veterinary services. However, there is growing potential due to government schemes, the involvement of self-help groups, and interest from private players. Integrated dairy models and breed improvement initiatives are being promoted to make dairy a reliable source of income and nutrition, especially for small farmers and women. A limited number of studies exist about dairy farmers' understanding of climate change along with their adoption measures in Bundelkhand, India. Indian production relies primarily on small-scale producers whose lack of education about economic aspects leads them to being poor (Kalia et al., 2021).

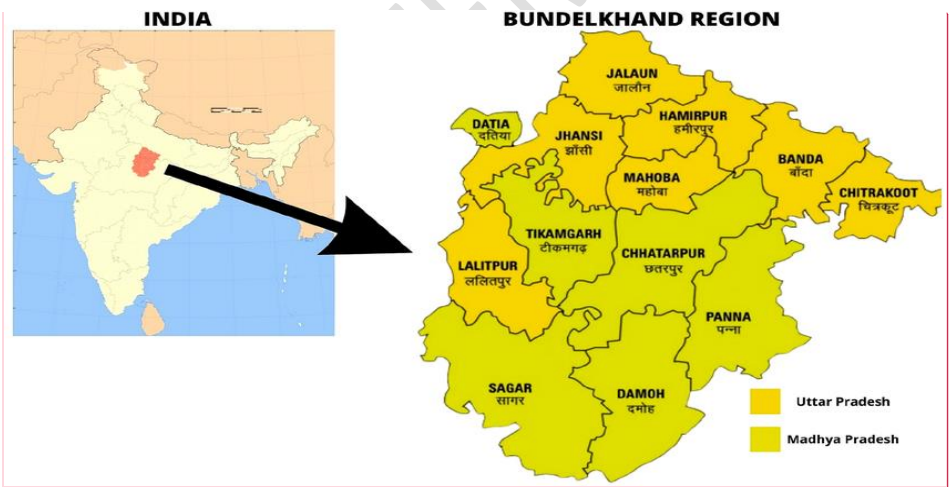
The dairy farmer's perception influenced by a wide range of factors including social economic and demographic variation in Bundelkhand region. Climate variability plays an important in change of feeding schedule of dairy animals (Mishra, et. al., 2025). Education, landholding, socio-economic status, information-seeking behaviour, economic motivation and scientific orientations are the most important factors of climate change awareness (Pathak et.al, 2024). Unforeseeable climate changes lead to abrupt environmental factor variations that dairy farmers have to address. The farmers who dwell in semi-arid Indian regions endured extensive severe drought throughout the year coupled with substantial rainfall pattern alterations during the last few decades affecting their dairy farming operations (Muralikrishnan et. al, 2022). Dairy farmers had medium level of knowledge about breeding, feeding, health care and management practices. Dairy farmers had medium level of knowledge about overall scientific dairy farming practices (Chaudhry, et. al., 2024). The dairy industry plays a crucial role in reducing poverty in rural regions because over 80 percent of rural families own livestock that provides milk for consumption. These families also receive additional revenue from the sale of milk and drought power for agriculture (Rahman and Gupta, 2015). Farmers face several challenges in adopting climate-smart agricultural practices. Some of main constraints are high cost of farm inputs, inadequate farm labour, lack of training and exposure visits to climate change (Pathak et. al, 2024). Livestock farming also faces significant obstacles, with feed shortages susceptibility of high-yielding breeds to climate stress, and breeding issues being major concerns. Socio-demographic factors such as landholding size, herd size, milk production, and annual income

have a strong correlation with the ability to overcome climate adaptation constraint (Yadav, et. al., 2025).

MATERIALS AND METHODS

The study was conducted in the Bundelkhand region of Uttar Pradesh, known for its frequent exposure to climate variability and where approximately 80% of the area is under dryland farming. Banda and Hamirpur districts were purposively selected, and from each, two blocks and two villages per block were chosen randomly. A total of 120 dairy farmers (15 per village) participated in the study. A descriptive research design was employed to assess dairy farmers' knowledge regarding climate change. Primary data was gathered through a structured and pre-tested questionnaire covering socio-economic details, landholding size, dairy experience, and perceptions of climate variability. The collected data were analyzed using statistical tools such as mean, frequency, standard deviation, range, and weighted mean method to draw conclusions.

Commenté [AZ4]: The methodology relies on using a questionnaire administered to a limited sample of respondents, which limits the results' representativeness. Furthermore, the collection of self-reported data may introduce societal desirability or interpretation bias. The lack of comprehensive qualitative data or direct observations also hinders a precise understanding of local dynamics and actual behaviors related to climate change.



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RESULTS AND DISCUSSION

Socio Economic Status of Dairy Farmers

Commenté [AZ6]: Although a thorough description of the socioeconomic traits of the dairy producers is given in the discussion, it is only descriptive and only lists percentages without further analysis or thematic grouping. The reader would be better able to comprehend the relationships between factors like age, education, and training access if the data were presented in a more cohesive manner.

Furthermore, some of the interpretations are hypothetical and superficial, such as the notion that middle-aged farmers are moving to dairying as a result of youth unemployment. The analysis's analytical strength is diminished because it lacks theoretical references and comparison data. Lastly, the chance to connect these socioeconomic elements to the more general issue of climate change and its effects on dairy production has been lost.

Social economic status data from dairy farmers was recorded at the investigation period and Table 1 shows those findings. Half of the dairy farmers (50.83%) involved in dairy business belonged to middle age (36-50) while 30.00% were young (<35 years) and 19.17% were of old age (>50 years). The dairy farmers received additional classification according to their academic achievement. The results showed that 25.83% of farmers were Illiterate while 12.50% of the farmers had education at primary school level, 6.67% had junior high school level education, 30.00% reached high school level education and 19.17% were intermediate educated. The level of graduate studies and above was only 5.83%. Approximate half of the respondents (49.17%) maintained medium-sized family arrangements, 15.83% of respondents had small families and 35.00% had large families among the total survey participants.

The respondent were further categorized based on their annual income in which 54.17% of the respondents found to be under medium family income category, whereas 25.83% and 20% belonged to low and high family income category respectively. It appears that the additional income from dairying has probably contributed much to the total income. In land holding criteria, 38.33% of the respondents had marginal size of land holding followed by small size (29.17%), medium size (19.17%), land less (7.50%) and large size (5.83%) respectively. In dairy experience condition 59.17% of the respondents had moderate experience in dairying followed by 21.67% and 19.17% of them had more and less experience in dairying, respectively. The reason for these results may be that in the study area, the middle aged farmers are forced to start dairying as a subsidiary occupation due to unemployment problem for educated youth.

In the study of dairy farmers, 32.50% had medium exposure to the media, 42.50% had low media exposure, and only 25.00% had high media exposure of communication in that research area. In social participation, the engagement of respondent was found in low category (46.67%) followed by medium (34.17%) and high (19.16%) respectively. From the table 1, 52.50% of the respondents belonged to under medium level. Further, 23.33% and 24.17% of them comes under large and small category of animals owned by dairy farmers respectively. The results pertaining to the training undergone by the dairy farmer revealed that more than three forth of the respondents (74.17%) were not attended any training programmes and 25.83% of the respondents attended training programmes organized by co-operative societies and KVK's etc. 26.67% dairy farmers had a medium risk orientation, 9.17% had a low risk orientation, and 64.17% had a high risk orientation. It might be because dairy farmers with small and marginal

land holdings were less financially stable than economically sound dairy farmers, making them less able to handle risk orientation.

Table-1: Socio Economic Status of Dairy Farmers

S. No.	Characteristics	Classification	Frequency	Percentage
1.	Age (years)	Young (<35)	36.00	30.00
		Middle (36-50)	61.00	50.83
		Old (>50)	23.00	19.17
2.	Education	Illiterate	31.00	25.83
		Primary School	15.00	12.50
		Junior High School	8.00	6.67
		High School	36.00	30.00
		Intermediate	23.00	19.17
		Graduation & Above	7.00	5.83
3.	Family Size (Numbers)	Small (< 4)	19.00	15.83
		Medium (5-8)	59.00	49.17
		Large (> 8)	42.00	35.00
4.	Annual Income (Rs.)	Low (< 100000)	31.00	25.83
		Medium (100000-300000)	65.00	54.17
		High (> 300000)	24.00	20.00
5.	Land Holding (Acre)	Land less (0)	9.00	7.50
		Marginal (< 2.5)	46.00	38.33
		Small (2.5-5.0)	35.00	29.17
		Medium (5.0-10.0)	23.00	19.17
		Large (> 10.0)	7.00	5.83
6.	Dairy Experience (Years)	Less (< 5 years)	23.00	19.17
		Moderate (5-10 years)	71.00	59.17
		More (> 10 years)	26.00	21.67
7.	Mass Media Exposure (Numbers)	Low (<8)	51.00	42.50
		Medium (8-12)	39.00	32.50
		High (>12)	30.00	25.00

9.	Social Participation (Numbers)	Low (<3.0)	56.00	46.67
		Medium (3.0-4.5)	41.00	34.17
		High (>4.5)	23.00	19.17
10.	Herd Size (Numbers)	Small (<4)	29.00	24.17
		Medium (4-8)	63.00	52.50
		Large (>8)	28.00	23.33
11.	Training	Attended	31.00	25.83
		Not Attended	89.00	74.17
12.	Risk Orientation	Low	11.00	9.17
		Medium	32.00	26.67
		High	77.00	64.17

Source of Awareness

Dairy farmer's awareness about climate change depends on variety of sources. These sources are present in Table 2. According to the data from Table 2, more than 81.66% of farmers got information on how climate change affects dairy farming by experiencing it for themselves and by watching or listening to news media and checking social networks. More than three-quarters of farmers or 74.17%, obtained information about farming through agricultural extension workers. On the other hand, just 40.83% got information from agricultural associations, whereas 70.00% used agricultural research centers and Krishi Vigyan Kendras (KVKs). In addition, nearly half of all farmers used the internet to look up information about climate change. They prove that events and programs at agricultural centers, KVKs and research stations successfully communicate to farmers how climate change impacts dairy farming.

Table-2: Source of awareness of Dairy Farmers about Climate Change

Sources	Yes (%)	No (%)
1. Personal Experience	81.66	18.34
2. Cooperative Association	40.83	59.17
3. TV Agricultural Programme	37.50	62.50

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☞ ***"The source of the table"***

Or more precisely in academic writing:

☞ ***"Source of the table:"*** (often written below a table as: The source of the table

4. Extension Persons (Public Sector)	74.17	25.83
5. Extension Persons (Private Sector)	67.50	32.50
6. Universities/KVK/ Research Stations	70.00	30.00
7. Internet Sources	54.16	45.83

Awareness about Climate Change

Dairy farmers need specific awareness about climate change to effectively adapt and reduce their environmental impact. This includes understanding the basics of climate change and how shifting weather patterns such as increased heat, droughts, and rainfall variability affect livestock, milk production, and feed availability.

The survey data reveals a high level of awareness about climate change among respondents, with 95.83% indicating they have heard of it and 85% recognizing its impact on agriculture. However, awareness significantly declines when examining more specific effects on dairy farming and environmental practices. For instance, only 35% of respondents are aware that burning crop residue contributes to climate change, and just 29.17% recognize the reduction in grazing and pasture land due to climate change. Awareness of climate change's impact on dairy animals such as reduced milk production due to heat stress and increased disease occurrence is also relatively low, ranging between 39% and 44%. This suggests that while basic knowledge of climate change is widespread, there is a notable gap in understanding its practical consequences on agriculture and livestock. Targeted education and outreach programs may help bridge this gap and promote more sustainable farming practices.

Table 3: Awareness of dairy farmers about climate change (N=120)

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S. No.	Statements	Yes Frequency	%	No Frequency	%
1.	Have you heard about Climate Change?	115	95.83	5	4.17
2.	Do you know about the effect of climate change on agriculture?	102	85.00	18	15.00
3.	Do you know burning of crop residue is a cause of climate change?	42	35.00	78	65.00
4.	Do you know Climate diversity affects temperature?	98	81.67	22	18.33

5.	Do you know climate change affects reproduction performance of dairy animals?	76	63.33	44	36.67
6.	Do you know Climate change affects dairy cow's health and increases occurrence of diseases?	53	44.17	67	55.83
7.	Do you know due to heat stress, milk production of dairy animals is affected?	47	39.17	73	60.83
8.	Do you know due to climatic variability there will be shortage of fodder for dairy animals in long run?	58	48.33	62	51.67
9.	Do you know due to climate change, grazing and pasture land area are decreasing day by day?	35	29.17	85	70.83
10.	Do you know high temperature affects the dairy animals feed and water consumption?	68	56.67	52	43.33
11.	Do you know due to climate change, availability of ponds and other natural water resources for livestock reduces?	77	64.17	43	35.83
12.	Do you know that practices like Destruction, burning of crop/fodder residues, grains and other ingredients in field is also contributing towards climate change?	51	42.50	69	57.50

Logistic Regression Method to Assess Knowledge about Climate Change

The use of the logistic regression analysis has become more important day after day because it is concerned with the analysis of data with a binary response in which the success variable takes a value (1), and a failure state takes a value (0). The logistic model is used to describe the relationship between the response variable (y), and one explanatory variable (x) or multiple explanatory variables (x_1, x_2, \dots, x_n) and that relationship is expressed in the following form:

$$p(x) = \frac{1}{1 + e^{-(a+bx)}}$$

The Wald statistic is used to test the significance of individual coefficients in the logistic regression model. The Hosmer Lemeshow statistic is used to assess the goodness of fit of logistic regression model and allows for any number of independent variables; either quantitative or qualitative. Table 4 shows that, the probability of correct classification for knows about climate change (1) is 92.4% and the probability of classification error is 7.6%. The probability of correct

classification for not knows about climate change (0) is 82.1% and the probability of classification error is 17.9%. This matrix shows that the model performs well, with high accuracy and strong balance between precision and recall.

Table 4: Classification

Classification by Response Probabilities			
Original Value	Yes	No	True Percentage
Yes	85	07	92.4
No	5	23	82.1

S.No.	Variable	Estimate	SE	Wald	Df	Sig.
1.	Age (years)	-0.101	0.054	3.4983	1	0.061
2.	Education	0.212	0.104	4.1553	1	0.042
3.	Family Size	-0.065	0.048	1.8338	1	0.176
4.	Annual Income	0.021	0.0058	13.1094	1	0.000
5.	Land Holding	0.075	0.036	4.3403	1	0.037
6.	Dairy Experience	0.032	0.015	4.5511	1	0.033
7.	Mass Media Exposure	0.034	0.031	1.2029	1	0.273
8.	Social Participation	0.015	0.103	0.0212	1	0.884

9.	Herd Size	0.164	0.087	0.5534	1	0.059
10.	Risk Orientation	-0.016	0.103	0.0241	1	0.877
-2 log likelihood=56.28, Hosmer Lemeshow test= 0.34,		Cox & Snell R ² = 0.513, p value= 0.99		NagelkerkeR ² = 0.621,		

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ion analysis indicates that several variables significantly influence dairy farmers' knowledge of climate change. Education, annual income, landholding, and dairy experience emerged as significant positive predictors. Notably, annual income had the strongest statistical significance ($p = 0.000$), suggesting that higher income levels substantially increase the likelihood of greater climate change knowledge. Education ($p = 0.042$), landholding size ($p = 0.037$), and dairy experience ($p = 0.033$) also significantly contributed, indicating that more educated, experienced farmers with larger farms tend to be better informed. Age showed a near-significant negative influence ($p = 0.061$), suggesting older farmers may have slightly less knowledge, though this was not statistically conclusive. Other variables, including family size, mass media exposure, social participation, herd size, and risk orientation, were not significant in the model.

Table 5: Coefficient of independent variables

Table 5 presents the results of the Hosmer-Lemeshow test, which is a key method used to assess the goodness-of-fit of a logistic regression model. This test evaluates how closely the observed outcomes align with the predicted probabilities. The chi-square value was 0.34 with 8 degrees of freedom, and the significance level ($p = 0.99$) exceeded the threshold of 0.05, indicating that the model fits the data well. Additionally, the model demonstrates strong explanatory power, as reflected by the Nagelkerke R² value of 0.621.

Association between Selected Independent Variables and Knowledge Assessment

As shown in Table 6, the study reveals that several independent variables have a significant positive association with dairy farmers' awareness of climate change. Among these, risk orientation and herd size show the strongest correlations, indicating that farmers who are more open to taking risks and those managing larger herds tend to possess greater climate change awareness. Education and annual income also have strong positive associations, suggesting that more educated and financially stable farmers are better informed. Moderate correlations are seen

with age, landholding size, while family size and dairy experience have weaker but still significant relationships. Notably, social participation and mass media exposure do not show a significant association, indicating it may not play a major role in influencing farmers' climate knowledge. Overall, the findings highlight that socio-economic and behavioral factors significantly influence how well dairy farmers understand climate change.

Table-6: Association between selected independent variables and Awareness about climate change

S. No.	Variables	Correlation Coefficient	p value
1.	Age (years)	0.31	0.0005
2.	Education	0.38	0.0000
3.	Family Size	0.22	0.0157
4.	Annual Income	0.37	0.0000
5.	Land Holding	0.29	0.0013
6.	Dairy Experience	0.18	0.0491
7.	Mass Media Exposure	0.17	0.059
8.	Social Participation	0.12	0.1885
9.	Herd Size	0.44	0.0000
10.	Risk Orientation	0.49	0.0000

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CONCLUSION

A survey was conducted to assess awareness among respondents regarding climate change and its specific impacts on agriculture. The logistic regression model was applied to examine the influence of various socio-economic and demographic variables on the dependent outcome. The model showed a good fit, with a -2 Log Likelihood of 56.28, Cox & Snell $R^2 = 0.513$, and Nagelkerke $R^2 = 0.621$, indicating that the model explains a substantial proportion of the variance in the dependent variable. Additionally, the Hosmer-Lemeshow test ($p = 0.99$) suggests a good model fit, with no evidence of poor calibration. Risk-taking behavior, herd size, education, age and income were found strongly associated with climate change awareness of dairy farmers. Social participation and mass media exposure do not show any meaningful impact on this. In this study, the majority of respondents were aware of climate change and its general

Commenté [AZ11]: The conclusion highlights key findings but lacks explanations for non-significant variables and provides overly general recommendations without concrete actions.

effects on agriculture, there was a clear lack of understanding regarding its specific and practical impacts on dairy farming and environmental degradation. The relatively low awareness of causal factors and livestock-related consequences suggests the need for targeted educational interventions to bridge knowledge gaps, promote sustainable practices, and enhance climate resilience in the agricultural sector.

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