Research Article

Indian Journal of Extension Education
Vol. 62, No. 4 (October–December), 2026, (174-179)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Decoding the Barriers to Adoption of Dairy Interventions among Farmers: A Principal Component Analysis from Uttar Pradesh, India

Ashutosh Suryavanshi[1], B. K. Gupta[2]*, Gaurav Mishra[1], A. P. Verma[2], B. P. Mishra[3] and Gaurav Shukla[4]

[1]Research Scholar, [2]Assistant Professor, [3]Professor & Head, Department of Agricultural Extension, [4]Department of Statistics and Computer Science, Banda University of Agriculture and Technology, Banda-210001, Uttar Pradesh, India
*Corresponding author email id: bkguptabuat75@gmail.com

HIGHLIGHTS

- Dairy farmers faced severe constraints in adopting dairy interventions.
- Feed cost, fodder scarcity and veterinary treatment cost were the major constraints.
- Principal component analysis retained five components explaining 63.83 per cent of total variance.

ARTICLE INFO

Keywords: Constraint severity index, Farmer's perception, Principal component analysis, Livestock services, Fodder scarcity.

https://doi.org/10.48165/IJEE.2026.62425

Citation: Suryavanshi, A., Gupta, B. K., Mishra, G., Verma, A. P., Mishra, B. P., & Shukla, G. (2026). Decoding the Barriers to Adoption of Dairy Interventions among Farmers: A Principal Component Analysis from Uttar Pradesh, India. *Indian Journal of Extension Education*, *62*(4), 174-179. https://doi.org/10.48165/IJEE.2026.62425

Reviewed by: Dr. Joginder Singh Malik (jsmalik67@gmail.com); Dr. Kalyan Ghadei (kalyan@bhu.ac.in); Dr. Kaushal Jha (kkjhanurd@rediffmail.com); Dr. Netrapal Malik (netrapalmalik1@gmail.com

ABSTRACT

The study was conducted during 2025-26 in Banda and Bulandshahr districts of Uttar Pradesh to identify and classify perceived constraints to dairy intervention adoption among farmers. Data were collected from 240 dairy farmers through a structured interview schedule covering 20 constraints. Constraints were analysed using frequency, percentage, weighted mean score, constraint severity index and principal component analysis. The overall constraint severity index was 73.70, indicating a severe constraint situation. High cost of cattle feed ranked first with a WMS of 4.41 and CSI of 88.25, followed by year-round non-availability of green and dry fodder (WMS 4.30; CSI 86.00) and high cost of veterinary medicines and treatment (WMS 4.27; CSI 85.33). The KMO value was 0.808 and Bartlett's test was significant. Five components were retained and together explained 63.83 per cent of total variance. The components represented production-resource and input, animal-health and breeding-service, extension and participation, credit and insurance, and milk-market access and price-realisation constraints. The findings indicated that farmers perceived constraints across production, service, financial and marketing areas of dairy farming.

INTRODUCTION

Dairying is a major livelihood activity for rural households in India, particularly for small and marginal farmers who depend on livestock for regular income, nutrition and risk reduction. India produced 247.87 million tonnes of milk during 2024-25, while per capita milk availability reached 485 g/day. Uttar Pradesh remained the leading milk-producing state, contributing 15.66 per cent of national milk production (Department of Animal Husbandry and Dairying, 2025)." Uttar Pradesh is the leading milk-producing state of the country, yet dairy development benefits are not uniform across regions or farm households. Productivity and profitability depend on farmers' access to quality feed and fodder, timely veterinary care, improved breeding services, credit, training, insurance and remunerative milk markets. Improved dairy interventions in breeding, feeding, health care, housing and management are promoted to improve animal productivity and farm income. Adoption of such practices varies across production contexts and is closely associated with the productivity status of milch animals (Pouchepparadjou et al., 2024). Dairy technology

Received 04-07-2026; Accepted 14-09-2026
The copyright: The Indian Society of Extension Education (https://www.iseeiari.org/) vide registration number L-129744/2023

adoption is shaped by enabling services, farm resources and the cost of using improved practices (Korir et al., 2023). Kaushik et al. (2024) identify lack of support, high cost and investment-related barriers as major challenges in dairy technology adoption, while Erdem and Agir (2024) relate adoption to income, investment, breed ownership and advisory interaction. Kirimi et al. (2024) report that income, education, credit, extension contact and farmer group participation influence adoption of modern dairy technologies. Reddy et al. (2024) identified knowledge, education and extension access as important factors in adoption of climate-resilient dairy farming practices. High feed cost, fodder scarcity, veterinary expenses, poor access to artificial insemination, credit difficulty, weak insurance coverage and unstable milk prices can restrict farmers' use of recommended interventions. Earlier dairy constraint studies report feed cost, veterinary expenditure, fodder scarcity, weak extension support, credit limitations, high input cost and lack of technical knowledge as important barriers to improved dairy farming (Gupta et al., 2013; Singh et al., 2016; Dhaka et al., 2017; Panchbhai et al., 2017; Smitha et al., 2019). Similar constraints related to green fodder, concentrate availability, veterinary service charges, emergency treatment and milk marketing are reported by Barman et al. (2024). Acharya et al. (2022) identify gaps in adoption of sustainable dairy management practices where management conditions and service access are limiting. In eastern Uttar Pradesh, Maurya et al. (2025) report that marginal and small dairy farmers face important institutional and financial constraints, with insurance-related problems emerging strongly. Recent evidence from Uttar Pradesh also shows that dairy farmers prefer low-cost and easily available feeding options (Shruti et al., 2025). The present study is located in two contrasting dairy situations of Uttar Pradesh. Bulandshahr represents a comparatively developed dairy production environment of Western Uttar Pradesh, whereas Banda represents Bundelkhand, where livestock production operates under comparatively greater limitations in water, feed resources and institutional support (Mishra et al., 2026). This contrast provides a useful setting to examine constraints affecting adoption of dairy interventions. Constraint severity analysis is used to assess the seriousness of individual constraints, while principal component analysis is applied to examine broader patterns among the constraint variables for extension planning and dairy-development support.

METHODOLOGY

The study was conducted during 2025-26 in Banda and Bulandshahr districts of Uttar Pradesh. The districts were purposively selected to represent contrasting dairy-production situations, with Bulandshahr representing Western Uttar Pradesh and Banda representing Bundelkhand. Two development blocks were selected randomly from each district, followed by four villages selected randomly from each block. Dairy farmers possessing at least two dairy animals were considered eligible, and 15 eligible farmers were selected randomly from each village, giving a total sample of 240 farmers. Inference was restricted to the two contrasting study settings. Primary data were collected through personal interviews using a structured and pre-tested interview schedule. Constraint items were identified through literature review, field observations, stakeholder consultation, expert scrutiny and pre-testing. The final schedule contained 20 constraints covering production resources, animal-health and breeding services, institutional support, credit and insurance, extension contact, milk marketing, labour and social participation. Internal consistency of the 20-item scale was satisfactory (Cronbach's $\alpha = 0.812$). Each constraint was rated on a five-point continuum from very severe to not a constraint, with scores of 5 to 1. Item scores ranged from 1 to 5 and the total possible score from 20 to 100.

Constraints were analysed using frequency, percentage, Weighted Mean Score (WMS) and Constraint Severity Index (CSI). WMS was computed as $WMS_j = \Sigma f_{ij}\ s_i/N$, where f_{ij} was the frequency in the i^{th} response category, s_i was the corresponding score and N was the number of respondents. CSI was calculated as $CSI_j = (WMS_j/5) \times 100$, following the weighted constraint-severity approach used in agricultural constraint analysis (Innazent et al., 2022). Equal class intervals of 0.80 classified WMS values of 4.21 to 5.00, 3.41 to 4.20, 2.61 to 3.40, 1.81 to 2.60 and 1.00 to 1.80 as very severe, severe, moderately severe, less severe and not a constraint, respectively. Principal Component Analysis (PCA) was applied to all 20 constraint variables. Suitability was assessed using the Kaiser-Meyer-Olkin measure, Bartlett's test of sphericity, individual Measures of Sampling Adequacy and extraction communalities. Components were initially examined using eigenvalues greater than one and the scree plot. The retention decision was further assessed through parallel analysis using 1,000 random datasets and the 95th-percentile criterion (O'Connor, 2000). Varimax rotation with Kaiser normalization was applied. Absolute component loadings of 0.50 or above were used for interpretation, and component names were assigned from the substantive meaning of the variables with the strongest loadings. Data were analysed using IBM SPSS Statistics 26.

RESULTS

Table 1 presents the constraints perceived by dairy farmers in the adoption of dairy interventions. The overall mean WMS was 3.69 and the overall CSI was 73.70, indicating a severe level of constraints. Three constraints were rated very severe. High cost of cattle feed ranked first with a WMS of 4.4125 and CSI of 88.25, followed by non-availability of green and dry fodder round the year (WMS 4.3000; CSI 86.00) and high cost of veterinary medicines and treatment (WMS 4.2667; CSI 85.33). Twelve constraints were classified as severe and four as moderately severe. Social or family restrictions limiting participation in training or dairy activities received the lowest WMS of 2.5708 and CSI of 51.42 and were classified as less severe.

Table 2 presents the sampling adequacy and extraction communalities of the 20 constraint variables used in principal component analysis. The Kaiser-Meyer-Olkin value was 0.808 and Bartlett's test of sphericity was significant ($÷^2 = 1662.152$, df = 190, $p < 0.001$), supporting the use of PCA. Individual MSA values ranged from 0.669 to 0.897, while extraction communalities ranged from 0.525 to 0.713. All variables recorded MSA and communality values above 0.50 and were retained for component extraction.

Table 3 presents the eigenvalues and variance explained by the retained principal components. Five components had eigenvalues greater than one. Component I had an eigenvalue of 4.552 and

Table 1. Constraints perceived by dairy farmers in adoption of dairy interventions

S.No.	Constraint	WMS	CSI	Severity	Rank
1.	High cost of cattle feed	4.4125	88.25	Very severe	I
2.	Non-availability of green and dry fodder round the year	4.3000	86.00	Very severe	II
3.	High cost of veterinary medicines and treatment	4.2667	85.33	Very severe	III
4.	Non-availability/high cost of improved/crossbred dairy animals	4.0583	81.17	Severe	IV
5.	Inadequate land or irrigation for fodder cultivation	3.9750	79.50	Severe	V
6.	Delay in emergency veterinary care	3.9167	78.33	Severe	VI
7.	Lack of need-based training and technical guidance	3.8583	77.17	Severe	VII
8.	Frequent animal-health issues/disease outbreaks	3.8000	76.00	Severe	VIII
9.	Low milk yield from local/non-descript animals	3.7833	75.67	Severe	IX
10.	Lack of regular interaction with extension/veterinary staff	3.7042	74.08	Severe	X
11.	Low and fluctuating prices received for milk	3.6875	73.75	Severe	XI
12.	Poor access to livestock insurance/claim procedures	3.6333	72.67	Severe	XII
13.	Difficulty obtaining cattle loans from banks	3.6083	72.17	Severe	XIII
14.	High labour cost for dairy management	3.5500	71.00	Severe	XIV
15.	Dependence on middlemen for milk marketing	3.5042	70.08	Severe	XV
16.	High interest/inflexible terms on cattle loans	3.4000	68.00	Moderately severe	XVI
17.	Low conception rate after artificial insemination	3.3833	67.67	Moderately severe	XVII
18.	Difficulty accessing quality artificial insemination services nearby	3.2833	65.67	Moderately severe	XVIII
19.	Absence of milk collection/chilling centres in village	3.0042	60.08	Moderately severe	XIX
20.	Social/family restrictions limiting participation in training/dairy activities	2.5708	51.42	Less severe	XX

Overall mean WMS = 3.69; Overall CSI = 73.70; Overall severity category = Severe.
Note: WMS = Weighted Mean Score; CSI = Constraint Severity Index.

Table 2. Sampling adequacy and communalities of constraint variables used in PCA

Particulars	Value
A. KMO and Bartlett's test	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	0.808
Bartlett's Test of Sphericity: Approx. Chi-square	1662.152
Degrees of freedom	190
Significance under Bartlett's test	<0.001

Particulars	Extraction communality	Individual MSA
B. Extraction communalities of constraint variables		
High cost of cattle feed	0.662	0.857
High cost of veterinary medicines and treatment	0.642	0.818
Non-availability of green and dry fodder round the year	0.583	0.882
Inadequate land or irrigation for fodder cultivation	0.638	0.827
High labour cost for dairy management	0.525	0.897
Lack of need-based training and technical guidance	0.700	0.669
Difficulty accessing quality artificial insemination services nearby	0.556	0.867
Low conception rate after artificial insemination	0.563	0.848
Frequent animal-health issues/disease outbreaks	0.650	0.818
Delay in emergency veterinary care	0.685	0.833
Difficulty obtaining cattle loans from banks	0.660	0.776
High interest/inflexible terms on cattle loans	0.656	0.789
Poor access to livestock insurance/claim procedures	0.713	0.734
Low milk yield from local/non-descript animals	0.584	0.816
Non-availability/high cost of improved/crossbred dairy animals	0.581	0.889
Lack of regular interaction with extension/veterinary staff	0.691	0.700
Absence of milk collection/chilling centres in village	0.670	0.728
Dependence on middlemen for milk marketing	0.707	0.693
Low and fluctuating prices received for milk	0.690	0.730
Social/family restrictions limiting participation in training/dairy activities	0.609	0.783

Individual MSA values were obtained from the diagonal of the anti-image correlation matrix. MSA = Measure of Sampling Adequacy.

Table 3. Total variance explained by retained principal components

Component	Initial eigenvalue	Variance explained (%)	Cumulative variance (%)	Rotated sum of squared loadings	Rotated variance (%)	Rotated cumulative variance (%)
I	4.552	22.761	22.761	3.510	17.550	17.550
II	2.876	14.382	37.143	3.014	15.068	32.617
III	1.920	9.601	46.744	1.932	9.662	42.279
IV	1.842	9.210	55.954	2.208	11.042	53.321
V	1.575	7.877	63.831	2.102	10.511	63.831

Parallel analysis based on 1,000 random datasets and the 95th-percentile criterion supported retention of five components. The observed eigenvalues for Components I-V exceeded the corresponding random eigenvalues, while Component VI did not.

explained 22.761 per cent of the total variance, followed by Components II, III, IV and V with eigenvalues of 2.876, 1.920, 1.842 and 1.575, respectively. Together, the five components explained 63.831 per cent of the total variance. After Varimax rotation, Components I-V accounted for 17.550, 15.068, 9.662, 11.042 and 10.511 per cent of the variance, respectively. Parallel analysis supported the same five-component solution. The observed eigenvalues for Components I-V exceeded their corresponding 95th-percentile random eigenvalues of 1.649, 1.517, 1.431, 1.354 and 1.293, whereas the sixth observed eigenvalue (0.705) was lower than the corresponding random eigenvalue (1.235).

The scree plot in Figure 1 showed a decline across the first five components followed by a marked drop between Components V and VI and a gradual flattening thereafter. Five components had eigenvalues greater than one. The scree pattern and parallel analysis both supported retention of the five-component solution.

Table 4 presents the Varimax-rotated component matrix of the 20 constraint variables. Absolute loadings of 0.50 or above were considered for interpretation. All variables recorded a loading above 0.50 on one component, with no salient cross-loadings at the adopted cut-off. Component I comprised six constraints related

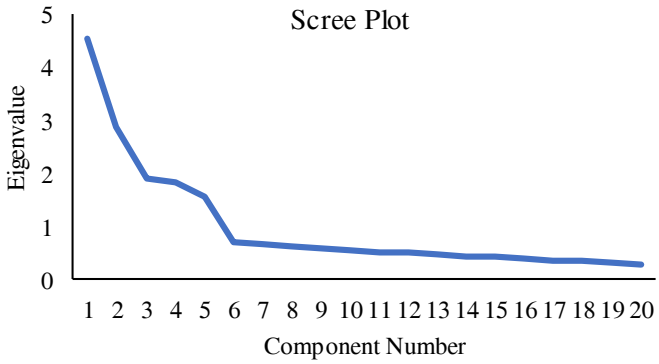

Figure 1. Scree plot showing eigenvalues of principal components

mainly to feed and fodder resources, labour, milk yield and access to improved dairy animals, and was termed production-resource and input constraints. Component II contained five constraints concerning veterinary care, animal health and artificial insemination and was termed animal-health and breeding-service constraints. Component III grouped need-based technical guidance, interaction with extension or veterinary personnel and restrictions on

Table 4. Rotated component matrix of perceived constraints to dairy intervention adoption

Constraint variable	Component I	Component II	Component III	Component IV	Component V
High cost of cattle feed	0.806				
Inadequate land or irrigation for fodder cultivation	0.789				
Low milk yield from local/non-descript animals	0.751				
Non-availability/high cost of improved/crossbred dairy animals	0.742				
Non-availability of green and dry fodder round the year	0.736				
High labour cost for dairy management	0.676				
Frequent animal-health issues/disease outbreaks		0.800			
Delay in emergency veterinary care		0.790			
High cost of veterinary medicines and treatment		0.772			
Difficulty accessing quality artificial insemination services nearby		0.739			
Low conception rate after artificial insemination		0.714			
Lack of need-based training and technical guidance			0.833		
Lack of regular interaction with extension/veterinary staff			0.801		
Social/family restrictions limiting participation in training/dairy activities			0.703		
Poor access to livestock insurance/claim procedures				0.838	
High interest/inflexible terms on cattle loans				0.793	
Difficulty obtaining cattle loans from banks				0.785	
Dependence on middlemen for milk marketing					0.831
Low and fluctuating prices received for milk					0.818
Absence of milk collection/chilling centres in village					0.803

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser normalization.

participation and was termed extension and participation constraints. Component IV comprised three constraints related to cattle loans and livestock insurance and was termed credit and insurance constraints. Component V grouped milk collection, dependence on middlemen and milk-price problems and was termed milk-market access and price-realisation constraints.

DISCUSSION

The overall Constraint Severity Index of 73.70 places the perceived constraints of dairy farmers in the severe category. High cost of cattle feed, year-round non-availability of green and dry fodder, and high cost of veterinary medicines and treatment occupy the first three ranks. These are regular requirements in dairy farming and add to the cost of maintaining recommended feeding and health-care practices. Smitha et al. (2019) similarly identify cattle-feed cost and expenditure on veterinary services and medicines among the major constraints of dairy farmers in Kerala. Barman et al. (2024) also report limited concentrate availability, high veterinary charges and difficulty in obtaining emergency treatment among important dairy-farming constraints. Comparable findings from Jabalpur identify year-round green fodder shortage, veterinary treatment cost, low conception after artificial insemination and low milk price among important dairy-farming constraints (Somtiya et al., 2024). The next group of highly ranked constraints includes the cost or non-availability of improved dairy animals, inadequate land or irrigation for fodder cultivation, delay in emergency veterinary care, lack of need-based technical guidance, frequent animal-health problems and limited interaction with extension or veterinary personnel. The ranking shows that farmers' difficulties are not confined to input prices; access to production resources and timely technical and veterinary services also remains important. Dhaka et al. (2017) report constraints related to knowledge, extension support and credit in the adoption of improved dairy practices. Maurya et al. (2025) also identify financial and institutional difficulties among dairy farmers in eastern Uttar Pradesh, with livestock insurance emerging as an important concern. Social or family restrictions receive the lowest rank in the present study, indicating that production, financial and service-related problems are rated more seriously within the set of constraints examined.

PCA provides a complementary view by showing which constraint ratings vary together across farmers. The five retained components explain 63.83 per cent of the total variance. Component I groups feed cost, fodder and land resources, labour cost, milk yield and access to improved dairy animals, forming a production-resource and input component. The inclusion of feed and fodder constraints in this component is consistent with their high position in the severity ranking. Component II brings together veterinary treatment cost, disease problems, emergency veterinary care and the two artificial-insemination constraints, giving a distinct animal-health and breeding-service component. The remaining components represent more specific institutional areas. Component III combines need-based training, regular interaction with extension or veterinary personnel and restrictions on participation. Component IV groups cattle-loan access, loan terms and livestock insurance, while Component V contains absence of milk collection or chilling facilities, dependence on middlemen and low or fluctuating milk prices. A similar combination of veterinary access, artificial insemination, credit, feed, technical knowledge and milk-marketing constraints has been reported among dairy farmers in northern Bihar (Saurav et al., 2024). Similarly group dairy constraints into service delivery, local market, artificial insemination, affordability and awareness-related categories using PCA. Gupta et al. (2021) also report separate patterns related to breeding, feeding, health care, management, marketing and finance. The present structure follows this broader pattern, although the composition of the components reflects the production and institutional conditions of the study area. The severity ranking and PCA serve different but complementary purposes. WMS and CSI identify the constraints rated most seriously by farmers, whereas PCA groups constraints according to similarity in their response patterns. Feed and fodder costs require particular attention because of their high severity, while the component structure also identifies veterinary and breeding services, extension contact, credit and insurance, and milk marketing as separate areas of concern. Dairy-development efforts in the study districts should combine technical guidance with reliable service access and stronger financial and marketing support.

CONCLUSION

Dairy farmers in the study area face considerable production, service, financial and marketing constraints in using recommended dairy interventions. High feed cost, year-round fodder scarcity and veterinary treatment cost emerge as the most serious concerns. The component analysis further separates the constraints into five groups associated with production resources and inputs, animal-health and breeding services, extension and participation, credit and insurance, and milk marketing. The findings indicate that addressing individual constraints alone may leave other important difficulties unresolved. Greater availability of fodder resources, timely veterinary and breeding services, regular need-based technical guidance, easier access to institutional credit and livestock insurance, and stronger local milk-marketing arrangements are required to improve the conditions under which dairy farmers adopt and continue recommended practices.

DECLARATION

Ethics approval and informed consent: Informed consent was sought from the respondents regarding the study during the course of the data collection. The study involved no invasive procedure on human participants as such the committee of Department of Extension Education, BUAT Banda, India waived the ethical approval.

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.

Author's contributions: Conceptualisation of research (AS, BKG); methodology and design of the study (AS, BKG, APV, BPM); field investigation and data collection (AS); statistical analysis and interpretation (AS, GS); interpretation of findings (AS, BKG, GM,

APV, BPM, GS); preparation of the original manuscript (AS); review and revision of the manuscript (BKG, GM, APV, BPM, GS); supervision of the research (BKG). All authors read and approved the final manuscript.

Publisher's note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organisations, or those of the publisher, the editors, and the reviewers. Any product/ process or technology that may be evaluated in this article, or a claim that its manufacturer may make, is not guaranteed or endorsed by the publisher. The Indian Journal of Extension Education remains neutral with regard to jurisdictional claims.

REFERENCES

Acharya, K. K., Malhotra, R., Sendhil, R., Mohanty, T. K., & Sahoo, B. (2022). Adoption of sustainable dairy management practices among peri-urban dairy farmers in Odisha. *Indian Journal of Extension Education, 58*(3), 120-125. https://epubs.icar.org.in/index.php/IJEE/article/view/124981

Barman, B., Mohammad, A., Kisku, U., & Lepcha, C. Y. (2024). Exploring dairy farming practices and perceived constraints: A study of Rajbanshi farmers in Coochbehar. *Indian Research Journal of Extension Education, 24*(1), 44-52. https://doi.org/10.54986/irjee/2024/jan_mar/44-52

Department of Animal Husbandry and Dairying. (2024). Basic Animal Husbandry Statistics 2024. Ministry of Fisheries, Animal Husbandry and Dairying, Government of India.

Dhaka, B. L., Meena, G. S., Meena, N. L., Bairwa, R. K., & Nagar, B. L. (2017). Constraints analysis in adoption of improved dairy farming practices in Bundi district of Rajasthan. *Chemical Science Review and Letters*, 6(22), 995-999.

Erdem, M., & Agir, H. B. (2024). Enhancing dairy farm welfare: A holistic examination of technology adoption and economic performance in Kahramanmaraº Province, Turkey. *Sustainability, 16*(7), 2989. https://doi.org/10.3390/su16072989

Gupta, R. K., Saha, A., & Gupta, A. (2021). Identifying the perceived constraints of tribal dairy farmers by using principal component analysis: Insights from dairy farming in Balrampur District of Northern Hill Region, Chhattisgarh. *Journal of Community Mobilization and Sustainable Development, 16*(2), 357-366.

Gupta, B., Kher, S. K., & Nain, M. S. (2013). Entrepreneurial behaviour and constraints encountered by dairy and poultry entrepreneurs in Jammu Division of J&K State. *Indian Journal of Extension Education, 49*(3&4), 126-129.

Innazent, A., Jacob, D., Bindhu, J. S., Joseph, B., Anith, K. N., Ravisankar, N., Prusty, A. K., Paramesh, V., & Panwar, A. S. (2022). Farm typology of smallholders integrated farming systems in Southern Coastal Plains of Kerala, India. *Scientific Reports, 12*, 333. doi:10.1038/s41598-021-04148-0.

Kaushik, H., Rajwanshi, R., & Bhadauria, A. (2024). Modeling the challenges of technology adoption in dairy farming. *Journal of Science and Technology Policy Management, 15*(6), 1455-1480. https://doi.org/10.1108/JSTPM-09-2022-0163.

Kirimi, A. K., Nyarindo, W. N., & Gatimbu, K. K. (2024). Is adoption of modern dairy farming technologies interrelated? A case of smallholder dairy farmers in Meru County, Kenya. *Heliyon, 10*(19), e38157. https://doi.org/10.1016/j.heliyon.2024.e38157

Korir, L. K., Manning, L., Moore, H. L., Lindahl, J. F., Gemechu, G., Mihret, A., Berg, S., Wood, J. L. N., & Nyokabi, N. S. (2023). Adoption of dairy technologies in smallholder dairy farms in Ethiopia. *Frontiers in Sustainable Food Systems, 7*, 1070349. https://doi.org/10.3389/fsufs.2023.1070349

Maurya, A. S., Yadav, B., Srivastava, A. K., Bhavesh, & Malik, J. S. (2025). Perceived constraints among dairy farmers in Eastern India using logistic regression. *Indian Journal of Extension Education, 61*(4), 201-207. https://doi.org/10.48165/IJEE.2025.614RN03

Mishra, G., Gupta, B. K., Mishra, B. P., Verma, A. P., Mishra, D., & Shukla, G. (2026). Assessing climate change adaptation strategies among livestock rearers in Bundelkhand Region, India. *Indian Journal of Extension Education, 62*(1), 129-134. https://doi.org/10.48165/IJEE.2026.62121

O'Connor, B. P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. *Behavior Research Methods, Instruments, & Computers, 32*(3), 396-402. https://doi.org/10.3758/BF03200807

Panchbhai, G. J., Siddiqui, M. F., Sawant, M. N., Verma, A. P., & Parmeswaranaik, J. (2017). Constraints faced by co-operative dairy farmers in adoption of recommended dairy management practices. *International Journal of Current Microbiology and Applied Sciences, 6*(3), 1962-1966. https://doi.org/10.20546/ijcmas.2017.603.223

Pouchepparadjou, A., George Paradis, S., Swaminathan, N., Sivasakthi Devi, T., Venkatesan, S., & Umamaheswari, L. (2024). Adoption of dairy farming practices and productivity status of milch cows in the Union Territory of Puducherry. *The Indian Journal of Animal Sciences, 94*(7), 642-645. https://doi.org/10.56093/ijans.v94i7.150359

Reddy, D. A., Garai, S., Veldandi, A., Maiti, S., & Meena, B. S. (2024). Exploring the determinants of higher level of adoption of climate-resilient dairy farming practices. *Indian Research Journal of Extension Education, 24*(3), 111-119. https://doi.org/10.54986/irjee/2024/apr_jun/111-119

Saurav, S. K., Chandran, V., Chakravarty, R., Ponnusamy, K., Meena, B. S., Malhotra, R., & Bhakat, M. (2024). Perceived constraints and benefits of dairy farming practices in northern Bihar: A Garrett ranking analysis. *Journal of Community Mobilization and Sustainable Development, 19*(2), 287-293. https://doi.org/10.5958/2231-6736.2024.00098.3

Shruti, Yadav, S., Singh, M., Kala, A., Verma, H., & Choudhary, K. (2025). Mapping dairy farmers' preferences for improved feeding practices using paired comparison method. *Indian Journal of Extension Education, 61*(4), 25-30. https://doi.org/10.48165/IJEE.2025.61405.

Singh, V., Gupta, J., & Nain, M. S. (2016). Role and status of antecedent characteristics of dairy farmers in quality milk production. *Indian Journal of Extension Education, 52*(3&4), 171-176.

Smitha, S., Devi, M. C. A., Devi, L. G., & Subash, S. (2019). Analysis of constraints in dairy farming in Kerala-multi stakeholder perspective. *Indian Journal of Dairy Science, 72*(3), 342-346. https://doi.org/10.33785/IJDS.2019.v72i03.016

Somtiya, A., Naberia, S., Rajan, P., Shrivastava, A., & Singh, U. (2024). Perceived constraints and strategic recommendations by commercial dairy farmers in Jabalpur, Madhya Pradesh, India. *Asian Journal of Agricultural Extension, Economics & Sociology*, *42*(6), 270-275. https://doi.org/10.9734/ajaees/2024/v42i62489