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UNVEILING AND PRIORITIZING DAIRY CONSTRAINTS FACED BY SCHEDULED CASTE HOUSEHOLDS

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ABSTRACT

India, the world's most populous country, relies heavily on agriculture and allied sectors for sustaining rural livelihoods, with the dairy sector serving as a cultural and economic backbone. Rajasthan, an arid state with a significant Scheduled Caste (SC) population, depends extensively on animal husbandry due to its limited agricultural potential. However, SC dairy farmers face multiple production and market-related challenges that restrict livelihood enhancement. The present study aimed to identify and prioritize constraints faced by SC households engaged in dairy farming in Rajasthan's arid districts of Bikaner and Hanumangarh. Employing an ex-post facto research design, data were collected from 240 respondents selected from six villages. The Analytical Hierarchy Process (AHP) was used to determine the relative importance of constraints through pairwise comparisons and to assess consistency ratios. Results revealed breeding constraints as the most critical (priority weight = 0.49), primarily due to poor heat detection knowledge and inadequate artificial insemination services. Feeding constraints ranked second (0.23), dominated by high feed costs and green fodder scarcity, while healthcare constraints (0.16) stemmed from limited veterinary availability and costly private services. Marketing constraints (0.12) were relatively less severe, with non-remunerative milk prices and lack of organized cooperatives emerging as key issues. The study concludes that targeted interventions such as improved reproductive management, feed resource development, affordable veterinary care, and strengthened market linkages are essential to enhance dairy productivity and ensure sustainable livelihoods for marginalized SC communities in Rajasthan's arid ecosystem.

Keywords: *arid, constraints, dairy, livelihood, productivity*

INTRODUCTION

India, the most populated country in the world with 1.43 billion people (Hertog et al., 2023), relies heavily on agriculture and allied activities for sustaining rural livelihoods. Within this framework, the dairy sector plays a pivotal role, both culturally and economically. India ranks first globally in milk production, contributing 24.76 per cent of total output, with production rising from 146.31 million tonnes in 2014–15 to 239.30 million tonnes in 2023–24 per capita supply has gone up by 48 percent, with more than 471 grams a day in 2023-24, well above the global average of 329 grams. The livestock sector contributes 30.23 per cent of Gross Value Added (GVA) in agriculture and allied activities, and 5.50 per cent of national GVA (2014–15 to 2022–23), making it a cornerstone of food security and rural development (Srivastava, 2015).

Rajasthan, the largest state by area, holds a significant share of India's Scheduled Caste (SC) population, comprising 17.78 per cent of residents and spread across 59 subgroups (Pareek & Sole, 2019). Despite their large numbers, most SC households remain socio-economically disadvantaged due to dispossession and poverty, relying primarily on animal husbandry for livelihood. In the state's arid and semi-arid zones, where agriculture alone is unsustainable, animal husbandry contributes 10.21 per cent to Gross State Domestic Product (GSDP) and accounts for 14.44 per cent of national milk production. With 577.32 lakh cattle (11% of India's total) recorded in the 2012 livestock census, Rajasthan produced 18.50 million tonnes of milk in 2015–16, ranking second nationally (Press Information Bureau, n.d.). Buffaloes contribute nearly 60 per cent of milk output, while resilient native breeds such as Rathi, Tharparkar, and Nagori also play a major role. However, climatic adversities such as erratic rainfall and scarce water resources constrain production. Despite progress, SC farmers face multiple barriers in dairy development. Constraints include delays in disbursing fodder development incentives (Ramesh et al., 2021), a 35.6 per cent nationwide deficit in green fodder (Kumar et al., 2023), high feed costs, and low conception rates in artificial insemination (Singodia et

al., 2019). Marketing challenges such as non-remunerative milk prices, poor storage facilities, high construction costs, and lack of veterinary services further hinder development (Meena et al., 2020; Mahammad et al., 2022; Mahammad et al., 2021). NDCS members report a lack of technical guidance and weak marketing knowledge, while DCS members face low risk-taking ability and irregular payments from vendors (Sharma et al., 2020). A majority of producers (83.67%) lack exposure to mass media, limiting awareness of improved practices (Usadadiya et al., 2023), while the unavailability of fodder seeds and slips has been identified as a critical barrier in states such as Andhra Pradesh (Rao et al., 2022). Breeding constraints include poor heat detection knowledge, feeding is affected by insufficient concentrate feeds, and veterinary services remain costly and inaccessible (Barman et al., 2024). Additional concerns, such as food insecurity (FAO, 2003), epidemic livestock diseases, inadequate compensation, and weak local governance, further aggravate challenges (Bhattacharjee et al., 2021). The previous studies have mainly focused on general constraints of dairy farmers (Meena et al., 2020; Singh et al., 2019; Gamit et al., 2021), with limited attention to caste-specific challenges faced by marginalized communities. Moreover, most analyses relied on simple ranking or scoring methods, which fail to capture the interdependence and relative importance of multiple constraint dimensions. The application of the Analytical Hierarchy Process (AHP) in the present study provides a systematic and quantitative approach to prioritize these constraints based on their relative weights and consistency measures. This methodological advancement fills a crucial gap by offering an objective prioritization of issues specific to SC households in the arid region of Rajasthan, thereby generating evidence for more targeted and inclusive policy interventions in the dairy sector.

OBJECTIVE

To Identify and prioritize the constraints faced by Scheduled Caste households in dairy activities

METHODOLOGY

The study followed a positivist philosophy with a deductive and quantitative approach, aimed at objectively prioritizing dairy constraints using numerical weights. A survey-based ex-post facto design was employed, as the research examined existing conditions without experimental manipulation. The study was conducted in Rajasthan's arid region, covering Bikaner and Hanumangarh districts, purposively selected for their Scheduled Caste (SC) population exceeding 25 per cent (Government of Rajasthan, Census of India, 2011). From each district, one block and three villages were selected, with 40 respondents per village, yielding a total of 240 SC dairy farmers. Data were collected during 2023–24 using a pre-tested structured interview schedule covering socio-economic and constraint dimensions. Interviews were conducted in local dialects to ensure comprehension, supplemented with field observations for contextual validation. To prioritize constraints, the Analytical Hierarchy Process (AHP) developed by Saaty (1980) was used. AHP is a structured multi-criteria decision-making method that integrates qualitative judgments into quantitative rankings through pairwise comparisons and consistency checks.

Stepwise Process of AHP

Step 1: A five n x n matrix for five components on the dairy production system to Scheduled Caste farmers, denoted as A, B, C, D and E, are created using the pairwise comparisons with the elements aij indicating the value of ith criterion relative to jth criterion, as shown in the following formula.

$$A = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{a1} & \cdots & a_{an} \end{bmatrix}$$

a_{ij} = Pairwise comparison of the i^{th} row relative to the j^{th} column.

Step 2: Forming a judgmental scale

Table 1: **Scoring pattern for pair-wise comparisons in AHP**

Which one is more important	How much
Equally Important	1
Slightly important	2
Moderate important	3
Strongly important	4
Strongly important	5
Strongly plus important	6
Very strongly important	7
Very very strongly important	8
Extremely important	9

Step 3: Filling the value in the matrix

The following expressions: $a_{ij} = 1$, $a_{ij} = 1/a$, where $a_{ij} > 0$ for all i, yield the values aij. Therefore, if element i was given a number in comparison to element j, then element j had the reciprocal value in comparison to i.

Step 4: Obtaining of normalized matrices

$$B = \begin{bmatrix} \frac{a_{11}}{a'_1} & \cdots & \frac{a_{1n}}{a'_n} \\ \vdots & \ddots & \vdots \\ \frac{a_{n1}}{a'_1} & \cdots & \frac{a_{nn}}{a'_n} \end{bmatrix}$$

Here, a'$_1$, a'$_2$, ……, a'$_n$; are sum of column 1, 2, ……., n respectively

Step 5: Calculation of criteria weights/priority vector/ scaling factor

Here, i, ii, ……., m; are the criteria weights

$$\sum\left(\frac{a_{11}}{a'_1}, \frac{a_{12}}{a'_2}, \ldots\ldots, \frac{a_{1n}}{a'_n}\right)/n = i$$

$$\sum\left(\frac{a_{21}}{a'_1}, \frac{a_{22}}{a'_2}, \ldots\ldots, \frac{a_{2n}}{a'_n}\right)/n = ii$$

$$\sum\left(\frac{a_{n1}}{a'_1}, \frac{a_{12}}{a'_2}, \ldots\ldots, \frac{a_{nn}}{a'_n}\right)/n = m$$

Step 6: Calculating the consistency ratio to check whether the calculated value was correct or not.

Calculation of the λ_{max} . λ_{max} is the largest eigenvalue of the matrix A

$$Consistency\ Index = \frac{(\lambda_{max} - n)}{n-1}$$

The prioritisation results are consistent if the CR ratio is less than 0.1. CR is calculated as the ratio of CI to RI (CR=CI/RI) where RI is random index as indicated in random index table by Saaty (1980) and depends on the number of elements being compared.where, *RI* is the random index as indicated in random index table by Saaty (1980) and depends on the number of elements being compared.

Table 2: Value of Random Consistency Index

N	1	2	3	4	5	6	7	8
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41

(Adopted from Saaty and Forman, 1992; actual calculation made by Saaty, 1997)

Step 7: The criteria weight for each component matrix was written in the highest to lowest form

RESULTS AND DISCUSSION

The results presented in accordance with the findings are summarized in Table 3, which provides a detailed overview of the prioritized constraints identified through the Analytical Hierarchy Process (AHP)

Breeding constraints

Breeding constraints emerged as the most critical issue, with an overall weightage of 0.492. Lack of heat detection ranked first (0.58), not only within breeding but across all dairy constraints. Farmers noted that heat detection is particularly difficult during summer, especially in buffaloes, resulting in failed conception and prolonged calving intervals. Poor bull quality (0.19), inadequate AI facilities (0.16), farmers said that AI technicians were either irregular or located far away, forcing dependence on local untrained service providers. and high susceptibility of crossbreds to disease (0.06) followed in order of importance. These findings are consistent with earlier studies (Kant *et al.*, 2015; Reddy *et al.*, 2024 and Singh *et. al*, 2021). These findings affirm that reproductive management inefficiency is a major bottleneck limiting dairy productivity among Scheduled Caste households in arid Rajasthan.

Feeding constraints

Feeding was the second most critical component (0.23). High feed cost ranked first with a weightage of 0.54, aligning with the studies of Matre *et al*. (2020), Bhattacharjee *et al*. (2021) and Lokhande *et al*. (2012), who also highlighted low availability and high feed cost as major issues. Lack of green fodder (0.17), especially in arid conditions with erratic rainfall saline groundwater and restricted green fodder cultivation was a significant concern, as similarly reported by Sabapara *et al.* (2012). Limited knowledge of balanced rations (0.17) and silage/hay preparation (0.11) indicated knowledge gaps that restrict efficient feed management. It was found that feeding issues were not merely financial but also informational and environmental, requiring context-specific solutions for arid zones.

Healthcare constraints

Healthcare constraints were led by the unavailability of government veterinarians (0.39), followed by dependence on para-vets and high cost of private veterinary services (0.26), and lack of awareness of animal healthcare (0.27) further hindered disease management. Similar patterns were reported by Gamit *et al*. (2021), who noted high costs, scarcity of trained experts, and limited emergency services. While, the susceptibility of crossbred animals ranked lowest (0.11). Field realities thus corroborate that access to affordable and timely veterinary services remains one of the weakest links in the dairy production system of Scheduled Caste farmers in Rajasthan.

Marketing constraints

Marketing constraints were relatively less severe. Non-remunerative milk prices ranked highest (0.59) as low returns discourage farmers from expanding or investing in dairy activities. It was followed by the lack of organized markets and dairy cooperatives (0.29) limits bargaining power, and also respondents revealed that prices fluctuated daily and were decided solely by buyers. In Hanumangarh, some women farmers mentioned being paid after 10–15 days,

Table 3: Constraints faced by Scheduled Caste households in dairy-related activities (n=240)

Sr. No.	Dairy components	Components weight	λ max	Consistency Ratio	CI	Constraints	Constraint weightage within components	Constraint Rank within components	Global weights	Global rank
1	**Breeding Constraints**	0.49	4.37	0.06	0.13	B1: Lack of knowledge of heat detection	0.58	1	0.28	1
						B2: Inadequate facilities of AI	0.16	3	0.08	6
						B3: High susceptibility of cross-bred animals to disease	0.06	4	0.03	13
						B4: Poor quality of bulls at the village	0.20	2	0.10	5
2	**Feeding Constraints**	0.23	4.16	0.06	0.05	F1: Lack of availability of green fodder around the year	0.17	3	0.04	12
						F2: Lack of knowledge of balanced Ration	0.18	2	0.04	9
						F3: Inadequate knowledge of Silage and hay preparations	0.11	4	0.03	14
						F4: Affordability of feed	0.54	1	0.12	3
3	**Health care constraints**	0.16	4.14	0.05	0.04	H1: Dairy farmers rely heavily on para-vets	0.26	2	0.04	8
						H2: Unavailability of veterinary officers and high cost of private veterinary services	0.39	1	0.07	7
						H3: Inadequate supply of vaccines	0.11	4	0.02	15
						H4: Lack of awareness of animal healthcare	0.24	3	0.04	10
4	**Marketing Constraints**	0.12	3.11	0.11	0.06	M1: Non-remunerative price of milk received from private vendors	0.67	1	0.18	2
						M2: Lack of organized market & dairy cooperatives	0.30	2	0.09	4
						M3: Milk spoilage due to poor hygiene conditions and lack of preservation facilities	0.03	3	0.04	11

leading to financial strain, leaving smallholders dependent on middlemen for sales. Spoilage due to poor hygiene and preservation facilities was the least important (0.12). These findings concur with Timba (2023) and Jain *et al*. (2023); Chaudhari et al. (2025); Patel et al. (2025); Kumawat et al. (2025); Pandey et al. (2024); Mahammad et al. (2022); Mahammad et al. (2021).

Overall constraints

Table 4: Dimension-wise analysis of priority weightage/scaling factor

Sr. No.	Dimension	Priority weightage	λ_{max}	CI	CR	Ranks
1	**Breeding constraints**	0.49	4.13	0.017	0.019	1
2	**Feeding constraints**	0.23				2
3	**Health care constraints**	0.16				3
4	**Marketing constraints**	0.12				4

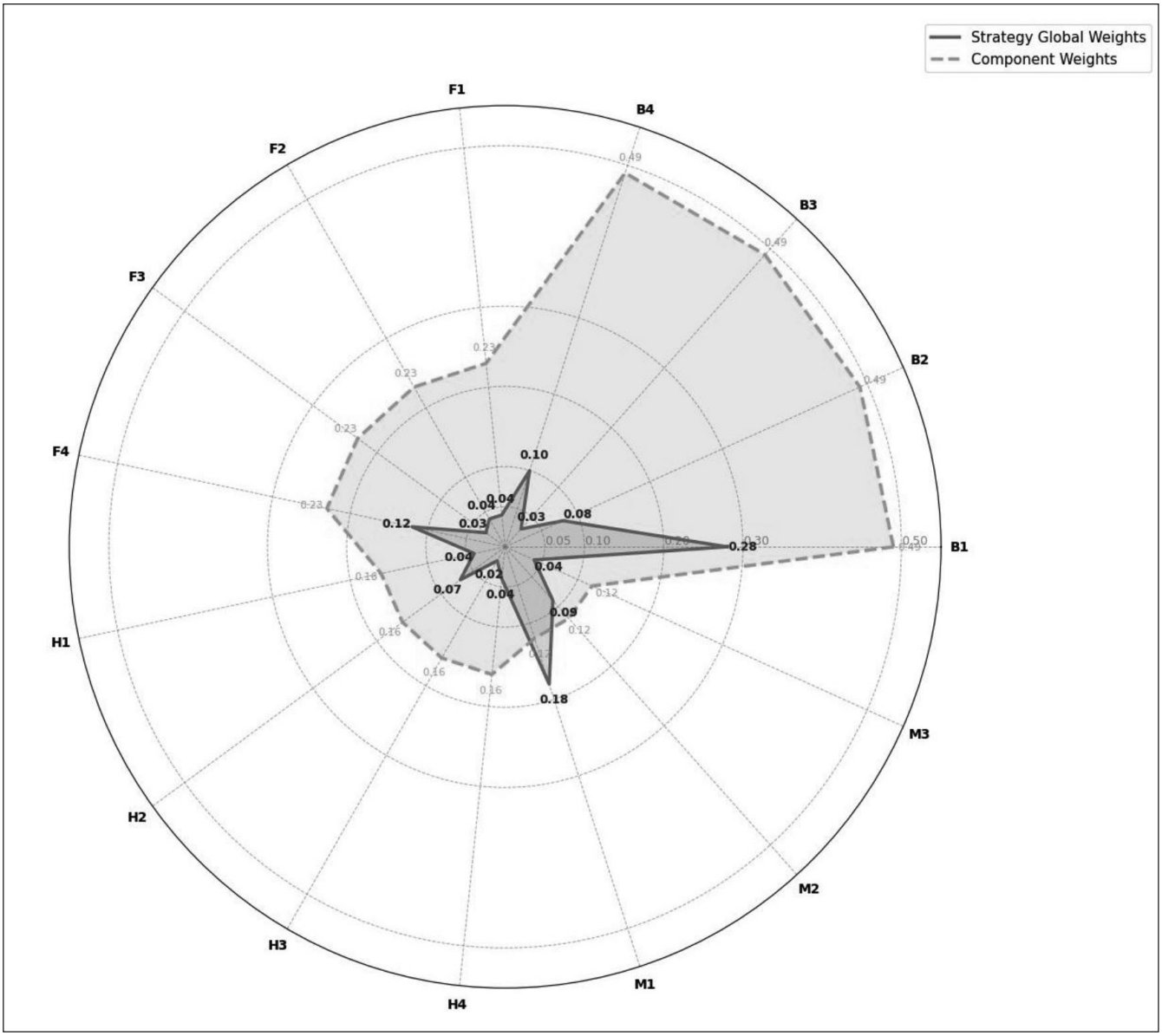

Fig.1: Priority weightage of dairy components within component and component weightage

The overall prioritization of dairy constraints, as summarized in Table 4 and depicted in Figure 1, clearly indicates that Breeding issues, particularly heat detection failures, were the most significant overall, directly affecting conception, calving intervals, and herd productivity (Kumar *et al.,* 2020). Feeding constraints ranked second, as high feed costs and fodder scarcity increased financial burdens on smallholders (Singh *et al*., 2019; Praveen *et al*., 2019). Marketing and healthcare were comparatively less critical but remained notable challenges. Dairy farmers from Scheduled Caste communities face multifaceted challenges that limit their productivity and income. Low education levels and poor financial capacity restrict the adoption of improved dairy practices and investment in quality livestock. The absence of reliable technical guidance and quality breeding stock further constrains management efficiency. Additionally, weak market access and high transport costs expose these farmers to middlemen exploitation, collectively hindering their progress toward sustainable dairy livelihoods ((Rajput et al., 2023; Jegoda et al., 2022).

CONCLUSION

The study identified breeding constraints as the most critical challenge faced by Scheduled Caste dairy farmers, primarily due to poor heat detection knowledge. Feeding constraints ranked second because of high feed costs and limited fodder availability, followed by healthcare and marketing constraints. Within individual factors, lack of heat detection awareness and non-remunerative milk prices emerged as the most severe issues. These findings highlight that reproductive management and input affordability have the highest impact on dairy productivity among SC households in Rajasthan's arid zones. Addressing these key constraints can directly improve herd performance and income stability within this socio-economically vulnerable group.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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