Journal of Posthumanism

2025
Volume: 5, No: 5, pp. 4569–4580
ISSN: 2634-3576 (Print) | ISSN 2634-3584 (Online)
posthumanism.co.uk

DOI: https://doi.org/10.63332/joph.v5i5.1938

Socio-Economic Impact of Outbreak Cases Foot Mouth Disease (FMD) on Livestock Farmers

Ihsani Merdekawati[1], Meirli Kurniawan[2], Achsan Jamalurrusid[3], Soby Eko Cahyaningati[4]

Abstract

The re-outbreak of Food Mouth Disease (FMD) in cattle in Indonesia, including Probolinggo City, has caused several unavoidable impacts. One of them is the impact of socio-economic losses. This study aims to calculate the economic losses incurred due to the spread of FMD in cattle during the outbreak period with a focus on livestock farmers and also to find the social impact of FMD. This study used a quantitative calculation used to measure the total economic losses, and descriptive analysis based on the results of questionnaires to know the social impact and also quantitative calculations used to measure the total economic losses. The total economic loss reached USD 25,456. This loss appears as a loss arising from the death of beef cattle, the decrease in milk productivity of dairy cattle and the cost of controlling the spread of FMD in the form of treatment costs for infected cattle. In this location of study, it was found that the beef cattle were more affected than dairy cattle. Then, control costs arising not only from vaccination, but also from the provision of traditional medicine (herbs) and vitamins to restore the condition. For social impact, it was discovered that livestock farmers experienced stress and anxiety, which affected their relationships with their families.

Keywords: *Cattle. Economic Losses, FMD, Livestock Farmer, Social Impact.*

Introduction

Foot and Mouth Disease (FMD) is the most important livestock disease in the world. This disease is a transboundary disease that is highly contagious in cloven-hoofed animals, including livestock and wild animals (Sutmoller, Barteling, Olascoaga, & Sumption, 2003) According to the World Animal Health Organization (WAHO), FMD is a disease that spreads rapidly and widely between countries and can have severe economic and social impacts (Ministry of Agriculture, 2022). A virus causes FMD in the Picornaviridae family and induces vesicles in the feet, mammary glands, and oral cavity of infected animals (Grubman & Baxt, 2004) FMD virus (FMDV) can be transmitted through different routes in the form of direct or indirect contact between infected and susceptible animals, their secretions, contaminated animal products, Etc (Paton, Gubbins, & King, 2018) This virus can cause affected animals to experience several problems, including loss of milk production and fertility problems, and this disease can cause major losses in milk production (Knight-Jones & Rushton, 2013).

[1] Department of Research and Development, Bappeda Litbang Kota Probolinggo, 67211, Indonesia, Email: sanimerdekawati@gmail.com, (Corresponding Author)
[2] Department of Research and Development, Bappeda Litbang Kota Probolinggo, 67211, Indonesia, Email: meirlikurniawan@gmail.com
[3] Department of Research and Development, Bappeda Litbang Kota Probolinggo, 67211, Indonesia, Email: achsan.jamal@gmail.com
[4] Department of Research and Development, Bappeda Litbang Kota Probolinggo, 67211, Indonesia, Email: sobyekocahyaningati@gmail.com

Indonesia has been hit by the Foot and Mouth Disease (FMD) virus since 1887, and this disease is very contagious and affects the cattle farming population. Indonesia was only declared free of FMD in 1986 and was recognized internationally by the World Animal Health Organization in 1990. This FMD began to spread again in Indonesia in April 2022 in Gresik, East Java (Rachmawati, 2022) As of July 2022, the Indonesian Government reported that the FMD outbreak had infected livestock in 227 districts or cities and infected 313,636 cattle, 105,675 of which had recovered, 2,734 died, and 1,948 had to be slaughtered (in serious condition) (Emergy Plan of Action, 2022) FMD was detected in 19 Provinces and 38 Regencies/Cities in East Java. Of the 38 regencies/cities in East Java, they have been divided into 4 regional statuses based on their epidemiological units, of which 4 regencies have been designated as outbreak areas, 21 regencies/cities are infected areas, 4 are suspected areas, and 9 areas are still free (Kepmen Nomor 500.1/ KPTS/ PK.300/ M/ 06/ 2022).

Probolinggo City is among the 21 regencies/cities designated as areas infected with Foot and Mouth Disease (FMD). According to data from Probolinggo City Food Security, Agriculture, and Fisheries Service dated 18 July 2022, it is known that from a population of 7,290 cattle, there were 881 cases detected, consisting of 159 sick, 8 dead, 3 forced slaughter, and 711 recovered. Meanwhile, 10 cases of FMD infection were identified in sheep, and they recovered. The number of cases has increased from initial data on 13 May 2022 from 25 suspected cattle cases; of the 6 samples taken, 5 cattle were positive for FMD. If you look at the development of FMD cases from May to July, you can see that there has been a very large increase in cases of cattle being detected with FMD, up to 884 heads.

Several previous studies, such as (Knight-Jones & Rushton, 2013), have indicated that the annual economic losses in regions affected by Foot and Mouth Disease (FMD) range from US$ 6.5 to 21 billion, while in FMD-free zones, they exceed US$ 1.5 billion. This research also distinguishes between two types of impacts caused by losses: direct losses arising from decreased production and changes in livestock and indirect losses arising from costs arising from FMD control, limited market access, and constraints in the utilization of production technology. However, the impact of losses will be different for (1) poor people whose lives depend directly on livestock; (2) in countries with ongoing control programs; (3) the threat of FMD which hinders access to international markets; (4) in FMD-free countries where FMD occurs periodically and requires high costs to recover. Meanwhile, research (Alhaji et al., 2020) discusses the economic impact on dairy farming in Nigeria, reaching USD 15,591,694.30, and control costs reaching USD 463,673.70. The total losses also show that FMD has an impact on milk and livestock production. Hence, it needs to be controlled to ensure food security, the local income of farmers, and human protein needs, especially for children. Furthermore, in Indonesia alone, the total loss in cattle and buffalo was IDR 38.67 trillion (Firman, Trisman, & Hadiwijaya Puradireja, 2022). The similarity among the three studies is that they only discuss the economic losses experienced by livestock farmers and none of them discuss its social impact on livestock farmers. This research differs from other studies, in addition to discussing its economic impact, it also addresses its social impact. However, as explained by ((Knight-Jones & Rushton, 2013), the economic losses due to FMD can vary in different regions. In this research, cultural differences within the community also play a role in influencing the economic losses experienced by cattle farmers in the Probolinggo City. Farmers perceive their livestock as highly valuable assets, prompting them to exert maximum effort in treating any sick animals.

Therefore, this research aims to understand the socio-economic impact of FMD and also to assess the economic losses incurred by livestock farmers due to cases of Foot and Mouth Disease

(FMD). The findings of this study can serve as valuable insights for policymakers in formulating effective strategies to mitigate the impacts of such losses. The research was conducted from May to July during the FMD outbreak period, and it was carried out using descriptive analysis and quantitative calculations.

Method

Characteristic Study Area

This research was carried out at the Probolinggo city, East Java, Indonesia. It has five districts, with the number of populations reaches 243,200 in 2022. The total of 9,289 residents of Probolinggo city works in the agricultural sector (BPS, 2023). The Data from Department of Food Security, Agriculture, and Fisheries of Probolinggo City in 2022 said that the total of livestock farmers reached 2,540 and spread across 5 district and 29 sub-districts. Characteristic of livestock farmers consist of dairy cattle and beef cattle farmers. Dairy cattle farmers are located in Mayangan District. Beef cattle are spread throughout the sub-district areas in Probolinggo City.

The study focuses on dairy and beef cattle farmers aged 30 and above who live in the study area during the survey period. Farmers in this age group are assumed to possess veterinary knowledge and a strong understanding of livestock health, given their long-standing experience in managing their animals (Mariner and Paskin, 2000).

Study Design and Sample

This research uses both primary and secondary data. Primary data are collected by a cross-sectional study based on interview questionnaires was conducted in 2022 to determine the economic and social impacts. Design questionnaire was using an exploratory sequential approach (Creswell & Plano Clark, 2011). This questionnaire containing close and open-ended questions (Thrusfield M., 1995). The sample size was determined using the Slovin sampling method with a standard error of 0.1, resulting in a total of 96 farmers as the research sample (Riyanto & Hatmawan, 2020). The secondary data used in this research were collected from the Department of Food Security, Agriculture, and Fisheries of Probolinggo City (DKPP).

Questionnaire Development, Data Collection.

A structured questionnaire, primarily composed of open-ended questions, was developed to gather data on epidemiological, economic, and social factors. It was divided into six sections: (i) demographic details of livestock farmers, (ii) livestock-related information, (iii) farmers' understanding of FMD, (iv) economic factors, (v) social factors, and (vi) disease mitigation strategies. The questionnaire was formulated with input from relevant stakeholders**.** The questionnaire was designed based on authors from literature review and were discussed with stakeholder that related to the case. Then, was pre-tested by expert judgement (Thrusfield, 2009). Expert judgment consists of Development Planning Agency (Bappeda Litbang Kota Probolinggo), Department of Food Security, Agriculture, and Fisheries of Probolinggo City (DKPP). Parameters that used for economic, and social impact are:

No.	Category	Parameters
1.	Dairy Cattle	- Number of cattle owned - Number of infected cattle (infected, dead, forced slaughter)

		- Price of Milk Cattle - The average catlle's milk production inffected FMD every day (MPmilk) - Vetenary Service Fee (USD/animal visit) - Average medicine cost (USD/animal) - Other costs for livestock recovery - Preventive measures to animals not affected - Treatment details for those that applied treatment - Other ways the outbreack or quarantine impact to family - impact on income due to forgone sales
2.	Beef Cattle	- Number of beef cattle owned - Number of infected cattle (infected, dead, forced slaughter - Beef Cattle price (USD) before and after FMD - Vetenary Service Fee (USD/animal visit) - Average medicine cost (USD/animal) - Other costs for livestock recovery - Preventive measures to animals not affected - Treatment details for those that applied treatment - Other ways the outbreack or quarantine impact to family - impact on income due to forgone sales

Table 1. Parameters That Used for Analysis

1 USD is approximated to 15.592 Rupiah according to average exchange rate in 2022

Source: Literature Review Processed, 2022

For this research, research staff from the Urban Development Planning Agency, along with veterinary personnel, conducted interviews with farmers in Indonesian. Prior to the interviews, the staff received a briefing to ensure preparedness. The collected data included farmers' names, the geographical coordinates of their farms, and the previously mentioned parameters. The financial data were recorded in Indonesia Rupiah and later converted to US dollars (USD) using an exchange rate of 1 USD to 15.592 Rupiah, based on the average exchange rate in 2022.

Epidemiological Characteristic

For identification epidemiological characteristic used descriptive analysis. For assessing the relation between cumulative incident of FMD and vaccination process were examined using the Chi-square test (Getaneh, Mekonnen, & Hogeveen, 2017). The overall cumulative incidence and vaccination was calculated by the total number of animals showing clinical symptoms that occurred in the field and also with as a binary outcome (the presence of infected beef with clinical FMD symptoms). For overall cumulative incidence and mortality, the data used were the last 3 months (May, June, and July) and were taken from data from Department of Food Security, Agriculture, and Fisheries of Probolinggo City. The cumulative mortality was determined used the numerator representing the number of deceased animals or those culled due to clinical FMD symptoms. To determine the effect between vaccination and FMD incidence, linear regression analysis was used to see the effect of vaccination on FMD incidence.

Estimation of Economic Impact

From the 2.540 livestock farmers, the economic impact was calculated from dairy cattle and beef cattle farmers.

Economic losses are measured by summing the value of both direct (visible) and indirect production losses, along with expenditures incurred for control, as outlined by previous studies (Alhaji et al.,2020;Rushton, Thornton, & Otte, 1999; Tambi, Maina, & Ndi, 2006). This research distinguishes several economic losses incurred, as follows:

- **Estimation of cost of the mortality losses**

The mortality losses were equivalent to the replacement costs of the cows affected by FMD that either died or were culled = ∑ [(Number of dead beef cattle x Price of Beef cattle)].

- **Estimation of cost of the morbidity losses**

In this research, morbidity losses were calculated from the loss of milk production from dairy cattle. Estimated cost of milk production in dairy cattle ∑ [(Number of Dairy cattle that infected FMD x Average amount of milk production lost each day x Duration/length of time infected x Price of milk per liter)] (Chanchaidechachai, Saatkamp, Inchaisri, & Hogeveen, 2022).

- **Cost incurred as an effort to cure and control the spread of FMD**

In Probolinggo, the treatment of clinical FMD, vaccine is free from government but the medicine and doctor costs are the cost burden that must be borne by farmers. The costs incurred in efforts to cure and control the spread of FMD are obtained from the number of infected cattles multiplied by the costs incurred for healing and control (Alhaji et al., 2020). By calculation (Chanchaidechachai et al., 2022) and adjusted the field as follows the cost of treatment of clinical FMD = ∑[(Number of beef/cattle that infected FMD x Costs incurred by veterinarians who inject drugs x The number of veterinary visits that occurred during the period of animal sick)+(Number of beef/cattle that infected x Average medical costs incurred for sick animals)].

Meanwhile, to determine the impact felt by farmers, a Wilcoxon test analysis was conducted on their income before and after the FMD (Foot and Mouth Disease) outbreak. The Wilcoxon test is used to assess whether there is a significant difference between two paired or related groups. This test is classified as a non-parametric method, meaning it does not require the data to follow a normal distribution (Ramachandran & Tsokos, 2021). This analysis was conducted on a sample of farmers, assuming the income they should have received before the FMD outbreak and the income they would receive afterward, after deducting the costs for treating and restoring their livestock based on interview data.

Socio Impact

For this research to acquire socio impact of FMD, used descriptive analysis from the questionnaire and deep interview from livestock farmer. The sample size was determined using the Slovin sampling method with a standard error of 0.1, resulting in a total of 96 farmers as the research sample. The following parameters were estimated in order to assess the social impact that arises from preventive measures to animals not affected; treatment details for those that applied treatment; others ways the outbreak or quarantine impact to family; impact on income due to forgone sales (Limon et al., 2020).

Result and Discussion

Epidemiological Characteristic

Based on the data epidemiological, the development of the FMD outbreak in cattle in Probolinggo City reached 884 cases in May-July with the highest number of infected cattle reached 564 cases in July (Figure 1). This number is significantly higher than the cases of FMD reported in China during the period from 2010 to 2022, which only reached 123 cases (Ren, Li, Li, & Qian, 2024). In fact, 884 case of FMD in Probolinggo City only lasted 3 month, the spread was faster than in China. This indicates that FMD is highly contagious in cloven-hoofed animals (Harada, Lekcharoensuk, Furuta, & Taniguchi, 2015). It is also known until July, the total number of beef cattle that died due to FMD until July was 8 head and 3 were forcibly slaughtered during the same period (DKPP, 2022) with the mortality rate reached 1.2% of the total cases during period. However, the mortality rate is comparatively lower than in china, who stated that the overall and calf-specific mortality rates were 2.4% and 9.7% for the crop–livestock mixed system (Ren et al., 2024).

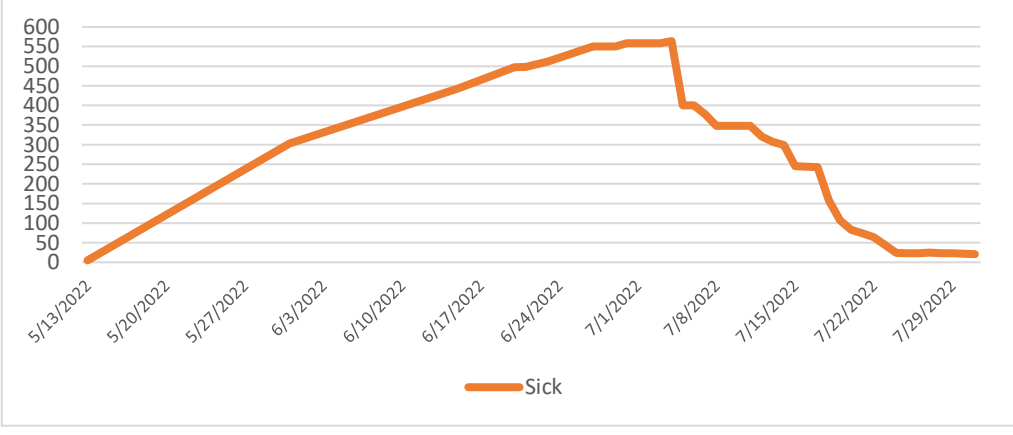

Figure 1. Number of Sick or Infected Livestock from May to June

Source: Food Security, Agriculture, and Fisheries Service of Probolinggo City, 2022

For the areas with the highest number of FMD cases were Wonoasih district compared to other district areas. The most affected area were beef catle farming, whereas dairy cattle farming in Mayangan District is less affected. Dairy cattles are predominantly found in the northern area of Probolinggo City, particularly in the Mayangan district, with only 3 infected dairy cattle reported with the cummulative incidence rate is 1.4% and cummulative mortality 0 percent (Table 2). These finding differs from the research results (Chanchaidechachai et al., 2022) which stated that FMD occurs more frequently in dairy cattle because there are many dairy farms in that research area.Transmission can occur through direct contact with infected animals, semen, food products, aerosols, and fomites. The morbidity rate of this disease is very high, but the mortality rate is low, and it spreads very quickly(Knight-Jones & Rushton, 2013). The low morbidity rate allows new cases to occur on one farm and can spread to other livestock and reach 100% of the existing population(Alexandersen & Donaldson, 2002). From the results of interviews with farmer respondents, it is known that farmers typically own at least 2 to 30 cattle, which causes the transmission of this virus to spread quickly. The impact from beef cattle that infected with

FMD will have impact to business actors who primarily trade in cattle.

District	Number of infected beefs	Cummulative Incidence (%)	Cummulative Mortality (%)	Vaccination practice
Kademangan	172	10.30%	1.74%	5%
Kanigaran	19	4.19%	5.26%	4%
Kedopok	304	8.41%	0.33%	7%
Mayangan	3	1.40%	0.00%	64%
Wonoasih	386	14.85%	1.55%	8%

Table 2. Number of Infected Beef, Cummulative Incidence, Mortality and Vaccinaton Practice of FMD in the Five District Studied

Source: Analysis, 2022

The results of the chi-square Fisher's exact test showed that there was a relationship between the number of animals infected with FMD and the vaccination carried out, with P value < 0.000. When looking at the effect of the vaccine on the incidence of FMD cases, it showed that there was an effect between vaccination and the incidence of FMD, with R2 0.44 and P value < 0.000. This was evidenced by the decrease in the number of animals infected with FMD from July 5 to July 30, 2022, with only 21 sick cattle reported. This reduction in the number of sick cattle aligned with preventive efforts in the form of cattle vaccination, which was conducted by the Department of Agriculture, Food Security, and Fisheries of Probolinggo City from June 27, 2022, to July 6, 2022, and vaccinated a total of 695 cattle. Vaccination in cattle had been proven to prevent and control the spread of the Aphthovirus FMD virus (Lee et al., 2022).

Estimated Total Economic Losses FMD in Probolinggo City

Estimated economic losses resulting from the spread of FMD in Probolinggo City can be calculated by considering the losses incurred from cattle deaths, the reduction in milk productivity of dairy cattles, and the costs associated with controlling the spread of FMD.

- **Estimation of cost of the mortality losses**

The calculation of economic losses from mortality losses, resulting from the spread of FMD to beef cattle in Probolinggo City is based on the number of animals that died or were forcibly slaughtered, without distinguishing between the age or size of the cattle. Additionally, the selling price of cattle was assumed to be the same, based on the selling price of local cattle at the Animal Market at that time. The selling price of local cattle at the animal market is approximately USD 1,026. According to data from the Department of Agriculture, Food Security, and Fisheries, the total number of beef cattle that died due to FMD in Probolinggo City until July was 8 head, while 3 beef cattle were forcibly slaughtered during the same period. With a mortality rate of 1.2% during that period. This figure is still below the findings of Ren et al. (2024), who stated that the overall and calf-specific mortality rates were 2.4% and 9.7% for the crop–livestock mixed system. The estimated losses based on impact on income due to forgone sales at that time amounted to USD 11,286 (Table 3).

Cattle Livestock	Quantity (Heads)	Local Cattle Price (USD)	Amount (USD)
Dead	8	1,026	8,208
Force cut	3		3,078
Total	11		11,286

Table 3. Estimated Cattle Losses in Probolinggo City

1 USD is approximated to 15.592 Rupiah according to average exchange rate in 2022

Source: Analysis Results, 2022

The total loss from beef cattle deaths in Probolinggo City exceeded that reported in the study FMD in Thai that the loss resulting from the death of one cattle was USD 56 (Chanchaidechachai et al., 2022). This disparity occurred because the deceased cattle was dairy cattle and not intended for sale, resulting in a different valuation of the loss. However, to gain an in-depth understanding of the economic impact, a primary survey was conducted through interviews with respondents affected by FMD.

- **Estimation of cost of the morbidity losses**

Based on the results of interviews conducted at dairy farms, it was observed that the average milk production of a local dairy cow decreased from 15 liters per day before the FMD outbreak to 10 liters per day during the outbreak. This indicates that one beef infected with FMD lost 5 liters of milk per day. The duration of infection for each beef was 14 days. From these data, it was found that only three beef were infected. Therefore, the estimated loss from reduced milk productivity was USD 269.37 considering the selling price of milk was USD 0.64 per liter.

- **Cost incurred as an effort to cure and control the spread of FMD**

Based on the interview results with respondents, it was found that during the FMD outbreak, 76% of the farmers stated that their livestock were infected with FMD, with the number of infected cattle reaching 169 heads. It was found the average owner has 5-9 cattles, while for dairy cattle, each owner on average has 2-30 head of cattle. From the number of respondents whose cattle were infected, it can be observed that costs were incurred as an effort to cure and control the spread of FMD. They mentioned that they had to incur additional expenses for the care of their cattle, such as: The cost of making herbal medicine and the cost of administering injectable medication. On the other hand, for the cost of animal feed, they usually find grass on their own, so there are no expenses incurred for animal feed during the FMD period.

According to the interview results, the average cost of making herbal medicine reached USD 16.03 with their average expenditures can be seen in the Table 4. Their expenditures are cost of drug injections, herbal medicine for their cattle (25 or 20 kg turmeric), coconut water, and brown sugar. However, the total medical expenses incurred by farmers can vary, typically ranging from USD 16.03 to 160.33. This amount depends on the number of cattle owned by the farmer and the types of treatments given to care for them.

No.	Medical Costs	Total
1.	Cost of Drug Injections	USD 3.2/cattle
2.	Herbal Medicine Cost (25 or 20 Kg	USD 11.22

	Turmeric)	
3.	Coconut water costs	USD 0.64
4.	Brown sugar cost	USD 0.22/kg

Table 4. The Average Expenditure for the Care of Cattle Livestock.

1 USD is approximated to 15.592 Rupiah according to average exchange rate in 2022

Source: Analysis Results, 2022

Some of the interviews from the respondent can be seen below:

"For me, I spent total of USD 22.44 with USD 16.03 for making herbal medicine and USD 6.41 for the injection costs for my livestock and for feeding my livestock, I gather wild grass." (Male farmer, 50, Sumberwetan District).

"I have 2 cattle. I had to spend a total of USD 19.24 with USD 16.03 for making herbal medicine and IDR USD 6.41 for injection medication costs for my cattle. I made herbal medicine which required 20-25 kg of turmeric and brown sugar. For feeding my livestock, I didn't spend any money at all (Male farmer,37, Jrebeng Kidul District).

"I spent USD 24.37 for medicine cost my livestock for injection and herbal medicine. I also spent money to buy coconut water or vitamin C drinks for my livestock (Female farmer, 38, Pohsangit Kidul District).

From the results of interviews, it is evident that livestock farmer considers cattle to be their most valuable asset, and thus make every effort to facilitate their recovery. Cost incurred as an effort to cure and control the spread of FMD include providing vaccinations, herbal medicine, vitamins, and other health supplements.

The estimated total cost of treatment and control of infected livestock in Probolinggo City can be calculated from the 884 cases that occurred based on data Department of Agriculture, Food Security, and Fisheries of Probolinggo City, with the assumption that the cost of treating one infected cattle is USD 16.03, then the cost of treating the cattle will amount to USD 14,170. Meanwhile, the breakdown of cattle care costs is detailed in Table 5.

Number of Infected Cattle Cases	**Injection Costs**	**Cost of medicines, herbs, etc**	**Total**
884	USD 3.2	USD 12.83	USD 14,170

Table 5. Estimated Medical Costs of Treatment

1 USD is approximated to 15.592 Rupiah according to average exchange rate in 2022

Source: Analysis Results, 2022

For the explanation can be concluded that The total economic losses in a city are the combination of the estimated mortality costs and the estimated expenses for treating and caring for cattle infected with FMD (Foot and Mouth Disease) until they recover. The total losses amount to USD 25,456. The estimated total cost of FMD control that must be incurred in this study differs from

study to study (Chanchaidechachai et al., 2022; Knight-Jones & Rushton, 2013; Rushton et al., 1999). From the overall calculation of economic losses, it was found in this study that beef cattle were more affected than dairy cattle.

In addition to assessing the losses incurred, the Wilcoxon test was conducted to determine whether the FMD (Foot and Mouth Disease) outbreak had a significant impact on farmers. The Wilcoxon test results indicate a decrease in income before and after the FMD outbreak. This is evident from the negative rank with N = 75, representing the number of farmers who experienced a decline in income. Furthermore, the Wilcoxon test results show a p-value of 0.000, which is less than 0.05, confirming that there is a significant difference in farmers' income before and after the FMD outbreak. The negative Z-value (-7.528) suggests that the post-FMD income is generally lower than the pre-FMD income, aligning with the assumption that farmers experienced financial losses due to treatment costs and reduced livestock productivity.

Social Impact of FMD Disease on Livestock Farmers Respondent in Probolinggo City

As for the physical losses experienced by the farmers, these included the physical fatigue often encountered due to the need for constant care of the cattle until they recovered. This care involved feeding cattles that had no appetite, administering vitamins or medicine to infected cattle, monitoring their condition, isolating infected livestock, and maintaining the cleanliness of the barn. Meanwhile, regarding mental losses, interview results revealed that 91 percent of farmers reported experiencing stress or anxiety, while 9% claimed to have been unaffected as their cattle remained healthy.

Out of the 91 percent of farmers who experienced stress, they acknowledged that the impact of has affected their family relationships. Their income has decreased, making it harder to meet daily needs, while expenses have increased, often leading to arguments. This situation has also affected their trust in the livestock groups fostered by the Probolinggo City Government, as they feel that these groups are not functioning properly due to the slow response of the Probolinggo City Government in handling the FMD outbreak through the livestock groups. From the interview results, it was also found that, to meet daily needs during the FMD outbreak, 88% of farmers had additional income from side jobs, while 12% of farmers did not have any additional income. Among the 88% of farmers with side jobs, the most common occupation was farming, while the rest worked as traders, fishermen, construction workers/laborers, designers, casual laborers, pedicab drivers, tailors, corn huskers, drivers, water drillers, and goat herders.

Conclusion

This research has shown that the impact of economic losses caused by Foot and Mouth Disease (FMD) on livestock farmers reached USD 25,456. This loss appears as losses arising from the mortality losses, decreased milk productivity of dairy cattle and cost incurred as an effort to cure and control the spread of FMD. In this research, it was found that beef cattle are more affected than dairy cattle. Then by looking at the effect of vaccine on the incidence of FMD cases, it is also known that the vaccination affects the reduction in the number of livestock affected by FMD. Besides vaccination to control costs, it turns out that farmers also providing herbs and vitamins to restore the cattle's condition. From this research also revealed a decrease in income experienced by farmers due to the FMD outbreak. As social impact can be found that livestock farmer experiences stress or anxiety affect their lives, their income has decreased and their expenses have increased. To cope with reduced income, they must have another job besides farming.

The overall results of this study can be considered by the Government in making policies to control FMD cases and minimize the socio-economic losses experienced by the community.

Acknowledgment

We would like to thank all parties who have assisted in this research, especially the Urban Development Planning Agency (Bappedalitbang Kota Probolinggo); and Food Security, Agriculture and Fisheries Service of Probolinggo City (DKPP).

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