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Design and Validation of a Scale to Assess Dairy Farmers' Attitudes toward Climate-Resilient Dairy Farming

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HIGHLIGHTS

- A scale assessing dairy farmers' attitudes toward climate-resilient dairy farming was developed using the Likert summated rating scale method.
- Out of 50 initial statements, 27 were retained after the relevancy test, with an overall mean relevancy score of 3.191.
- The final scale, comprising 23 items with t-values of 1.75 or higher, showed a reliability coefficient of 0.86.
- The results of content validity and internal consistency reliability analyses indicated that the scale is both valid and reliable.

ARTICLE INFO

Keywords: Attitudes, Climate resilient, Content validity, Cronbach's alpha, Dairy farmers, Guttman split-half coefficient, Likert scale, Spearman-brown coefficient.

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ABSTRACT

The study, carried out in 2025, aimed to develop a tool for assessing dairy farmers' attitudes toward climate-resilient dairy farming practices. For this purpose, an attitude scale was created using a Likert-type scale development method. Initially, 50 statements were compiled (both positive and negative) together and later improved in accordance with Edward's fourteen principles for constructing scales. The overall mean relevancy score obtained was 3.191. In a non-sampling area, a pilot study involving 60 farmers was undertaken, after which 27 statements were kept for subsequent analysis. Subsequently, after calculating the t-values for all statements, 23 had t-values of 1.75 or higher. A Cronbach's alpha of 0.732 indicated the scale's internal consistency, and the scale's content validity was determined based on the experts' evaluation. This completed scale is suitable for measuring the attitude of dairy farmers toward climate-responsive dairy practices in the current research setting, and with proper contextual adjustments, it can be used in other regions as well.

INTRODUCTION

Climate change is a global phenomenon with region-specific and localized effects. In India, livestock serves as a major source of livelihood, particularly for small and marginal dairy farmers who possess limited resources and a few animals. However, livestock are highly sensitive to climatic variations and simultaneously contribute to greenhouse gas emissions. Among the major economic impacts of climate-induced stress, the decline in milk yield is particularly significant. Upadhayay et al. (2007) projected that rising temperatures could reduce India's overall milk production by more than 15 million tonnes. Climatic factors such as heat waves, floods, and droughts adversely affect livestock health, productivity, and reproduction (Reddy et al., 2023). Consequently, variations in rainfall patterns and increased ambient temperature led to feed and water scarcity, deterioration of animal health and decline in milk productivity (Reddy et al., 2023). Furthermore, reproductive and productive performances of dairy animals are negatively affected under climatic stress conditions (Bossche & Coetzer, 2008).

Dairy farming remains an essential livelihood for rural households, offering steady income and employment opportunities

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(Reddy et al., 2023). Growing consumer demand for milk and milk-based products has further strengthened its economic significance (Mohapatra et al., 2012). However, the sustainability of this sector is increasingly threatened by climate variability and extreme weather events. These conditions force dairy animals to divert energy toward thermoregulation, limiting their production potential even within normal temperature ranges (Banerjee et al., 2023). The rising frequency of heatwaves and erratic rainfall patterns has intensified these challenges, leading to considerable declines in milk production and significant income losses for farmers (Reddy et al., 2024).

Uttar Pradesh, the largest milk-producing state in India, relies heavily on mixed crop–livestock systems, where dairy farming provides crucial supplementary income to resource-poor households (Yadav et al., 2022). Yet climate-related uncertainties have already caused substantial losses, and these are projected to increase in the coming years. Studies indicate that dairy cattle in the state may experience up to a 30% decline in milk yield due to heat stress, accompanied by higher mortality rates resulting from increased disease susceptibility (Sukumaran & Y C, 2025). Heat stress–related losses in the Northern Plains may reach INR 12.44 billion annually, underscoring the severe economic burden on dairy farmers (Choudhary & Sirohi, 2022). This vulnerability is compounded by the relatively low productivity of indigenous cattle breeds under sub-optimal conditions, compared to the higher yields observed in buffaloes under improved management systems (Singh & Ukey, 2024). These impacts highlight the urgent need for climate-resilient dairy strategies in regions highly vulnerable to climatic shifts (Pandey et al., 2022; Banerjee et al., 2023).

Effectively addressing these challenges requires promoting the adoption of climate-responsive practices. Understanding farmers' knowledge, attitudes and perceptions is critical for strengthening their intention to adopt such measures (Ghanghas et al., 2015; Bharat et al., 2021). The widely used Likert technique provides a reliable method for assessing these attitudes (Özsayýn, 2023). Hence, a region-specific Likert-type scale is essential for accurately measuring attitudes toward climate-resilient dairy farming (Kumar, 2023; Seji et al., 2023).

METHODOLOGY

An attempt was undertaken to evaluate how dairy farmers perceive climate-resilient dairy farming practices. The Likert's Summated Rating Scale technique was employed for the construction of the attitude scale, as it effectively captures individual or subject-centred differences among respondents regarding specific aspects (Ramya et al., 2019). The methodological framework suggested by Shitu et al. (2018), Reddy et al. (2023), Chandra et al. (2024), and Singh et al. (2025) was followed for scale development. Initially, a pool of 50 attitude statements related to climate-resilient dairy farming practices was generated through a review of literature, consultation with experts, and field observations. These statements were then evaluated against 14 criteria for attitude statement construction as proposed by Edwards (1957) and Wing (1932). After scrutiny, 23 statements were found relevant to the objectives of the study and were retained for further analysis. The selected statements were arranged in a five-point continuum, ranging from strongly agree to strongly disagree, and compiled into a preliminary questionnaire. To obtain expert validation, the questionnaire was sent to 100 professionals possessing specialized knowledge in animal husbandry, dairy science, and extension education. Based on the experts' feedback, a pilot study was conducted with 60 randomly selected dairy farmers from non-sampling villages, namely Sheer Goverdhanpur and Narottampur, located around Varanasi city (Uttar Pradesh). During item analysis, the t-values were calculated for each statement, and those with a t-value equal to or greater than 1.75 were retained following the procedure outlined by Edwards (1957). Consequently, 27 statements were eliminated, and 23 statements were finally included in the attitude scale used for the study.

$$RW = \frac{MR+R+SWR+LR+NR}{MPS}$$

$$MRS = \frac{MR+R+SWR+LR+NR}{n}$$

Whereas, MR = Most relevant (5), R= Relevant (4), SWR = Some What Relevant (3), LR= Less Relevant (2), NR= Not Relevant (1), MPS= Maximum Possible Score (40×5 = 200), n=Number of judges (40)

$$OMRS = \frac{MR+R+SWR+LR+NR}{\text{Number of Judges} \times \text{Number of statements}}$$

$$t = \frac{\bar{X}H - \bar{X}L}{\sqrt{\frac{\Sigma(X_H - \bar{X}_H)^2 + \Sigma(X_L - \bar{X}_L)^2}{n(n-1)}}}$$

Whereas,

$$\Sigma(X_H - \bar{X}_H)^2 = \Sigma(X_H)^2 - \frac{(\Sigma X_H)^2}{n} \text{ and } \Sigma(X_L - \bar{X}_L)^2 = \Sigma(X_L)2 - \frac{(\Sigma X_L)^2}{n}$$

$\bar{X}_H$ = Mean score of given statements in the high group,

$\bar{X}_L$ = Mean score of given statements in the low group,

$\Sigma(X_H)^2$ = Sum of squares of individual scores on a given statement for the high group,

$\Sigma(X_L)^2$ = Sum of squares of individual scores on a given statement for the low group,

ΣX_H = Summation of scores on a given statement for the high group,

ΣX_L = Summation of scores on a given statement for the low group,

Items were selected on criterion; Relevancy Weightage (RW) > 0.80, Mean Relevancy Score (MRS) > Overall Mean Relevancy Score (OMRS), *i.e.,* 3.191

A constructed scale was developed with the help of 40 experts belonging to the field of animal husbandry and dairy professionals. They reviewed all of the revised statements and gave their expertise on the scrutinize of the final statements. There are 23 items considered to assess the attitude towards climate-resilient dairy farming practices. The Cronbach's alpha coefficient was determined using an SPSS tool. The scale was administered to 60 dairy farmers of non–sampling areas. The scale reliability was assessed using the split-half method. The scale was divided into two sets on the basis of odd and even numbers of items with the help of the following formula.

$$R = \frac{2r}{1+r}$$

Whereas, R = reliability coefficient of the whole scale
r = Estimated correlation between two (sets) halves

RESULTS

Table 1 presents the t-values for the selected items, encompassing statements related to climate-resilient dairy farming practices. For scale standardization, reliability was measured using the split-half approach (Spearman-Brown coefficient), Pearson correlation, and Cronbach's alpha, and content validity was determined through expert evaluation.

Assessment of the scale's validity and reliability

The internal consistency reliability of the Dairy Farmers' Attitudes toward Climate-Resilient Dairy Farming Scale was checked using a number of reliability coefficients by using SPSS 22. The 23 items were divided into two sets, one with 12 items and the other with 11, for using the split half method (Combination presented at the bottom of Table 2). Although Cronbach's alpha for the two split halves of the attitude scale was moderate (Part 1 = .531; Part 2 = .501), this does not indicate poor reliability of the overall instrument. In split-half analysis, each half contains fewer items, and Cronbach's alpha is highly sensitive to the number of items in a scale. Shorter scales inherently produce lower alpha values even when the items are internally consistent (Vaske et al., 2017). For the full 23 item scale, Cronbach's alpha was .732, suggesting acceptable internal consistency for measuring dairy farmers' attitudes toward climate resilient dairy farming. The correlation between the two halves was .762, showing a strong relationship between them. After applying the Spearman–Brown formula, the reliability estimate rose to .865 (for both equal and unequal length), which reflects excellent split half reliability. The Guttman Split Half coefficient was very similar at .861, further supporting the strength of the measure. Overall, these results show that the scale is reliably measuring the intended attitudes and is suitable for use in this context.

A scale is considered valid if it precisely reflects the construct it is intended to evaluate. Content validity was established by gathering statements from existing literature and consulting experts in animal husbandry with extensive experience in the field, and sending them to the experts for obtaining their agreement about the

Table 2. Reliability Coefficients of the Attitude Scale

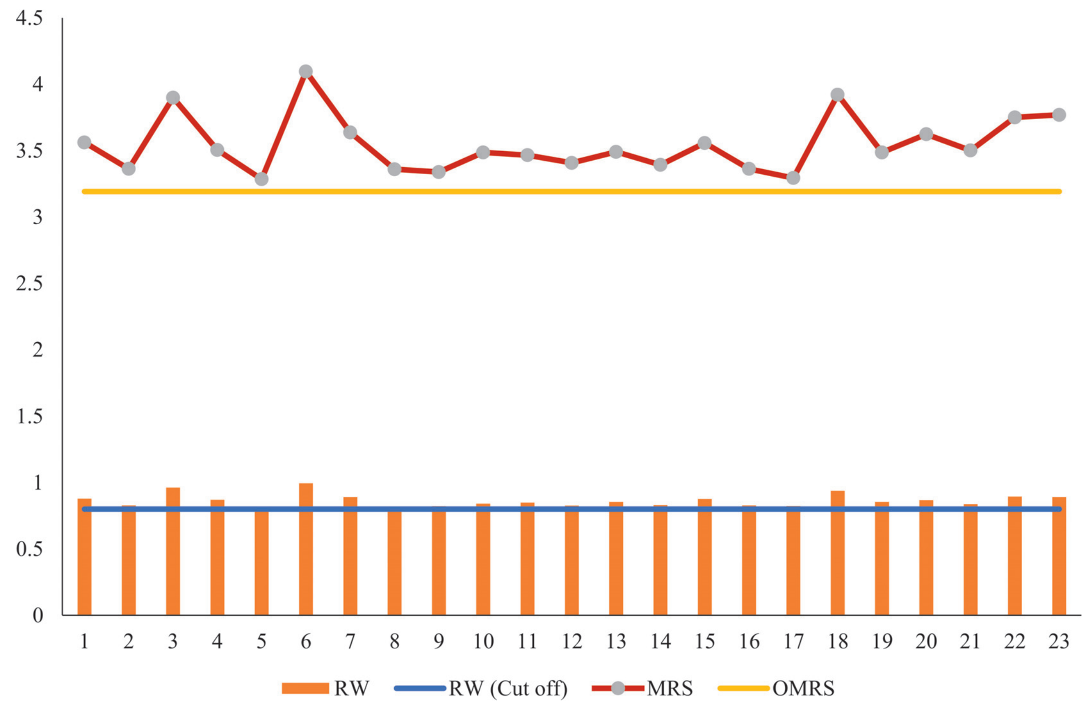
S.No.		Reliability Statistics		
1.	Cronbach's Alpha	Part 1	Value	.531
			N of Items	12[a]
		Part 2	Value	.501
			N of Items	11[b]
		Total N of Items		23
		For Whole Scale		.732
2.	Correlation Between Forms			.762
3.	Spearman-Brown Coefficient	Equal Length		.865
		Unequal Length		.865
4.	Guttman Split-Half Coefficient			.861

a. The items are: 1., 3., 5., 7., 9., 11., 13., 15., 17., 19., 21., 23.
b. The items are: 2., 4., 6., 8., 10., 12., 14., 16., 18., 20., 22.

Table 1. Final selected items of the attitude scale

S.No.	Statements	t-value
1	Proper feed management helps reduce nutrient loss and enhances sustainability.	2.484
2	Indigenous breeds utilize local feed more efficiently under harsh conditions.	2.127
3	Precision feeding helps deliver the right nutrients at the right time.	2.970
4	High-quality forage, especially with legumes, improves digestion and reduces emissions.	2.653
5	Use of sprinklers or ventilation systems helps reduce heat stress.	2.782
6	Indigenous cattle breeds are better suited to hot and humid conditions.	3.238
7	Crossbred cattle cannot survive extreme climate conditions.	3.627
8	Indigenous breeds adapt well to drought and feed scarcity.	2.809
9	Proper manure management reduces emissions and improves soil health.	2.249
10	Water conservation techniques like rainwater harvesting are important.	2.632
11	Community-based resources like fodder banks help during climate shocks.	3.094
12	Climate change increases the risk of livestock diseases.	2.670
13	Heat stress reduces semen quality in breeding bulls.	2.688
14	Regular vaccination and sanitation help prevent disease outbreaks.	2.849
15	Climate-resilient dairy practices are necessary for sustainable farming.	2.962
16	I am open to adopting new technologies that improve climate resilience.	2.925
17	Combining scientific methods with local knowledge improves farm resilience.	3.029
18	Cross-breeding can improve both productivity and climate tolerance.	3.171
19	Heat stress decreases both the quantity and quality of milk.	1.890
20	Lack of timely climate updates makes dairy planning difficult.	2.119
21	Government incentives can motivate farmers to adopt resilient practices.	3.183
22	Insurance can reduce climate-induced financial losses in livestock.	2.755
23	Preserving indigenous breeds ensures future sustainability in dairying.	2.981

Figure 1. Relevancy measures of the attitude scale against cut-off values



relevance of the items to represent the intended universe of the construct. The three indices, namely Relevancy Weightage (RW), Mean Relevancy Score (MRS), and Overall Mean Relevancy Score (OMRS), were utilized to ensure the relevance of each item based on expert judgement (Figure 1). This step was carried out before checking the reliability of the scale using respondents from a non-sampling area.

DISCUSSION

The focus of this study was to evaluate the validity and reliability of the instrument used for the data collection. To ensure the reliability of our measuring instrument, we employed the Cronbach alpha coefficient, a well-known indicator of internal consistency. Reinforcing confidence in the scale's reliability (Cronbach, 1951), a Cronbach alpha value of 0.732 reflected a satisfactory reliability of the scale. It indicates the reliability of the scale item that is used to measure the same construct across different respondents. Additionally, Additional analyses were carried out to confirm the scale's reliability, following methods employed by other researchers (Kumar et al., 2015; Ramya et al., 2019; Gupta et al., 2022; Gupta et al., 2023; Reddy et al., 2023; Chandra et al., 2024; Singh et al., 2025). A Spearman-Brown coefficient of 0.865 indicated the split-half reliability of the scale. Furthermore, the Pearson correlation coefficient among all scale items was 0.762, further confirming the strong internal consistency of the scale. Content validity ensures the reliability of items that accurately represent the construct being measured, and therefore it is crucial to measure.

CONCLUSION

In this study, the developed attitude scales provide robust tools for thoroughly assessing dairy farmers' attitudes toward climate-resilient dairy farming practices. It will be used by policymakers, researchers, and stakeholders as an effective intervention tool. Furthermore, climate change presents a serious threat to the sustainability of dairy farming, highlighting the necessity for farmers to adapt their practices to evolving environmental conditions. By assessing farmers' attitudes toward these practices, policymakers can create intervention tools that work more efficiently and effectively. These interventions will benefit farmers directly while also enhancing the overall sustainability and resilience of the dairy farming sector

DECLARATIONS

Ethics approval and informed consent: Informed consent was sought from the experts possessing specialized knowledge in animal husbandry, dairy science, and extension education to obtain validation. Based on the experts' feedback, a pilot study was conducted with 60 randomly selected dairy farmers from non-sampling villages.

Conflict of interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

The authors declare that during the preparation of this work, they thoroughly reviewed, revised, and edited the content as needed. The authors take full responsibility for the final content of this publication.

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