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Estimation of Economic Losses due to Clinical Mastitis in Crossbred Cattle in Ahmednagar District of Maharashtra State

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ABSTRACT

Mastitis is a significant lactation disorder that considerably influences dairy farming. The crossbreeding program and Operation Flood increased the crossbred bovine population, leading to a higher prevalence of mastitis, mainly due to management challenges such as inadequate milking practices, poor hygiene and suboptimal housing conditions, *etc*. Consequently, this has led to a significant increase in economic losses. The study examined the measurement of financial damages linked to clinical mastitis in the Ahmednagar district of Maharashtra, considering milk loss, labour expenses, treatment expenditures and animal replacement loss costs. Stratified sampling (based on rainfall levels) and multi-stage sampling (tehsil → village → household) from June 2015 to December 2016 were conducted by in-depth personal one-on-one interviews with farmers who owned at least five crossbred cattle. The prevalence of clinical mastitis in high, medium and low rainfall regions was found to be 22.98%, 17.88% and 14.95%, respectively. The treatment cost varied from ` 880 to ` 889 across the regions. The replacement loss cost varied from ` 1825 to ` 2766 across regions. The per animal cost affected by clinical mastitis was ` 1489.39, ` 1506.78 and ` 1724.31 in high, medium and low rainfall regions, respectively, which was calculated by combining milk loss data, treatment cost and replacement loss cost of the animal. The projected economic losses from clinical mastitis were ` 14.12 crore and ` 54.47 crore in crossbred cows within the Ahmednagar district and in Maharashtra state, respectively. This study seeks to provide valuable insights into the financial losses incurred due to clinical mastitis in the Ahmednagar district.

Key words: Ahmednagar, Clinical mastitis, Economic losses, Prevalence.

India's economy is largely agrarian, with dairy farming serving as a vital contributor to agricultural growth and expansion. The income generated from dairy animals supports rural livelihoods and strengthens the sector's sustainability. The livestock industry represents 5 per cent of the total GDP and contributes 18 per cent to the agricultural GDP (Press Information Bureau, 2024). The dairy industry in India is an alternate means of generating money and ensuring food security. Furthermore, it significantly contributes to the socio-economic development of rural areas by enhancing household incomes and generating sustainable employment opportunities, particularly for landless individuals and small or marginal farmers (Dash, 2017). The dairy industry encounters several disease-related challenges that contribute to significant economic losses from animal deaths and reduced output (Singh and Prasad, 2008). The livestock sector has faced significant challenges, including reduced investment, diminished resource efficiency and lower animal productivity due to disease outbreaks. Mastitis, a multifaceted and financially burdensome disease, is considered one of the most significant ailments affecting dairy herds (Beheshti *et al.*, 2010). Ranked second to foot and mouth disease (Varshney and Mukherjee, 2002), this disease poses a significant challenge in high-yielding dairy animals. The study was conducted in the Ahmednagar district, which has the highest percentage share (9.2 per cent) of the cattle population in the state (20th Livestock Census, 2019). The crossbred cattle are meant for milk production in the area. Hence, the present study aimed to analyze economic losses due to clinical mastitis in the crossbred cattle in the Ahmednagar district in Maharashtra state.

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Study type, duration and questionnaire development

The present study utilized a combination of stratified sampling (based on rainfall levels) and multi-stage sampling (tehsil → village → household) from June 2015

to December 2016 in the Ahmednagar district of Maharashtra state.

The questionnaire was developed based on expert consultations with academicians from the National Dairy Research Institute, Karnal, India and a veterinarian from Rahuri Vidyapeeth, Ahmednagar. The questionnaire was structured to address socioeconomic profile, animal inventory, milk production data, clinical history, treatment cost, replacement cost of animals and other information, including closed and open-ended questions. The initial draft of the questionnaire underwent evaluation by three expert researchers to assess content validity and identify ambiguities. After a pilot test with ten dairy farmers and ten agriculture economics postgraduate students to refine its length, clarity and sequence, ambiguous or non-relevant items were removed, resulting in a final version.

Sample size

The study targeted dairy farmers as the source population, with inclusion criteria requiring participants to own at least five dairy animals, regardless of land ownership.

Using the Raosoft sample size calculator (http://www.raosoft.com/samplesize.html?nosurvey), a sample size of 643 dairy milch population was estimated based on a 50% response distribution, a 5% margin of error and a 99% confidence level. Fourteen tehsils of Ahmednagar district were categorized into three groups based on their precipitation levels: low, medium and high rainfall areas. From these categories, three tehsils were randomly selected from the low rainfall zone, two from the medium rainfall zone and one from the high rainfall zone. Two villages were chosen randomly from the selected tehsil. All households in the particular village were screened for clinical mastitis; those with complete information on all parameters were considered for the economic loss study.

Ethical considerations

The research adhered to the Declaration of Helsinki and complied with national standards. Participation in the study was voluntary, with participants being fully informed about the study's objectives. They were assured that their personal information would remain confidential and be used exclusively for research.

Statistical analysis

The survey data were compiled in Microsoft Excel 2010, cleaned for inconsistencies and further analyzed using SPSS version 21.0 (SPSS Inc., IBM, Armonk, NY, USA).
The prevalence of clinical mastitis was calculated as,

$$\text{Prevalence rate} = \frac{\text{Number of clinical mastitis cases}}{\text{Total number of crossbred lactating animals}} \times 100$$

Economic Loss Estimation

Economic losses due to clinical mastitis were estimated by summing up three components: milk loss, treatment loss and replacement loss cost, which were calculated as follows;

Milk loss (`) = Average yield loss (litres/day) × Number of affected days × Price of milk (`/litre)

The present study assumed an average milk loss of 1 litre per day per affected animal due to mastitis, calculated for an average of 5 days at the milk rate of ` 25 per litre to standardize calculations. This assumption was made to simplify the estimation process and represents a generalized average across lactation stages, severity of mastitis and regional variations. While actual milk loss may vary, ranging from 1.5-3 litres/day based on lactation stage and disease severity, this standardized value was chosen to facilitate uniformity in data analysis and reporting.

Treatment cost (`) = Cost per animal × Number of treated animals × Number of veterinary visits

Replacement loss cost (`) = Cost of new animal - Selling value of mastitis-affected animal

Replacement loss cost was only considered for those animals whose productivity and reproductive performance declined significantly due to mastitis, making them economically unviable to retain.

Total economic loss (`) = Milk loss + Treatment cost + Replacement loss cost

Per-animal cost (`) = Total economic loss/ Number of affected animals.

The present study obtained 211 (87.9%) responses out of 240 targeted surveys, with 180 (75%) respondents providing complete information. Surveys with incomplete information were eliminated from the study.

Demographic details

Most respondents (47.2%) of the present study were between 25-50 years old, whereas only 15% were below 25 years (Table 1).

The majority of male respondents (66.1%) actively participated in the study. The survey showed that 32.2% of respondents were graduates and the majority of respondents were in the agriculture and dairy industry, but a considerable proportion of respondents (43.3%) were also active in other types of employment activities in addition to dairy farming (Table 1). The medium (36.1%) and large (30%) landholders had more than ten animals reported in the study.

Prevalence of clinical mastitis in different rainfall regions

The prevalence of clinical mastitis in high, medium and low rainfall regions was found to be 22.98% (n=315, milch crossbred population (MCBP)=1371), 17.88% (n=480, MCBP=2685) and 14.95% (n=578, MCBP=3865), respectively.

Higher prevalence in high rainfall areas due to increased moisture and muddy conditions, which promote bacterial contamination in bedding and milking environments. Damp conditions make it harder to maintain

udder hygiene, while high humidity encourages bacterial growth, weakening animals' immune defences. Proper barn drainage and improved hygiene practices can help mitigate the risks.

Economic losses due to clinical mastitis

The total economic loss due to clinical mastitis in regions with high, medium and low rainfall is shown in Table 2.

The milk loss resulting from mastitis in the crossbred cattle population observed in these rainfall regions amounted to ` 41879, ` 68861 and ` 81486, respectively. Clinical mastitis in high-yielding animals results in significant milk losses and the current study noted a higher number (n=578) of clinical mastitis cases in low rainfall regions compared to other areas. This increased occurrence contributes to the higher associated costs in these regions. The calculation of milk loss in the current study used a standardized value of 1 litre per day per affected animal. This approach may underestimate actual losses in specific scenarios, such as acute cases during early lactation, where losses can be higher. Future studies could benefit from more precise data to capture variations in milk yield loss across different stages of lactation and clinical presentations.

The treatment costs for mastitis cases in high, medium and low rainfall regions were ` 281280, ` 422393 and ` 514162, respectively. The variation in treatment costs across different rainfall zones can be attributed to differences in accessibility and the frequency of veterinary visits. Although the unit cost of treatment per animal is relatively similar across regions- ` 892.95 in high rainfall areas, ` 880.98 in medium rainfall areas and ` 889.55 in low rainfall areas-the total treatment cost is higher in low rainfall zones due to a larger number of animals requiring treatment in these areas.

The replacement loss cost was calculated for those animals suffering from clinical mastitis whose production and reproduction performance had decreased and retaining such animals would result in a loss instead of a profit to the farmer. The replacement cost in high, medium and low rainfall regions was ` 146000, ` 232000 and ` 401000, respectively. The number of animals replaced reported by the current study was 80, 120 and 145 from high, medium and low rainfall regions, respectively. The replacement loss cost varied from ` 1825 to ` 2766 across regions. The total replacement loss cost is higher in low rainfall areas because more animals were replaced than in other areas. The replacement cost difference is lower as farmers often sell animals during the subsequent lactation, or sell pregnant animals or recently calved animals, which fetch higher prices in the market.

The total economic losses in high, medium and low rainfall regions were calculated as ` 469159, ` 723254 and ` 996648, respectively. The per animal cost affected by clinical mastitis was ` 1489.39, ` 1506.78 and ` 1724.31 in high, medium and low rainfall regions, respectively.

Projected economic losses of clinical mastitis in Maharashtra state

The projected economic losses due to clinical mastitis in crossbred cows in Ahmednagar district were calculated based on the observed prevalence rate multiplied by the

Table 1: Demographic profile of respondents.

	Demographic details	No. of respondents	Percentage (%)
Age	Below 25 yrs	27	15.0
	25-50 yrs	85	47.2
	50 and above	68	37.8
Sex	Male	119	66.1
	Female	61	33.9
Education	Illiterate	37	20.6
	Upto 12th	85	47.2
	Graduate	58	32.2
Occupation	Farming	102	56.7
	Job	78	43.3
Landholding	Marginal (<0.5-1 Ha)	41	22.8
	Small (1-2 Ha)	20	11.1
	Medium (2-4 Ha)	65	36.1
	Large (>4 Ha)	54	30.0

Table 2: Economic losses due to clinical mastitis in various rainfall regions.

Rainfall region	Milk loss(`)	Treatment cost (`)	Replacement loss cost (`)	Total economic losses (`)	Peranimal cost (`)
High	41879	281280	146000	469159	1489.39
Medium	68861	422393	232000	723254	1506.78
Low	81486	514162	401000	996648	1724.31
Overall	192226	1217835	779000	2189062	4720.28

Table 3: Projected economic losses of clinical mastitis in crossbred cattle in Ahmednagar district and Maharashtra state.

			Ahmednagar district			Maharashtra state		
Rainfall region	Mastitis prevalence (%)	Per animal cost (`)	Milch crossbred population	Expected affected crossbred population	Total economic loss (`) crore	Milch crossbred population	Expected affected crossbred population	Total economic loss (`) crore
High	22.98	1489.39	60785	13968	2.08	136411	31347	4.67
Medium	17.88	1506.78	227905	40749	6.14	681195	121798	18.35
Low	14.95	1724.31	228978	34232	5.9	1220117	182407	31.45
					14.12			54.47

milch crossbred population and estimated loss per animal in the respective rainfall region of Ahmednagar district. The projected economic losses in the high rainfall region were ` 2.08 crore. The corresponding figure was ` 6.14 crore in the medium rainfall region and ` 5.9 crore in the low rainfall region of Ahmednagar district. A total projected economic loss due to clinical mastitis in the Ahmednagar district was reported to be ` 14.12 crore (Table 3).

The projected economic losses due to clinical mastitis in the high rainfall region of Maharashtra state were ` 4.67 crore; in the medium rainfall region were ` 18.35 crore and in the low rainfall region were ` 31.45 crore. A total projected economic loss in the crossbred cattle in Maharashtra state is estimated to be ` 54.47 crore (Table 3). It is important to understand that calculating exact losses is not feasible, as all figures are inherently estimates or projections. However, having a specific benchmark is essential for evaluating potential losses. This benchmark can be established by expected economic losses, providing a reference point for assessment. According to an estimate by Bansal and Gupta (2009), the total annual economic loss due to mastitis in India amounts to ` 7165.51 crores, with ` 503.49 crores attributed specifically to the Punjab region. In the current study, the estimated costs are significantly lower as the focus is solely on the crossbred cattle population, excluding buffaloes, non-descript cattle and indigenous breeds. Another researcher, Dua (2001), estimated the overall economic impact of mastitis in cows in Punjab at ` 46.57 crores. In comparison, the present study reports slightly higher economic losses of ` 54.47 crores, which may be attributed to differences in the timeline or the parameters used for economic estimation.

Christy (2014) estimated the annual economic loss due to mastitis in the Villupuram district at ` 7.07 crores, with a weighted average total direct economic loss of ` 2086.96 per case. In contrast, the present study reported an average cost of ` 1573.49 per clinical mastitis case in the crossbred population of Ahmednagar district. This lower cost could be attributed to differences in timelines or variations in the livestock population considered in the studies. Another study by Rakesh *et al.* (2011) reported an economic loss of 124.88 crores in Uttar Pradesh due to clinical mastitis; in contrast, the present study noted the economic loss of ` 54.47 crores in the crossbred cattle population.

In the present study, the average economic loss per animal is significantly lower compared to Bardhan's (2013) findings, which reported an average monthly loss due to mastitis per crossbred cow at ` 3206.55 in an optimistic scenario and ` 3549.59 in a pessimistic scenario. This difference may be attributed to regional variations in milk prices, differences in milk production across species and breeds, as well as varying agro-climatic conditions. Singh *et al.* (2014) reported an economic loss of ` 1314 per animal per lactation in crossbred cattle in Uttar Pradesh, which aligns closely with the findings of the current study. In contrast, Pvk *et al.* (2002) reported a much lower loss of ` 326 per infected cow from an organized dairy farm in Hyderabad and Fareed *et al.* (2017) noticed per animal economic loss of 640 Pakistan rupees in water buffaloes in Pakistan. This lower loss can be attributed to the implementation of best management practices and stringent herd health measures typically observed in organized dairy farms. Several researchers have observed discrepancies in production, treatment and total loss. These variances could be attributed to disparities in the calculating methodologies employed and differences in the periods under consideration. The occurrence of significant losses in crossbred cows highlights the need for specific attention to be given to the prevention of mastitis in dairy farms.

CONCLUSION

The findings of the current study offer a quantitative assessment of the economic impact of clinical mastitis, a condition that significantly affects both the quality and quantity of milk production, thereby influencing the dairy industry. These insights will aid researchers, planners and policymakers in making informed decisions and formulating effective strategies to prevent and manage the disease. Additionally, raising awareness and educating farmers about the economic implications of mastitis and the extent of related losses can play a crucial role in disease control and the implementation of preventive measures.

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Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

No animal was used in the study.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis and decision to publish, or preparation of the manuscript.

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