

Original Article

Epidemiology, Risk Factors, and Farmer Awareness of Lumpy Skin Disease in Dairy and Beef Cattle in Habiganj, Bangladesh

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Abstract - Lumpy Skin Disease is a viral infection caused by the Lumpy Skin Disease virus, a member of the genus *Capripoxvirus*. LSD results in significant economic losses in cattle production through its effects on milk yield, growth rate, an increased incidence of abortion, and restrictions against trade. There is limited information on the prevalence of LSD; moreover, the risk factors and farmer knowledge are not well documented in Bangladesh. A cross-sectional survey study was thus carried out in Habiganj district from June 2025 to September 2025 and included 50 farms with a total of 400 cattle (300 dairy and 100 beef). Through structured questionnaires, clinical assessments, and farmer interviews, the prevalence, risk factors, and farmer knowledge of LSD were determined. The prevalence of animals was 27.5%, which increased to 50% for local breeds, and the animals of over 2 years of age had a higher prevalence rate compared to the calves. Moreover, the prevalence rate of LSD was significantly lower in vaccinated animals than in unvaccinated animals, at 10%. Among these, the commonly reported clinical signs included skin nodules, fever, and Lymphadenopathy. The prevalence rates of skin nodules, fever, Lymphadenopathy, reduction in yield of milk, and poor growth in beef cattle were recorded as 81.8%, 63.6%, 45.5%, 54.5%, and 13.6%, respectively. This study has identified moderate levels of farmer awareness about LSD; it was recorded that only 60% of farmers were aware that LSD is transmissible, while only 50% of farmers in this study were practising vaccinations in their cattle. The smallholder farms were more severely affected, and there were no biosecurity measures employed by farmers. Considering the given findings, there is a need for vaccination campaigns, farmer education, vector control management practices, and routine epidemiological surveillance to monitor LSD in Bangladesh.

Keywords - Lumpy Skin Disease, LSDV, Prevalence, Risk Factors, Farmer Awareness, Habiganj, Bangladesh.

1. Introduction

Lumpy skin disease is a highly contagious viral disease of cattle caused by the Lumpy Skin Disease Virus, LSDV, in the genus *Capripoxvirus* within the family *Poxviridae* [1, 2]. The general manifestations of LSD include fever, nodular skin lesions, Lymphadenopathy, edema, mastitis, decrease in milk production, infertility, abortion, and at the worst, death [3, 4]. LSD is considered an important transboundary threat due to its fast dissemination from Africa to the Middle East, Europe, and lately Asia, causing both animal health and economic catastrophes [1,5]. It was an emerging disease in Bangladesh and neighboring countries; hence, it is of major concern to smallholder farmers and national livestock industries.

The major route of transmission of LSDV is by mechanical vectors: mosquitoes (*Aedes*, *Culex* spp.), biting flies (*Stomoxys calcitrans*), and ticks [7, 8,26]. It may be transmitted by direct contact between infected animals or by contaminated instruments, but these are generally considered secondary routes of transmission [9]. High humidity and rainfall, together with dense vegetation, favor the proliferation of vectors. These have been correlated with

a high incidence of the disease [10]. Husbandry practices that have been relevant in the epidemiology of LSD have included Housing, Grazing Systems, and Biosecurity. Adult cattle and indigenous breeds have been affected more commonly due to increased exposure to vectors, lower levels of immunity, and less intensive management practices [11, 12].

LSD causes huge economic losses in cattle production. Some of the clinical manifestations, such as nodular skin lesions and reduction of milk yield, directly lead to productivity losses, while abortions, poor growth, and infertility are important elements that add to the economic burdens [13]. Lesions that damage the hide reduce the market value of the hide. In addition, the longer the calf has to heal, the more expensive the costs of feed and veterinarian care. In addition to these costs at the farm level, LSD outbreaks disrupt international trade due to bans on all livestock and livestock products being imported from the countries affected by the outbreak.

Aside from these impacts at the farm level, LSD outbreaks disrupt trade as international bans occur on livestock and animal products originating from affected



countries [14, 24]. Reports from Africa and South Asia show that outbreaks can reduce milk production by 20% – 60% and decrease body weight gain in beef cattle, hence incurring substantial financial losses for smallholder households [15,16].

Vaccination remains the cornerstone for preventing LSD. Live attenuated vaccines, including sheep pox- and goat pox-based formulations, have shown their value in reducing morbidity and mortality [17,18,25]. Uptake, however, is irregular across endemic regions in general and more so for small-scale farmers because of a lack of access, high costs, and lack of awareness [19]. Experience from India, Pakistan, Ethiopia, and Kenya suggests that broad vaccination coverage accompanied by vector control, biosecurity measures, and farmer education is paramount for effective management of the disease [20–23].

Vector seasonality, density of farms, and animal movements also affect the distribution and dynamics of the disease outbreak. The first sporadic reports of LSD appeared in Bangladesh in the late 2010s, and the country still lacks systematic epidemiological data. Habiganj and other parts of the northeastern districts have a high density of cattle, and smallholder farming systems drive their farming systems, so they are considered high risk for disease establishment [23,28]. Moreover, environmental conditions in these areas are conducive to the rapid proliferation of vector populations. A few earlier studies have shown outbreaks in isolation, but comprehensive prevalence, risk factors, and farmer awareness analyses have not been conducted. These are very important parameters for early detection, targeted vaccination, and hence effective control interventions. Farmer knowledge about clinical signs, vaccination,

quarantine practices, and vector control is highly related to the success of preventative programs. Epidemiological surveys provide the necessary baseline information to support evidence-based control strategies. Identification of high-risk breeds, age groups, and farm types informs prioritization of vaccination and education. The integration of environmental and managerial risk factors in smallholder systems enhances the ability to identify specific risk factors for prevention[27]. In particular, in smallholder farming systems with intensive contact between animals and limited biosecurity measures, these factors contribute to the risk of infection [28,29]. These approaches not only reduce disease incidence but also make a very important contribution to minimizing broader economic and welfare impacts on livestock-dependent households. The objectives of the study were to:

1. Prevalence of LSD in dairy and beef cattle of Habiganj District of Bangladesh.
2. Determine what breed, age, vaccination status, and farm type are most at risk for LSD infections.
3. Evaluate how aware, knowledgeable, and proactive farmers are in preventing and controlling LSD. Specific epidemiological data from this study will aid veterinary authorities, policymakers, and farmers in formulating appropriate action plans regarding the current status of LSD in Habiganj District.

The findings shall be useful in advocating for evidence-based interventions comprising vaccination drives, vector control, improvement of Biosecurity, and education programs aimed at farmers for enhancing the health, production, and livelihood of cattle in the area.

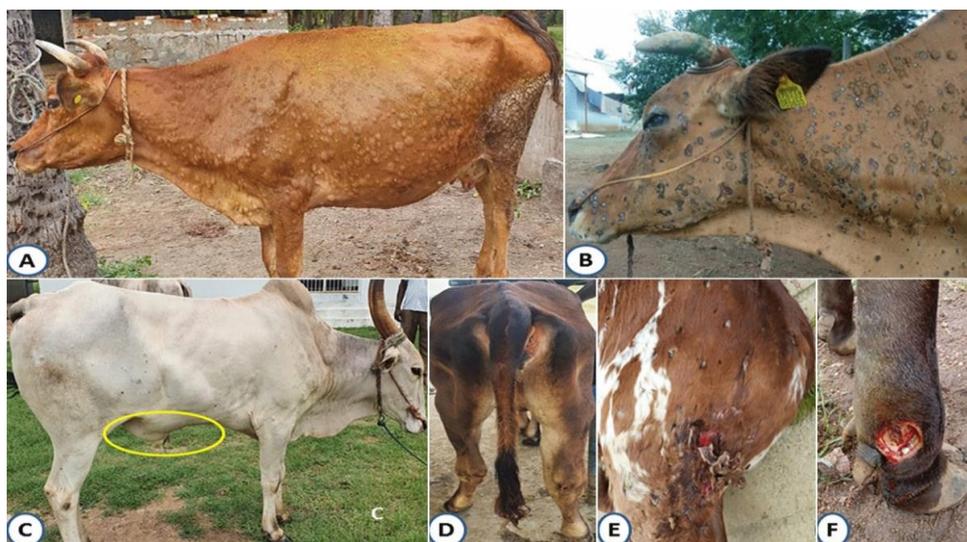


Fig. 1 LSD Affected Cattle

2. Materials and Methods

2.1. Study Area and Population

The study was carried out in Habiganj, a district situated in northeastern Bangladesh, and the study area is mentioned in the study. The upazilas of Habiganj Sadar,

Bahubal, and Ajmiriganj were also part of the study area. The subtropical Habiganj district has high humidity and rainfall, which can be beneficial for arthropod vectors to survive. The target population presented in the research included smallholder dairy and beef cattle from commercial

and smallholder farms. The animals in the target population included both local and crossbred animals of both sexes and more than six months of age.

2.2. Study Design

A cross-sectional study was carried out from June 2025 to September 2025. Farms were randomly selected based on stratified sampling based on farm size and cattle type, done in a proportional manner. Within the selected farms, animals were chosen in proportion to herd size. Cattle were selected based on inclusion criteria, which included apparently healthy as well as clinically affected cattle, for the purpose of representative prevalence data collection.

2.3. Sample Size

Sample size was calculated using the formula:

$$n = \frac{Z^2 P (1-P)}{d^2}$$

Where P is the expected prevalence (20%), Z is 1.96 for a 95% confidence, and d = 5% margin of error. This yielded 400 animals (300 dairy, 100 beef) across 50 farms.

2.4. Data Collection

- Structured Questionnaire: Farmers were asked to respond to questions regarding their farm characteristics, herd size, housing, feeding, vaccination history, and knowledge of LSD

3.1 Animal and Farm – Level Prevalence

Animal – Level Prevalence

- Clinical Examination: Animals were examined for scabs and nodules on the skin, fever (rectal temperature above 39.5°C), Lymphadenopathy, decreased production of dairy milk, and inadequate growth (beef)
- Laboratory Confirmation: A small number of animals were sampled for blood and/or skin in order to confirm LSDV infection by PCR.

2.5. Data Analysis

Data was entered into Microsoft Excel and analyzed with SPSS v26. Descriptive statistics (frequency, percentage, and mean) were calculated for prevalence, clinical signs, and farmer awareness.

Chi-square tests and logistic regression were used to analyze associations between risk factors (breed, age, vaccination, farm type) and the occurrence of LSD. A threshold of statistical significance was set at p<0.05 for all tests. Graphical representation included bar charts, pie charts, and geographical maps for prevalence distribution.

3. Result

Farms Surveyed: 50

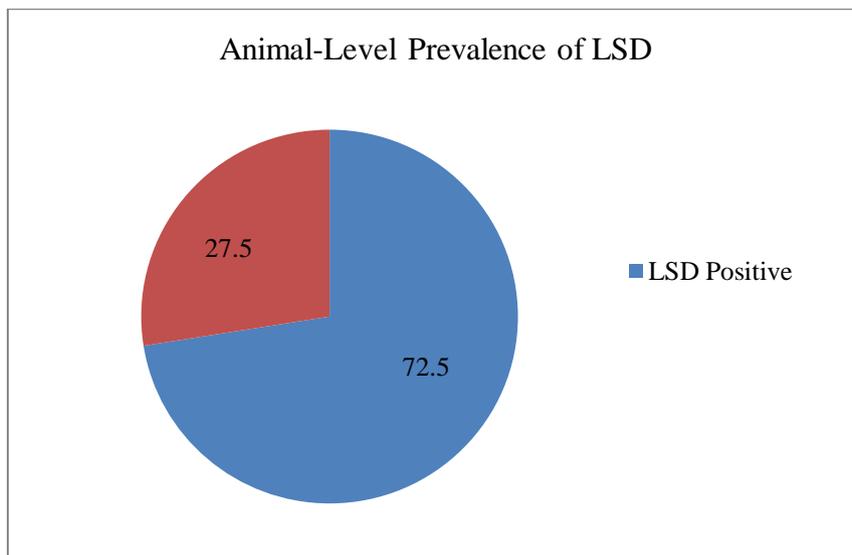
Animals Surveyed: 400 (300 dairy, 100 beef)

Average Herd Size: 6 animals/farm

Farm Types : smallholder (70 %), commercial (30 %)

Table 1. Animal–Level Prevalence

Cattle Type	Number Surveyed	LSD positive	Prevalence (%)
Dairy	300	90	30
Beef	100	20	20
Total	400	110	27.5



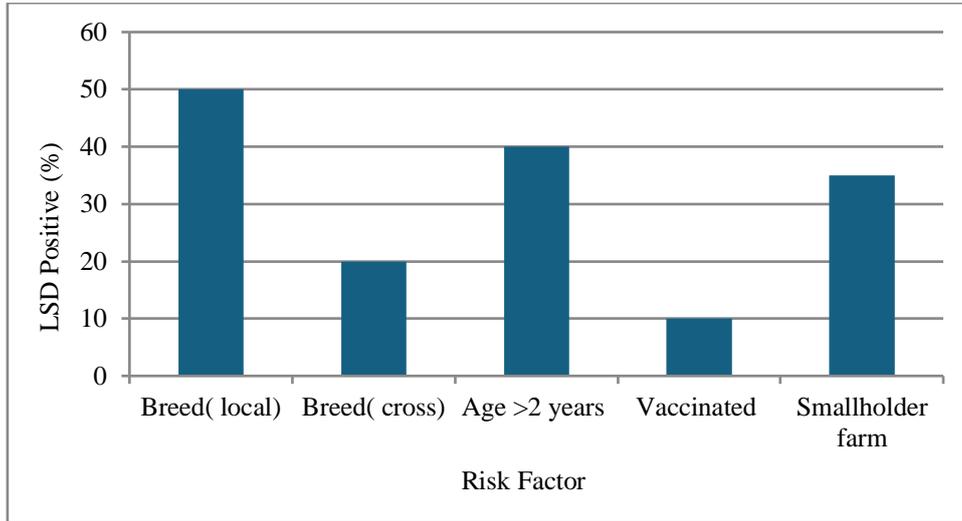
Farm – Level Prevalence

Table 2. Farm-Level Prevalence

Cattle Type	Number of farms	Farms affected	Prevalence (%)
Dairy	50	25	50
Beef	30	10	33
Total	50	30	48

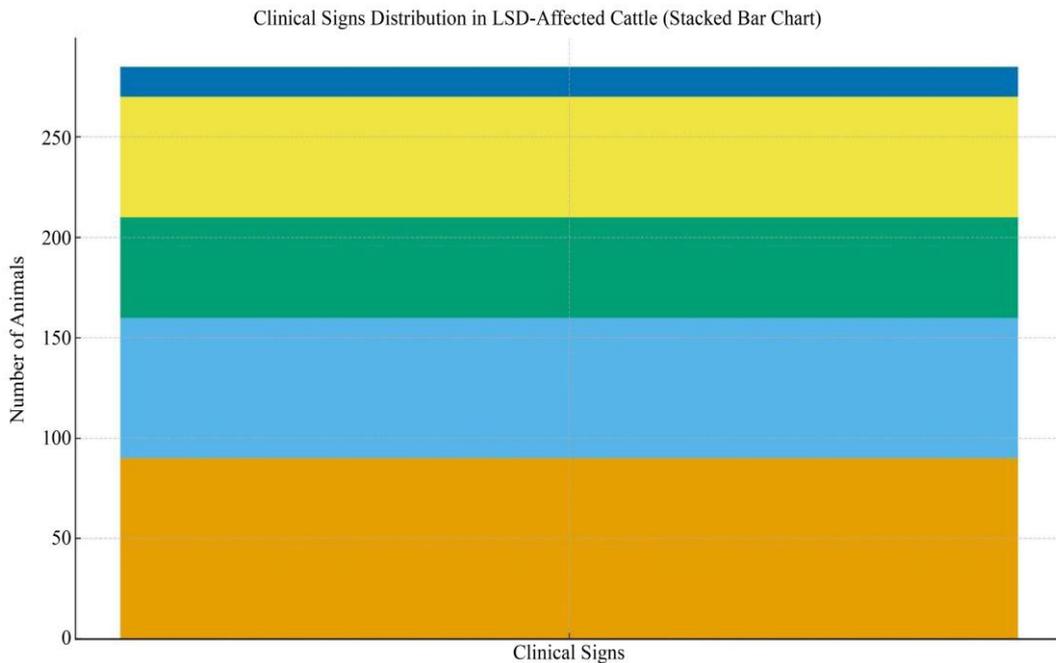
3.2. Risk Factor

Risk Factor		LSD positive	LSD negative	P- value	Odds ratio
Breed(local)	50		50		0.02 2.0
Breed(cross)	20		80		0.03 1.0
Age >2 years	40		60		0.01 1.8
Vaccinated	10		90		0.001 0.2
Smallholder farm	35		65		0.04 1.5



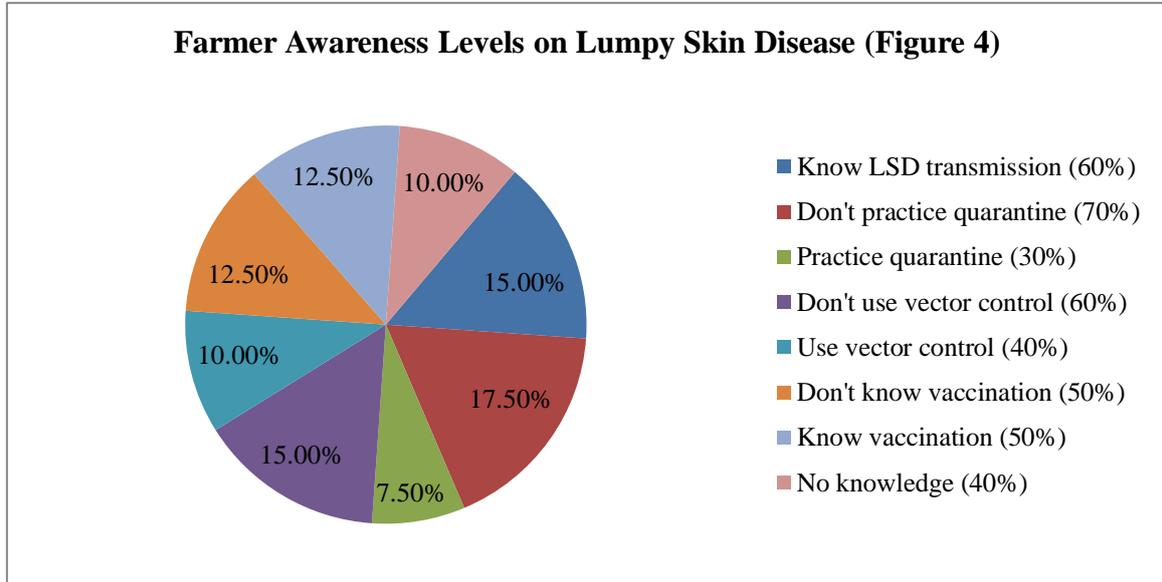
3.3. Clinical Sign

Clinical sign	Number of animals	Percentage (%)
Skin nodules	90	81.8
Fever	70	63.6
Lymph node swelling	50	45.5
Reduced milk (dairy)	60	54.5
Reduced growth (beef)	15	13.6



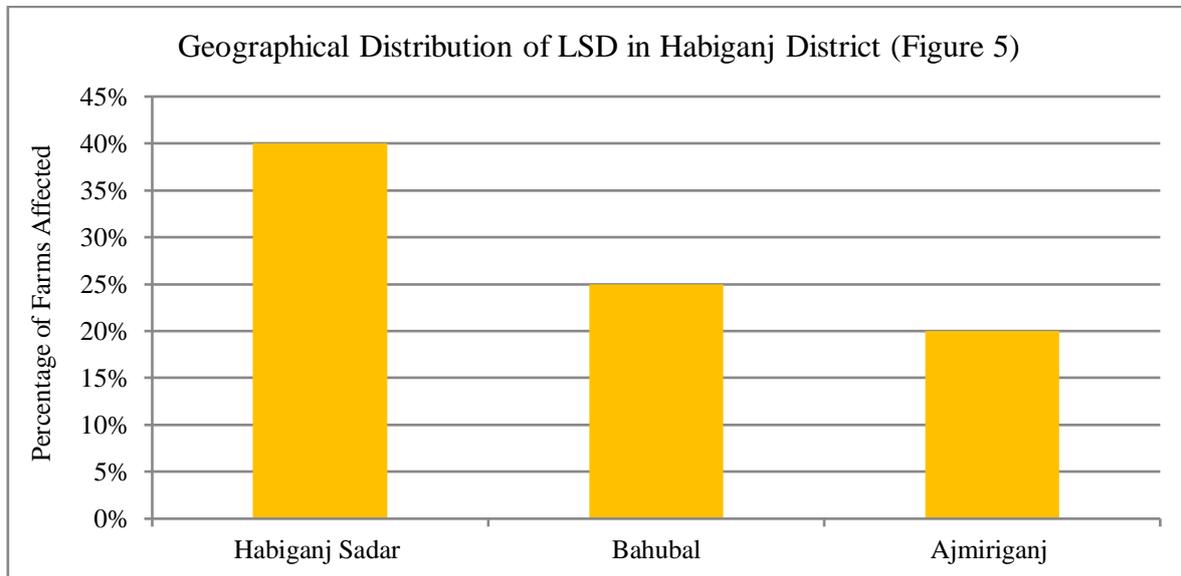
3.4. Farmer Awareness

Awareness parameter	Yes (n, %)	No (n, %)
Know LSD transmission	30 (60 %)	20 (40 %)
Know Vaccination	25 ((50 %)	25 (50 %)
Use Vector Control	20 (40 %)	30 (60 %)
Practice Quarantine	15 (30 %)	35 (70 %)



3.5. Geographical Distribution

- Habiganj Sadar: 40 % farms affected
- Bahubal : 25 % farms affected
- Ajmiriganj : 20 % farms affected



4. Discussion

This study constitutes an epidemiological assessment of lumpy skin disease in dairy and beef cattle in the Habiganj district with an animal-level prevalence of 27.5% and a farm-level prevalence of 48%. This study has also shown that LSD is a severe public health and economic problem within the livestock industry in northeastern Bangladesh.

The farm-level prevalence indicated that most farms were exposed to the LSD virus, although not all of their animals developed clinical manifestations of the disease. The level of exposure revealed in this study is of grave concern inasmuch as in study areas where cattle are plentiful, the likelihood of explosive transmission of the disease is increased.

In the present study, breed was highlighted as a significant risk factor. Specifically, the disease prevalence in the local breeds was significantly higher (50%) compared to the crossbred cattle (20%). Local breeds are more common; however, this is expected to be due to management factors and not genetic susceptibility. Most of the local breeds are raised under open or semi-intensive systems, which expose them to arthropod vectors such as mosquitoes, biting flies, or ticks. Crossbred dairy cattle, which are generally kept in more intensive systems with better housing and veterinary care, are less likely to come in contact with vectors and more likely to receive preventive measures such as vaccination. The conclusions from this study are in agreement with the results obtained in India, Pakistan, and Ethiopia, where local or indigenous cattle are more affected by LSD than crossbred cattle under similar husbandry conditions.

Age was another important risk factor; cattle older than two years had a greater prevalence (40%). Older animals have a longer cumulative exposure to vectors and may also be stressed through lactation, breeding, or pregnancy, potentially affecting immune responsiveness. Younger cattle typically remain closer to sheltered areas and receive greater management attention, resulting in lower exposure risk. Age-associated susceptibility is consistent with reports from elsewhere in the world, indicating the need to put in place prevention strategies focused on adult cattle.

Vaccination was an important protective factor since only 10% of animals reported to have been vaccinated were infected, which implicated vaccination as the most significant intervention to tackle LSD. However, only half of the farms reported vaccinating their cattle, with barriers to owning vaccination, which included the availability of the vaccine, the cost, and limited knowledge on the confirmed efficacy of the vaccine. Therefore, if we want to reduce disease burden and control outbreaks, we need to strengthen a mass vaccination programme, especially amongst smallholder farmers.

Smallholdings were particularly affected, with higher levels of disease, 35% positive, being identified. Several contributory factors were identified as inadequate housing and drainage, high levels of vector exposure, too little Biosecurity, and the low levels of utilisation of prevention measures. As an example, only 40% of farmers reported using vector control measures, and only 30% of farmers quarantined new or sick animals, suggesting that education and training programmes for farmers may aid in awareness, Biosecurity, and reduction of disease spread within and between herds. Clinical signs observed in affected cattle, including nodular skin lesions, fever, Lymphadenopathy, and decreased milk production, together with failure of growth, were consistent with the classical LSD signs reported in other countries across the globe. The economic impacts are significant, given that diseased dairy cows produce less milk and lower household incomes, while beef cattle that fail to gain weight take longer than usual to become ready for market and reduce profitability. Furthermore, there are losses due to treatment, recovery

times, reproductive loss, and possible hidden damage. LSD has impacts on animal health as well as livelihoods.

The prevalence patterns seen in Habiganj were likely facilitated by favourable climatic conditions that could allow vector proliferation: high humidity, rainfall, and dense vegetation. The higher prevalence of cases in Habiganj Sadar compared to Bahubal and Ajmiriganj may be attributed to higher cattle density, livestock movements, and markets contributing to LSD perpetuation. These results support the inclusion of management and environmental aspects in control strategies. The results presented in this study correspond with both regional and global findings and reflect the cross-boundary nature of LSD. For example, higher vector density related to poor husbandry, in both South Asia and East Africa, likely contributed to the overall LSD risk. Our study also supports recommendations for integrated control, including vaccination against LSDV, vector management, biosecurity measures, and education of farmers, with increased surveillance and rapid confirmation by the laboratory of suspected cases.

The main limitations of the study were the reliance on clinical diagnosis with most cases, which can confound other dermatological diseases like viral skin disease, and the reliance on farmer-reported data, which is sensitive to recall bias. Given a low number of human resources and the inability to measure the vector populations that may be responsible for important vectors, the examination of transmission dynamics associated with vectors was limited. Nevertheless, the study yielded baseline data that will be used to move HIV and evidence-based recommendations for LSD control programmes in Bangladesh and other tropical areas. In conclusion, LSD is prevalent in cattle in the Habiganj district – local breeds and older cattle are specifically affected. Vaccination is effective in decreasing the incidence of disease, while smallholder farms remain highly vulnerable given the lack of biosecurity measures and other preventative practices. Thus, addressing knowledge gaps in cattle care for farmers, improving vaccination practices, and attempting to reduce vector populations via integrated vector management would represent important steps toward decreasing and addressing the economic and welfare consequences of LSD in the region.

5. Recommendations

Based on the results of this study, recommendations for successful control and prevention of Lumpy Skin Disease (LSD) within both Habiganj District and similar areas of Bangladesh are to:

5.1. Provide Vaccination Programmes

Routine and targeted vaccination campaigns should be performed, focusing primarily on the highest-risk populations, which will include native breeds, mature cattle, and other high-risk animals. The greatest effort should be made to ensure that vaccines are available in a timely manner, especially in the case of smallholder farms. The working relationship between veterinary authorities and

local agricultural extension services will help to increase vaccine coverage. Public awareness campaigns should highlight the importance of completing the entire vaccination programme, as this will improve herd immunity and prevent outbreaks

5.2. Educate and Train Farmers

Farmers should receive comprehensive education on Lumpy Skin Disease's mode of transmission, clinical signs, measures to be taken to reduce potential exposure, and ways to identify a suspected case of LSD. Educational training should include practical training on vaccination processes, methods for quarantining new animals and/or sick animals, methods of controlling vectors, and methods of implementing biosecurity measures. By educating farmers regarding the importance of preventive measures, the incidence of LSD will decrease, resulting in economic loss to the farmer.

5.3. Control of Vector

To lower the number of biting flies, mosquitoes, and ticks serving as mechanical vectors for the Lumpy Skin Disease Virus (LSDV), Integrated Vector Management (IVM) strategies should be used. Examples of these strategies include insecticide application, environmental sanitation, draining standing water, proper disposal of animal waste, use of repellents, and seasonal vector surveillance.

5.4. Enhanced Biosecurity

Smallholder producers should implement Basic Biosecurity (BS) measures for their herds. Basic Biosecurity will include isolation of sick or new animals, restricting access to the farm to only authorized personnel, providing sanitary housing, and controlling the movement of animals between herds. Smallholder farmers can limit the transmission of LSD by establishing designated feeding and watering areas for sick and healthy cattle.

5.5. Epidemiological Surveillance

Routine monitoring systems need to be established for detecting LSD in cattle and monitoring new case developments. Routine clinical examinations and laboratory testing (including Polymerase Chain Reaction [PCR] testing) will enable a rapid response to outbreaks. The information collected through epidemiological surveillance will identify the areas at risk of LSD in the future and thus facilitate the establishment of interventions at the time when they are needed.

5.6. Policy and Veterinary Support

Veterinary authorities, as well as local governmental authorities, must provide the necessary resources needed for effective LSD treatment/control. Vaccines, diagnostic tools, and Extension Service personnel must be available to allow for the successful control of the disease (LSD). With the reduction of LSD prevalence, livestock morbidity rates will decrease as well, increasing the productive potential of all cattle in Habiganj District and throughout Bangladesh; as a result, the livelihoods of farmers will become increasingly

more stable and secure. The policies enabling subsidised vaccination for smallholder farmers, along with the establishment of formal reporting systems for LSD outbreaks, are key elements in a series of coordinated approaches to control LSD on both a regional and national level.

5.7. Research and Continuous Assessment

Continued research into the ecology, transmission, and socio-economics of LSD will provide the tools necessary to assess the overall effectiveness of vaccination in the on-farm setting and to identify potential socio-economic impacts attributable to LSD. Through conducting ongoing assessments of LSD control measures, the future will be positive based on the continued research to assess how to improve these interventions for maximum effectiveness.

6. Conclusion

Lumpy Skin Disease (LSD) is one of the most prevalent diseases afflicting cattle in Habiganj district, Bangladesh. In this study, we found that 27.5% of all cattle had LSD at some level, and 48% of farms had at least one infected cow. Therefore, cattle herds experience a lot of infection. Several factors make domestic (Indigenous) cow breeds and older (>2 years) cattle more susceptible to LSD, including long-term exposure to arthropods, which transmit infections, and inadequate preventive care for older animals.

Regardless of whether local breeds and older animals tested positive for LSD, these results suggest that management strategies and disease preventative strategies should take into consideration both breed differences and animal age differences.

Based on the study, vaccines appear to be a very effective preventative measure for lumpy skin disease. Only 10% (one in ten) of vaccinated cows tested positive for LSD. However, many farmers in Bangladesh do not vaccinate their cows for various reasons, including limited access to vaccines, costs of vaccination, and a lack of understanding of vaccine benefits. Therefore, the study results indicate that promotional vaccination campaigns are the best way to reduce the incidence of LSD and help prevent outbreaks of LSD in Bangladesh's livestock industry.

Due to their limited biosecurity resources and the living conditions of cattle, the small-scale producer(s) suffered most severely from the effects of the Lumpy Skin Disease (LSD). They also have limited access to management practices related to LSD and other animal diseases, and have an increased risk to their animals due to the impact of extreme weather on their growth and development.

The following symptoms have been observed in beef cattle affected by LSD: hyperplasia of the skin, fever, swollen lymph nodes, weight loss, and decreased milk production. Although LSD will have a negative effect on the production of food from animals, it is likely to cause significant financial losses to farmers who depend upon their cattle for income, food, and security.

At present, farmers have a moderate level of understanding regarding how LSD is transmitted, why vaccination is important, and how to manage the vectors of LSD effectively; therefore, there is a need to increase the awareness of farmers to enhance their ability to prevent and manage cases of LSD.

Farmers must be made more aware of the need for increased knowledge and implementation of preventive measures for controlling LSD, including vaccination and vector control, quarantining new animals and/or sick animals, and improving their biosecurity practices. The environmental conditions in Habiganj have been affected by:- Extreme heat/humidity and rain.- Extended drought conditions.- Nutrient or nutrient deficiencies.- Pests or parasites.- Lack of veterinary services and/or education about other harmful disease/pathogen targets, including LSD.

Overall, the present research offers important data on the prevalence of LSD, risk factors, and farmer awareness of LSD in Habiganj. The results can be used to inform and support evidence-based strategies for controlling LSD by policymakers, veterinarians, and agricultural extension officers/agents. Under a system of routine monitoring, the early detection and laboratory confirmation of LSD outbreaks will aid in the mitigation of the negative effects of LSD on industry production through various forms of integrated management and prevention efforts/measures. To achieve successful management of LSD in Bangladesh, it will be necessary to implement an integrated management scheme that includes vaccination, education, Biosecurity, control of pest and vector organisms, and ongoing monitoring/surveillance/assessment of the continuing threats posed by LSD to the productivity of both the cattle industry and farmers' respective livelihoods.

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Declaration

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Ethics Approval

The Ethical Review Committee at Habiganj Agricultural University approved the majority of the processes that took place to conduct this research. The requirements for the ethical conduct of animal handling and clinical examinations were followed. Prior to data collection, verbal informed consent was received from the owners of all farms involved in this research.

Consent to Participate

Informed verbal consent was obtained from all individual participants (farm owners) included in the study.

Data Availability

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Authorship Contribution

Md. Nazmul Hossen: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing – Original Draft Preparation, Writing – Review & Editing. As the sole author, I am also the corresponding author responsible for all correspondence.

References

- [1] World Organisation for Animal Health (WOAH), Technical Disease Card. [Online]. Available: <https://rr-middleeast.woah.org/en/technical-disease-cards/>
- [2] World Organisation for Animal Health (WOAH), Codes and Manuals. [Online]. Available: <https://www.woah.org/en/what-we-do/standards/codes-and-manuals/>
- [3] World Organisation for Animal Health, *Terrestrial Animal Health Code*, 2024. [Publisher Link]
- [4] S. Babiuk et al., "Capripoxviruses: An Emerging Worldwide Threat to Sheep, Goats and Cattle," *Transboundary and Emerging Diseases*, 2008. [CrossRef] [Google Scholar] [Publisher Link]
- [5] E.S.M. Tuppurainen et al., "Capripoxvirus Diseases: Current Status and Opportunities for Control," *Transboundary and Emerging Diseases*, 2015. [CrossRef] [Google Scholar] [Publisher Link]
- [6] Jihane Hamdi et al., "Capripoxvirus Infections in Ruminants: A Review," *Microorganisms*, vol. 9, no. 5, 2021. [CrossRef] [Google Scholar] [Publisher Link]
- [7] Farazi Muhammad Yasir Hasib et al., "Lumpy Skin Disease Outbreak in Cattle Population of Chattogram, Bangladesh," *Veterinary Medicine and Science*, vol. 7, no. 5, pp. 1616-1624, 2021. [CrossRef] [Google Scholar] [Publisher Link]
- [8] Sumon Sarkar et al., "Occurrences of Lumpy Skin Disease in Cattle in Dinajpur Sadar, Bangladesh," *Research in Agriculture Livestock and Fisheries*, vol. 7, no. 3, pp. 445-455, 2020. [CrossRef] [Google Scholar] [Publisher Link]
- [9] Md. Farhan Labib Nobel et al., "Prevalence, Duration of Illness, and Mortality of Lumpy Skin Disease at Chuadanga Sadar Upazila, Bangladesh," *Bangladesh Journal of Veterinary Medicine*, vol. 21, no. 2, pp. 91-98, 2023. [CrossRef] [Google Scholar] [Publisher Link]

- [10] Subrato Biswas et al., “Prevalence of Lumpy Skin Disease in Cattle at Netrokona Sadar in Bangladesh,” *Research in Agriculture Livestock and Fisheries*, vol. 11, no. 2, pp. 137-147, 2024. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [11] Saad Muhammad Rafe-Ush-Shan et al., “Sero-prevalence and PCR Identification of Lumpy Skin Disease Virus in Cattle at Mymensingh District of Bangladesh,” *Veterinary Integrative Science*, vol. 23, no. 2, pp. 1-13, 2025. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [12] Rokshana Parvin et al., “Clinical Epidemiology, Pathology, and Molecular Investigation of Lumpy Skin Disease Outbreaks in Bangladesh During 2020–2021,” *Viruses*, vol. 14, no. 11, 2022. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [13] Rokshana Parvin et al., “Serological Response to Lumpy Skin Disease in Recovered and Vaccinated/Unvaccinated Cattle in Bangladesh,” *Frontiers in Veterinary Science*, vol. 12, 2025. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [14] Eirini I. Agianniotaki et al., “Lumpy Skin Disease Outbreaks in Greece During 2015–16, Implementation of Emergency Immunization and Genetic Differentiation Between Field Isolates and Vaccine Virus Strains,” *Veterinary Microbiology*, vol. 201, pp. 78-84, 2017. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [15] Sylvester Ochwo et al., “Seroprevalence and Risk Factors for Lumpy Skin Disease Virus Seropositivity in Cattle in Uganda,” *BMC Veterinary Research*, vol. 15, 2019. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [16] Arman Issimov et al., “Risk Factors Associated with Lumpy Skin Disease in Cattle in West Kazakhstan,” *Preventive Veterinary Medicine*, vol. 207, 2022. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [17] Govinda Khatri et al., “Epidemic of Lumpy Skin Disease in Pakistan,” *Veterinary Medicine and Science*, vol. 9, no. 2, pp. 982-984, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [18] Nabaneeta Smaraki et al., “An Insight into Emergence of Lumpy Skin Disease Virus: A Threat to Indian Cattle,” *Archives of Microbiology*, vol. 206, 2024. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [19] Md. Jisan Ahmed et al., “Lumpy Skin Disease in Cattle and Buffalo in Asian Countries: A Systematic Review and Meta-analysis,” *Veterinary Medicine and Science*, vol. 11, no. 5, 2025. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [20] S. M. Abutarbush et al., “Lumpy Skin Disease in Jordan: Disease Emergence, Clinical Signs, Complications and Preliminary-Associated Economic Losses,” *Transboundary and Emerging Diseases*, 2013. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [21] Selim Ahmed, “Lumpy Skin Disease: A Review of Epidemiological Study and Preventive Measures,” *Bangladesh Journal of Veterinary Medicine*, vol. 22, no. 1, pp. 7-16, 2024. [[Google Scholar](#)] [[Publisher Link](#)]
- [22] Parvez I Sindhi et al., “Comprehensive Review of Emergence of Lumpy Skin Disease in Indian Subcontinent,” *International Journal of Veterinary Sciences and Animal Husbandry*, vol. 11, no. 1, pp. 246-250, 2026. [[CrossRef](#)] [[Publisher Link](#)]
- [23] Ali Mazloun et al., “Lumpy Skin Disease: History, Current Understanding and Research Gaps in the Context of Recent Geographic Expansion,” *Frontiers in Microbiology*, vol. 14, pp. 1-20, 2023. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [24] Food and Agriculture Organization of the United Nations, Empowering Women in Food and Agriculture. [Online]. Available: <https://www.fao.org/home/en/>
- [25] Strengthening the Regional Preparedness against Lumpy Skin Disease in Central Asia, FAO, 2023. [Online]. Available: <https://openknowledge.fao.org/server/api/core/bitstreams/fe05c0ed-0926-4928-8999-6788462fedd3/content>
- [26] R.P. Kitching, “Vaccines for Lumpy Skin Disease, Sheep Pox and Goat Pox,” *Developments in Biological*, vol. 114, pp. 161-167, 2003. [[Google Scholar](#)] [[Publisher Link](#)]
- [27] A. Sprygin et al., “Transmission of Lumpy Skin Disease Virus: A Short Review,” *Virus Research*, vol. 269, 2019. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher Link](#)]
- [28] FAO Alerts Countries In Near East, North Africa And Southern Europe to Enhance Preparedness for Lumpy Skin Disease, FAO, 2024. [Online]. Available: <https://openknowledge.fao.org/server/api/core/bitstreams/9fbc74c0-392b-4753-800e-453d13dc211d/content>
- [29] World Organisation for Animal Health, WAHIS: World Animal Health Information System. [Online]. Available: <https://wahis.woah.org/#/home>