**Knowledge and Practice in the Assessment of Frequent Landscape Disease Risk in Cattle Populations along the Madhumati River, Gopalganj, Bangladesh**

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**Abstract**

Introduction: Cattle have been domesticated for thousands of years for various purposes by humans. Despite advancements in agricultural technologies, challenges like disease outbreaks continue to impact productivity and economic stability in the cattle industry. This study investigates the prevalence and risk factors associated with various diseases in cattle around the Madhumati River in Gopalganj, Bangladesh. Our findings provide insights into the current landscape of diseases focusing on FMD and LSD, animal health status, farmer knowledge, and existing treatment and prevention strategies in Gopalganj.

Method: A standardized closed-ended questionnaire was administered using KoboToolBox software (version 2021.2.4) for data collection. Statistical analyses involved descriptive statistics, Fisher's exact test, χ2 test, and multivariate logistic regression models with 95% confidence intervals. These analyses were conducted using R (version 4.4.0) and SPSS (Statistical Package for the Social Sciences version 27.0.1) to explore associations between variables influencing disease prevalence.

Result: This study indicated that FMD (17.39%) and LSD (13.04%) were the most prevalent diseases. Significant correlations between disease prevalence and risk factors were observed, with a p-value of 0.05. A linear model (95% CI) predicted that poor husbandry practices, lack of knowledge, and inadequate treatment strategies contributed to disease occurrence in different regions of Gobra, Gopalganj.

Conclusion: This cross-sectional study investigated the prevalence rate and causes of major diseases in Gobra region of Gopalganj, Identifying FMD and LSD as a significant risk in cattle farming. FMD occurred mostly in cooler months, while LSD was prevalent in hotter months. Strategies to mitigate disease prevalence include seasonal preventive measures, routine vaccination, deworming protocols, and stringent sanitation practices.

**Keywords:** FMD, LSD, Disease prevention, Husbandry practices, Epidemiology

**Introduction**

Dating back to the ten thousand years ago when wild aurochs were domesticated in Mesopotamia, Egypt and the Indus Valley, human civilization greatly impacted agriculture and the economy by choosing cattle rearing for different purposes. The Romans advanced cattle husbandry as an essential food source and meant for field ploughs. Modern era especially post-industrial revolution brought significant improvement in cattle industry. Advancement in breed improvement, integration practices and technological integration makes these cattle rearing a large global industry1.

Despite the growing demand for the cattle rearing industry, many crucial factors like outbreaks of diseases can lead to substantial economic losses and reduction in productivity. Livestock production remains on peak only if they are kept free from diseases outbreak. Various challenges negatively affect the productivity of livestock among which infectious diseases are on the top. Livestock are susceptible to viral as well as bacterial diseases like FMD (Foot and Mouth Disease), Mastitis, Bovine Mastitis, Bovine (Lumpy Skin Disease) and other infectious diseases each year and accounts nearly 20% to 25% losses in world’s livestock population2,3.

In the United States, diseases affecting cattle caused significant economic losses. Parasite infections cost $50.67 per animal yearly, Johne's disease costs $200– $250 million and Neosporin caninum costs $546.3 million. Similarly, each infected animal with lumpy skin disease (LSD) costs $1176, and bovine viral diarrhoea virus (BVDV) resulted in loss of $24.85 per each animal4. In case of Bangladesh two major diseases like FMD and LSD shares major contribution in economic losses.

FMD is caused by antigenically diverse RNA VIRUS, Foot and Mouth Disease Virus (FMDV). The FMD virus is a member of the genus Apthovirus in the family Picornaviridae. There are seven serotypes of FMD virus: O, A, C, SAT 1, SAT 2, SAT 3, and Asia 1. It possesses rapid transmission from acutely infected animals to healthy animals through respiratory aerosols and droplets or indirectly via environment mechanisms5. The susceptible animals like cow, buffalo, sheep, goat shows the signs of fever, lameness, vesicular lesions and blisters in mouths, lips, tongue, feet and teats. The disease may cause severe losses in reproduction, lactation, growth, and draught power. Annual financial losses due to FMD in Bangladesh would be $ 2220.82 million6.

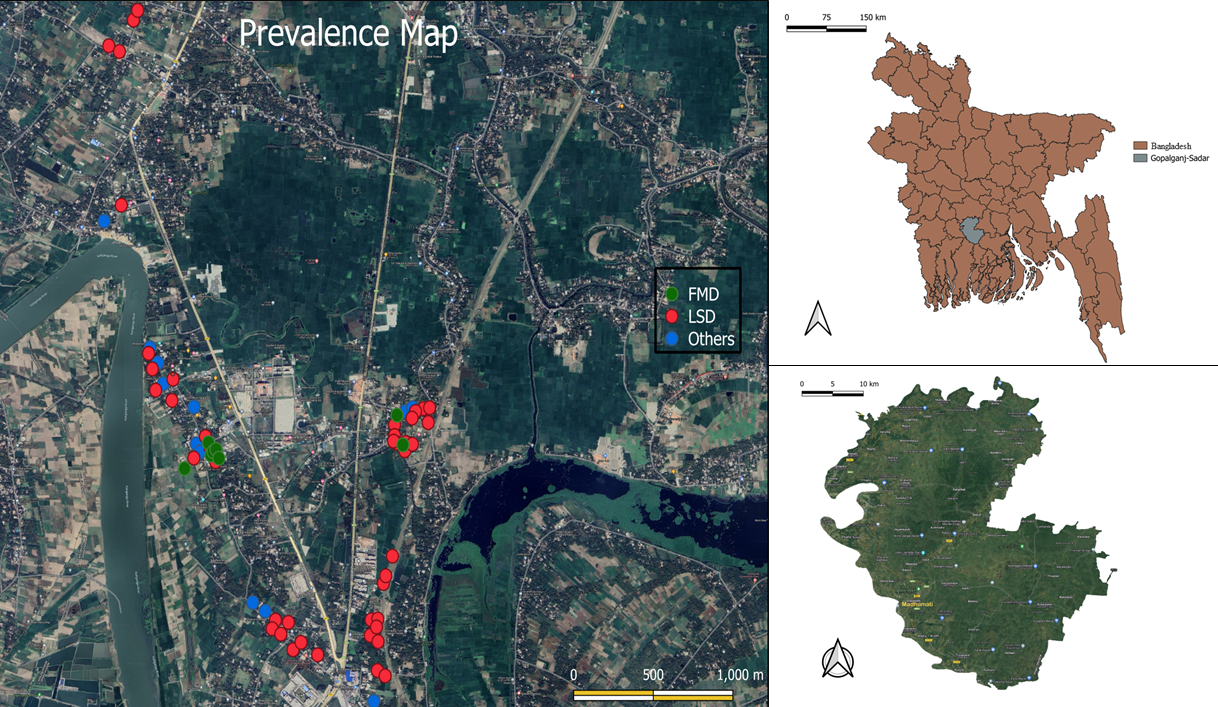
The lumpy skin disease virus (LSDV) is a member of the Capripoxvirus genus in the Poxviridae family. LSD possesses different serotypes (Neethling, and bovine) according to their virulence and geographical distribution. The symptoms of LSD include fever, swollen lymph nodes, and skin nodules. The disease spreads by direct contact with diseased animals, contaminated feed and water, and vectors like flies and mosquitoes 7. Animals that are susceptible, such cows and buffaloes, display signs like fever, lameness, skin nodules, and lymph node swelling. Due to decreased milk supply, weight loss, infertility and increased mortality and morbidity rates, LSD can result in significant financial losses5,8.Lumpy skin disease causes high morbidity (26%) and low-moderate mortality rates (0-20%).Vaccination and vector control are two important preventative and control strategies that are essential for reducing the negative effects of LSD9. The total estimated annual loss due to lumpy skin disease in Bangladesh was 91.33 million US$ found in Mymensingh region10.There is no effective antiviral or vaccination against LSDV infection in Bangladesh which is the major challenges for farmers. Currently only live attenuated vaccines are available, which are based on either attenuated LSD or goat pox viruses. Early diagnosis and prevention of these viral Disease like FMD and LSD only can be helpful in controlling the spread of infection and reduce the economic loss for farmers.

In this study we have focused on these two Contagious viral infections (FMD and LSD). We have systemically collected the information about prevalence of FMD, LSD and others major diseases occurring in the village of Gopalganj area alongside the Madhumati River. Our study involves the investigation of prevalence rate of FMD and LSD along with other important diseases that the farm animals are more susceptible with, the risk factors, farm practices, adoption of treatment facilities and prevention methods, feeding nature and government involvement in eradication.

The findings and results from study have been successful in giving overall view about the outbreaks of FMD, LSD along with other disease in Gopalganj, present condition of animals, knowledge of farm owners about disease prevalence and infection, their strategy of treatment and prevention. Along with the problems, our study managed in suggesting the alternatives or solutions to the ongoing problems with the farmers to reduce their economic burden and methods of practice in farms to eventually eradicate the contagious infections like FMD and LSD from the area at a time and from the nation as a whole in upcoming years.

**Methods:**

**Study Design and Population:** The study was conducted over 5 months (January to May 2024) in Gobra, Gopalganj Sadar, Gopalganj, Dhaka, Bangladesh, during the peak time for the disease outbreak. We selected two regions: the roadside and the close side of the Madhumati River. The selection of the area was based on information from the Upazila Veterinary Hospital, Gopalganj, and by local people in Gobra. Each farm was considered as an individual observation in this study, and a total of 382 houses were visited, among them 97 houses had domesticated cattle. On average, 283 cattle were inspected directly; among which 5 were already suffering from lumpy skin disease (Figure1).

Figure1:Prevalence rate of diseases

**Collection and Preservation of Data:** A standard, closed-ended questionnaire was made to find the most frequent diseases and associated factors. KoboToolBox software (version 2021.2.4) and the app were used to manage and collect data. There were five subsections of the questionnaire form: demographic information (e.g., breed, age, sex), husbandry practices (e.g., grazing, feeding, water supply), medication (e.g., type of antibiotics, prebiotics, nutritional supplements), biosecurity (e.g., disinfection, routine cleaning, fencing, ventilation), and clinical information (e.g., signs arising during a disease condition, any abnormalities). The questionnaire data were obtained by visual examination of the farm, reviewing the records and inquiring the farmer.

**Statistical Analysis:** Descriptive statistics were used to evaluate the characteristics of the study population. Statistically significant tests like the Fisher's exact test and the χ2 test were performed to fabricate cross-tabulations between different observations. Multivariate logistic regression models and 95% confidence intervals (95% CIs) were used to investigate the associations between independent variables influencing the dependent variable in the model. Gender, education, and location have an impact on cattle domestication. All statistical tests, including risk factors, were considered to be statistically significant with a P-value < 0.05. R (version 4.4.0) programming language and SPSS (Statistical Package for the Social Sciences version 27.0.1) were used for data analysis, summarization, data visualization, mapping, and generating interactive tables.

**Ethical Approval:**Written informed consent was obtained from the patient and family members. This study was conducted by the Declaration of Helsinki (revised in 2013) and was approved by the Ethics Committee of Bangabandhu Sheikh Mujibur Rahman Science and Technology University, Department of Animal Science and Veterinary Medicine.

**Results:**

A significant difference found in the location of the farm (p = 0.044), where 46% of male owners and 23% of female owners having farms close to the river. A higher percentage of female owners (77%) have farms far from the river compared to male owners (54%). In terms of area of residence, there is no significant difference (p = 0.2) seen in the similar distribution across different areas for both genders. Pathalia, where a higher percentage of both female (35%) and male (31%) owners reside. Educational levels show no significant difference between genders (p = 0.8). Maximum farm owners have only primary education (65% of females and 71% of males), with very few reaching graduate level (0% of females and 2.9% of males). Professional training is also relatively low, but more common among male owners 16% compared to female owners 7.7% (Table1).

| **Characteristic** | **Female**, N = 26*1* | **Male**, N = 70*1* | **p-value***2* |
| --- | --- | --- | --- |
| Location of the Farm |  |  | **0.044** |
| Close to river | 6 (23%) | 32 (46%) |  |
| Far from river | 20 (77%) | 38 (54%) |  |
| Area of Residence |  |  | 0.2 |
| Balurmath | 5 (19%) | 7 (10%) |  |
| Charghata | 2 (7.7%) | 6 (8.6%) |  |
| charsunakur | 2 (7.7%) | 1 (1.4%) |  |
| Ghonapara | 3 (12%) | 8 (11%) |  |
| GobraMadrasa | 2 (7.7%) | 2 (2.9%) |  |
| Nilamath | 0 (0%) | 4 (5.7%) |  |
| Pathalia | 9 (35%) | 22 (31%) |  |
| ShobhanSarak | 0 (0%) | 12 (17%) |  |
| Shuterkul | 0 (0%) | 1 (1.4%) |  |
| South gobra | 3 (12%) | 7 (10%) |  |
| Level of Education |  |  | 0.8 |
| Graduate | 0 (0%) | 2 (2.9%) |  |
| High School | 7 (27%) | 12 (17%) |  |
| Intermediate | 2 (7.7%) | 5 (7.1%) |  |
| Primary | 17 (65%) | 50 (71%) |  |
| Professional Training | 2 (7.7%) | 11 (16%) | 0.5 |

Table1: Demographic analysis

The farm conditions, water sources, feeding practices, and health status of animals, categorized by the location of the farm. Farm conditions are similar between the two locations, with no significant difference (p = 0.4). Average farms are reported as fair or good condition, with slightly more farms close to the river rated as excellent (5.4%) compared to none far from the river. Water sources show significant differences (p = 0.001), with tubewell being the predominant source far from the river (57%) compared to close to the river (45%). Feeding practices do not show significant differences (p = 0.5), local market grazing being common in both locations. The health status of animals described as "Excellent" is slightly higher far from the river area (5.3%) compared to close to the river (2.6%). The majority of animals are reported as being in good health in both locations (Table2).

| **Characteristic** | **Close to river**, N = 38*1* | **Far from river**, N = 58*1* | **p-value***2* |
| --- | --- | --- | --- |
| Farm Condition |  |  | 0.4 |
| Excellent | 2 (5.4%) | 0 (0%) |  |
| Fair | 17 (46%) | 27 (47%) |  |
| Good | 13 (35%) | 24 (41%) |  |
| Poor | 5 (14%) | 7 (12%) |  |
| Sources of water |  |  | **0.001** |
| Others | 1 (2.6%) | 2 (3.4%) |  |
| Pond | 1 (2.6%) | 11 (19%) |  |
| Pond Others | 0 (0%) | 1 (1.7%) |  |
| Pond Tubewell | 0 (0%) | 3 (5.2%) |  |
| River | 9 (24%) | 2 (3.4%) |  |
| River Tubewell | 9 (24%) | 6 (10%) |  |
| Tubewell | 17 (45%) | 33 (57%) |  |
| Type of feed and source |  |  | 0.5 |
| Grazing Household | 12 (32%) | 13 (22%) |  |
| Local Market Grazing | 9 (24%) | 23 (40%) |  |
| Local Market Grazing Household | 12 (32%) | 18 (31%) |  |
| Local Market Grazing Imported Household | 2 (5.4%) | 2 (3.4%) |  |
| Local Market Grazing Others | 0 (0%) | 1 (1.7%) |  |
| Local Market Household | 2 (5.4%) | 1 (1.7%) |  |
| Unknown | 1 | 0 |  |
| Current health status |  |  | 0.8 |
| Excellent | 1 (2.6%) | 3 (5.3%) |  |
| Fair | 5 (13%) | 5 (8.8%) |  |
| Good | 29 (76%) | 45 (79%) |  |
| Poor | 3 (7.9%) | 4 (7.0%) |  |

Table2: Feeding Information

A significant difference exists in the use of medications between those who self-medicate and those who use a veterinarian (p = 0.008). Owners using veterinarians report higher usage 82% compared to those self-medicating 55%. The types of medications used do not show significant differences (p = 0.3), though antibiotics combined with pain relievers are common. Recurrence of health issues post-medication is reported more by those using veterinarians 15% compared to self-medication 3.2%, but this is not significant (p = 0.14). Nutritional supplements are similarly used by both groups, with no significant difference (p = 0.2). All respondents report no side effects from medication. Vaccine and de-worming practices are more regular among those using veterinarians 47% compared to those self-medicating 19%, with p value of 0.015. This strongly suggests that professional veterinary service is linked to better preventative health measures (Table 3).

| **Characteristic** | **Self Medication**, N = 31*1* | **Veterinarian**, N = 52*1* | **p-value***2* |
| --- | --- | --- | --- |
| Medications to treat animals | 17 (55%) | 41 (82%) | **0.008** |
| Types of medications |  |  | 0.3 |
| Antibiotics Antihistamine | 1 (3.8%) | 4 (8.5%) |  |
| Antibiotics Antihistamine Others | 0 (0%) | 2 (4.3%) |  |
| Antibiotics Antihistamine Pain Reliever | 17 (65%) | 19 (40%) |  |
| Antibiotics Antihistamine Pain Reliever Others |  | 4 (8.5%) |  |
| Antibiotics Pain Reliever |  | 3 (6.4%) |  |
| Antibiotics Pain Reliever Others |  | 1 (2.1%) |  |
| Antihistamine Others | 1 (3.8%) | 0 (0%) |  |
| Others | 7 (27%) | 12 (26%) |  |
| Pain Reliever | 0 (0%) | 1 (2.1%) |  |
| Pain Reliever Others | 0 (0%) | 1 (2.1%) |  |
| Recurrence | 1 (3.2%) | 8 (15%) | 0.14 |
| Nutritional supplements |  |  | 0.2 |
| Minerals Others | 1 (3.6%) | 0 (0%) |  |
| No | 17 (61%) | 31 (63%) |  |
| Others | 1 (3.6%) | 0 (0%) |  |
| Vitamin | 0 (0%) | 3 (6.1%) |  |
| Vitamin Minerals | 5 (18%) | 12 (24%) |  |
| Vitamin Minerals Others | 4 (14%) | 3 (6.1%) |  |
| Side Effects of Medication |  |  |  |
| No | 31 (100%) | 52 (100%) |  |
| Vaccination and De-worming |  |  | **0.015** |
| Irregular | 14 (45%) | 18 (35%) |  |
| Never | 11 (35%) | 7 (14%) |  |
| Regular | 6 (19%) | 24 (47%) |  |
| Regular Irregular | 0 (0%) | 2 (3.9%) |  |

Table 3: Medication and nutrient supplementation

Professional training of farm owners shows no significant difference across seasons (p = 0.6), though it is more common in the rainy season 33%. The location of the farm shows a significant difference (p = 0.007), with farms close to the river more common in the rainy winter (100%) compared to other seasons. Farm condition does not show significant differences (>0.9), with fair conditions being most common. Disease incidence is high across all seasons, with no significant difference (p = 0.7), and symptoms align predominantly with Lumpy Skin Disease (LSD) (p = 0.091). Animal mortality does not show significant seasonal variation (p = 0.7), though other causes are more frequently reported in some seasons such as 67% in summer (Table 4).

| **Characteristic** | **Rainy**, N = 6*1* | **Summer**, N = 47*1* | **Winter**, N = 14*1* | **p-value***2* |
| --- | --- | --- | --- | --- |
| Professional Training | 2 (33%) | 8 (17%) | 1 (7.1%) | 0.6 |
| Unknown | 0 | 1 | 0 |  |
| Location of the Farm |  |  |  | **0.007** |
| Close to river | 2 (33%) | 22 (47%) | 1 (7.1%) |  |
| Far from river | 4 (67%) | 25 (53%) | 13 (93%) |  |
| Farm Condition |  |  |  | >0.9 |
| Excellent | 0 (0%) | 2 (4.3%) | 0 (0%) |  |
| Fair | 2 (33%) | 22 (48%) | 7 (50%) |  |
| Good | 3 (50%) | 16 (35%) | 5 (36%) |  |
| Poor | 1 (17%) | 6 (13%) | 2 (14%) |  |
| Disease occurrences |  |  |  | 0.7 |
| No | 1 (17%) | 5 (11%) | 4 (31%) |  |
| Yes | 5 (83%) | 38 (86%) | 9 (69%) |  |
| Confirmatory Disease |  |  |  | 0.091 |
| FMD | 2 (50%) | 4 (9.1%) | 1 (8.3%) |  |
| LSD | 2 (50%) | 33 (75%) | 6 (50%) |  |
| Others | 0 (0%) | 7 (16%) | 5 (42%) |  |
| Unknown | 2 | 3 | 2 |  |
| Mortality |  |  |  | 0.7 |
| FMD | 0 (0%) | 2 (17%) | 1 (20%) |  |
| FMD LSD | 0 (0%) | 1 (8.3%) | 0 (0%) |  |
| LSD | 0 (0%) | 1 (8.3%) | 1 (20%) |  |
| Others | 1 (100%) | 8 (67%) | 3 (60%) |  |

Table 4: The health status and disease incidence of animals across different seasons

**Discussion:**

In this research, we collected data from multiple areas within Gobra Union in Gopalganj Sadar, Gopalganj. The area included balurmath, charpathalia,north and south area of Ghonapara, nilarmath. According to data we evaluate most prominent diseases are FMD and LSD along with these diseases’ hemorrhagic septicemia, tympany and bloat, dermatitis, mastitis, protozoan diseases and some other frequently occuring disease condition like seasonal diarrhea are noticed in the cattle. Environmental factor plays the crucial role in the outbreak of majority of the diseases. In our study region frequent FMD outbreaks are found in winter season and post monsoon when there is high humidity and low temperature in the environment. Some previous studies also indicated that FMD outbreaks are prominent in the cooler months of the year11.

LSD outbreaks are noticed prominently in summer season, showing clinical signs like high fever, weakness, anorexia, subcutaneous nodules all over the skin and in acute cases we observed rupture of nodules and formation of lesions. Similar findings found in other studies also12.Whereas, HS cases are found mostly in rainy season when there is high humidity and relatively low temperature in the environment which provides favorable condition for the outbreak of disease. We distinguished HS from our major concern diseases those are FMD & LSD by the observation of following clinical signs like high fever, dyspnea, accompanied by frothing at the mouth or nostrils, and edematous swellings in the submandibular region. In some cases, swelling spread to the neck as well as brisket and sometimes to the forelegs13.

Along with LSD and FMD there are some other health issues stimulating adverse effect upon animal husbandry. In Babesiosis case we found farmer using contaminated fish feed due to lack of knowledge. Couple of the cases of mastitis occurred particularly due to poor sanitation, significant cases of tympany & bloat, seasonal diarrhea due to parasitic infestation and few incidences of paralysis in winter period. Mastitis cases associated with BCS>4, higher milk yield, and early lactation stage. Mastitis has long term effect on production as a result it may be difficult to achieve previous production levels14.

Over the period of our study, we observed that despite of the willingness of the farmers, they couldn’t practice scientific managemental practices due to various obstructions such as poverty, lack of education, lack of proper training facility, insufficient coordination from the governmental authorities is the prime cause. In contrast, we have observed in few of the households, they have managed their farms very well and the condition of animals was also far better. As per our observation the main reason behind better farm management is the sound financial condition of the owner, higher education level and some degree of training regarding animal farming of at least one of the family members. Previous study indicates that farmer’s education level, financial status and training level are closely interlinked with each other with demographic characteristics which in combine can create remarkable impact upon the overall management and well-being of farm animals15. Managemental issues like drinking water and supplied feed also have pivotal role in healthy and profitable animal farming. In our study area close to Madhumati River, farmers frequently visit river and take their cattle for bathing and prominently use river water for cooking and drinking purpose for livestock. Therefore, river water has the potential to harbor wide range of disease-causing pathogens, posing risk of disease outbreaks in the community. Whereas, in the areas far from river, farmers are bound to use canal or pond water because the underground water have very high level of iron and arsenic which is again toxic for both humans and animals. In case of supplied feed, farmers generally use household surplus or locally available comparatively cheaper feed which is cheap in nutrient content too. Hence, as a result of ragged financial condition, inadequate knowledge level and unfavorable geographical location farmers are unable to supply clean fresh drinking water and nutritious feed to their cattle. Studies have demonstrated that cattle reared by using deep tubewell water have far better medication receptibility and less occurrences of contagious diseases16.

Previous studies have shown that biosecurity plays a crucial role in sustainable and profitable animal farming. In our study area, farmers face significant challenges in managing proper biosecurity. Issues such as lack of sufficient space leads to overcrowding, causing difficulties in cleaning and disinfection which results in the wet and slippery floors that cause injuries and infections. Additionally, insufficient space creates difficulty in proper isolation and quarantine measures, compounded by the threat of animal smugglers. Scientific ventilation is also rare, causing the accumulation of poisonous gases inside the farms. Despite of these challenges we observed, few farmers are maintaining fair level of biosecurity with proper cooling and heating facilities, mosquito repellents, dry and clean floors17.

**Conclusion:**

The study was conducted to investigate the most prevailing diseases and the causes of their prevalence, which resulted in indicating FMD and LSD as a major disease risk for the animals of the Gopalganj region. FMD was found to occur mostly during cooler months whereas LSD in hotter months of the year. Besides diseases like mastitis and hemorrhagic septicemia and other health issues were also seen as potential problems in the village. Timely prevention according to different seasons, regular vaccination and de-worming, cleaning, disinfecting the herd area in scheduled time, avoiding river, pond water during the outbreak season might help to reduce the prevalence rate. The study was limited by its reliance on self-reported data by the locals which may be subject to bias and any of the laboratory tests were not also performed either. This study can serve as a baseline for researchers and policymakers to assist in understanding disease outbreaks.

**Abbreviations:**

**FMD =** Foot and Mouth Disease

**LSD =** Lumpy Skin Disease

**HS =** Haemorrhagic Septicemia

**RNA =** Ribonucleic Acid

**SAT** = Southern African Territories

**FMDV** = Foot and Mouth Disease Virus

**LSDV** = Lumpy Skin Disease Virus

**Declaration generative AI and AI assisted technology:**

The authors did not use any artificial intelligence assisted technologies in the writing process

**Declaration of competing interests**

The authors declare that they have no conflict of interest.

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**Data availability**

The datasets used in the study are available from the corresponding author on reasonable request.

**Author contributions**

**Abdullah Al Mamun:** Conceptualization, Investigation, Data curation, Methodology, Software, Result interpretation, Writing—original draft, Writing—review and editing. **Asmita Karki:** Formal analysis, Result interpretation, Writing —original draft, Writing —review, and editing. **Hari Prasad Panthi**: Investigation, Formal analysis, Interpretation of results, Writing —original draft, Writing —review, and editing. **Navin Pandey:** Conceptualization, Writing—original draft, Writing—review and editing. **Eshita Mohtarima:** Writing— original draft, Writing—review and editing. **Hoor E Jannat Jaoti:** Supervisor, Investigation.

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