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Association of somatic cell count with quality and quantity of milk in indigenous and crossbred cattle

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Abstract

The study evaluated the relationship between somatic cell count (SCC) and milk production traits—yield and composition—in indigenous and crossbred cattle at Pune, Maharashtra during 2024–2025 across the *rainy*, *winter*, and *summer* seasons. Significant breed–season interactions were evident as SCC in indigenous cattle peaked during the *rainy* season (143.07×10^3 cells/ml) and was lowest in winter (122.49×10^3), whereas crossbreeds consistently exhibited higher SCC values in all seasons, highest in the *rainy* season (150.66×10^3), reflecting lower adaptability to climatic stress. Average milk yield showed an inverse trend to SCC, with both breeds yielding most in winter. Indigenous breeds maintained superior milk composition year-round, indicating better thermal adaptation and udder health. Strong negative correlations were found between SCC and average milk yield in both groups, most pronounced in *winter* for indigenous breeds ($r = -0.756$) and in the *rainy* season for crossbreeds ($r = -0.465$); in crossbreeds, SCC also negatively correlated with lactose during *summer*. Indigenous cattle had statistically higher milk fat (3.82–3.98%), solids-not-fat (8.70–8.87%), protein (3.27–3.40%), and lactose (4.81–4.85%) than crossbreeds (3.19–3.29%, 8.13–8.23%, 3.02–3.09%, 4.32–4.47%, respectively). The highest thermal stress (THI 71.72) occurred in *summer*. Overall, indigenous breeds have greater environmental resilience, consistently better udder health, and superior milk quality, as compared to crossbreeds during periods of climatic stress.

Keywords: Somatic cell count, milk yield, fat, solid not-fat, protein, lactose

1. Introduction

Agriculture and allied sectors remain key drivers of India's development, supporting inclusive growth, employment, and nutritional security (Union Budget, 2025-26) ^[57]. Livestock, a rapidly emerging sector, contributed 31.2% of the Gross Value Added (GVA) in agriculture and allied sectors in 2023–24, up from 25.6% in 2011–12, and accounts for 5.5% of the total national GVA (NSO, 2025; BAHS, 2024; MoFAHD, 2024) ^[45, 23, 22]. The sector supports over 70% of rural households, especially marginalized groups, serving as a critical tool for social inclusion and poverty reduction (BAHS, 2024; MoFAHD, 2024) ^[23, 22].

India possesses the largest livestock population globally, exceeding 537 million animals (Livestock Census, 2019) ^[21], forming the backbone of its dairy economy. India is the world's largest milk producer, contributing around 25% of global milk output (BAHS, 2024) ^[23]. Milk has emerged as the highest-value agricultural commodity, surpassing cereals and pulses, with per capita milk availability reaching 471 g/day in 2023–24, significantly above the global average of 329 g/day (FAO, 2023) ^[24]. Both crossbred and indigenous cattle have contributed to this growth, with indigenous breeds valued for climate resilience and disease resistance under fluctuating environmental conditions (BAHS, 2024; MoFAHD, 2024) ^[23, 22].

Despite these successes, dairy production faces challenges from extreme climatic factors that diminish milk yield and impair quality by lowering fat, protein, solids-not-fat (SNF), and lactose levels (Guzmán-Luna *et al.*, 2022; Inbaraj *et al.*, 2016) ^[27, 34]. Global warming, with average surface temperature increases projected to surpass 1.5°C within this century (IPCC, 2014, 2018, 2022) ^[35, 37, 38], intensifies stressors, especially in humid tropical zones like India, where extended heat and humidity threaten dairy productivity (IPCC, 2007; Stefanski and

Sivakumar, 2011)^[36, 59].

Climate-induced variability disrupts livestock systems by causing unstable productivity, fodder shortages, and a rise in animal diseases (Phand and Pankaj, 2021; Rymbai *et al.*, 2016)^[48, 50]. Resilience—the capacity to withstand and recover from stress—is increasingly recognized as essential in livestock management for sustainable production (Colditz and Hine, 2016; Scheffer *et al.*, 2018; Berghof *et al.*, 2019)^[18, 51, 10]. However, practical breeding and management strategies to enhance resilience remain limited.

Within this context, mastitis stands out as a major disease negatively impacting udder health, milk yield, and composition (Radostits *et al.*, 2000; Sharma *et al.*, 2012)^[49]^[52]. Subclinical mastitis (SCM), characterized by elevated somatic cell counts (SCC) without visible symptoms, is economically more damaging due to reduced productivity and quality and costs India's dairy sector approximately ₹16,000–18,000 crore annually (BAHS, 2024; MoFAHD, 2024)^[23, 22]. SCC remains a key diagnostic and quality indicator, affected by species, management, health, lactation stage, and environmental factors (Alhussien and Dang, 2018; Uzmay *et al.*, 2003)^[6, 61]. Heat stress elevates SCC and reduces milk output, emphasizing the need for early detection and integrated management to mitigate adverse outcomes (Harmon, 1994; Perissinotto *et al.*, 2007; Habeeb *et al.*, 2018; Adkins and Middleton, 2018)^[32, 47, 28, 2]. This investigation examines the association of SCC with milk quality and quantity in indigenous and crossbred cattle under varying seasonal and climatic conditions, contributing valuable insights for sustainable dairy production in India.

2. Materials and methods

Lactating cattle of each indigenous and cross breeds were randomly selected from the Division of Animal Husbandry and Dairy Science, College of Agriculture, Pune. The milk samples from respective indigenous and crossbred cattle were collected on a weekly basis, during 2024-25, for three seasons, namely rainy, winter and summer using sampling bottles of about 50 ml capacity for quality and quantity analysis.

2.1 The following observations were recorded during investigation

2.1.1 Somatic cell count

Somatic Cell Count was analysed seasonally (rainy, winter, summer) using Everest Milk Somatic Cells Analyzer EKOMILK SCAN, for the collected milk samples, following the manufacturer's protocol. The milk analyzer Ekomilk Scan measures the flowing time of the milk with prime solution through the sample mixer capillary and determines the number of somatic cells in accordance with this time. There is proportional relation between the viscosity of mixture (milk – Ekoprim) and number of somatic cells of the tested milk.

For the preparation of 100 ml prime solution, 3.5 g ekoprim powder was weighed on weighing balance and then dissolved in 100 ml distilled water.

2.1.2 Milk quality

Milk composition (fat, protein, SNF and lactose) was analysed using Essae Milk Analyser on a weekly basis for three seasons namely rainy, summer and winter.

2.1.3 Milk quantity

Record of daily average milk yield was maintained for each of indigenous and crossbred cattle for three seasons namely rainy, summer and winter.

2.1.4 THI

The Temperature Humidity Index (THI) was assessed monthly and seasonally using the Phule Amrutkal application. THI was calculated using the NRC 1971^[44] formula:

$$THI = (1.8 \times T + 32) - [(0.55 - 0.0055 \times RH) \times (1.8 \times T - 26.8)]$$

Where T is the ambient temperature (°C) and RH is the relative humidity (%).

Phule Amrutkal is a Temperature Humidity Index based livestock advisory web and mobile application, available on Google Playstore for Android devices as well as on Apple Store for iOS devices, developed by ICRTC, Mahatma Phule Krishi Vidyapeeth, Rahuri that offers several benefits to farmers. It provides real-time updates on weather conditions and THI levels in their area or even in animal sheds, helping to make informed decisions about livestock feed and health management. It helps predict heat stress in animals due to changing seasonal conditions in real time and at a specific location and subsequently provides advisory services for livestock management by using real-time sensors placed on the farm and open-source APIs. It is a valuable tool for Indian farmers facing the challenges of climate change, as with its help, farmers can adapt to changing environmental conditions and ensure the well-being of their livestock.

2.2 Statistical Method

Karl Pearson's correlation coefficient was used to assess the association between SCC and milk yield/composition.

3. Result and discussion

3.1 Mean somatic cell count, milk yield and composition of cattle during different seasons

3.1.1 Indigenous cattle

The mean somatic cell count (SCC) was highest during the rainy season ($143.07 \pm 1.95 \times 10^3$ cells/ml), followed by the summer season ($124.04 \pm 1.20 \times 10^3$ cells/ml) and the lowest during winter ($122.49 \pm 1.61 \times 10^3$ cells/ml), indicated a significant seasonal influence on udder health, the humid rainy season having the greatest impact.

The average daily milk yield followed an inverse trend, found to be optimal during winter (7.11 ± 0.33 kg) and reached its lowest during the summer season (6.46 ± 0.35 kg), while being moderate in the rainy season (6.59 ± 0.37 kg), suggested a thermoregulatory burden impacting production efficiency.

Among milk composition parameters, fat content was highest in the winter season ($3.98 \pm 0.05\%$), followed by a slight decline in summer ($3.85 \pm 0.04\%$) and rainy ($3.82 \pm 0.07\%$) seasons. SNF showed a parallel seasonal trend, with the highest values in winter ($8.87 \pm 0.04\%$) and the lowest in the rainy season ($8.70 \pm 0.04\%$). Protein and lactose content also showed minor variations across seasons, with protein being slightly higher in winter ($3.40 \pm 0.05\%$) and lowest during the rainy season ($3.27 \pm 0.01\%$), whereas lactose remained stable, varying between 4.81% to 4.85%. Results are presented in Table 1.

Table 1: Mean somatic cell count, milk yield and composition of indigenous cattle during different seasons.

Season (n)	SCC ($\times 10^3$) (cells/ml)	Average Milk Yield (kg)	Fat (%)	SNF (%)	Protein (%)	Lactose (%)
Rainy (57)	143.07 $\pm$ 1.95	6.59 $\pm$ 0.37	3.82 $\pm$ 0.07	8.70 $\pm$ 0.04	3.27 $\pm$ 0.01	4.81 $\pm$ 0.01
Winter (82)	122.49 $\pm$ 1.61	7.11 $\pm$ 0.33	3.98 $\pm$ 0.05	8.87 $\pm$ 0.04	3.40 $\pm$ 0.05	4.85 $\pm$ 0.03
Summer (64)	124.04 $\pm$ 1.20	6.46 $\pm$ 0.35	3.85 $\pm$ 0.04	8.80 $\pm$ 0.04	3.31 $\pm$ 0.02	4.83 $\pm$ 0.02

In the present study, the mean SCC was highest in the rainy season, which aligns with 3.31 $\pm$ 0.02 4.83 $\pm$ 0.02 findings by Ambade *et al.*, (2012) [7] and Sharma *et al.*, (2023) [54] who observed higher SCC during monsoon, consistent with this study. Sharma *et al.*, (2020) [55] and Alhussien and Dang (2018) [5] reported similar seasonal variation in SCC and milk quality, attributing higher SCC in rainy season to microbial exposure and poor hygiene. Their findings support the observation of elevated SCC in indigenous cattle during rainy months.

Bernabucci *et al.*, (2015) [11] showed that high THI levels during summer and monsoon months elevate SCC and reduced milk quality, especially in tropical cattle. The lower milk yield and fat percent observed in summer in this study matches their conclusions.

Average milk yield was found to be peaked in winter, reflecting favourable thermal conditions and was consistent with Ahmad *et al.*, (2018) [4] who documented enhanced productivity under low-stress environments. Aatralarasi *et al.*, (2021) [1], Boro *et al.*, (2018) [16], Hammami *et al.*, (2013) [29], and Kul *et al.*, (2019) [39] reported that there was seasonal influence on milk yield and composition.

Fat and protein levels were highest in winter and slightly declined during summer and rainy seasons. These observations align with earlier findings by Bernabucci *et al.*, (2010) [12], who reported superior milk quality in cooler climates. Gaafar *et al.*, (2011) [25] observed a decline in milk composition traits under heat stress, confirmed the finding of reduced SNF and protein values during summer. Aggarwal and Singh (2009) [3] also noted improved hormonal balance and productivity in thermally comfortable seasons, supporting these findings.

Similar seasonal trend was reported by Maurya *et al.*, (2020) [42], who attributed winter improvements to thermal comfort and reduced environmental stress and found that there was improved milk composition in indigenous cattle during

thermally comfortable months.

However, contradictory results were observed by Ghavi Hossein-Zadeh *et al.*, (2013) [26], who reported no significant seasonal variation in SCC, possibly due to controlled housing. Herbut and Angrecka (2012) [33] and Lambert *et al.*, (2014) [40] found that milk fat remained stable across seasons in their settings. Beheshti *et al.*, (2010) [9] found steady milk composition year-round in herds maintained under uniform nutrition and hygiene, unlike the seasonal fluctuations seen in our indigenous cattle. Nasr and El-Tarabany (2017) [43] also observed that there was minimal seasonal variation in SCC and milk traits in cows housed in climate-controlled barns, and suggested that management overrides seasonal influence.

3.1.2 Crossbreed cattle

Crossbreed cattle exhibited higher SCC values than indigenous cattle across all seasons, with the highest recorded during the rainy season (150.66 $\pm$ 4.30 $\times 10^3$ cells/ml), followed closely by summer (149.99 $\pm$ 2.82 $\times 10^3$) and lowest in winter (131.13 $\pm$ 2.31 $\times 10^3$). This indicated that crossbreeds were more vulnerable to udder health issues under humid and heat stress conditions.

Average milk yield peaked in winter (11.99 $\pm$ 1.05 kg), was intermediate during the rainy season (9.89 $\pm$ 0.60 kg), and dropped considerably in summer (8.20 $\pm$ 1.01 kg).

Fat and SNF content showed minimal seasonal fluctuations, though lactose and protein levels were slightly better in winter. Milk fat content remained lower across all seasons and it ranged from 3.19 to 3.29%, with the lowest during the rainy season, SNF and protein levels remained below those of indigenous cattle and showed limited seasonal variation with SNF ranged from 8.13 to 8.23%, while protein from 3.02 to 3.09%, and lactose content was lowest in the rainy season (4.32%) and improved slightly in winter (4.47%). Overall, milk composition improved during the winter season. Results are presented in Table 2.

Table 2: Mean somatic cell count, milk yield and composition of crossbreed cattle during different seasons.

Seasons	SCC ($\times 10^3$) (cells/ml)	Average Milk Yield (kg)	Fat (%)	SNF (%)	Protein (%)	Lactose (%)
Rainy (26)	150.66 $\pm$ 4.30	9.89 $\pm$ 0.60	3.19 $\pm$ 0.06	8.18 $\pm$ 0.04	3.02 $\pm$ 0.02	4.32 $\pm$ 0.03
Winter (28)	131.13 $\pm$ 2.31	11.99 $\pm$ 1.05	3.29 $\pm$ 0.08	8.23 $\pm$ 0.06	3.09 $\pm$ 0.02	4.47 $\pm$ 0.03
Summer (20)	149.99 $\pm$ 2.82	8.20 $\pm$ 1.01	3.26 $\pm$ 0.05	8.13 $\pm$ 0.04	3.03 $\pm$ 0.02	4.42 $\pm$ 0.03

The crossbreed mean SCC was found significantly higher in rainy and summer seasons, 3.03 $\pm$ 0.02 4.42 $\pm$ 0.03 consistent with Bernabucci *et al.*, (2015) [11], who highlighted that THI-induced stress in crossbreeds leads to increased SCC and reduced milk yield and fat, solids-not-fat (SNF) and protein. Alhussien and Dang (2018) [5], reported higher SCC and decreased fat and protein content in crossbreeds exposed to heat stress. Sharma *et al.*, (2020) [55] observed elevated SCC in crossbreeds during the rainy season due to increased bacterial exposure and reduced immunity.

Milk composition parameters such as fat, solids-not-fat (SNF), and protein were lower in crossbreeds, particularly in the rainy season, which confirmed their lower adaptive capacity. These findings are in agreement with Bohmanova *et al.*, (2007) [15], Das *et al.*, (2016) [20], and Harikumar (2017) [30], who highlighted that thermal stress had impact on

crossbreed performance. Similar results were reported by Smith *et al.*, (2013) [58], and Sharma *et al.*, (2020) [55], who observed reduced milk quality in heat-stressed crossbreeds. Ahmad *et al.*, (2018) [4] and Gaafar *et al.*, (2011) [25] noted a significant reduction in protein and lactose during heat stress periods in exotic and crossbreed cows.

However, several studies provide dissimilarities in results, like Zhao and Lacasse (2008) [62], who indicated that effective mastitis control can limit SCC irrespective of seasonal variation. Beheshti *et al.*, (2010) [9] and Toghdory *et al.*, (2022) [60], suggested that management and hygiene practices may reduce SCC regardless of breed. Costa *et al.*, (2019) [19] reported stable lactose across climates, contrasting with the present observation. These findings implied complex breed environment interactions, and that crossbreeds required more robust thermal stress management to ensure consistent milk

quality and udder health.

3.2 Correlation between somatic cell count and milk yield, milk composition in cattle during different seasons

3.2.1 Indigenous cattle

A highly significant negative correlation was observed between SCC and milk yield in all three seasons: rainy ($r = -0.412$), winter ($r = -0.756$), and summer ($r = -0.298$), being most prominent in winter ($r = -0.756$), which indicated that slight increase of somatic cells negatively affected milk production. Other milk composition traits showed weak or

non-significant correlations, that indicated a relatively minor influence of SCC on composition in indigenous breeds.

For milk composition parameters, no significant correlations were detected though some weak and non-significant associations were present, which suggested that the milk composition of indigenous cattle might be less sensitive to somatic cell elevation. This suggested that while SCC significantly influences milk quantity, its effect on milk quality (composition) was less pronounced in indigenous breeds.

Table 3: Correlation between somatic cell count and milk yield, milk composition in indigenous cattle during different seasons.

	Seasons	n	Average Milk Yield (kg)	Fat (%)	SNF (%)	Protein (%)	Lactose (%)	r _{tab} (5%)	r _{tab} (1%)
Log ₁₀ SCC	Rainy	57	-0.412**	-0.207	0.076	0.050	-0.049	0.239	0.313
	Winter	82	-0.756**	-0.001	0.073	-0.083	-0.012	0.214	0.281
	Summer	64	-0.298*	-0.030	0.030	0.069	-0.033	0.232	0.304

[Note: *, ** indicate significance at 5% and 1% respectively]

Similar findings were reported by Singh and Ludri (2001) [56], Sharma *et al.*, (2016) [53], and Sinha *et al.*, (2021) [1], emphasizing a negative SCC-yield association. Ambade *et al.*, (2012) [7] and Kul *et al.*, (2019) [39] also observed minimal impact of SCC on milk solids in native breeds. Studies by Cinar *et al.*, (2015) [17] and Bobbo *et al.*, (2017) [14] confirm the reduced influence of SCC on composition in well adapted breeds.

However, contradictory results were recorded by Matei *et al.*, (2010) [41], Anirban Guha and Gera (2012) [8], and Patnaik *et al.*, (2014) [46], who reported a significant decline in fat and protein with higher SCC. Differences may arise from infection severity, lactation stage, or parity. Bertocchi *et al.*, (2014) [13] and Harjanti and Sambodho (2020) [31] found stronger SCC-composition links under high stress housing

systems.

3.2.2 Crossbreed cattle

In crossbreed cattle, SCC exhibited a statistically significant negative correlation with milk yield across all seasons. The strongest inverse correlation was seen during the rainy season ($r = 0.465$), followed by winter ($r = -0.399$), and summer ($r = -0.451$).

In the summer season, SCC also showed a highly significant negative correlation with lactose content ($r = -0.556$), which suggested impaired udder health can impact lactose synthesis under heat stress conditions. Moderate to weak correlations were also seen with fat, SNF and protein during different seasons.

Table 4: Correlation between somatic cell count and milk yield, milk composition in crossbreed cattle during different seasons

	Seasons	n	Average Milk Yield (kg)	Fat (%)	SNF (%)	Protein (%)	Lactose (%)	r _{tab} (5%)	r _{tab} (1%)
Log ₁₀ SCC	Rainy	26	-0.465**	-0.082	-0.072	-0.061	0.051	0.361	0.463
	Winter	28	-0.399*	-0.208	-0.188	-0.231	-0.384*	0.367	0.470
	Summer	20	-0.451*	-0.388	-0.095	-0.091	-0.556**	0.413	0.526

[Note: *, ** indicate significance at 5% and 1% respectively]

The present results are consistent with findings by Bohmanova *et al.*, (2007) [15] and Sharma *et al.*, (2020) [55], where higher SCC was directly linked to metabolic burden and decreased secretion. Cinar *et al.*, (2015) [17], Bobbo *et al.*, (2017) [14], Harikumar (2017) [30], and Ahmad *et al.*, (2018) [4], observed that high SCC impairs milk composition, especially lactose.

However, contradictory results were observed by Beheshti *et al.*, (2010) [9], who found a non significant SCC-lactose correlation in well-managed herds. Patnaik *et al.*, (2014) [46] and Nasr and El Tarabany (2017) [4] reported inconsistent composition loss with SCC rise.

4. Conclusion

Seasonal variation significantly influenced somatic cell count, milk yield, and composition in indigenous and crossbreed cattle. Indigenous cattle showed the lowest SCC during winter and highest during rainy season, with peak milk yield and optimal composition in winter. Crossbreeds demonstrated consistently higher SCC across seasons and greater susceptibility to mastitis, especially under humid and heat stress, despite higher milk yields. Their milk composition parameters, notably fat and lactose, were inferior to

indigenous cattle.

Correlation analyses revealed a strong negative association between SCC and milk yield for both breeds, most pronounced in indigenous cattle during winter and crossbreeds during rainy and summer seasons. In crossbreeds, SCC also negatively correlated with lactose content in summer, reflecting impaired milk synthesis under heat stress. Overall, indigenous cattle exhibited superior milk quality and udder health, reinforcing their adaptability to climatic stress. The findings emphasize the need for breed-specific management strategies, especially for crossbreeds during high THI periods, to mitigate mastitis risk and preserve milk quality and productivity.

Conflict of Interest

Not available

Financial Support

Not available

References

1. Aatralarasi S, Dhaliwal LK, Kingra PK, Jain G. Prediction of future milk production trend in India and

- Central Punjab. *J Anim Res*. 2021;11(6):1051–1058.
2. Adkins PR, Middleton JR. Methods for diagnosing mastitis. *Vet Clin Food Anim Pract*. 2018;34(3):479–491.
 3. Aggarwal A, Singh M. Changes in hormonal levels during early lactation in summer calving cows kept under mist cooling system. *Indian J Anim Nutr*. 2009;26(4):337–340.
 4. Ahmad M, Bhatti JA, Abdullah M, Javed K, Ali M, Rashid G, *et al*. Effect of ambient management interventions on the production and physiological performance of lactating Sahiwal cattle during hot dry summer. *Trop Anim Health Prod*. 2018;50(6):1249–1254.
 5. Alhussien MN, Dang AK. Impact of different seasons on the milk somatic and differential cell counts, milk cortisol and neutrophils functionality of three Indian native breeds of cattle. *J Therm Biol*. 2018;78:27–35.
 6. Alhussien MN, Dang AK. Milk somatic cells, factors influencing their release, future prospects, and practical utility in dairy animals: An overview. *Vet World*. 2018;11(5):562–570.
 7. Ambade RB, Bonde SW, Takarkhede RC. Cellular and biochemical indicators of bovine subclinical mastitis. *Anim Sci Rep*. 2012;6(1):3–7.
 8. Guha A, Gera S. Evaluation of chemical and electrolyte components of milk in subclinical mastitis in Holstein × Haryana cattle. *Explor Anim Med Res*. 2012;1(2):137–140.
 9. Beheshti R, Shaieghi J, Eshratkhan B, Ghalehkandi JG, Maheri-Sis N. Prevalence and etiology of subclinical mastitis in ewes of the Tabriz region, Iran. *Glob Vet*. 2010;4(3):299–302.
 10. Berghof TV, Poppe M, Mulder HA. Opportunities to improve resilience in animal breeding programs. *Front Genet*. 2019;9:692.
 11. Bernabucci U, Basiricò L, Morera P, Dipasquale D, Vitali A, Cappelli FP, *et al*. Effect of summer season on milk protein fractions in Holstein cows. *J Dairy Sci*. 2015;98(3):1815–1827.
 12. Bernabucci U, Lacetera N, Baumgard LH, Rhoads RP, Ronchi B, Nardone A. Metabolic and hormonal acclimation to heat stress in domesticated ruminants. *Animal*. 2010;4(7):1167–1183.
 13. Bertocchi L, Vitali A, Lacetera N, Nardone A, Varisco G, Bernabucci U. Seasonal variations in the composition of Holstein cow's milk and temperature–humidity index relationship. *Animal*. 2014;8(4):667–674.
 14. Bobbo T, Ruegg PL, Stocco G, Fiore E, Gianesella M, Morgante M, *et al*. Associations between pathogen-specific cases of subclinical mastitis and milk yield, quality, protein composition, and cheese-making traits in dairy cows. *J Dairy Sci*. 2017;100(6):4868–4883.
 15. Bohmanova J, Misztal I, Cole JB. Temperature–humidity indices as indicators of milk production losses due to heat stress. *J Dairy Sci*. 2007;90(4):1947–1956.
 16. Boro P, Debnath J, Das TK, Naha BC, Debbarma N, Debbarma P, *et al*. Milk composition and factors affecting it in dairy buffaloes: A review. *J Entomol Zool Stud*. 2018;6(3):340–343.
 17. Cinar M, Serbest U, Ceyhan A, Gorgulu M. Effect of somatic cell count on milk yield and composition of first and second lactation dairy cows. *Ital J Anim Sci*. 2015;14(1):3646–3654.
 18. Colditz IG, Hine BC. Resilience in farm animals: Biology, management, breeding and implications for animal welfare. *Anim Prod Sci*. 2016;56(12):1961–1983.
 19. Costa A, Lopez-Villalobos N, Sneddon NW, Shalloo L, Franzoi M, De Marchi M, *et al*. Milk lactose—Current status and future challenges in dairy cattle. *J Dairy Sci*. 2019;102(7):5883–5898.
 20. Das R, Sailo L, Verma N, Bharti P, Saikia J, Kumar R. Impact of heat stress on health and performance of dairy animals: A review. *Vet World*. 2016;9(3):260–268.
 21. Department of Animal Husbandry and Dairying. 20th Livestock Census–2019: All India Report. New Delhi: Government of India; 2019.
 22. Department of Animal Husbandry and Dairying. Annual Report 2023–24. New Delhi: Government of India; 2024.
 23. Department of Animal Husbandry and Dairying. Basic Animal Husbandry Statistics 2024. New Delhi: Government of India; 2024.
 24. FAO. Dairy Market Review: Emerging trends and outlook in 2023. Rome: FAO; 2023.
 25. Gaafar HMA, Gendy ME, Bassiouni MI, Shamiah SM, Halawa AA, Hamd MA. Effect of heat stress on performance of dairy Friesian cows' milk production and composition. *Res J*. 2011;3(5):85–93.
 26. Ghavi Hossein-Zadeh N, Mohit A, Azad N. Effect of temperature–humidity index on productive and reproductive performances of Iranian Holstein cows. *Iran J Vet Res*. 2013;14(2):106–112.
 27. Guzmán-Luna P, Mauricio-Iglesias M, Flysjö A, Hospido A. Analysing the interaction between the dairy sector and climate change from a life cycle perspective: A review. *Trends Food Sci Technol*. 2022;126:168–179.
 28. Habeeb AAM, Gad AE, El-Tarabany AA, Atta MAA. Negative effects of heat stress on growth and milk production of farm animals. *J Anim Husb Dairy Sci*. 2018;2(1):1–12.
 29. Hammami H, Bormann J, M'hamdi N, Montaldo HH, Gengler N. Evaluation of heat stress effects on production traits and somatic cell score of Holsteins in a temperate environment. *J Dairy Sci*. 2013;96(3):1844–1855.
 30. Harikumar S. Behavioural, physiological and biochemical stress responses of crossbreed cows to varying thermal indices in different management systems [PhD thesis]. Pookode: Kerala Veterinary and Animal Sciences University; 2017. 145 p.
 31. Harjanti DW, Sambodho P. Effects of mastitis on milk production and composition in dairy cows. *IOP Conf Ser Earth Environ Sci*. 2020;518(1):012032.
 32. Harmon RJ. Physiology of mastitis and factors affecting somatic cell counts. *J Dairy Sci*. 1994;77(7):2103–2112.
 33. Herbut P, Angrecka S. Forming of temperature–humidity index and milk production of cows in the free-stall barn during summer heat. *Anim Sci Pap Rep*. 2012;30(4):363–372.
 34. Inbaraj S, Sejian V, Bagath M, Bhatta R. Impact of heat stress on immune responses of livestock: A review. *Pertanika J Trop Agric Sci*. 2016;39(4):459–482.
 35. Intergovernmental Panel on Climate Change; Edenhofer O, editors. Climate change 2014: Mitigation of climate change. Cambridge: Cambridge University Press; 2014.
 36. Intergovernmental Panel on Climate Change. IPCC AR4: The physical science basis. Agenda. 2007;6(7):333–334.
 37. Intergovernmental Panel on Climate Change. Global warming of 1.5 °C. Geneva: World Meteorological Organization; 2018.
 38. Intergovernmental Panel on Climate Change. Climate

- Change 2022: Impacts, Adaptation, and Vulnerability. Cambridge: Cambridge University Press; 2022.
39. Kul E, Şahin A, Atasever S, Uğurlutepe E, Soydaner M. The effects of somatic cell count on milk yield and milk composition in Holstein cows. *Vet Arhiv*. 2019;89(2):143–154.
 40. Lambertz C, Sanker C, Gauly M. Climatic effects on milk production traits and somatic cell score in lactating Holstein-Friesian cows in different housing systems. *J Dairy Sci*. 2014;97(1):319–329.
 41. Matei ST, Groza I, Andrei S, Bogdan L, Ciupe S, Petrean A. Serum metabolic parameters in healthy and subclinical mastitis cows. *Bull UASVM Vet Med*. 2010;67(1):110–114.
 42. Maurya A, Shukla PC, Gupta DK, Sharma RK, Nayak A, Singh B, *et al*. Prevalence of subclinical mastitis in cows in and around Jabalpur, Madhya Pradesh. *J Entomol Zool Stud*. 2020;8(4):40–44.
 43. Nasr MA, El-Tarabany MS. Impact of three THI levels on somatic cell count, milk yield and composition of multiparous Holstein cows in a subtropical region. *J Therm Biol*. 2017;64:73–77.
 44. National Research Council. A guide to environmental research on animals. Washington, DC: National Academy of Sciences; 1971. 196 p.
 45. National Statistics Office (MoSPI). Statistical report on value of output from agriculture and allied sectors (2011–12 to 2023–24). New Delhi: Government of India; 2025.
 46. Patnaik S, Prasad A, Ganguly S. Biochemical characterization and antibiogram of Staphylococcal microorganisms associated with subclinical mastitis in lactating crossbreed cows. *Anim Sci*. 2014;8(4):123–129.
 47. Perissinotto M, da Cruz VF, Pereira A, de Moura DJ. Influência das condições ambientais na produção de leite da vacaria da Mitra. *Rev Ciênc Agrár*. 2007;30(1):143–149.
 48. Phand S, Pankaj PK. Climate-resilient livestock farming to ensure food and nutritional security. In: *Climate Change and Resilient Food Systems*. Singapore: Springer; 2021. p. 381–398.
 49. Radostits OM, Gay CC, Blood DC, Hinchcliff KW. *Veterinary medicine: A textbook of the diseases of cattle, sheep, pigs, goats and horses*. 9th ed. London: Saunders; 2000. p. 603–700.
 50. Rymbai D, Feroze SM, Singh R, Sarkar A, Ray LI. Climate change and investment in agricultural research: Policy challenges in India. *Econ Aff*. 2016;61(2):313–320.
 51. Scheffer M, Bolhuis JE, Borsboom D, Buchman TG, Gijzel SM, Goulson D, *et al*. Quantifying resilience of humans and other animals. *Proc Natl Acad Sci USA*. 2018;115(47):11883–11890.
 52. Sharma A, Chhabra R, Sindhu N. Prevalence of subclinical mastitis in cows: Its etiology and antibiogram. *Indian J Anim Res*. 2012;46(4):348–353.
 53. Sharma A, Sharma S, Singh N, Pal RS, Nanda B. Effect of non-genetic factors on somatic cell count in Tharparkar cows under hot arid region. *J Anim Res*. 2016;6(6):1001–1005.
 54. Sharma D, Kaniamathan S, Manimaran A, Kumaresan A, Sivaram M, Rajendran D, *et al*. Seasonal, physiological and bacteriological risk factors for subclinical mastitis in dairy cows under different farming conditions. *J Dairy Res*. 2023;90(2):164–172.
 55. Sharma P, Bhardwaj K, Wadhwa DR, Katoch S. Subclinical mastitis and its effect on milk components in crossbreed cows. *Him J Agric Res*. 2020;46(1):95–99.
 56. Singh M, Ludri RS. Influence of stages of lactation, parity and season on somatic cell counts in cows. *Asian Australas J Anim Sci*. 2001;14(12):1775–1780.
 57. Sitharaman N. Union Budget 2025–2026. *Finance India*. 2025;39(1).
 58. Smith DL, Smith T, Rude BJ, Ward SH. Comparison of the effects of heat stress on milk and component yields and somatic cell score in Holstein and Jersey cows. *J Dairy Sci*. 2013;96(5):3028–3033.
 59. Stefanski R, Sivakumar MVK. Climate change and food security in South Asia. In: Springer; 2011. p. 14–30.
 60. Toghdory A, Ghoorchi T, Asadi M, Bokharaeian M, Najafi M, Ghassemi Nejad J. Effects of environmental temperature and humidity on milk composition, microbial load and somatic cells in milk of Holstein cows in northeast Iran. *Animals*. 2022;12(18):2484.
 61. Uzmay C, Kaya İ, Akbaş Y, Kaya A. Effects of udder and teat morphology, parity and lactation stage on subclinical mastitis in Holstein cows. *Turk J Vet Anim Sci*. 2003;27(3):695–701.
 62. Zhao X, Lacasse P. Mammary tissue damage during bovine mastitis: Causes and control. *J Anim Sci*. 2008;86(Suppl 13):57–65.

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