Research Article

Lumpy Skin Disease: Evaluating its Impact on Reproductive and Productive Performance of Cattle

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Abstract | Lumpy skin disease (LSD) is an emerging transboundary viral disease that poses serious risks to cattle health and productivity, especially in developing countries like Pakistan. The current study was designed to assess the impact of LSD on cattle reproductive and productive performance in Sindh, Pakistan. The study comprised 300 cattle from four districts (Dadu, Khairpur, Shaheed Benazirabad, and Tharparkar) between March 2025 and August 2025. Farm records, farmer interviews, and field surveys were used to collect data. Animals were classified by age and breed (indigenous and crossbred), and statistical analysis was performed using SPSS, including the Chi-square test and the paired sample t-test. The findings showed that the overall mortality rate was 15.0%, with calves having a much higher mortality rate (32.6%) than adult animals. Abortion and repeat breeding rates were found to be 12.1% and 40.6%, respectively, indicating a negative impact on reproductive performance. Breed-wise investigation revealed that compared to native breeds (10.7%), crossbred cattle were more prone to reproductive losses, especially abortion (19.6%). Additionally, milk production was found to have significantly decreased, with an average yield of 6.15 liters after infection compared to 8.21 liters prior to infection ($P < 0.05$). In conclusion, LSD has a severe negative influence on cattle survival, reproduction, and milk production in the research area, resulting in significant economic losses. The results emphasize the critical need for efficient control strategies, such as immunization, better management techniques, and early disease identification, to minimize the impact of LSD and optimize cattle production in Pakistan.

Keywords | Cattle, Livestock production, Lumpy skin disease, Mortality, Reproduction, Transboundary animal disease

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INTRODUCTION

Lumpy skin disease (LSD) is an infectious viral disease caused by the Lumpy skin disease virus (LSDV) (Khan *et al.*, 2021; Kumar *et al.*, 2021). LSDV belongs to the Capripoxvirus subfamily and Poxviridae family (Khan *et al.*, 2023; Tuppurainen *et al.*, 2017). LSD is a nonzoonotic, vector-borne disease that mostly affects ruminants, specifically cattle (Abbas *et al.*, 2025; Bianchini *et al.*, 2023). Mosquitoes, ticks, and biting flies are examples of arthropod vectors that help spread viruses between animals that are separated by short geographic distances (Sprygin *et al.*, 2019; Tuppurainen *et al.*, 2013).

The disease spreads rapidly and causes huge financial losses from poor hide, decreased milk production,

infertility, abortion, slow growth rates, and even death of an animal (Saqib *et al*., 2023). The World Organization for Animal Health (WOAH; formerly OIE) declared it a transboundary and mandatory notifiable disease (Gongal *et al*., 2022; Wilhelm and Ward, 2023; Zafar *et al*., 2023). The recent LSD outbreak in developing nations highlights the need of controlling and eliminating the disease (Sprygin *et al*., 2019). The main signs of LSD are fever or pyrexia, nasal discharge, lymph node swelling, nodules or nodular lesions covering the skin of entire body of an animal, and mucous membranes of the respiratory and gastrointestinal tract (Namazi and Tafti, 2021).

Disease spread to Egypt and other Middle Eastern countries between 1989 and 2000. This epidemic expanded throughout several nations, including Asia, Europe, Turkey, and Iraq, between 2003 and 2009. Cases were reported in the eastern Mediterranean, China, South Asia, Bangladesh, and India between the end of 2013 and 2019 (Abera *et al*., 2015). After 2021, the virus spread throughout Pakistan (Chandio *et al*., 2026). All provinces of Pakistan were impacted and are still experiencing this disease, but to a lesser level than in 2021 and 2022 (Memon *et al*., 2025; Missaghi *et al*., 2022).

Pakistan is among the many countries where the virus has spread. LSDV is currently a major issue in almost every part of Pakistan (Jamil *et al*., 2022; Khatri *et al*., 2023). The first disease suspect was found in Pakistan at the end of 2021 (Manzoor *et al*., 2023; Ul-Rahman *et al*., 2022). Pakistan is among several nations where the virus has spread. Pakistan is now dealing with serious LSDV issues in some of its regions. A recent study in Pakistan found that an LSD infection at the herd level frequently causes an overall economic loss of USD 3 million (El-Neweshy *et al*., 2013). The first case of LSD was discovered in the Jamshoro area of Sindh, Pakistan, in November 2021. By the end of April 2022, 36,000 cattle had been infected by LSD, with a fatality rate of 0.8%, leading the Sindh livestock department to declare an epidemic (Shah and Khan, 2022). The most affected districts in southern Punjab were Multan and Bahawalpur. Compared to Northern Punjab, Southern Punjab had a higher incidence of lumpy skin disease (Imran *et al*., 2022).

Despite increasing reports of lumpy skin disease (LSD) in Pakistan, there is little field-based evidence of its combined impact on reproductive and productive performance under local farming environments. The purpose of this study was to assess the effects of LSD on mortality, reproductive performance, and milk production in cattle in Sindh, Pakistan.

MATERIALS AND METHODS

Study area

The study was carried out from March 2025 to August 2025 in four distinct districts in of Sindh region of Pakistan including: Dadu, Khairpur, Shaheed Benazirbad, and Tharparkar. 300 cows with lumpy skin disease were chosen from four different districts. Farms were selected using convenience sampling from villages with reported LSD outbreaks. Only farms with at least five cattle and confirmed LSD cases within the previous six months were included. For this study, animals from houses and farms were mostly taken into consideration. To determine the incidence of the disease, all types of LSD-affected animals were considered for this research, including calf, heifer, adult cows, and bulls. The data was then collected through a direct conversation with the farm owner. The responses from owners were noted on the pretested questionnaire. In some cases, the animals were inspected and the accessible farm records were checked for further information.

Grouping of animals

For this study, the animals were divided into two groups. All cattle (both male and female) that showed clinical signs of LSD during the study period were included. The impact of LSD on reproductive and productive performance was observed in both indigenous and crossbred animals. LSD diagnosis was based on characteristic clinical signs (fever, nodular skin lesions, lymphadenopathy). In order to facilitate the research, animals between the ages of 0 and 6 months and up to 1 year were categorized as calves. Calves included both male and female animals aged below one year. The animals were divided into various age groups (Table 1).

Table 1: Grouping of animals according to their age

S. No	Age interval years	No of animals
1	0-1	104
2	>1-2	44
3	>2-3	83
4	>3-4	51
5	>4-5	18
Total 300		

Data management and statistical analysis

For statistical analysis of data SPSS software (version 25.0) was used. Percentages were calculated for overall mortality, calf mortality, abortion, and repeat breeding rate. The Chi-square test was used to estimate significant correlations between various age groups in the case of mortality and between various breeds in the case of repeat breeding, abortion, and mortality. The significant difference between milk production before and after lumpy skin disease was

determined using a paired sample T-test. The level of significance for all analyses was set at a P value less than 0.05.

RESULTS

Overall mortality, calf mortality, abortion and repeat breeding rate in LSD

A total of 300 animals were observed, including 45 deaths, for an overall mortality rate of 15.0%. Calf mortality was significantly greater, with 34 deaths out of 104 afflicted calves, or a rate of 32.6%. 10 abortion cases were found out of 82 affected animals, resulting in a 12.1% abortion rate, indicating reproductive losses as well. Additionally, recurrent breeding was prevalent, with 13 incidents out of 32 animals reported, making up the highest incidence of any parameter at 40.6%. These results show that lumpy skin disease has a significant impact on both health and reproductive performance, especially in calves and breeding animals. Overall mortality, calf mortality, abortion and repeat breeding rate of LSD are summarized in Table 2.

Table 2: Overall mortality, calf mortality, abortion and repeat breeding rate in lumpy skin disease (LSD).

Parameters	Total animal observed	Total positive cases	Rate %
Mortality	300	45	15.0
Calf mortality	104	34	32.6
Abortion	82	10	12.1
Repeat Breeding	32	13	40.6

Age-wise mortality rate in LSD

The mortality rate of animals with lumpy skin condition varied considerably with age. With 34 deaths out of 104, or 32.7% mortality rate, the youngest animals (0–1 year) had the highest mortality rate. The mortality rates for animals aged 1-2 years and 2-3 years were significantly lower, at 4.5% and 7.2%, respectively, and the mortality rate for animals aged 3-4 years was 3.9%. The age group of 4–5 years old had no recorded deaths. 45 of the 300 animals that were observed died, resulting in a 15% total mortality rate. The variations in mortality rates across age groups were highly significant, demonstrating that younger animals are more vulnerable to the disease. Age-wise mortality rate of LSD is summarized in Table 3.

Breed-wise mortality, calf mortality, abortion and repeat breeding rate in LSD

The effects of lumpy skin disease on different breeds of cattle showed differences in survival and reproductive outcomes. Although this difference was not statistically significant (P = 0.820), mortality rates in crossbred cattle were relatively higher, with 26 deaths out of 170 positive cases (15.3%) compared to 16 deaths out of 130 indigenous animals (12.3%). With 11 cases out of 56 positive cases (19.6%) and 3 cases out of 28 indigenous cattle (10.7%), the incidence of abortion was much higher in crossbred animals, with a statistically significant difference (P = 0.012). Ten crossbred animals (50%) and four native animals (32.3%) showed evidence of repeat breeding, however the difference was not statistically significant (P = 0.170). Overall, our findings indicate that crossbred cattle may be more sensitive to reproductive losses caused by lumpy skin disease, particularly abortion. Breed wise mortality, calf mortality, abortion and repeat breeding rate of LSD are summarized in Table 4.

Table 3: Age-wise mortality rate in lumpy skin disease (LSD).

Age interval (years)	No. of animals	Deaths	Mortality rate (%)	P value
0–1	104	34	32.7	<0.001
>1–2	44	2	4.5	
>2–3	83	6	7.2	
>3–4	51	2	3.9	
>4–5	18	0	0.0	
Total	300	45	15.0	

Note: Chi-square test showed highly significant differences among age groups (P < 0.001). Mortality rate = (deaths / number of animals in that age group) × 100.

Table 4: Breed wise mortality, calf mortality, abortion and repeat breeding rate in lumpy skin disease (LSD).

Parameter	Breed	Number of animals at risk	Number of events	Rate (%)	P value
Mortality	Cross	170	26	15.3	0.820
	Indigenous	130	16	12.3	
Abortion*	Cross	56	11	19.6	0.012
	Indigenous	28	3	10.7	
Repeat breeding†	Cross	20	10	50.0	0.170
	Indigenous	11	4	32.3	

*Abortion denominator: only pregnant cows at time of infection.
†Repeat breeding denominator: only cows inseminated at least twice after recovery.

Effects of LSD on milk production in lactating cows

Milk production in affected animals showed a marked decline following lumpy skin disease. Across 44 observations, the mean daily milk yield decreased from 8.21 liters before infection to 6.15 liters after infection. A strong positive correlation (r = 0.989) between pre- and post-infection values was observed, indicating consistency in individual animal responses. The paired sample t-test confirmed that this reduction in milk yield was highly

significant (P = 0.00), highlighting the considerable impact of the disease on lactation performance. Effect of milk production before and after LSD is shown is Table 5.

Table 5: Effect of milk production before and after lumpy skin disease.

No. of observations	Mean		Correlation	Paired sample T test
	Before LSD	After LSD		
44	8.2109	6.1457	0.989	0.00

The average daily milk production dropped from 8.21 liters prior to infection to 6.15 liters following infection during 44 observations. Pre- and post-infection values showed a good positive correlation (r = 0.989), suggesting that individual animal responses were consistent. This decrease in milk yield was shown to be highly significant (P = 0.00) by the paired sample t-test, indicating the severe influence of disease on lactation performance of animals.

DISCUSSION

The current study provides essential field-based evidence of the considerable impact of lumpy skin disease (LSD) on both reproductive and productive performance of cattle in Sindh, Pakistan. The overall fatality rate (15.0%) reported in this study is greater than previous reports from Pakistan and nearby regions. In this regard, endemic areas like Africa and portions of the Middle East have frequently recorded lower fatality rates (<5%) (Tuppurainen *et al*., 2017). Similarly, fatality rates from outbreaks in South Asia, such as Bangladesh and India, have often been between 1 and 10% (Kumar *et al*., 2021). As previously noted by Ul-Rahman *et al*. (2022), young animal populations, lack of preexisting immunity, insufficient vaccination coverage, and poor farm-level disease management during the initial outbreak phase in Pakistan may be responsible for the relatively increased mortality in the current study.

The high calf mortality rate (32.6%), which suggests that younger animals are more susceptible to LSD infection, was one particularly concerning observation. This is consistent with other research that found calves were more vulnerable because of their immature immune systems and increased exposure to environmental stresses (Abera *et al*., 2015). Similar patterns have been noted in African nations, where during LSD outbreaks, calf mortality was disproportionately higher than that of adult cattle (Bianchini *et al*., 2023). The assumption that age is a key risk factor impacting the severity of disease is further supported by the considerable variance in mortality between age groups seen in this study. The higher mortality in calves may be explained by their immature immune systems, smaller body reserves, and greater susceptibility to dehydration and secondary infections during febrile illness. Additionally, calves may have received less attentive care during outbreaks when farmers prioritized adult animals.

Abortion (12.1%) and repeat breeding (40.6%) rates demonstrated a significant reduction in reproductive performance. These results are in line with past research suggesting that one of the main effects of LSD infection is reproductive problems. In particular, El-Neweshy *et al*. (2013) reported that high fever and systemic infection in diseased animals were linked to infertility and abortion. According to research conducted in Ethiopia and other parts of Africa, abortion rates range from 5 to 15%, which is in close agreement with the results of this investigation (Abera *et al*., 2015). Hormonal abnormalities, ovarian malfunction, and stress brought on by the condition have all been suggested as potential root causes for the high repeat breeding rate (Khan *et al*., 2023).

Breed-specific comparisons found that crossbred cattle were more negatively impacted than indigenous breeds, notably in terms of abortion rates. This finding is consistent with earlier studies showing that crossbred and exotic animals are particularly more vulnerable to infectious diseases because they are less able to adapt to local environmental circumstances (Memon *et al*., 2025). Similar results have been documented in Pakistan and other tropical areas, where native breeds showed comparatively greater resistance to LSD infection (Saqib *et al*., 2023). The pattern indicates a greater susceptibility of crossbred animals, which calls for more research even though variations in mortality and repeat breeding between breeds were not statistically significant.

The significant drop in milk production ranging from 8.21 L to 6.15 L after LSD infection clearly demonstrates the negative impacts on dairy productivity. This decrease is in alignment with results from earlier outbreaks, where milk yield losses ranging from 10 to 65% have been documented, depending on the severity of the disease and management strategies (Saqib *et al*., 2023). The reduction in milk production following LSD infection can be explained by systemic illness, fever, reduced feed intake, and metabolic disturbances, which collectively impair lactation performance (Kumar *et al*., 2021; Bianchini *et al*., 2023). This high association between milk yield before and after infection in current study indicates that the disease has a continuous suppressive effect on productivity of an animal.

Overall, the findings of this study suggest that the impact is relatively severe in the local context of Sindh, Pakistan. This could be due to variances in management techniques, vector control tactics, environmental conditions, or preparedness levels. The study emphasizes the urgent need for improved vaccine regimens, early detection, and effective disease control programs to reduce the economic and reproductive

costs of LSD. In addition, specific interventions for high-risk populations, particularly calves and crossbred animals, should be prioritized to reduce disease burden and increase livestock productivity in impacted regions.

This study has certain limitations. Milk production data prior to infection were based on farmer recall, which may introduce recall bias. Mild or subclinical cases may have been underreported. Additionally, laboratory confirmation of LSD was not performed in all cases, which may affect diagnostic accuracy

CONCLUSION

This study revealed that lumpy skin disease (LSD) significantly impairs reproduction and production of cattle in Sindh region of Pakistan. Younger animals were more susceptible to the disease, as seen by the comparatively high total mortality and the significantly greater losses in calves. Furthermore, the high rate of abortion and repeat breeding highlights the negative effects of LSD on reproductive efficiency, which may have long-term impacts on farm profitability and herd sustainability.

The results also show that genetic adaptation plays a role in disease resilience, as crossbred cattle are more likely to experience reproductive losses than native breeds. The economic impact of LSD on dairy farmers, which affects both income and food security, is confirmed by a sharp drop in milk production after infection.

Overall, the study underscores that LSD is not only a health concern but also a major constraint to livestock productivity in the region. Effective control strategies, including timely vaccination, improved farm management, vector control, and early disease detection, are essential to minimize its impact. Special attention should be given to high-risk groups such as calves and crossbred animals. These findings provide useful field-based evidence to help policymakers and stakeholders plan targeted approaches to manage LSD and protect livestock sector of Pakistan.

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NOVELTY STATEMENT

This study provides field-based evidence on the combined effects of lumpy skin disease (LSD) on mortality, reproductive performance, and milk production of cattle under Sindh's farming conditions. It highlights the greater susceptibility of calves and crossbred cattle to disease-associated losses. The research quantifies reproductive losses through abortion and repeat breeding rates alongside production losses in milk yield. These findings contribute valuable regional data to support evidence-based LSD control and livestock management strategies in Pakistan.

AUTHOR'S CONTRIBUTION

Sajad Ali Laghari Conceptualized the study, collected data and wrote an initial draft. Muhammad Mohsen Rahimoon and Majid Hussain Soomro suggested methodology and analyzed the data. Fazul U Rahman Soomro, Baby Yasmeen and Muhammad Rashid Shar reviewed and edited the manuscript. Qudratullah Kalwar supervised the process.

Ethical considerations

This study was conducted in accordance with ethical standards for field-based research. Verbal consent was obtained from farm owners prior to data collection. No invasive procedures were performed on animals.

Generative AI and AI assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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