



## Research Article

# Prevalence, Clinicopathological Investigation and Economic Impact of FMD in Cattle in a Selected Area of Bangladesh

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**Abstract** | This study was aimed to determine the prevalence of Foot and Mouth Disease (FMD) in the Joypurhat district of Bangladesh and also to investigate clinicopathological changes and economic impact of this disease in cattle. At Akkelpur upazila in Joypurhat district, a survey was done on 82 cattle to find out the prevalence and economic impact of FMD. To calculate the economic impact, treatment costs, and labour costs including extra care and feed supplied to the FMD affected cattle for recovery of body weight were included. The prevalence of FMD were 41.67% and 69.56% in young and adult cattle respectively. Indigenous and cross-bred cattle showed 53.57% and 65.38% prevalence of FMD respectively. FMD prevalence was higher in females 67.19% than males 22.22%. Among the FMD-affected cattle, ten cattle having the active disease state, aged between 1.5 to 3.5 years were undergone clinicopathological examination. Blood samples were also collected from those cattle for biochemical analysis. All the ten cattle were affected with temporary lameness (100%). The vesicular lesions in the inter-digital space were present in 80% of cattle. Maggot infestation and mouth-tongue lesions were found in five cattle (50%). The biochemical parameters were altered in the cattle having an active cascade of the disease. Regarding the economic impact on the farmers, FMD exerts huge economic losses to the farmers. During the disease period, the highest loss was incurred due to treatment purposes (64%). This study concluded that FMD caused clinical and pathological changes in cattle and exerted economic loss on the farmers.

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**Keywords** | FMD, Prevalence, Clinico-pathology, Plasma biochemistry, Economic impact, Cattle



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## Introduction

Foot and mouth disease (FMD) is a highly contagious disease that affects both domestic and wild cloven-footed ruminants. It is endemic to Asia and Africa (Parida, 2009). It affects animal productivity

by lowering milk production, weight loss and abortion of the pregnant animals. Serious clinical symptoms are displayed by FMD-infected cattle; typically, they develop vesicular lesions on the tongue, gums, soft palate, dental pad, and nostrils, along with fever. The animal is unable to eat and exhibits excessive sal-

ivation, with the saliva appearing as long string-like ropes. The vesicles are thin walled that contain straw colored fluid. When the vesicles in the foot rupture, there is extreme agony and lameness. The disease causes high mortality in adult animals. The clinical disease also varies with the species, breed of the animal affected, and serotype and strain of FMD virus (Kitching, 2005; Donaldson, 2004). The virus can affect animals of all ages. According to Sarker *et al.* (2011), FMD is more common in older cattle than in adults and younger. The blood plasma biochemical parameters of FMD affected cattle are also altered due to the severity of disease.

Although, livestock contributes significantly to the national economy of Bangladesh, poverty alleviation, and food security but animal diseases continue to be a key barrier to the economic growth. FMD is one of the most important contagious transboundary animal illnesses that severely damages economies (Bhuiyan *et al.*, 2019; Khokon *et al.*, 2017; FAO, 2007).

The economic impact of FMD has not been investigated at the farmers' level in Bangladesh. Therefore, the present study was aimed to determine the prevalence of FMD in relation to age, sex, and breed of cattle, to investigate the plasma biochemical changes in cattle affected with FMD, and also to determine the economic impact of FMD in cattle in the study area.

## Materials and Methods

### *Ethical Approval*

All experimental procedures were performed in accordance with the guidelines for care and use of animals as established by Animal Welfare and Experimentation Ethics Committee (AWEEC), Bangladesh Agricultural University (BAU), Mymensingh [Approval Number: AWEEC/BAU/2023 (11)].

### *Study area*

The study was conducted from September 2022 to March 2023 at Akkelpur upazila of Joypurhat district which is located in the north-west of Bangladesh, adjacent to the hilly border. This area is attractive for dairy and meat production. Jamalgonj, Gopinathpur, and Sonamukhi are the unions under Akkelpur upazila producing huge milk and the cattle population is comparatively dense in this area.

### *Study population*

This study examined a total of 82 cattle from differ-

ent geographical locations and management systems at Akkelpur upazila of Joypurhat district with both sexes and aged from 1.5 to 6 years with no history of vaccination against FMD virus.

### *Data collection*

A questionnaire was prepared to gather information from the farmers based on the objectives of the study and it was designed simply so as a quick understanding of the farmers. The data collection was proceeded by visiting the farmer's house and going through direct contact with them. Data was taken if there is any evidence or history of FMD within the last few years. The questionnaire included all the queries to collect information about the owner, FMD disease history, and FMD sequelae examination of cattle.

### *Determination of prevalence*

The prevalence of FMD was expressed in percentage based on age, sex, and breed of cattle respectively.

### *Clinicopathological investigation*

Clinicopathological examination was performed in 10 cattle among the 47 FMD-affected cattle aged between 1.5 to 3.5 years. Physical examinations were performed by observing clinical signs such as ulceration of mouth and hoof, the dirty wound of hooves, maggot infestation in interdigital space, sloughing of hooves, pain, and swelling of the hoof, and abnormal condition of the hoof. The cattle were examined in standing position or dorsal recumbency with the help of the cattle owner and examined carefully for lesions in the mouth and interdigital space of the hoof. Hoof structures including interdigital claw, heel bulb, coronet, abaxial wall, axial wall, and sole were examined carefully. While grazing in the pasture field, cattle were also observed for lameness. Abnormal gait was also observed and marked as a positive indication of lameness.

### *Blood collection and plasma preparation*

Five milliliter blood samples were collected from the jugular vein of ten FMD-affected cattle having active disease states using an 18G needle and kept in sterile vacutainer tubes without anti-coagulant undisturbed for a few minutes. The tubes were centrifuged at 3000 rpm for 15 min, plasma was separated and stored at -20°C until laboratory analysis.

### *Biochemical analysis*

Plasma samples of diseased cattle were utilized for

**Table 1:** Prevalence of FMD in infected cattle based on age, sex and breed of cattle.

Parameters	age		Sex		Breed	
	Young < 2 years	Adult (2-4) years	Male	Female	Indigenous	Cross-bred
Cattle examined	36	46	18	64	56	26
Cattle infected	15	32	4	43	30	17
Prevalence (%)	41.67	69.56	22.22	67.19	53.57	65.38

**Table 2:** Clinicopathological investigation of ten FMD affected cattle used for biochemical analysis.

SL No	Description of patient			Temperature (°F)	Salivation	Vesicular lesion		Temporary lameness	Maggot infestation
	Age (Year)	Sex	Breed			Mouth and tongue	Inter digital space		
1	2.5	Female	Indigenous	106	Profuse	P	A	P	A
2	2		Indigenous	106	P	A	P	P	A
3	3		Indigenous	102	A	A	P	P	P
4	2.5		Indigenous	105	A	A	P	P	A
5	1.5		Indigenous	106	P	P	A	P	A
6	3.5		Cross-bred	106	A	A	P	P	P
7	2.5		Indigenous	104	A	A	P	P	A
8	2.5		Indigenous	106	Profuse	P	P	P	P
9	5		Cross-bred	105	Profuse	P	P	P	P
10	1.5		Cross-bred	103	P	P	P	P	P

A=Absent, P=Present.

biochemical analysis, including aspartate aminotransferase (AST), alanine amino transferase (ALT), creatinine, total protein, albumins, blood urea nitrogen (BUN), glucose, following manufacturer’s protocol either by kinetic or endpoint method where applicable. All the tests were performed on a semiautomatic biochemistry analyzer (Clindia<sup>®</sup> SA-20, Belgium) at the determined wavelength.

*Estimation of economic loss*

For estimating financial loss due to FMD infection only direct losses such as treatment cost, extra feed cost, and labour cost for taking care of infected cattle were considered. During the FMD outbreak, the farmers of the affected farms had to spend extra time nursing the affected animals and disinfecting sheds and surroundings. The cost of labour was calculated at the prevailing market price of Tk. 500.00 for 8 hours of working hours a day. The infected cattle become weak due to reduced feed intake. The farmers had to supply extra concentrate feed and vitamins to the affected animals for recovery of body weight. Treatment costs were calculated including veterinary doctor’s fees and fees for drugs.

*Data analysis*

Collected data about disease history and the economic information generated from this experiment was coded and entered in Microsoft Excel Worksheet, checked, organized, and processed for further analyses. The percentage for different variable traits and means was calculated by using IBM SPSS Statistics 20.0.

**Results and Discussion**

*Prevalence of FMD based on age, sex and breed of cattle*

The prevalence of FMD in association with age, sex, and breed of cattle is placed in Table 1. Age is an important factor in assessing disease risk in cattle. The age of cattle was analyzed in two categories. The prevalence of FMD were 41.67% and 69.56% in young and adults respectively. The results showed that the prevalence was higher in females 67.19%, than the males 22.22%. In the present investigation, breed susceptibility was higher in crossbred cattle 65.38% compared to indigenous 53.57%.

*Clinicopathological evaluation of FMD infected cattle used for biochemical analysis*

Ten FMD infected cattle used for biochemical analysis were undergone clinicopathological evaluation

**Table 3:** Plasma biochemical parameters in cattle infected with FMD.

Sample no.	Glucose mmol/L	Total Protein g/dl	Albumin g/dl	TG mg/dl	Cholesterol mg/dl	BUN mg/dl	Creatinine mg/dl	ALT U/L	AST U/L
1	4.882	7.561	4.324	56.822	222.547	187.633	1.098	58.018	135.300
2	4.815	7.741	4.517	72.193	245.315	83.432	1.514	262.450	119.902
3	4.197	8.185	4.736	48.580	236.541	151.891	1.085	69.980	145.160
4	4.156	8.048	4.537	87.660	220.714	127.697	1.218	113.560	209.370
5	4.812	7.932	4.911	56.663	226.378	190.878	1.273	53.716	124.767
6	3.955	7.240	5.010	69.342	192.280	228.764	1.735	43.962	82.773
7	3.660	7.075	4.203	56.202	189.615	244.820	1.704	36.959	72.606
8	3.769	8.265	4.707	60.514	183.617	149.032	1.357	56.454	89.641
9	3.973	8.939	5.044	46.750	180.506	249.770	1.031	49.055	89.256
10	3.688	8.772	4.700	57.045	184.450	208.363	1.108	29.659	77.328
Mean±SD	4.19±0.47	7.97±0.60	4.66±0.27	61.17±12.19	208.19±24.51	182.22±53.94	1.31±0.25	77.38±8.97	114.61±2.03
Reference value*	2.33-4.44	6.7-8.8	3.3-4.3	10-19	163-397	7-19	0.4-0.9	6.9-35	54-135

\*Reference value (Faruk et al., 2017)

**Table 4:** Summary of total financial loss due to FMD.

Breed	Cattle infected	Treatment cost/cattle (Tk.)	Labour cost/cattle (Tk.)	Feed cost/cattle (Tk.)	Total treatment cost (Tk.)	Total labour cost (Tk.)	Total feed cost (Tk.)
Crossbred	17	1170	200	580	19890	3400	9860
Indigenous	30	940	150	320	28200	4500	9600
Total loss (Tk.)					48090	7900	19460
% Loss					63.73	10.47	25.79

and the result is placed in Table 2.

Among ten cattle, seven were indigenous breeds and others were cross-bred. Several clinical parameters such as salivation, vesicular lesion, lameness, and maggot infestation were recorded and categorized as present or absent. 100% of cattle were affected with temporary lameness. Among the ten cattle, eight (80%) showed vesicular lesions in the interdigital space. Maggot infestation and mouth-tongue lesions were present in five cattle (50%).

*Plasma biochemical profile in FMD affected cattle*

The plasma biochemical profiles of ten FMD-affected cattle are placed in Table 3. Nine biochemical parameters were evaluated from each sample. The lowest Albumin, Glucose, TP, TG, Cholesterol, BUN, Creatinine, ALT, and AST were 4.20g/dl, 3.66mmol/L, 7.07g/dl, 46.75mg/dl, 180.51mg/dl, 83.43mg/dl, 1.03mg/dl, 29.65U/L, 72.6U/L respectively and the highest level of Albumin, Glucose, TP, TG, chole-

sterol, BUN, Creatinine, ALT, AST were 5.04g/dl, 4.88mmol/L, 8.94g/dl, 87.66mg/dl, 245.31mg/dl, 249.77mg/dl, 1.73 mg/dl, 262.45U/L, 209.37 U/L respectively. The average value of Albumin, Glucose TP, TG, Cholesterol, BUN, Creatinine, ALT, and AST were 4.66±0.27g/dl, 4.19±0.47mmol/L, 7.97±0.6g/dl, 61.17±12.19mg/dl, 208.19±24.51mg/dl, 182.22±53.94mg/dl, 1.31±0.25mg/dl, 77.38±8.97U/L and 114.61±2.03U/L respectively.

*Economic impact of FMD in cattle*

The financial loss incurred due to the occurrence of FMD is summarized in Table 4. During the survey period, a total of 17 crossbred and 30 indigenous cattle were found to be affected by FMD. The average treatment costs per affected cattle were Tk.1170 and Tk.940 for crossbred and indigenous cattle, respectively. The total treatment cost for crossbred and indigenous cattle was Tk. 19890 and Tk. 28200 respectively.

Hence the total cost of treatment for infected cattle

was Tk. 48090. The costs of labour for the extra care for each affected animal were Tk. 200 and Tk. 150; and feed costs were Tk.580 and 320, for crossbred and indigenous cattle, respectively. The total costs of labour and feed were estimated to be Tk. 7900 and Tk.19460 respectively for 47 infected cattle. The table shows that the highest (64%) loss incurred due to treatment costs, followed by feed cost (26%) and labour cost (10%).

FMD is a transboundary animal disease that affects all cloven-hoofed domestic animals including cattle, sheep, goats, pigs, and buffalo, and causes economic loss due to reduced production of animals. The survey study on FMD in cattle in Joypurhat district shows a higher prevalence in crossbred cattle (65.38%) than in indigenous cattle (53.57%). This is in accordance with [Giasuddin et al. \(2017\)](#) found 77.8% and 56.5% positive cases in crossbred and indigenous cattle, respectively. This higher prevalence in crossbred cattle might be due to a high chance of getting exposure and suboptimum management practices. Foot and Mouth Disease is an acute, extremely contagious, and highly communicable viral disease of all cloven-hoofed animals. The prevalence of FMD was higher in adults compared to young cattle which is similar to the previous study by [Datta et al. \(2015\)](#) but disagreed with the findings of [Fakhrul et al. \(2017\)](#). The reasons for increased susceptibility to adult cattle were malnutrition, poor management system and repeated exposure to FMD. The present study also identified that female cattle were commonly affected by FMD, which is similar to [Fakhrul et al. \(2017\)](#). Clinical signs such as high fever, frothy salivation, and lesions like sore mouth, sore tongue, temporary lameness, and maggot infestation were observed in this study and these are in agreement with the study of [Fakhrul et al. \(2017\)](#).

Ten FMD-affected cattle were gathered for clinical study. This current study found that the plasma biochemical analysis of cattle with clinically infected FMD showed a substantial increase in ALT, BUN, TG, albumin, and creatinine, which could be attributed to the degenerative changes by the harmful effects of the FMD virus on the liver and heart or to hepatocellular damage. These findings are in agreement with [Nath et al. \(2014\)](#) and [Nasr El-Deen et al. \(2017\)](#). In this study, the level of glucose, total protein, and cholesterol in cattle affected with FMD remained in the normal range. In this study, 47 cattle were affected

due to the FMD outbreak, which caused a financial loss of Tk.75450 during the infected period of FMD. The costs of feed and labor to nurse the affected animal were Tk. 580.00 and Tk. 320.00 for crossbred and indigenous cattle, respectively. In this report, only direct financial loss was considered. Here possible indirect losses such as abortion, impact on market price, trade, public health and nutrition, and food security were not considered. However, based on this data, it seems that FMD outbreaks might cost as much as Tk. 75450. This analysis reveals that the biggest 64% loss occurred due to treatment costs, followed by feed costs (26%), and then losses related to labor costs of affected cattle (10%) but [Giasuddin et al. \(2020\)](#) found the highest cost for the death of affected cattle (63.47%).

## Conclusions and Recommendation

The prevalence of FMD in the study areas was seen more in adult cattle compared to young. Female cattle were commonly affected by FMD. Crossbred cattle were more susceptible than indigenous cattle. The active state of the disease exerts some changes in the plasma biochemical parameters notably those of albumin, TG, BUN, Creatinine, and ALT which were elevated in this study. Foot and mouth disease (FMD) is a severe and highly contagious disease that causes huge losses to the farmers as well as to the economy of Bangladesh. The losses were attributed to veterinary expenses, followed by feed costs and labor costs throughout the infection. Therefore, the findings of the study suggested that FMD has clinical and systemic effects on cattle health and it has also detrimental impacts on household income and the economy of Bangladesh.

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## Novelty Statement

FMD is highly contagious and the actions of one farmer affect the risk of FMD occurring on other holdings; thus, sizeable externalities are generated. FMD production losses have a big impact on the world's poorest where more people are directly dependent on livestock. FMD reduces herd fertility

leading to less efficient herd structures and discourages the use of FMD susceptible, high productivity breeds. Overall, the direct losses limit livestock productivity affecting food security. This study provided important data on the financial loss of farmers caused by FMD during the ongoing and post-recovery period in a certain area of Bangladesh which may be helpful for the field veterinarian as well as farmers to take necessary action on it.

### Author's Contribution

**Md. Mahmudul Alam:** Conceptualization, Methodology, Resources, Funding acquisition, finalizing the manuscript.

**Suravi Akter:** Methodology, Investigation, Writing-Original draft preparation.

**Md. Bipul Mondal:** Review writing and editing the manuscript.

### Conflict of interest

The authors declare that there is no conflict of interests regarding the publication of this article.

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