EFFECTS OF VACCINATION AGAINST LUMPY SKIN DISEASE (LSD) ON PRODUCTION PERFORMANCE OF DAIRY CATTLE AT NARSINGDI DISTRICT

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ABSTRACT

A study was done to evaluate the effects of the Lumpy Skin Disease (LSD) vaccine on dairy cattle milk production and mortality status at different upazilas in Narsingdi district. The data was collected from rural dairy farmers using a semi-closed questionnaire with multiple choice. The sample size was determined using $N= Z^2 (1-P) P/L^2$ statistical formula. A total of 32 dairy household farmers were interviewed. A total of 62.5% of the farmers reported the LSD outbreak among their farms. In addition, 3.13% of the farmers reported that their cows stopped producing milk after being infected with the disease. In comparison, 18.75% reported average milk production, and 46.88% reported a 50% reduction in milk production. Furthermore, 43.75% of farmers diagnosed LSD by observing clinical symptoms instead of seeking veterinarian advice. Among all farmers, twenty farmers (62.5%) failed to vaccinate their dairy herd, while 37.5% reported cattle vaccination against LSD. Rural farmers' lack of LSD vaccination was due to the long distance between their homestead and the agrovet facilities. In addition, the vaccine providers were located in urban areas. Furthermore, the Neethling strain and SIS Neethling strain were the two primary vaccines sold in agrovet shops in Narsingdi district. Although there is a relationship between cattle vaccination against LSD, milk production and mortality rates among dairy farms, vaccine suppliers' access to a significant barrier to vaccine uptake in all upazilas.

Keywords: Gender, education, production, farmer, mortality.

CHAPTER I

INTRODUCTION

In Bangladesh, Cattle and buffalo are mainly considered as dairy animals. Dairy farming is a significant and promising agricultural sector in Bangladesh. Almost 85% of the nation's people work in agriculture and the livestock sector (Raha, 2000). There are about 24.7 million cattle, 1.5 million buffaloes, 3.7 million sheep and 26.7 million goats in Bangladesh (DLS, 2022). Cows are the primary source of milk in Bangladesh. 950% of the nation's milk consumption was covered by cows' milk, followed by goats with 1% and buffalo with the remaining 4% (Hossain et al., 2022). Bangladesh's dairy sector is dominated by smallholder farmers. Smallholder dairy farmers make up more than 70% of the sector and they supply roughly 70% to 80% of the nation's milk supply (Uddin et al., 2012). During 2021–2022 Fiscal Year the annual milk production was 13 million metric tons (DLS, 2022).

The lumpy skin disease virus (LSDV), which belongs to the family Poxviridae, causes lumpy skin disease (LSD), an economic and arthropod borne viral disease of cattle (Tulmanet al., 2001). The disease caused significant economic losses due to decreased productivity, poor hide quality, slow growth, infertility, and even mortality, hence the World Organization for Animal Health(OIE) listed it as a notifiable trans-boundary disease(Anonymous, 2021; Tuppurainen et al., 2017; Tuppurainen and Oura, 2012).The local veterinary services administration in Bangladesh reported an epidemic of an unidentified syndrome with nodular skin lesions in various commercial and backyard cattle populations in the middle of 2019 (Anonymous, 2019). Department of Livestock Services (DLS) initially confirmed the outbreak report based on clinical indications and later confirmed it using the reverse transcription polymerase chain reaction (RT-PCR) test and notifying the OIE of the disease as LSD in August 2019 (Anonymous, 2019). Nodular lesions appearing on the entire body's skin are a hallmark of LSD (Tageldinet al., 2014). LSD has the potential to result in systemic side effects such pneumonia, dysgalactia, fever, anorexia, and sores in the mouth and upper respiratory tract (Davies, 1991). The condition was found to be more severe in cows during the peak of lactation and caused a significant reduction in milk production and clinical indications in young animals are typically more severe (Ince et al., 2016; Ince and Türk, 2019).

There is currently no effective LSD treatment available. For symptomatic treatment, antibiotics and anti-inflammatory medications are administered. Appropriate intervention and preventive measures must be performed in order to control the disease, which include: a) Restrict movement, b) Restrict vector movements and c) Vaccination. Although LSD outbreaks have been reported in numerous nations, it is still unclear which strain or variants will be the best choice for vaccine development (Ayeletet al., 2013; Ben-Gera et al., 2015). Companies prepared vaccines based on various LSD virus strains. It is either based on Neethling strain like Bovivax (MCI Sante Animale, Morocco), or based on SIS Neethling type Lumpyvax (MSD Animal Health-Intervet, South Africa). Since the virus that causes sheeppox and goatpox is closely related to LSD, the vaccine for those diseases can be used to prevent LSD (Tuppurainen et al., 2015). Zhugunissovet al. (2020) demonstrated that a robust protective response is elicited by the goatpox virus (G20-LKV) vaccination strain, and cattle showed complete protection against LSD. A heterogenous goatpox vaccination was done to 34,000 cattle in Chattogram, Bangladesh, according to DLS-Bangladesh officials, and the vaccine was effective in preventing LSD (Tribune, 2020).

However, the influence of LSD vaccine in different parts of the country, especially in Narsingdi district, has not been adequately studied. Therefore, the objective of this study was to evaluate how the use of the LSD vaccine influenced milk production and mortality of dairy cattle.

Objectives of the study:

- To know the production and mortality status of LSD affected dairy cattle in order to establish future plan for LSD prevention.
- To know the vaccine efficacy against LSD in dairy cattle in order to determine production performance at farm level.

CHAPTER II

MATERIALS AND METHODS

2.1 Study Area Selection

The study was conducted at Narsingdi district of Bangladesh, which has six upazilas: Narsingdi Sadar, Raipura, Belabo, Shibpur, Monohardi and Palash (Red dots at Figure 1). The dairy farms were selected from every upazila to complete the study. Figure 1 shows the map of the study area.

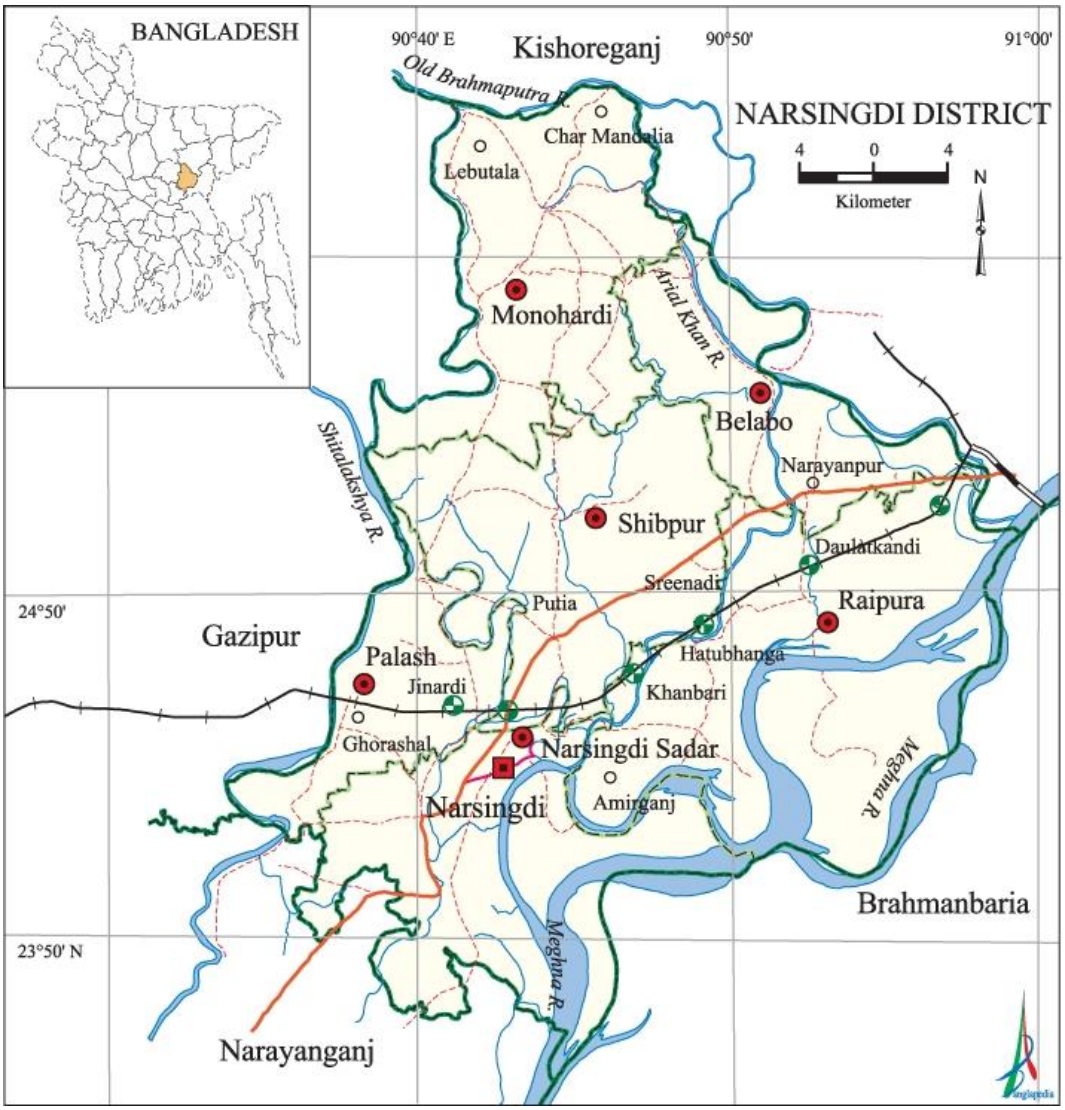

Figure 1: Map of the Study Area [Narsingdi District, Bangladesh].

2.2 Sampling Procedure and Sample Size Determination

The study area in the Narsingdi district was chosen using the purposive sampling technique. A simple random sample procedure was employed to choose the farms that took part in the study when choosing the dairy farms for the survey. Dairy farmers that have at least 5 dairy cattle were interviewed for the survey. A list of dairy farms in each village was provided by the livestock officers in each upazila. Using an Excel random number generator, the numbers given to the farms were chosen at random. The calculated sample size was established using the following proportional probability to an unknown population formula (Pfeiffer, 2010):

$$n = Z^2 (1-P) P/L^2$$
$$= 1.645^2 (1-0.5) [0.5/0.01]$$
$$= 67.65 \text{ or } 68$$

Where n is the sample size for respondents; Z-value is the desired level of Confidence of 1.645; P is an estimate of the proportion of the population keeping dairy cattle; L is the absolute size of the error in estimating, which is 10%.

In this work, a 50% P-value was chosen. Finding the precise number of dairy farmers in Narsingdi was difficult because most household raise dairy cattle. Nevertheless, the sample size accurately reflected the study population since their roles and responsibilities are similar within the same category; hence any variation in the study population's data was insignificant.

2.3 Data Collection Period

The present study was conducted using an appropriate pre-designed questionnaire during the period from 9 July 2022 to 15July 2022.

2.4 Data Collection

Semi-closed questionnaires with multiple choice were used to collect the farmers data in all upazilas. Among the data collected were records of disease outbreaks, milk production and mortality status concerning vaccination and other preventive measures against LSD. Questionnaires were administered through face-to-face interviews with the households by ownself.

2.5 Statistical Analysis

After data collection, all information was edited, cleaned, sorted, coded and inputted into MS-Excel 2021. It was then imported into the STATA (STATA version 14.2) for statistical analysis. To generate means, percentages, and frequencies, descriptive statistics were utilized. Different variables were cross tabulated to show their relationships in tabular form. The hypothesis that the LSD vaccine had no impact on dairy cattle mortality and milk production was put to the test using the Chi-Square test, which also served to demonstrate the relationship between the variables. An independent sample T-test was also utilized to compare the means of cattle that had received vaccinations and those who hadn't.

PHOTO GALLERY

Fig 2.1: Data Collection from Farmer

Fig 2.2: Data Collection from Farmer

Fig 2.3: Farm Data Recording

Fig 2.4: LSD Affected Cow

Fig 2.5: LSD Affected Cow

Fig 2.6: LSD Affected Calf

CHAPTER III

RESULTS

3.1 Demographic Characteristics

Only 32 of the 68 targeted farmers were interviewed due to farmers availability, time, weather and financial constraints. Males made up the majority of farmers (75%). However, men farmers had higher levels of education than female farmers, with 29.17% having completed secondary school compared to 12.5% of female farmers. Thus, the majority of women (50%) only received a primary school education, as shown in Table 1.

Table 1. Respondents gender distribution and their education level.

Variable	Category	Frequency	Percentage (%)
Gender of the Farmers	Male	24	75.00
	Female	8	25.00
Education level (Male)	Primary	6	25.00
	Secondary	7	29.17
	College	5	20.83
	Illiterate	6	25.00
Education level (Female)	Primary	4	50.00
	Secondary	1	12.50
	College	1	12.50
	Illiterate	2	25.00

3.2 Disease Outbreak, Diagnosis and Determination

Table 2 displays the farmers' remarks regarding their encounters with disease outbreaks, LSD diagnosis and who determined the disease.62.5% of farmers reported disease outbreaks on their farms. However, 65.63% of those surveyed who reported this disease outbreak was LSD. Even then, only 3.1% of the cases had veterinary diagnoses; the majority (56.3%) were self-diagnoses based on clinical signs and symptoms.

Table 2. Responses on disease outbreak, diagnosis and determination.

Variable	Category	Frequency	Percentage (%)
Disease outbreak	Yes	20	62.50
	No	12	37.50
Diagnosis	LSD	21	65.63
	N/A	11	34.38
LSD Determined	By a Veterinarian	7	21.88
	By the farmer	14	43.75

3.3 The Relationship between Milk Production and LSD Vaccination

Table 3 displays the proportion of farmers who stated that milk output changed as a result of the disease outbreak. In contrast, table 4 displays the connection between the LSD immunization and the modification in milk production. Of the 65.63% of farmers who claimed their cattle got LSD, 3.13% said their cows stopped producing milk after the illness, 18.75% said their cows produced normal amounts of milk, and 46.88% said their cows produced half as much milk as usual. The cows produced 50% more milk than usual, according to the 46.88% of farmers, 14 (43.75%) of whom indicated they do not vaccinate, while only one farmer said they do.

Table 3. Percentage effect on milk production due to LSD outbreak.

Variable	Category	Frequency	Percentage (%)
Drop-in milk production (%)	100	1	3.13
	75	3	9.38
	50	15	46.88
	25	7	21.88
	0	6	18.75

Table 4. Relationship between milk production and LSD vaccination.

Variable	Drop-in milk production (%)	Do you vaccinate them against LSD?		
		No (Frequency)	Yes (Frequency)	Total
How was milk production affected? And by how much?	100	1	0	1
	75	3	0	3
	50	14	1	15
	25	2	5	7
	0	0	6	6

3.4 Cattle Mortality and LSD Vaccination

To compare the mortality rate in cattle under vaccine and non-vaccination conditions, an independent sample T-test was used. There was a significant difference ($P < 0.05$) in mortality between vaccinated and non-vaccinated cattle (Table 5).

Table 5. Mortality and vaccination against LSD.

Variable	Vaccinated		Non-vaccinated		Mean difference (A-B)	P-value
	Mean (A)	SD	Mean (B)	SD		
Mortality rate	0.083	0.289	0.9	0.852	-0.817	0.001

Note: *Represents Significance at P<0.05

3.5 Handling of a Sick Cattle

Figure 3 displays the farmers responses when asked how they handled sick animals.37.5% of farmers said they used herbal medicine. The blend of herbs, which included turmeric, garlic, and other medicinal plants, was applied to skin lesions. However, 50% of the farmers acknowledged using antibiotics, whereas 6.25% simply isolated their animals.

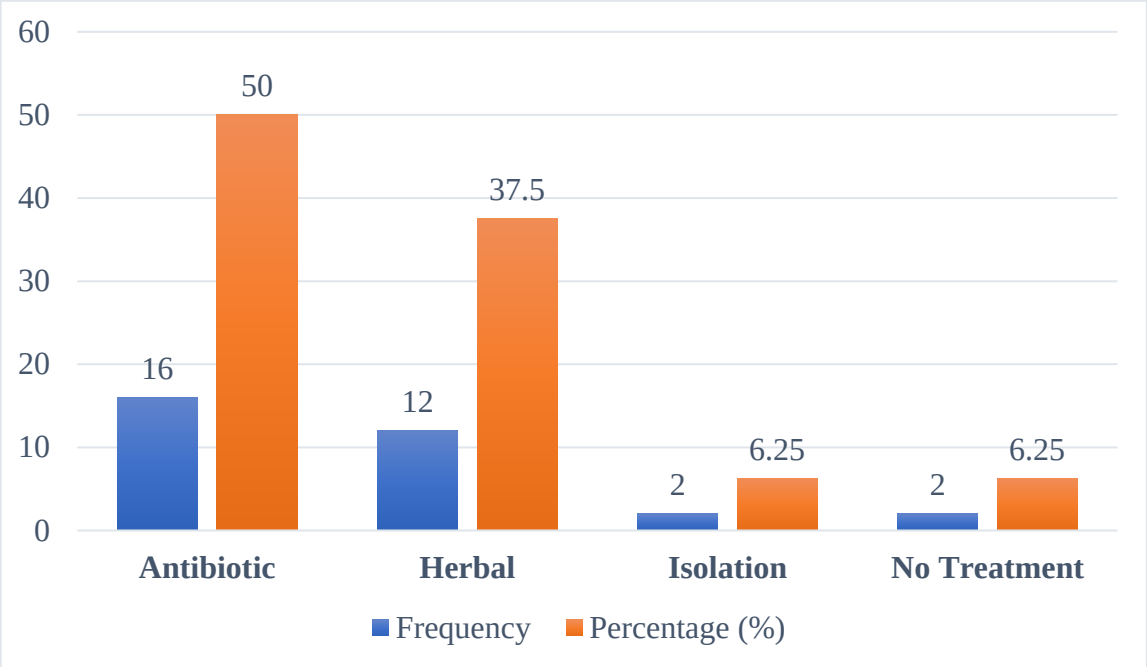

Figure 3: Handling of a sick animal.

3.6 Indigenous Preventive Measures for LSD

When asked farmers if they took any further preventive measures against LSD, 18.75% of farmers responded that they utilized mosquito nets. In comparison, 15.63% stated they use a mosquito coil as a preventative strategy, while 46.88% indicated they don't take any precautions at all. The frequencies and percentages are displayed in Table 6.

Table 6. Indigenous practices for prevention of LSD outbreaks.

Variable	Frequency	Percentage (%)
Chemical Insecticide	2	6.25
Mosquito coil	5	15.63
Mosquito Net	6	18.75
Straw fumigation	4	12.50
Not used anything	15	46.88

3.7 The Most Appropriate Time to Vaccinate the Cattle

The responses regarding the ideal timing to immunize cattle are shown in Table 7. The optimal timing for vaccination varied among farmers, with some choosing to vaccine before disease outbreaks (9.38%), sick cattle after disease outbreaks in the farm (6.25%), the neighborhood (12.5%) and (9.38%) when cattle in the village were ill. However, 62.5% of the farmers were unaware of the ideal vaccination time.

Table 7. Responses on the most appropriate time to vaccinate the cattle

Variable	Frequency	Percentage (%)
When an animal is healthy	3	9.38
When a member of a herd is sick	2	6.25
When a neighbor's animal is sick	4	12.50
When an animal in the village is sick	3	9.38
N/A	20	62.50

3.8 Barriers to Cattle Vaccination

Table 8 outlines the barriers to immunization of cattle. The main barriers were lack of resources, difficulty obtaining vaccines and the expense of vaccines. 62.5% of the farmers said they had trouble getting access to vaccination supplies; 21.88% were unable to afford the vaccination. However, when questioned about their access to LSD vaccines, 59.38% had no knowledge of this. Finally, when asked if vaccination may prevent the disease, 46.88% responded in the affirmative, but their primary barriers was a lack of money and availability to the vaccine.

Table 8. Barriers to vaccinating cattle

Variable	Category	Frequency	Percentage (%)
Do you have access to vaccine suppliers against LSD	Yes	12	37.50
	No	20	62.50
Can you afford the vaccine against LSD	Yes	13	40.63
	No	7	21.88
	Do not know	12	37.50
Do you think that vaccination can prevent LSD in animal	Yes	15	46.88
	No	4	12.50
	Do not know	13	40.63
Do you have access to information on vaccinating animal	Not at all	19	59.38
	Small extent	3	9.38
	Medium extent	7	21.88
	High extent	3	9.38

3.9 Record Keeping

Figure 4 shows the percentages of farmers keeping farm records. 53.13% farmers reported they keeps regular farm records; while the remaining 46.87% farmers were not kept any farm records.

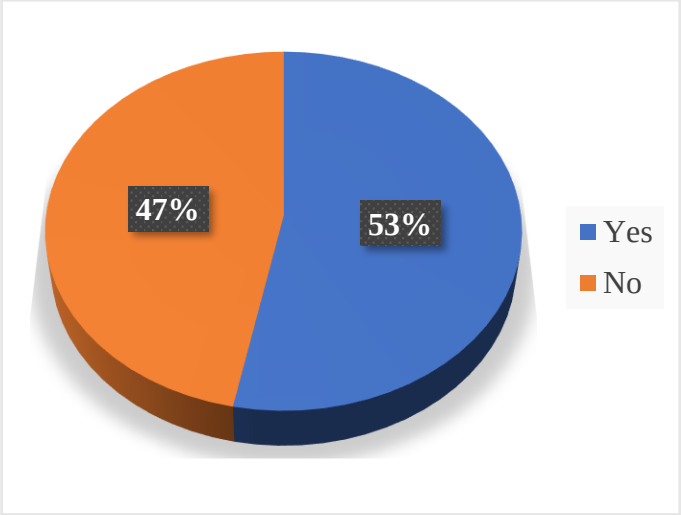

Figure 4: Percentage of farms keeping records.

CHAPTER IV

DISCUSSION

This study was done to assess of effects of the Lumpy Skin Disease (LSD) vaccine on milk output and mortality in dairy cattle. According to the survey, LSD was the most common disease that dairy farmers reported. The disease was confined to larger Africa until 1988 before gradually spreading to the Middle East, Eastern Europe, and then the Russian Federation after that (Calistriet al., 2019). New cases have now been reported in South and East Asia in 2019 as the outbreak continued to expand (Calistri et al., 2020; Sudhakar et al., 2020). Bangladesh was LSD-free before the middle of 2019, and the very first LSDV infection was reported to the OIE in August 2019 in Anwara, Karnaphuli, and Patiya Upazila (subdistrict), Chattogram (Anonymous, 2019). The first incident was reported on July 14, 2019, making Bangladesh the first hotspot in South Asia, according to an OIE report (OIE, 2020). India and China, two additional Asian nations in addition to Bangladesh, also reported the first outbreak in the middle of 2019 (Anonymous, 2019). Three nations may have helped spread the disease to one another because Bangladesh and China share a significant portion of their borders with India.Additionally, Bangladesh is located in a tropical area of the world, where the climate is ideal for the many vectors needed for LSD transmission.

Farmers noted that the most common clinical sign they observed was several skin nodules by the cattle; The farmers complaints matched with the LSD infection's clinical symptoms. Comparatively, this study found that the majority of farmers (43.57%) diagnosed LSD based solely on clinical indications. Hasib et al. (2021) mention that the overall clinical prevalence of LSD in Chattogram District was 10% similar to some previous studied in Saudi Arabia, Ethiopia and Turkey who reported 6%–12% prevalence in their cattle population. Again, with this study 43.57% of the farmers reported that they had experienced LSD, and it was self-diagnosed. The farmers' diagnostic method was based on the clinical indications by the cattle showed. Due to lack of familiarity and logistical issues, diagnosing LSD by farmers was much difficult. Clinical symptoms of LSD might be confused with other disease conditions such as foot and mouth disease (FMD), an insect bite, demodicosis, and hypersensitivity. Tentative diagnosis was made by the farmers on

the basis of skin nodules observed on all over the body with high fever and production fall. In their rural setting, laboratory diagnostic testing was unachievable.

The disease has significant economic consequences because of morbidity rather than fatality, as the mortality rate is often low. LSD results in lower production of milk and beef, loss of draft power, death, as well as higher costs for treatment and vaccination and hence, LSD may have an impact on both the farmers and the country's overall economies (Gari et al., 2011). When LSD occurs in dairy cows, milk production will drop dramatically along with weight loss, an increase in miscarriage rates, and damage to hides (Tuppurainen et al., 2012). A recent study in Ethiopia revealed that LSD is a financially devastating viral disease that causes issues in the dairy sector due to significant losses in milk production, infertility, abortion and occasionally death (Gumbe, 2018). In the farmers who claimed that their cows had ceased producing milk, the Chi-square analysis test demonstrated a correlation between LSD vaccination and milk production. The test revealed a significant ($P<0.05$) difference between cow vaccination and milk production. However, the test also showed that even though the vaccine-protected cows were affected by the disease, they continued to produce milk. Cattle that have received an LSD vaccine may suffer by the disease if the vaccine was handled incorrectly and administered at the incorrect dosage. On the other hand, 21.8% of farmers claimed they couldn't afford the costs of vaccines and couldn't get their animals vaccinated against LSD. A study carried out by Mutua et al. (2019) reported that costs play a significant role in determining vaccine uptake in communities where the expense of immunizing livestock exceeds available disposable income.

Although LSD is a viral disease, the investigation into prescribed medications in the outbreak area revealed that approximately 50% of cases were treated with antibiotics. The reason for the high percentage of antibiotic use may be that veterinary practitioners occasionally choose medicines to stop secondary bacterial infections. However, this practice has significant drawbacks, such as the antibiotic resistance of environmental pathogens and commensal bacteria. During the study, it was discovered that 37.5% of farmers treated their sick animals using herbs rather of using medications. The study found that because of the distance between farms and agrovets, farmers had trouble getting access to inputs for production. This is in contrast to the study mentioned earlier, which revealed that farmers' access to local vaccine suppliers was their biggest challenge. More research is needed to overcome the LSD problem and how small holder dairy farming can be advanced.

CHAPTER V

CONCLUSION

LSD outbreaks in cattle were believed by farmers to result in high morbidity and reduced milk production. Moreover, there was a correlation between LSD vaccination, milk production and mortality rates in cattle. Despite the fact that most farmers did not receive the LSD vaccine, access to vaccine suppliers and the distance to agrovets were the main barriers; to increase rural farmers access to vaccines, effective policies should be implemented to support the veterinary extension service. For the purpose of creating a viable vaccine candidate, more research should emphasize on the molecular characterization of the entire genome of the local strain of Lumpy Skin Disease Virus (LSDV). Department of Livestock Services (DLS) and Livestock Research Institution (LRI) should take quick responses to produce LSD vaccine form local strain of LSDV. The study's findings would be helpful to Bangladesh's field veterinarians and decision-makers in the field of animal health and additionally, it will help in implementing the necessary precautions to stop future outbreaks or relapses of this condition.

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QUESTIONNAIRE

Objectives:

- To know the production and mortality status **Date:** ……/……/2022
- To know the vaccine efficacy

Farm's name:

Location:

A) Farmer's Information:

1. Farmer's name: …….
2. Education: ☐Primary ☐Secondary ☐College ☐Illiterate
3. Gender of the farmer: ☐Male ☐Female
4. When did you start dairy farming?..... years

B) Farm population:

1. Total number of cattle: ……

C) Farm structure:

1. Housing System: ☐Intensive ☐Semi-intensive ☐Loose ☐Extensive
2. Shed number:
3. Isolation shed: ☐Yes……..... ☐No
4. Quarantine shed: ☐Yes…… ☐No

D) Production status:

1. How many times a day do you milk your cows?
   ☐Once ☐2 times ☐3 times
2. Milking practices: ☐Hand milking ☐Machine milking ☐Both
3. Average milk production: ……. liters/day, from ……number of milking cows.
4. Decrease milk production due to disease outbreak: ……..liters/day

E) Vaccination status:

1. Do you vaccinate your cattle against LSD? ☐Yes ☐No
2. If yes, when did you vaccinate? ☐When animal is healthy
   ☐When a member of a herd is sick
   ☐When a neighbor's animal is sick
   ☐When an animal in the village is sick
   ☐N/A

F) Vaccine barriers:

1. Do you have access to vaccine suppliers against LSD? ☐Yes ☐No
2. Can you afford the vaccine against LSD? ☐Yes ☐No ☐Do not know
3. Do you think that vaccination can prevent LSD in cattle?
   ☐Yes ☐No ☐Do not know
4. Do you have access to information on vaccinating cattle? ☐Not at all
   ☐Small extent
   ☐Medium extent
   ☐High extent

G) Disease diagnosis:

1. Outbreak: ☐Yes ☐No
2. Number of animals affected: ☐Cow……..☐Calf……
3. Disease diagnosis: ☐LSD☐N/A
4. Disease diagnosed by: ☐Veterinarian ☐Own experience

H) Mortality status:

1. Any death cases? ☐Yes ☐No
2. If yes, number of death cases occurred: ☐Cow……☐Calf……

I) Handling of sick animals:

1. Did you treat sick animals? ☐Yes ☐No
2. Antibiotic treatment: ☐Yes ☐No
3. Herbal medicine treatment: ☐Yes ☐No
4. Isolation from herd: ☐Yes ☐No

J) Disease prevention practices:

1. Did you practice any preventive measures for LSD? ☐Yes ☐No
2. If yes, which measure did you practice: ☐Mosquito Net ☐Straw fumigation
   ☐Mosquito coil ☐Chemical insecticide

K) Record keeping:

1. Do you practice record keeping on your farm? ☐Yes ☐No

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The Author

BIOGRAPHY

Mohimanul Islam, Son of **Aminul Islam** and **Masuda Akter**, was born on 21 February, 1997 at Narsingdi district. He passed his Secondary School Certificate Examination from Brahmondi K. K. M. Govt. High School, Narsingdi in 2013 (GPA 5.00). Then he passed his Higher Secondary School certificate examination from Narsingdi Govt. College, Narsingdi in 2015 (GPA 5.00). Now he is completing his one-year long internship program for fulfilling the requirement of Doctor of Veterinary Medicine (DVM) degree in Chattogram Veterinary and Animal Sciences University, Chattogram, Bangladesh. During his internship period he received his clinical training on Veterinary Medicine from CVASU Lab Rotation, Shahedul Alam Quadery Teaching Veterinary Hospital (SAQTVH), PRTC, Teaching & Training Pet Hospital and Research Center (TTPHRC), UVH Narsingdi Sadar, ACDI/VOCA, RV & F Depot, Chattogram Military Farm, and managemental training from Chattogram based farm etc.

His primary research interest is in zoonoses and poultry diseases. But he feels much interest to work on emerging infectious diseases of different animals.