



Economic Losses of Foot-and-Mouth Disease Based on Business Characteristics and Regional Policies in Indonesia and Japan

TRI ANGGRAENI KUSUMASTUTI¹, IKUO KOBAYASHI², AHMAD JUWARI³, LOVIN DIKA ANTARI^{4*}

¹Department of Livestock Social-Economics, Faculty of Animal Science, Universitas Gadjah Mada, Indonesia, 55281; ²Division of Livestock Production Research and Support, Center for Animal Disease Control, University of Miyazaki, Japan; ³Master Student at Leadership and Policy Innovation, Graduate School of Universitas Gadjah Mada, Indonesia, 55281; ⁴Master Student at Animal Science, Universitas Gadjah Mada, Indonesia, 55281.

Abstract | Foot and Mouth Disease (FMD) is a strategic disease in cloven-hoofed animals according to the World Organisation for Animal Health or *Office International Des Epizooties* (OIE). The last case of the spread of FMD in Indonesia occurred in 2022 and Japan in 2010. This research aims to determine the value of economic losses based on the conditions of beef and dairy cattle farms in two regions, namely East Java Province and Miyazaki Prefecture based on the consideration that they are cattle production centers. SWOT analysis is used to support a description of the condition of internal factors (strengths and weaknesses) and external factors (opportunities and threats) of animal husbandry in two countries. Data analysis was carried out descriptively and quantitatively. Primary and secondary data were collected from July to September 2023. The results showed that economic losses due to FMD in cattle in Miyazaki Prefecture amounted to USD 775,184.77/farmer (beef cattle and dairy cattle), higher than losses in East Java province with USD 2,508.27/farmer for dairy cattle and USD 2,747.26/farmer for beef cattle. The high economic losses per farmer in Miyazaki are related to the characteristics of the number of livestock ownership and price of each animal. The results of the SWOT analysis show that the main weaknesses in East Java are limited facilities, budget, and livestock mobility conditions but the support of the central government and human resources supports the success of the FMD handling policy. In Miyazaki, policy support is dominated by facilities, human resources, and a strong budget even though there were problems with time accuracy in the initial case of FMD.

Keywords | SWOT, Economic losses, FMD, Strategic disease

Received | January 18, 2024; **Accepted** | February 11, 2024; **Published** | March 07, 2024

***Correspondence** | Lovin Dika Antari, Master Student at Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta Province, Indonesia; **Email:** lovindikaantari@mail.ugm.ac.id

Citation | Kusumastuti TA, Kobayashi I, Juwari A, Antari LD (2024). Economic losses of foot-and-mouth disease based on business characteristics and regional policies in Indonesia and Japan. *Adv. Anim. Vet. Sci.*, 12(5):862-872.

DOI | <https://dx.doi.org/10.17582/journal.aavs/2024/12.5.862.872>

ISSN (Online) | 2307-8316



Copyright: 2024 by the authors. Licensee ResearchersLinks Ltd, England, UK.

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

INTRODUCTION

Foot and Mouth Disease (FMD) is a virus that infects cloven-hoofed animals, some domesticated ruminants, pigs and also wild animals (Jamal and Belsham, 2013). The rapid spread and impact on livestock health make this disease one of the most avoided diseases in the world. The World Animal Health Organization or *Office International*

des Epizooties (OIE), even placed this disease on the “OIE listed Diseases and Other Diseases of Importance” list, which means that all countries in the world must report its occurrence to the OIE. With the potential for far-reaching impacts on the economy and food security, Alhaji *et al.* (2020) mentions that FMD is a very dangerous disease.

Several countries based on a study conducted by Knight-

Jones and Rushton (2013) have experienced FMD outbreaks and experienced large losses due to deaths and reduced livestock productivity, including Taiwan with losses of up to USD 6.617 billion, Uruguay with USD 0.08 billion, and the UK with USD 92 billion. Apart from that, FMD was also endemic in India in 2012-2013 and 2015-2016. Govindaraj *et al.* (2021) estimated the losses due to FMD in India to be USD 3.2 billion/year during the outbreak.

Meanwhile, Indonesia and Japan, which are island countries in Asia, are also not immune from the spread of the virus. The emergence of the first case in the two countries and the development of the spread have different ranges. Japan's first case was reported in April 2010 in Miyazaki prefecture ten years of its last appearance in 2000. As of July 2010 (the last outbreak), 292 confirmed cases were reported while around 290,000 livestock were culled (Muroga *et al.*, 2012). On February 5 2011 Japan was declared FMD-free. Meanwhile in Indonesia, FMD cases reappeared in May 2022 with O stereotype viruses (Susila *et al.*, 2023). Until now (December 2023), Indonesia is still not free from FMD and has spread to 27 provinces out of a total of 38 provinces. The emergence of cases in 2022 is the first incident since Indonesia received FMD-free status in 1990 from the OIE. Sutawi *et al.* (2023) stated that FMD outbreaks in Indonesia have a negative impact on cattle agribusiness from upstream to downstream, such as the declining cattle population and potentially derailing the beef self-sufficiency target in 2026.

In terms of economic losses due to the FMD outbreak, Hayama *et al.* (2017) calculates the total costs incurred by Japan reached 85 billion yen, consisting of direct losses to the livestock industry of 51.2 billion yen and indirect losses of 25.5 billion yen. Meanwhile, the costs incurred to control the outbreak reached 8.2 billion yen. In Indonesia, in 2015 Sudrajat estimates that potential losses due to the widespread spread of FMD nationally are estimated at 22.59 trillion rupiah or the equivalent of 1.4 billion USD (not including the costs of controlling and eradicating it) (Tawaf, 2018). Futhermore, Sutawi *et al.* (2023) also highlighted the social impact of FMD in Indonesia with

farmers losing their jobs because their livestock died or stopped producing.

On the one side, farm characteristics influence the economic losses of FMD. Based on business scale, Japan has an advanced average business scale with a business model that includes average ownership of 98 dairy cattle and 62 beef cattle (MAFF, 2022). This is in contrast to the relatively small holdings (three cows) which account for 95% of farmers in Indonesia (Tawaf, 2018). Greenwood describes the general conditions of livestock between Japan and Indonesia in Table 1.

In the aspect of handling FMD, speed and accuracy of strategy are crucial in countries affected by the outbreak, including Japan and Indonesia. Even though the mortality rate is low, Knight-Jones and Rushton (2013) noted that FMD causes large losses. According to Seitzinger *et al.* (2022), a strategic response to FMD outbreaks is important to minimize losses.

SWOT analysis based on indicators of strengths, weaknesses, opportunities and threats helps identify the goals and factors, both positive and negative, of an organization (Osita *et al.*, 2014). In practice, the four SWOT elements are a description of two aspects; internal and external. Internal consists of strengths and weaknesses. Strengths indicate excellence, while weaknesses consist of disadvantages within the organization. On the other hand, in the external aspect, opportunities relate to the environment that can be exploited to provide benefits, while threats indicate possibilities in the environment that will cause problems (Teoli *et al.*, 2023). In connection with the handling of FMD in Japan and Indonesia, SWOT analysis was used to look at strengths, weaknesses, opportunities, and threats regarding conditions when the outbreak occurred in Japan in 2010 and in Indonesia in 2022. Similar research using SWOT analysis was also used during the outbreak of African Swine Fever (ASF) in the Philippines by Hsu *et al.* (2023). This research gathered various perspectives on current conditions, diagnosis, and ASF control policies.

Table 1: Comparison of Japanese and indonesian livestock conditions (Greenwood, 2021).

Japan	Indonesia
Average herd size is about 50 head among the 50 thousand or so specialist beef producers, with producer numbers gradually declining	Indonesia has about 17 million head of cattle mainly on smallholder farms which supply about 45% of domestic beef consumption.
There are about 2.5 million head of beef cattle in Japan of which the Wagyu breeds, predominantly Japanese Black, comprise about 1.6 million head and 0.8 million are either F1-Wagyu-cross or Holstein	Javanese producers typically have 2–4 stall-fed cattle on holdings with cropping and live- stock, whereas there are herds of 5–50 or more cattle within more extensive systems in other regions or islands with more plentiful land.
Beef production and consumption in Japan has focused mainly on highly marbled beef	Indonesian smallholder beef production systems provide meat, manure, draught power and financial assets.

In the context of the spread of FMD spreading in Japan and Indonesia, the use of analysis is aimed at looking at the handling strategies of the two countries which then have an impact on losses due to the FMD outbreak. The analysis revealed factors that influenced the success of the policies for handling FMD in both countries. Based on the description above, it can be formulated what problems are strengths, weaknesses, opportunities, and threats in the policies for handling FMD in both countries and the impact of SWOT conditions on economic losses in each country.

MATERIALS AND METHODS

TIME AND PLACE

Research in Indonesia and Japan is conducted from July to September 2023. In Japan, the area that experienced the FMD outbreak was Miyazaki prefecture, while in Indonesia it was carried out in East Java which was the province most affected by FMD.

DATA TYPES AND DATA COLLECTION METHODS

The data collected is in the form of primary data and secondary data. Primary data is data obtained directly by researchers (Ajayi, 2016), while secondary data is data collected by other people (Daas and Tóth-Judit, 2012). Primary data was obtained through interviews with questionnaires on 30 farmers in East Java, Indonesia, while data collection in Miyazaki was carried out through interviews and obtaining data reports from the government. 30 leader farmer's group in Indonesia were selected through purposive sampling in districts in East Java where FMD cases were first discovered, including Lamongan and Gresik districts as beef cattle centers and Malang district as a dairy cattle center. The interviews aim to discover evaluation measurements of the level of satisfaction of farmers by using a Likert scale where according to Joshi *et al.* (2015), this scale is effective for conducting psychometric assessments with a scale of 1 to 5. This scale is to indicate satisfaction with a weight value: Not satisfied (1), Unsatisfied (2), Quite satisfied (3), Satisfied (4), and Very satisfied (5). The indicators assessed by the survey in likert scale are the causes of FMD, efforts to deal with FMD, assessment policies, and the consequences of FMD. The results of Likert scale analysis are used as a basis for identifying SWOT.

Meanwhile, the secondary data of statistics comes from the results of statistical surveys, while non-administrative data is data that is freely accessible (Daas and Tóth-Judit, 2012). Sources of data collected include documents or statistical data, data on conditions during the FMD outbreak obtained from the government as well as research related to the FMD outbreak in Indonesia and Japan since the emergence of cases (Indonesia-April 2022 and Japan-April

2010). Apart from that, this research also uses data website of Records on Epidemic Prevention, Regeneration and Reconstruction of Foot and Mouth Disease that Occurred in Miyazaki Prefecture in 2010 (Miyazaki Prefecture, 2012) from the Livestock Promotion Division, Livestock Bureau, Ministry of Agriculture, Policy and Fisheries.

DATA ANALYSIS

Economic losses due to FMD outbreaks in cattle are measured based on direct losses including loss of milk production, weight loss, and livestock death (Knight-Jones and Rushton, 2013). The formulation for calculating losses for beef and dairy cattle farmers in Indonesia and Japan is calculated using the following formula:

Data analysis for SWOT is analyzed through a 2x2 matrix (Nikolaou *et al.*, 2011) which shows internal and external aspects, in this case, related to policies for handling FMD in Japan and Indonesia as also described by Knierim and Nowicki (2010) in Figure 1. Based on the analysis of these aspects, helps in finding critical factors of an implemented plan (or management strategy/practice) or a future plan (Nikolaou *et al.*, 2011). Internal aspects (strength and weakness) are assessed from an internal assessment of the organization including human resources, facilities, location, products, and services produced, while external aspects (opportunity and threat) are assessed from social, economic, political, developing technological and competitive environment (Dyson, 2004). For specific purposes, the data processed in SWOT analysis can be created specifically by integrating qualitative and quantitative data, from limited, medium, or long-term periods (Knierim and Nowicki, 2010).

Direct losses to beef cattle farmers in Indonesia

A. Loss weight = Percentage of loss weight x average weight cattle in Indonesia x price of live cattle x (average population-average dead animal in a farm)

B. Dead animal = Average of dead animal x average price of live cattle

Total direct losses to beef cattle farmers (A+B)

Direct losses to dairy farmers in Indonesia

C. Loss of milk production = average loss of milk production x average milk price x average population in a farm x average duration of illness due to FMD

D. Dead animal = Average dead calf x price of calf

Total direct losses to dairy cattle farmers

Direct losses to farmers in Japan

E. Loss of beef cattle = average of beef cattle population in a farm x price of beef cattle

F. Loss of dairy = average of dairy population in a farm x price of dairy

Total direct losses of farmers in Japan (E+F)

Several indicators of the strengths and weaknesses of policies for handling FMD in Japan and Indonesia focus on human resources by looking at the conditions and characteristics of farmers, the facilities they own, geographical conditions, and the livestock products produced. Apart from these indicators, other indicators, namely government responsiveness, the role of institutions/communities, and the budget that supports policies for handling FMD are also seen as strengths and weaknesses of the two countries. On the one hand, external aspects, both opportunities and threats, look at several indicators of social, political, and economic conditions, developing technology, and environmental support which have an influence on the success of the FMD policy. These external aspects also include the general characteristics of the spread of the FMD virus which have the potential to be controlled or become a threat in the future.

By collecting and analyzing the above data, this research has the potential limitation of comparing research in Miyazaki in Japan and East Java in Indonesia, which has the characteristics of two different regions with the emergence of FMD cases in different years. This has resulted in diverse data sources from the respective regions. The analysis conducted by the researcher attempts to deepen from these various sources to generate research conclusions. In addition, the selection of two regions in East Java, Indonesia, and Miyazaki, Japan, in general, does not yet reflect the entire nation, especially with the different characteristics of the archipelagic regions in Indonesia and Japan.



Figure 1: SWOT scheme, (Knierim and Nowicki, 2010).

RESULTS AND DISCUSSION

Based on the results of surveys that have been conducted, the direct losses experienced by beef cattle farmers are a decrease in body weight of 24% from the initial weight and death with an average of 1 head per farmer. Losing weight certainly affects selling prices, especially as the majority of livestock farmers in East Java aim to fatten them. The types of cattle developed are Limousin cattle (13.33%) and Simental cattle (86.67%). Meanwhile, the losses experienced by dairy cattle farmers are a decrease in milk production and cow deaths. The average milk production in East Java is 24.06 ± 7.57 liters/head/day and cows experiencing FMD infection experience an average decrease of 18.6 ± 8.55 liters/head/day or the equivalent of $72.71\% \pm 18.20\%$. The average death rate experienced by dairy and beef cattle farmers is 1.33 ± 0.57 head/farmer. Production and economic parameters from the survey results and literature review can be seen in Table 2.

Table 2: Economic and production parameters.

Parameters	Value	Unit	Source
Average population in a farm	6.83±10.32	head/farm	Survey
Percentage of loss weight	24	%	Survey
Average weight cattle in Indonesia	305	Kg/head	(Marino <i>et al.</i> , 2020)
Price of live cattle	50,600	IDR/Kg	(Jawa Pos; Radar Boyolali, 2022)
Average of dead animal	0.50±0.75	head/farm	Survey
Average price of live cattle	20,375,000±11,706,835	IDR/head	Survey
Average loss of milk production	18.6±8.55	liter/head/day	Survey
Average milk price	6,033±351	IDR/liter	Survey
Average duration of illness due to FMD	42.5±20.76	day	Survey
Average dead calf	1.22± 0.44	head/farm	Survey
Price of calf	5,000,000	IDR/head	(Taniku, 2023)
Average of beef cattle population in a farm	62	head/farm	(MAFF, 2021)
Price of beef cattle in Miyazaki	1,200,000	JPY/head	Interview
Average of dairy population in a farm	98	head/farm	(MAFF, 2021)
Price of dairy cattle in Miyazaki	360,292	JPY/head	Based on Hokuren market data for 2021 and 2022 for cows in maturity

Source: Primary and secondary data.

Table 3: Calculation of direct losses for farmers in east Java and Miyazaki.

Description	(Total/outbreak)			
	East Java Indonesia	USD	Miyazaki Japan	USD
Losses of beef cattle farmers				
A. Loss weight	22,223,520	1,433.24		
B. Mortality	20,375,000	1,314.02		
Total direct losses of beef cattle farmers	42,598,520	2,747.26	74,400,000	524,605.56
Losses of dairy cattle farmers				
C. Decreased milk production	33,892,688	2,185.81		
D. Dead calf	5,000,000	322.46		
Total direct losses for dairy cattle farmers	38,892,688	2,508.27	35,308,616	250,579.21
Total direct losses of farmers	81,491,208	5,180.22	109,708,616	775,184.77

Source: Primary and secondary data

The results of the analysis of direct loss calculations for farmers in East Java and Miyazaki can be seen in [Table 3](#).

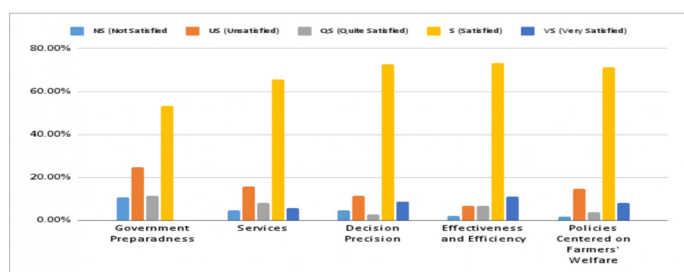


Figure 2: Level of farmer satisfaction with of FMD in East Java per indicator.

Based on evaluation measurements of the level of satisfaction of farmers with the FMD policy in East Java, it shows that farmers are satisfied (73.33%) as seen in [Figure 2](#). The questionnaire measured several indicators of government policy in FMD management including; government preparedness, services, decision precision, policy effectiveness and efficiency, and policies centered on farmers' welfare. The highest aspect is in the decision precision indicator as seen in [Figure 2](#) with 73.33% satisfied and 11.11% very satisfied. Meanwhile, the government preparedness indicator has the lowest percentage with 53%.. Details of the percentage of each question per indicator also can be seen in [Table 4](#).

The results of the SWOT handling analysis are depicted in a 2x2 matrix in both countries for each outbreak in Japan from April 2010 until the end of the emergency in February 2011. Meanwhile in Indonesia, the SWOT analysis looks at the period of handling policies from the start of the case in May 2022 until currently (November 2023). In general, the results of the policy analysis are depicted in the [Table 5](#) and [6](#).

Calculations using economic parameters in both regions show that the direct losses experienced by beef cattle

farmers in East Java averaged IDR 42,598,520,- or USD 2,747.26 and dairy cattle IDR 38,892,688,- or USD 2,508.27, while in Miyazaki the losses per farmer reached JPY 109,708,616 or USD 775,184.77 from beef cattle and dairy cattle. Greater losses among farmers in Miyazaki are correlated with higher average ownership and price per animal in Japan than in Indonesia. Average livestock ownership in Japan is 98 dairy cows and 62 beef cattle ([MAFF, 2022](#)), whereas in Indonesia the average cattle ownership is 1-3 cows which covers 95% of the total livestock farmers ([Tawaf, 2018](#)). On the aspect of cattle prices in each country, the price of dairy cattle in Miyazaki Japan is 360,292 Yen or USD 2,431.95/head and beef cattle is 1,200,000 Yen or USD 8,428.45/head, meanwhile the price of cattle (beef cattle and dairy cattle) in Indonesia is IDR 5,000,000 or USD 1,317.32/head. Based on the external and internal conditions of both countries, the explanation of these conditions is explained in the FMD outbreak in East Java and Miyazaki as follows.

FMD IN EAST JAVA, INDONESIA

The FMD outbreak in East Java was the beginning of cases of the spread of FMD in Indonesia in May 2022 with the discovery of cases in the districts of Sidoarjo, Gresik, Mojokerto, and Lamongan. One month after the outbreak was determined, in June 2022, East Java with 38 districts/cities was designated as a red zone ([Sinar Harapan, 2022](#)). The East Java red zone shows that at least 50% of sub-districts in the province have been infected with FMD.

The massive spread of the FMD virus to all districts/cities in East Java cannot be separated from the geographical conditions of East Java which has an economic density of livestock between districts/cities, including livestock traffic traded between regions. Not to mention that East Java is also a traffic area for exports and imports, namely at Juanda Airport and Tanjung Perak Port. The distribution of livestock is evenly distributed throughout the Regency, there are both beef cattle farms, while the distribution of

Table 4: Satisfaction of farmers in survey.

Questions	Percentage (%)				
	NS	US	QS	S	VS
Government preparedness					
Q1: The government's response was fast in dealing with the FMD outbreak	10	27	10	53	0
Q2: The government is responsive in dealing with the FMD problem, especially since the current FMD outbreak is not the first time	10	23	10	57	0
Q3: The government's SOP (standard operating procedure) for handling the culling of dead cattle due to FMD is clear	10	27	13	50	0
Q4: The government's SOP (standard operating procedure) for handling sick cattle due to the FMD outbreak is clear	13	20	10	57	0
Q5: The government's SOP (standard operating procedure) for implementing forced slaughter of cattle due to the FMD outbreak is clear	10	27	13	50	0
Services					
Q6: Providing veterinary paramedic services for cattle sick due to FMD helps farmers	3.0	20	17	60	0
Q7: The government's outreach regarding FMD is clear in handling and controlling the fmd outbreak	7.0	20	17	57	0
Q8: Veterinary medical personnel from the government are very helpful in handling the FMD outbreak	7.0	20	3.0	70	0
Q9: Providing free vaccination services helps farmers	0	13	7.0	60	20
Q10: Veterinary paramedics can calm farmers' anxiety	7.0	13	13	67	0
Q11: All services provided by the government can be delivered by all farmers equally	7.0	13	0	73	7.0
Q12: In its service the government is neutral (does not pay attention to social status, etc.)					
Decision precision					
Q13: The implementation of a lockdown in the outbreak zone is appropriate to prevent the FMD outbreak from spreading further	7.0	10	7.0	70	7.0
Q14: The implementation of cattle traffic restrictions is appropriate to prevent a more widespread FMD outbreak	7.0	10	3.0	73	7.0
Q15: Mass vaccination is appropriate as an effort to control the FMD outbreak	3.0	10	0	73	13
Q16: The policy to destroy dead cattle due to the FMD outbreak is appropriate	3.0	7.0	0	80	10
Q17: The policy of forcing cattle to be slaughtered due to the FMD outbreak is an effort to control the FMD outbreak	3.0	20	3.0	67	7.0
Effectiveness and efficiency					
Q18: After the cattle vaccine, you were not infected with FMD	3.0	10	3.0	67	17
Q19: After the lockdown zone was implemented, FMD cases in your area began to be controlled	3.0	7.0	10	70	10
Q20: The government involves various stakeholders in dealing with the FMD outbreak so that handling and controlling FMD is faster and more precise	0	3.0	7.0	83	7.0
Policies centered on farmers' welfare					
Q21: The forced slaughter cattle policy due to the FMD outbreak can reduce greater losses for farmers	0	13	3.0	77	7.0
Q22: Subsidies for farmers whose cattle die due to FMD help farmers	0	3.0	0	73	23
Q23: Subsidies for cattle dying due to FMD for both cattle and calves are given the same amount	7.0	30	3.0	30	7.0
Q24: The government has set a time limit for subsidies for compensation for dead cattle	0	27	7.0	67	0
Q25: There is no charge for free veterinary medical personnel from the government, reducing the loss on farmers	3.0	3.0	7.0	80	7.0
Q26: The government's outreach regarding FMD is very helpful in handling and controlling the FMD outbreak	3.0	3.0	3.0	83	7.0
Q27: The policy that cattle infected with FMD may be consumed is the right policy to reduce public anxiety and reduce losses for farmers	0	23	3.0	67	7.0

Source: Primary data.

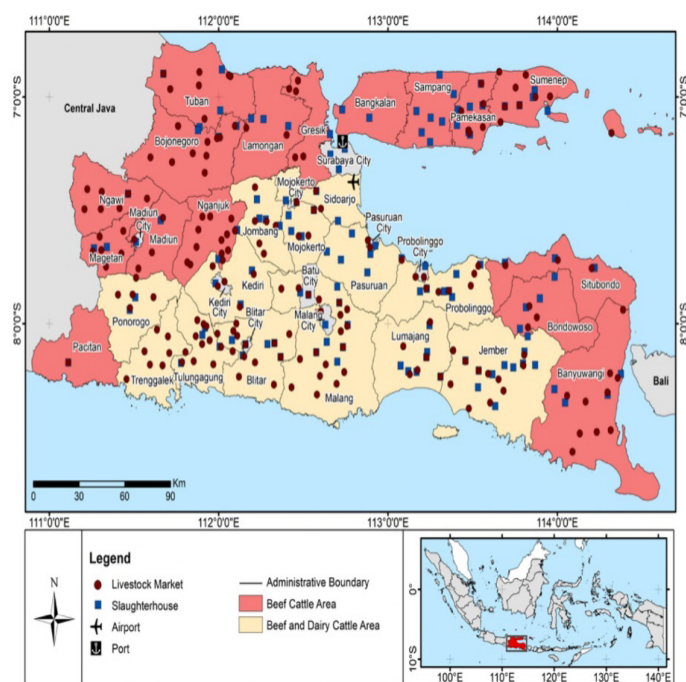


Figure 3: Map of the distribution of animal markets and slaughterhouses in East Java.

dairy cattle is according to the geographical conditions of the district, because dairy cattle have good performance if they are developed in cold areas, they are kept in the mountains or highlands. Apart from the distribution of

cattle, the distribution of slaughterhouses and animal markets can show the distribution of livestock mobility. All Regencies and Cities in East Java have at least one slaughterhouse in one Regency/City. Regencies and cities in East Java also have animal markets except for Bangkalan Regency, Malang City, Surabaya City, Pasuruan Regency, and Sampang Regency. The location of slaughterhouses, distribution of beef cattle and dairy cattle, animal markets, airports, and ports in East Java can be seen in Figure 3.

Another weakness expressed by the East Java Livestock Service is the reluctance of some farmers in East Java to carry out livestock vaccination programs. Even though vaccination achievements in East Java have reached 7,394,614 doses as of September 21, 2023 (contributing to 39 percent of vaccinations nationally) (Kompas, 2023), some farmers are worried that after the injection (vaccination), their livestock will get sick (interview with the East Java Livestock Service, 11 August 2023) and based on survey results in East Java there are 3 out of 30 (10%) farmers who do not vaccinate. These concerns occurred despite the government's socialization of the FMD vaccine. Farmers' concerns occurred because there was no confirmation from veterinary medical personnel about whether or not their animals were fit for vaccination. The existence of cases of refusal to vaccinate cannot be separated from the condition of livestock farming in Indonesia, and

Table 5: Analysis of internal and external conditions of farmers and handling of FMD in East Java, Indonesia.

Strenght	Weakness
<ul style="list-style-type: none"> The largest population in Indonesia with beef cattle: 4.94 million heads and dairy cattle: 301.78 thousand heads in 2021 (Badan Pusat Statistik, 2022). This condition is supported by the results of livestock density analysis which shows that the criteria for economic, farming, area, and population density in East Java Province are moderate, dense, very dense, and sparse (Edi, 2020). Compared to farms outside Java, livestock in East Java are kept in cages, making FMD vaccination easier The involvement of 2,500 officers including veterinarians, animal health paramedics, and army/police elements in the vaccination program Have decision precision in FMD management (survei in Figure 2) 	<ul style="list-style-type: none"> The reluctance of some farmers to vaccinate their livestock Budget limitations at the start of the FMD outbreak in 2022 in East Java Limited FMD virus testing facilities/laboratories Geographical conditions and livestock traffic that allow FMD to spread more easily
Opportunity	Threat
<ul style="list-style-type: none"> There is high support from the central government in efforts to handle the spread of FMD National-regional tiered regulations that provide space for more organized handling of FMD Use of media and information technology to make it easier for the public to understand the FMD virus 	<ul style="list-style-type: none"> Unpredictable emergence of FMD outbreaks. Indonesia obtained FMD-free status from the World Animal Health Organization (OIE) in 1990. When it reappears in 2022, Indonesia, especially stakeholders in East Java, is not prepared enough to face the FMD endemic. Weak management of livestock traffic control and high dependency between regions in Indonesia Government preparedness is not sufficiently prepared according to farmers' perceptions (survey in Figure 3)

Source: Interviews and secondary data.

Table 6: Analysis of internal and external conditions of farmers and handling of FMD in Miyazaki, Japan.

Strenght	Weakness
<ul style="list-style-type: none"> Japan, including Miyazaki, has advanced livestock capacity with a business model that includes an average ownership of 98 heads for dairy cattle and 62 for beef cattle. (MAFF, 2022). These conditions make it easier to organize government policies. Large financial support for handling FMD in Miyazaki with 8.2 billion yen to control the outbreak (Hayama <i>et al.</i>, 2017) Facility support for FMD virus testing. In Japan itself there are a total of 170 Local Livestock Hygiene Service Centers including the one in Miyazaki as well as PCR diagnosis by NIAH (National Institute of Animal Health) in 4 locations in Japan (Takehisa, 2014). Livestock mobility locations that are easy to control with the distribution of slaughterhouses (RPH) and animal markets (Figure 3). 	<ul style="list-style-type: none"> The lack of structured continuing education programmes (Weaver <i>et al.</i>, 2016) The review of existing programmes to assess their objectives, efficiency and cost-effectiveness; periodic audits of activities are recommended (Weaver <i>et al.</i>, 2016) Sanitation of cages and livestock at the farmers level is still low
Opportunity	Threat
<ul style="list-style-type: none"> National institutional structure and central government support, especially in the budgeting aspect with 9 additional budgets for prevention and stabilization of livestock conditions in Miyazaki (Miyazaki Prefecture, 2012). This makes the recovery process for livestock recovery in Miyazaki faster. Strict guidelines and regulations from the national government in eradicating the virus (Muroga <i>et al.</i>, 2012) 	<ul style="list-style-type: none"> Detection of the FMD virus by the government was considered late in March-April 2010 (Muroga <i>et al.</i>, 2012) The emergence of an unpredictable and highly contagious FMD outbreak in East Asia in 2010 (Hong Kong, Korea and Mongolia) (Muroga <i>et al.</i>, 2012)

Source: Secondary data.

East Java in particular, which has a traditional model of community farming. Apart from that, the budget during an outbreak is also a weakness when handling FMD in 2022. The East Java Livestock Service, which has duties and functions including controlling livestock diseases, does not have a special budget for handling FMD. At the provincial level, budgeting during an outbreak of FMD comes from BTT (Unexpected Costs) from the Regional Disaster Management Agency (BPBD) which has a limited allocation, even though handling FMD requires large costs (Badan Penelitian dan Pengembangan Provinsi Jawa Timur, 2022). Funds for handling FMD from the East Java Livestock Service will be available at least in August/September (3 months after the outbreak) to provide medicines for affected livestock.

On the other hand, external aspects in the form of support from the central government are the driving force for handling FMD in East Java. The central government has a dominant role, including providing vaccines to inhibit the spread of FMD in East Java. Even when the first case was discovered, the Ministry of Agriculture in Jakarta had the authority to designate the area in East Java as an Extraordinary Event which had broad implications for implementing a lockdown and limiting livestock traffic. Apart from that, the regulations issued by the government have clear levels between the central and local governments in the form of laws, government regulations, circulars from the FMD handling task force, regulations of the minister of agriculture, decisions of the minister of agriculture, and regulations issued by the ministry of home affairs and

regional governments. One example of a regulation relating to regional authority in handling FMD was issued by the Ministry of Home Affairs in the form of Instruction of the Minister of Home Affairs Number 32 of 2022 concerning Handling of Foot and Mouth Disease. Some of the points of instruction include the formation of a task force and organizing the handling of FMD down to the smallest level in the community, namely the Rukun Warga/Rukun Tetangga, and collecting data on the spread of FMD in an Integrated National Animal Health Information System (iSIKHNAS) (Instruksi Menteri Dalam Negeri Nomor 32 Tahun 2022 Tentang Penanganan Penyakit Mulut Dan Kuku, 2022). Apart from the support from the central government, the FMD virus, which is known to be easily contagious, has become a threat to handling FMD policies, especially when it first spread in East Java. The spread of FMD infection is the first since Indonesia received FMD-free status in 1990. With such a massive spread and minimal experience in handling FMD disease, it becomes a policy obstacle to face the FMD endemic better preparedness. A summary of the internal and external conditions of FMD handling (SWOT) in East Java is shown in Table 5.

FMD IN MIYAZAKI, JAPAN

The FMD policy in Miyazaki tends to be implemented well with an advanced livestock structure. After the case was discovered in April 2010, the government implemented strict biosecurity standards which had to be implemented on every farm, including disinfecting incoming vehicles, limiting human traffic entering the farm, and recording details of those who were allowed to enter the farm. In

terms of compliance with livestock standards set by the government, livestock in Japan, including Miyazaki prefecture, is considered very high with an average of above 90% (Takehisa, 2014). The existence of a slaughterhouse and livestock market in Miyazaki also shows that livestock mobility is relatively less dense when compared to conditions in slaughterhouses and animal markets in East Java, Indonesia. The distribution of cattle farms in Miyazaki is in Takachiho-Town, Ebino City, Takaharu-Town, Kobayashi City, Miyakonojo City, Kushima City, Saito City, Kijo Town, Misato-Town, Nobeoka City, Miyazaki City, Aya-Town, Kunitomi-Town, Takanabe-Town, Shintomi-Town, Kawaminami-Town, Tsuno-Town, Nichinan City, Mimata-Town, Kadokawa-Town, Morotsuka-Village, Shiiba-Village, Gokase-Town, Hinokage-Town and Hyuga City. For the distribution of slaughterhouses, there is only one in Miyazaki, namely Miyachiku Corp., Ltd Tsuno Plant in Kawakita, Tsuno-Town, Koyu-District, Miyazaki. Meanwhile, the distribution of animal markets are in the Nobeoka livestock market, Takachiho district livestock market, Koyu regional livestock market, Kobayashi regional livestock market, Miyazaki central agricultural cooperative livestock market, two livestock market in Miyakonojo, and Minami Naka regional livestock market. Details of the distribution points for cattle farms, slaughterhouses, and animal markets can be seen in Figure 4. The red coloured area shows the wagyu and dairy cattle area in Miyazaki according to the Miyazaki Prefecture.

The advanced livestock conditions above are also supported by aspects of financial capability and the availability of adequate FMD testing. A total of 167 Local Livestock Hygiene Service Centers are available at the prefectural level, while testing and diagnosis of FMD is carried out by NIAH (National Institute of Animal Health) which is located in 3 locations in Japan.

During the endemic in 2010 and during the outbreak, there were at least 3 important parties in handling FMD, including in Miyazaki; (1) Ministry of Agriculture, Forestry and Fisheries (MAFF) which provides basic policies and instructions as well as control measures for FMD. MAFF collaborates with the prefectural government, NIAH, and related organizations, (2) The prefectural government, has the role of developing veterinary service centers (Livestock Hygiene Service Centers) as the front guard in controlling FMD. This prefectural veterinary service center also receives training organized by MAFF, (3) National and local livestock industry associations for FMD control (such as Livestock and Livestock Products Hygiene Guidance Associations) whose role is to encourage farmers to vaccinate and disinfect FMD (Kumagai, 2018).

The three parties work together to take steps both for prevention and when cases are discovered. When prevention

is taking place, several steps to prepare for an outbreak are carried out by making instructions, recommendations, and orders to ensure appropriate biosecurity standards on farms as well as preparing burial sites for livestock due to culling. Restrictions on entry and exit of livestock/products are also carried out through animal quarantine by MAFF through interviews, inspections, and disinfection of items brought. Prevention is also carried out by tightening livestock biosecurity by encouraging compliance with bio-security standards, installing disinfection equipment, securing land locations for burial and infected material, as well as reporting the implementation of bio-security (Kumagai, 2018). These strictures are also followed by standards when cases of FMD are discovered on farms.

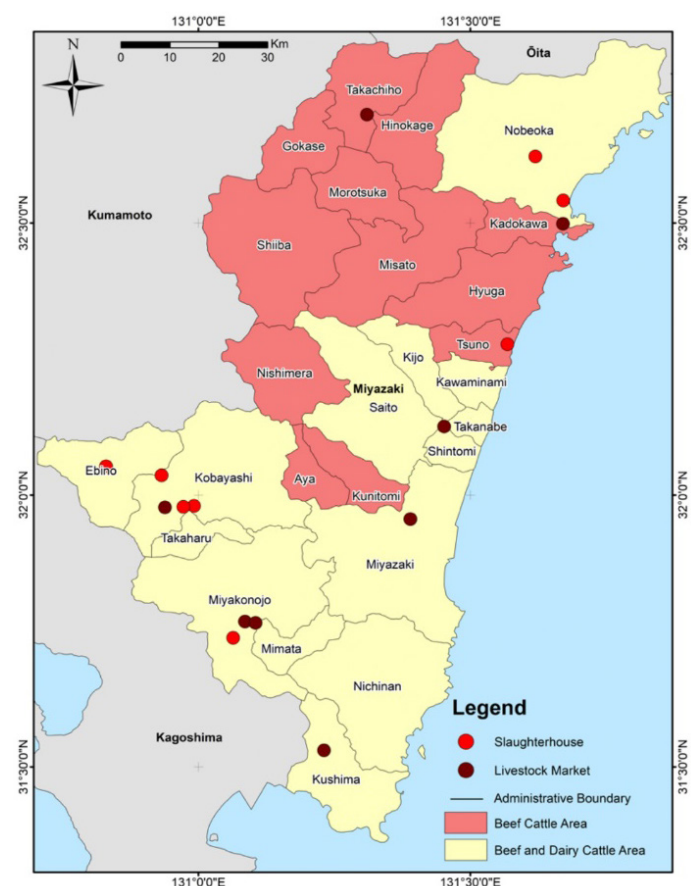


Figure 4: Map of the distribution of animal markets and slaughterhouse in Miyazaki.

Apart from the strength aspects above, the handling of FMD in Miyazaki, Japan is also not free from limitations and threats, especially during the initial detection of cases in April 2010. Samples taken from buffalo via RT-PCR testing on March 31 were confirmed to be infected with FMD. However, the first case in Miyazaki was determined on April 20, 2010. Furthermore, from the estimated date of appearance of clinical signs, FMD infection had already occurred in at least 10 farms on April 20, 2010 (Muroga *et al.*, 2012). Delays in detection became an obstacle to taking strategic steps at the start of the outbreak in Miyazaki. The

impact of this delay is the risk of not recording the spread of a virus which is known to spread quickly. Apart from the late detection, the Performance Veterinary Service (PVS) Evaluation Report by the OIE shows that there are weaknesses in the sustainability of the education program and a lack of depth in analyzing the efficiency and cost-effectiveness of the program, including in controlling animal diseases in Japan (Weaver *et al.*, 2016). A summary of the internal and external conditions of FMD handling (SWOT) in Miyazaki is shown in Table 6.

CONCLUSIONS AND RECOMMENDATIONS

Foot and Mouth Disease (FMD) which spread in Indonesia in 2022 and Japan in 2010 resulted in economic losses during outbreaks. Research shows that In East Java, the average farmer loss was USD 2,508.27/farmer for dairy cattle and USD 2,747.26/farmer for beef cattle, while Miyazaki was greater at USD 775,184.77 per farmer (dairy and beef cattle). The high losses per farmer in Miyazaki illustrate the characteristics of the condition of the average number of livestock and price in Miyazaki which is greater than in East Java. Besides that, both countries also have characteristic internal and external conditions. East Java Province, has the strength of better livestock conditions than other regions outside Java with a more organized system. In the 2022 endemic, there will be 2,500 officers from various elements working together to vaccinate livestock as an effort to handle FMD in East Java, although at the weaknesses in handling, there are factors such as limited facilities, budget, and livestock mobility conditions that widen the spread of FMD in Java East. Meanwhile, the handling of FMD policies in Miyazaki has facilities, budget support, and relatively good business model livestock management, even though during the 2010 endemic, there were problems with the accuracy of early detection of FMD. In addition, both regions have clear central and regional governance support/relationships in the division of authority between the central and regional governments for handling FMD. On the one hand, the threat of both regions as cattle farming areas in both countries remains relatively high considering the unpredictable emergence of FMD and the nature of it is easy to spread. With the internal and external conditions of both countries, an effective FMD management policy depends on how both countries manage the environment to bring impact in reducing losses due to FMD. Future research specific to the dominant aspects of strength, weakness, opportunity, as well as threat is needed to provide a more comprehensive policy view on FMD handling in Japan and Indonesia.

ACKNOWLEDGEMENT

This research is funded by Grants for Japan-Related Research Projects, Sumitomo Foundation 2023

NOVELTY STATEMENT

The novelty of this research is on the comparison of the two countries between Japan and Indonesia that have never been compared by researchers, especially the characteristics and policies of the both countries in dealing with the FMD virus. In addition, the analysis was carried out by calculating the direct losses of FMD outbreaks in Japan and Indonesia and also SWOT analysis to explore the strengths and weaknesses of the two countries both internally and externally.

AUTHOR'S CONTRIBUTION

TAK: contributed to designing, drafting, analyzing, and wrote the article. IK: contributed to reviewing and analyzing the article. AJ: contributed to drafting, analyzing, and reviewing the article. LDA: contributed to drafting, collecting data, and wrote the article. All authors accepted for the final manuscript.

CONFLICT OF INTEREST

The authors have declared no conflicts of interest.

REFERENCES

- Ajayi VO (2016). Primary sources of data and secondary sources of data.
- Alhaji NB, Amin J, Aliyu MB, Mohammad B, Babalobi OO, Wungak Y, Odetokun IA (2020). Economic impact assessment of foot-and-mouth disease burden and control in pastoral local dairy cattle production systems in Northern Nigeria: A cross-sectional survey. *Prevent. Vet. Med.*, 177(March): 104974. <https://doi.org/10.1016/j.prevetmed.2020.104974>
- Badan Penelitian dan Pengembangan Provinsi Jawa Timur (2022). Policy Brief; Langkah Strategis Penanganan Masalah PMK (Penyakit Mulut dan Kuku) pada Hewan Ternak. https://brida.jatimprov.go.id/frontend/web/data_litbang/PBMEI_2022_compressed.pdf.
- Badan Pusat Statistik (2022). Peternakan dalam Angka 2022; Populasi Sapi dan Kerbau. <https://www.bps.go.id/id>
- Daas P, Tóth-Judit A (2012). Secondary data collection. In *statistics Netherlands*.
- Dyson RG (2004). Strategic Development and SWOT Analysis at the University of Warwick. *Eur. J. Operat. Res.*, 152(3): 631–640. [https://doi.org/10.1016/S0377-2217\(03\)00062-6](https://doi.org/10.1016/S0377-2217(03)00062-6)
- Edi DN (2020). Analisis Potensi Wilayah untuk Pengembangan Komoditas Ternak Ruminanisa di Provinsi Jawa Timur. *Briliant: J. Riset Dan Konseptual*, 5(3): 562. <https://doi.org/10.28926/briliant.v5i3.473>
- Govindaraj BGK, Hegde AKR, Kumar N, Prabhakaran K,

- Wadhwan VM, Kakker N, Lokhande T, Sharma K, Kanani A, Limaye KN, Pn A, De AK, Khan TA, Misri J, Dash BB, Pattnaik B, Habibur R (2021). Foot and mouth disease (FMD) incidence in cattle and buffaloes and its associated farm-level economic costs in endemic India. *Prevent. Vet. Med.*, 190(January): 105318. <https://doi.org/10.1016/j.prevetmed.2021.105318>
- Greenwood PL (2021). Review: An overview of beef production from pasture and feedlot globally, as demand for beef and the need for sustainable practices increase. *Animal*, 15. <https://doi.org/10.1016/j.animal.2021.100295>
- Hayama Y, Osada Y, Oushiki D, Tsutsui T (2017). An economic assessment of foot and mouth disease in Japan. *OIE Revue Sci. Tech.*, 36(1): 207–215. <https://doi.org/10.20506/rst.36.1.2622>
- Hsu CH, Schambow R, Montenegro M, Miclat-Sonaco R, Perez A (2023). Factors affecting the spread, diagnosis, and control of african swine fever in the Philippines. *Pathogens*, 12(8): 1–14. <https://doi.org/10.3390/pathogens12081068>
- Instruksi Menteri Dalam Negeri Nomor 32 Tahun 2022 tentang Penanganan Penyakit Mulut dan Kuku (2022). (testimony of Kementerian Dalam Negeri).
- Jamal SM, Belsham GJ (2013). Foot and mouth disease: Past, present, and future. *Vet. Res.*, <https://doi.org/10.1186/1297-9716-44-116>
- Jawa P, Radar B (2022). Kena PMK , Perawatan Sapi Habiskan Biaya Hingga Rp500 Ribu per Ekor.
- Joshi A, Kale S, Chandel S, Pal D (2015). Likert scale: Explored and explained. *Br. J. Appl. Sci. Technol.*, 7(4): 396–403. <https://doi.org/10.9734/BJAST/2015/14975>
- Knierim A, Nowicki P (2010). SWOT analysis: Appraisal of a new tool in european rural development policies. *Outlook Agric.*, 39(1): 65–72. <https://doi.org/10.5367/000000010791169970>
- Knight-Jones TJD, Rushton J (2013). The economic impacts of foot and mouth disease - What are they, how big are they and where do they occur? *Prevent. Vet. Med.*, 112(3–4): 161–173. <https://doi.org/10.1016/j.prevetmed.2013.07.013>
- Kompas (2023). Upaya Jatim Menjadi Benteng Pangan Nasional. <https://www.kompas.id/baca/nusantara/2023/10/11/upaya-jatim-menjadi-benteng-pangan-nasional>
- Kumagai N (2018). Japan Animal Health System (Issue May). https://www.eu-japan.eu/sites/default/files/imce/session_1_dr_kumagai_japans_animal_health_system_for_website.pdf
- MAFF (2021). Outline of Japan's Food and Agriculture, Forestry and Fisheries Industry.
- MAFF (2022). Statistics on livestock by the Statistics Department of MAFF.
- Marino FA, Lomboan A, Pudjihastuti E, Sondakh EHB (2020). Berat potong, berat karkas dan persentase karkas ternak sapi potong lokal yang dipotong di rumah potong hewan manado. *Zootec*, 40(1): 191. <https://doi.org/10.35792/zot.40.1.2020.26952>
- Miyazaki Prefecture (2012). Records of epidemic prevention, regeneration, and reconstruction regarding foot and mouth disease that occurred in Miyazaki Prefecture in 2010 [in Japanese]. <https://www.pref.miyazaki.lg.jp/shinsei-chikusan/shigoto/chikusangyo/page00053.html>
- Muroga N, Hayama Y, Yamamoto T, Kurogi A, Tsuda T, Tsutsui T (2012). The 2010 foot and mouth disease epidemic in Japan. *J. Vet. Med. Sci.*, 74(4): 399–404. <https://doi.org/10.1292/jvms.11-0271>
- Nikolaou EI, Ierapetritis D, Tsagarakis KP (2011). An evaluation of the prospects of green entrepreneurship development using a SWOT analysis. *Int. J. Sustain. Dev. World Ecol.*, 18(1): 1–16. <https://doi.org/10.1080/13504509.2011.543565>
- Osita I, Onyebuchi I, Nzekwe J (2014). Organization's stability and productivity: The role of SWOT analysis an acronym for strength, weakness, opportunities, and threat. *Int. J. Innov. Appl. Res.*, 2(9): 23–32.
- Seitzinger AH, Hafi A, Addai D, Garner G, Bradhurst R, Breed AC, Capon T, Miller C, Pinol J, Tapsuwan S (2022). The economic benefits of targeted response strategies against foot-and-mouth disease in Australia. *Prevent. Vet. Med.*, 204(March): 105636. <https://doi.org/10.1016/j.prevetmed.2022.105636>
- Sinar Harapan (2022). Jawa Timur Zona Merah PMK, Kasusnya Mencapai 100.492 Ekor Ternak. <https://www.sinarharapan.co/umum/pr-3853746368/jawa-timur-zona-merah-pmk-kasusnya-mencapai-100492-ekor-ternak>
- Susila EB, Daulay RSD, Hidayati DN, Prasetyowati SRB, Wringinati, AE, Irianingsih SH, Dibia IN, Faisal SA, Yupiana Y, Hidayat MM, Zainuddin N, Wibawa H (2023). Detection and identification of foot-and-mouth disease O/ME-SA/Ind-2001 virus lineage, Indonesia, 2022. *J. Appl. Anim. Res.*, 51(1): 487–494. <https://doi.org/10.1080/09712119.2023.2229414>
- Sutawi WA, Malik A, Suyatno HA, Rahayu ID, Hartatie ES (2023). Re-emergence of foot and mouth disease outbreak in Indonesia: Review. *Adv. Anim. Vet. Sci.*, 11(2): 264–271. <https://doi.org/10.17582/journal.aavs/2023/11.2.264.271>
- Takehisa T (2014). FMD status and control strategy in Japan (Issue November). <https://www.maff.go.jp/j/syouan/douei/pdf/japan.pdf>
- Taniku (2023). Harga Sapi hari ini Tanggal 06 Juli 2023. <https://taniku.kulonprogokab.go.id/siganak/sapi>
- Tawaf R (2018). Dampak sosial ekonomi epidemi penyakit mulut dan kuku terhadap pembangunan peternakan di Indonesia. *Prosiding Seminar Nasional Agroinovasi Spesifik Lokasi Untuk Ketahanan Pangan Pada Era Masyarakat Ekonomi ASEAN*, 2: 1535–1547. <http://repository.pertanian.go.id/handle/123456789/7343>
- Teoli D, Sanvictores T, An J (2023). SWOT analysis. *National Library of Medicine*. <https://www.ncbi.nlm.nih.gov/books/NBK537302/>
- Weaver J, Punderson J, Stratton J (2016). PVS evaluation report (Issue October). <https://doi.org/https://www.woah.org/app/uploads/2021/03/20180727-final-oie-japan-pvs-report.pdf>