



# Re-Emergence of Foot and Mouth Disease Outbreak in Indonesia: A Review

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**Abstract** | The foot and mouth disease (FMD) outbreak has again infected hundreds of thousands of livestock in Indonesia after being declared FMD-free for 32 years since 1990. As of November 18, 2022, FMD is still spreading in 17 provinces in 146 regencies/cities with the the number of infected cows 578.060 heads, recovered 508.494 heads, conditionally cut 13.177 heads, died 10.269 heads, and vaccinated 5.847.113 heads. This article is carried out using literature study and secondary data exploration methods. There are three factors that can be attributed to the re-emergence of FMD outbreaks in Indonesia. First, the loss of the principle of maximum security. Indonesia's success in freeing itself from FMD after 100 years is thanks to the implementation of maximum security policy by enacting a country-based system, which is to only import livestock and livestock products into the country from FMD-free countries. Second, the share of imports of boneless frozen beef/buffalo meat originating from India continued to increase from 33.8% in 2016 to 51.9% in 2020. Third, economic bioterrorism, an act of terror using biological agents that infects Indonesia's cattle farming agribusiness. FMD outbreaks have a negative impact on cattle agribusiness from upstream to downstream: (1) the cattle population will shrink, (2) imports of cattle and beef will increase, (3) beef consumption will decrease, (4) economic losses are very large. FMD also poses a heavy social impact for farmers such as illness, stress, depression, stroke, divorce, and even suicide.

**Keywords** | Airborne disease, Cattle agribusiness, Economic bioterrorism, Economic losses, Foot and mouth disease

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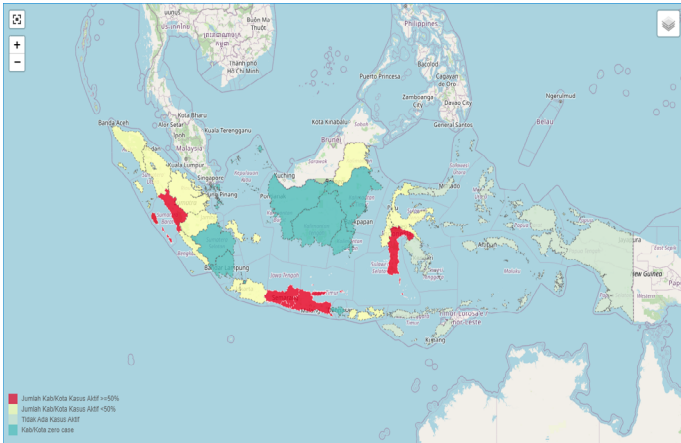
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## INTRODUCTION

The foot and mouth disease (FMD) outbreak has again infected hundreds of thousands of livestock in Indonesia after being declared FMD-free for 32 years since 1990. On April 28, 2022, the first case of FMD was identified in 402 beef cattle spread over 5 sub-districts and 22 villages in the Gresik Regency, East Java Province, which takes in the northern and western suburbs of Surabaya. A second case was reported on Sunday, May 1 in Lamongan

Regency, East Java Province, west of Surabaya involving 102 beef cattle spread over 3 sub-districts and 6 villages and 595 beef cattle, dairy cattle and buffalo spread over 11 sub-districts and 14 villages in the Sidoarjo Regency south of the city. The third case was reported earlier this week on Tuesday, May 3 in the Mojokerto Regency, East Java Province, to the south west of Surabaya and involved as many as 148 beef cattle spread over 9 sub-districts and 19 villages. Cases of FMD were also reported on May 11 in Aceh Tamiang Regency, Aceh province. The

FMD outbreak then spread to most of the archipelago in Indonesia. On August 17, 2022, FMD has spread in 19 provinces in 207 regencies/cities with the number of infected cows 492,894 heads, recovered 334,838 heads, conditionally cut 10.037 heads, died 6.435 heads, and vaccinated 1.529.343 heads. As of November 18, 2022, FMD is still spreading in 17 provinces in 146 regencies/cities with the the number of infected cows 578.060 heads, recovered 508.494 heads, conditionally cut 13.177 heads, died 10.269 heads, and vaccinated 5.847.113 heads (Figure 1) (DGLAHS, 2022).



**Figure 1:** Spread of FMD outbreak in Indonesia on November 18, 2022.

**Source:** DGLAHS (2022).

The history of FMD in Indonesia is reported to have first occurred in Malang Regency, East Java Province, in 1887 due to cattle imports from the Netherlands. FMD became endemic in East Java and spread throughout Java and other islands including Sumatra in 1892, Madura in 1906 and 1913, Kalimantan in 1906, Sulawesi in 1902, West Nusa Tenggara in 1911, and Bali in 1962 (Soehadji et al., 1994). Through a series of massive and sustainable policies and actions for a century, Indonesia succeeded in declaring FMD-free status in 1986 through the Decree of the Minister of Agriculture No. 260/1986. Indonesia gained world recognition of FMD-free status in the Resolution of the World Organization for Animal Health (WOAH), founded as Office International des Epizooties (OIE), No. XI of 1990. Indonesia's economic losses in handling FMD for 100 years (1887–1986) reached USD 1.66 billion (IDR 29 trillion) (Khudori, 2022). In 2013 Indonesia established FMD as a strategic infectious animal disease (Penyakit Hewan Menular Strategis, PHMS) that must be watched out for and prevented. Indonesia was declared FMD-free without a vaccination program with OIE Resolution No. XV of 2019. Indonesia and the Philippines are two of the 10 countries in the Southeast Asian (SEA) region that have been declared FMD-free by IOE. FMD is endemic in the majority of SEA and remains a major animal health problem within the region (Rweyemamu et al., 2008).

## FOOT AND MOUTH DISEASE OUTBREAK

FMD is an acute animal disease caused by a virus with the genus Aphtho virus of the family Picornaviridae (MacLachlan and Dubovi, 2017). FMD viruses consist of seven serotypes that immunologically differ from each other, namely: O, A, C, Asia 1, SAT-1, SAT-2 and SAT-3 (Naipospos and Suseno, 2017). Each serotype has a spectrum of antigenically different subtypes due to a high rate of mutations. FMD is a rapidly contagious animal disease affecting cloven hooves, such as cows, buffaloes, sheep, goats, pigs, deer, camels and elephants. Clinical signs of FMD include high fever, excessive mucus from the mouth and foaming, sores in the oral cavity and tongue, loss of appetite, limpness, injuries to the feet and ending with the loss of hooves, difficulty standing, shivering, quickness of breath and milk production dropping dramatically and becoming thin (Adjid, 2020; Sudarsono, 2022). The WOAHA lists FMD as the most dangerous animal disease on list A, but it is not zoonotic (not contagious to humans). The incubation period is 2-14 days. Morbidity can reach 100% in susceptible populations, while mortality is generally low (1-5%) in adult animals, but higher (20% or higher) in young calves, lambs and piglets (WOAH, 2022).

FMD is a highly infectious disease of cloven-hoofed animals, which can be transmitted by direct contact, fomites or through the air (Schley et al., 2009). FMD is also known as airborne disease, a disease that spreads through the air. Airborne transmissions have been recorded up to 50 km overland (Gloster et al., 2005) and over 200 km over water (Gloster and Burgin, 2007). Consequently, it is very important in the control of any outbreak to be able speedily both accurately and identify livestock that are at risk for airborne virus. FMD transmission takes place through direct or indirect contact with a transmission rate of 90-100% and very high economic losses (Nason, 2022). Transmission of FMD from sick animals to other animals occurs due to direct contact with sick animals, contact with secretions and materials contaminated with FMD virus, as well as carrier animals. FMD transmission can also occur due to contact with materials/tools contaminated with FMD virus, such as officers, vehicles, animal feed, livestock products in the form of milk, meat, offal, bones, blood, semen, embryos, and feces from sick animals.

The spread of FMD between farms or between regions/countries generally occurs through the movement or transportation of infected livestock, products of infected livestock origin and carrier animals. Livestock movement and trade in livestock products are the greatest risk factor in the transboundary spread of FMD in SEA involving complex and rapidly changing market chains linking producers to consumers (Blacksell et al., 2019). The outbreak in Malaysia shows that the main factor in the outbreak is the movement of animals, which is 66% of the

outbreaks that occur (Ramanoon et al., 2013). The spread of airborne disease through the air tends to be difficult to control, so handling it requires speed and accuracy in acting. For cases in Indonesia, after 2 weeks the number of infected villages will increase from initially only 1 village to 14 villages; if the action is late then in 4 weeks the number of infected villages rises to 84 villages; after more than 8 weeks it became more than 500 villages (Naipospos, 2014).

**FACTORS AND IMPACTS OF FMD OUTBREAK**  
**THREE FACTOR OF FMD**

There are three factors that can be attributed to the re-emergence of FMD outbreaks in Indonesia. First, the loss of the principle of maximum security. Indonesia's success in freeing itself from FMD after 100 years is thanks to the implementation of maximum security policy by enacting a country-based system, which is to only import livestock and livestock products into the country from FMD-free countries (Sudardjat, 2010). This country-based policy was then changed to zone based according to Law No. 18 of 2009 and its amendments, namely Law No. 41 of 2014 concerning Livestock and Animal Health. Through this zone-based policy, it is possible to import livestock products from a region or province in a country that has FMD-free zone, even though the status of the country has not been declared free. The goal of this policy is to expand the source of supply of cattle/buffalo and its products, so that it does not depend on Australia and the United States. The change in the law that turns country-based into zone-based from the principle of maximum security to minimum security is very dangerous both economical, healthily, and politically. The policy has a direct impact on the sustainability of human life, animal husbandry and overall animal health in Indonesia. This policy increases the risk that Indonesian-imported meat comes from non-FMD-free zones and is labeled in the FMD-free zone. In international trade, Indonesia has the potential to lose its status as an FMD-free country.

Second, imports of beef/buffalo meat from India. Indonesia needs about 700 thousand tons of meat (equivalent to 4 million heads of cattle) annually to meet the consumption needs of its 273 million-population. Domestic beef production is able to meet only about 500 thousand tons (equivalent to 3 million heads of cattle), so that 200 thousand tons (equivalent to 1 million heads of cattle) the shortage must be met from imports of cattle and beef. India, a country that has not been declared free of FMD disease, is one of the main countries of origin of imported Indonesian beef. FMD is endemic in India and the most frequently appearing serotypes are serotypes A, O and Asia 1 (Nagendrakumar et al., 2009; Madhanmohan et al., 2014). The share of imports of boneless frozen beef/buffalo meat originating from India continued to increase during 2016-2020. In 2016 the share of frozen

beef imports from India amounted to 33.8% of the total beef imports of 116,761 tons and continued to increase until it reached 51.9% of the total beef imports of 170,305 tons in 2020 (Table 1). Indonesia first imported buffalo meat from India in 2016. At that time, the consideration was the cheaper price of meat and to stabilize the price of meat in the domestic market. It is strongly suspected that the entry of FMD virus into Indonesia is the import of meat from India because the FMD virus strain found is the same as the virus strain in India, namely serotype O. In 2020 Indonesia also imported 30,000 tons of beef from Brazil. For the past 16 years no cases of FMD have been reported in Brazil. The FMD outbreak in Brazil was first reported in 1895 in the state of Minas Gerais and the last outbreak occurred in 2006 in the state of Mato Grosso do Sul. In Brazil, based on the official status of the World Animal Health Organization (OIE) there is a FMD-free zone with no vaccination practices in Santa Catarina State, while the State of Rio Grande do Sul in the southern region is a FMD-free zone with vaccines.

**Table 1: Indonesian boneless frozen beef imports, 2016-2020.**

Exporter	Value (US\$ 000)		Share (%)	
	2016	2020	2016	2020
India	141,463	263,560	33.8	51.9
Australia	210,561	155,963	50.3	30.7
USA	17,821	50,412	4.26	9.93

Source: MoA (2021).

Third, economic bioterrorism. Economic bioterrorism is an act of terror using biological agents that attacks a sector of the economy. FMD in Indonesia is not simply seen as a disease that infects cloven-hoofed animals, but it can also be suspected of being an act of economic bioterrorism. Bioterrorism in livestock is very effective for mass killing with huge socioeconomic losses. Economic losses are mainly due to a decrease in milk yield (25% per annum), beef cattle production (10-20%), labor uptake (60-70%), cow fertility (10%), a decrease in the level of pregnancy and an increase in calf mortality (20-40%), as well as from the culling of infected livestock. In addition to having a direct impact on livestock business activities (71%), FMD also has a participating impact on various sectors such as the hotel and restaurant business (52%), agriculture (58%), trade (47%), manufacturing industry (42%), transportation (42%), services and services (55%), financial business (23%) and construction (49%) (Susanti, 2022). In Indonesia, it has never been officially reported that there has been a form of bioterrorism (Astuti et al., 2021). However, in addition to FMD, there are several cases of the virus that occur in Indonesia that are suspected of being a form of bioterrorism attacks. In 2003-2004 Indonesia experienced an outbreak of avian influenza (AI) which caused 9.4



million chickens to die with a total loss of more than IDR 10 trillion. There are allegations that the spread of bird flu in the past and current FMD in Indonesia is related to acts of bioterrorism in livestock.

The goal of economic bioterrorism is to inhibit, damage, or destroy the joints of the economy from factors of production, distribution, investment, consumption, to economic growth. If this terror is masterminded by foreign parties, the motivation is to destroy Indonesia's cattle farming agribusiness, which further creates a lasting dependence on cattle and beef commodities from abroad. If masterminded by the domestic cattle import cartel, the motivation is to increase the volume and profit of cattle and beef imports for the group. In 2016 the Business Competition Supervisory Commission (Komisi Pengawas Persainagn Usaha, KPPU) has convicted 32 companies that are members of the Indonesian Meat and Feedlot Producers Association (Asosiasi Produsen Daging dan Feedlot Indonesia, APFINDO) for conducting cartel practices and regulating beef prices in the Jakarta, Bogor, Tangerang, Depok, and Bekasi (Basri, 2019). The company was punished by the KPPU to pay various fines, ranging from IDR 71 million to IDR 21 billion for violating Law No. 5 of 1999 concerning Prohibition of Monopoly Practices and Unfair Business Competition (Riyadi and Syamsah, 2018).

**IMPACT OF FMD**

FMD outbreaks have a negative impact on cattle agribusiness upstream to downstream. First, the cattle population will decline and potentially derail the beef self-sufficiency target by 2026. Indonesia's cattle population in 2020 was 17.467 million heads, which were ready to cut about 3 million heads (equivalent to 500 thousand tons of meat). The need for beef for 273 million populations is about 700 thousand tons (equivalent to 4 million cows), so there is a deficit of 200 thousand tons of meat (equivalent to 1 million heads of cattle). The beef deficit is increasing every year as the economy improves, incomes increase, population, and nutritional awareness. The government has declared beef self-sufficiency since 2000 through the

Beef Self-Sufficiency Program (Program Swasembada Daging Sapi, PSDS), but three times failed to achieve the target, namely PSDS 2005, PSDS 2010, and PSDS 2014. PSDS is again targeted to be achieved in 2026 through two programs called (Sapi Indukan Wajib Bunting (SIWAB) which means mother cows must be pregnant in 2016-2019 and Sapi Kerbau Komoditas Andalan Negeri (SIKOMANDAN) which mean cattle and buffalo are the country's mainstay commodities in 2020. The government claims that the SIWAB program has produced 2,743,902 calves born until December 2019, while SIKOMANDAN targets the birth of 4 million cows and buffaloes nationwide by 2020. As of November 18, 2022, FMD is still spreading in 17 provinces in 146 regencies/cities with the the number of infected cows 578.060 heads, recovered 508.494 heads, conditionally cut 13.177 heads, died 10.269 heads, and vaccinated 5.847.113 heads (DGLAHS, 2022). FMD causes a decrease in beef cattle production (10-20%), cow fertility (10%), a decrease in the level of pregnancy and an increase in calf mortality (20-40%), as well as from the culling of infected livestock (Susanti, 2022).

Second, imports of cattle and beef will increase. Indonesia has a greater dependence on beef imports as indicated by the IDR (Import Dependency Ratio) value of 18.38% in 2016 and continues to increase to 24.83% in 2020. Indonesia's beef trade balance deficit during 2016-2020 in terms of volume and value is also increasingly swelling. In 2016 the beef trade volume deficit amounted to 116,747 tons (valued at USD 493,703), increasing to 170,277 tons (worth USD 606,817 million) in 2020 (Table 2). Indonesia's beef imports in 2020 were dominated by India (43.43%), Australia (39.88%), and the United States (8.96%) (Table 3). Since India is among the countries that have not been declared FMD-free by the OIE, imports of cattle and beef in the coming year will shift to Australia, the United States, and New Zealand which were already FMD-free. This shift in beef imports will hurt consumers because the price of beef from Australia (US\$ 3.5/kg), America (US\$ 5.58/kg) and New Zealand (US\$ 3.5/kg) is more expensive than the price of beef from India (US\$ 3.4/kg).

**Table 2:** Exports, imports and trade balance of Indonesian beef, 2016-2020.

No	Description	Year				
		2016	2017	2018	2019	2020
1	Export					
	- Volume (Ton)	15	29	14	24	28
	- Value (USD 000)	23	82	36	54	54
2	Import					
	- Volume (Ton)	116,761	118,647	164,261	201,554	170,305
	- Value (USD 000)	493,726	480,564	618,471	711,486	606,871
3	Balance					
	- Volume (Ton)	-116,747	-118,618	-164,247	-201,531	-170,277
	- Value (USD 000)	-493,703	-480,482	-618,435	-711,432	-606,817

Source: MoA (2021).

**Table 3:** Country of origin of Indonesian beef imports, 2016-2020.

No	Country of origin	Value (USD 000)		Share (%)	
		2016	2020	2016	2020
1	India	141,463	263,560	28.7	43.4
2	Australia	277,572	242,026	56.2	39.9
3	USA	21,382	54,376	4.3	9.00
4	New Zealand	51,592	19,553	10.5	3.2
5	Brazil	-	16,041	-	2.6
6	Spain	1,298	10,188	0.26	1.68
7	Japan	181	1,088	0.04	0.18
8	Singapore	169	39	0.03	0.01
9	Malaysia	70	-	0.01	0.00
10	Other countries	-	0.28	-	0.00
	Total	493,726	606,871	100	100

Source: MoA (2021).

Third, beef consumption will decrease. The beef consumption of the Indonesian population is 2.3 kg per capita per year, lower than the Philippines 3.9 kg, Malaysia 7.2, Singapore 13.5 kg, and the world average 6.4 kilograms. The low consumption of beef is due to low purchasing power due to the low per capita income of the population and the high price of beef. The World Bank recorded in the income of Indonesians in 2020 at USD 3,869 (equivalent to IDR 54.58 million) per capita

per year, while beef prices reached IDR 120,000-140,000 per kg. The income of Indonesians is fifth among the 10 ASEAN countries, below Singapore, Brunei, Malaysia, and Thailand. The population's expenditure on food of IDR 603,236 per capita per month, only IDR 26,441 (4.38%) was used to buy meat of various types (Table 4) (BPS, 2021). The FMD epidemic will cause the meat supply to decrease, the price of meat to increase, and the population's beef consumption to decrease drastically. Price elasticity of beef in Indonesia is elastic (Umaroh and Vinantia, 2018). This means that if the prices of beef rises by 1% then the demand for beef decreases by more than 1%, and vice versa. As a result of the widespread FMD, beef prices in July 2022 increased from the normal price of IDR 110,000-120,000/kg to IDR 150,000-160,000/kg and the demand for beef decreased by 50%.

Fourth, the economic losses are huge. The total costs that can be gained from FMD-free state in Indonesia is IDR 9.9 trillion (USD 761.3 million) in a year (Table 5). This indicates that the indirect impact such as on tourism, which is the spillover effect incurs 66% or more than half of the total indirect impacts. If the indirect impacts which are the overflow effects added to the ripple effect, then both incur 91% proportion. If all industries and trade related to agricultural sector are accounted for, then the proportion is 25% (Naipospos and Suseno, 2017). Recent studies on the FMD impact on smallholder systems were identified

**Table 4:** Monthly average expenditure per capita of Indonesian by food commodity 2016-2020 (IDR).

No	Food commodity	Year				
		2016	2017	2018	2019	2020
1	Cereal	64,566	61,455	66,936	64,961	66,789
2	Fish/shrimp/common squid/shells	33,620	40,478	43,352	45,304	46,570
3	Meat	20,526	24,987	23,006	24,783	26,441
4	Eggs and milk	28,025	29,357	32,196	32,435	34,860
5	Prepared food and beverages	133,834	172,600	189,223	201,107	206,736
6	Cigarette and tobacco	63,555	65,586	65,439	70,537	73,442
7	Other	116,513	133,493	136,747	133,424	148,398
	Food	460,639	527,956	556,899	572,551	603,236

Source: BPS (2021).

**Table 5:** Estimation of FMD economic impacts in Indonesia.

Impacts	Costs in IDR	Costs in USD
FMD financial impacts at national level	901.4 billion	69.3 million
FMD impacts on sugar cane tops export	622.9 million	47.9 million
FMD impacts on raw leather export	880.8 billion	67.7 million
FMD impacts on meat and processed meat export	43.6 billion	3.4 million
FMD impacts on domestic prices	942.5 million	72.5 million
FMD impacts on tourism industry	6.5 trillion	500.5 million
Total	9.9 trillion	761.3 million

Source: Naipospos and Suseno (2017).

in developing countries. Studies in Cambodia reported a reduction in household income of 4.4–11.7% annually following an outbreak of FMD with a loss of 54–92% of animal value (Shankar et al., 2012; Young et al., 2012). This compares to a reported 22–30% loss in of animal value in Laos following FMD (Rast et al., 2010). In Sudan losses of USD 25 per cow per year (Barasa et al., 2008), and in Pakistan found that compared to pre-FMD milk yield 60 days after the disease was still reduced by a third (Ferrari et al., 2013). In Isingiro district of Uganda, during FMD outbreaks bulls and cows were salvage sold at 83% and 88% less market value respectively, amounting to a loss of USD 196.1 in small cattle herd sized farms and USD 1,553 in medium farms annually (Baluka et al., 2014). FMD in India cause greatest production loss to the tune Rs. 3184.00 in crossbreed cows and Rs. 3062.50 in buffaloes, whose share was 74.31 and 81.69 per cent, respectively among the respondents at farm level (Sinha et al., 2018).

Heavy losses have also been experienced by developed countries affected by FMD outbreaks. The 2001 UK FMD, widespread culling was used to contain the disease and ultimately over 6 million animals were slaughtered, approximately 7% of all UK cattle and 15% of all sheep (Rushton et al., 2002). In Taiwan an outbreak of FMD in 1997 was estimated to have reduced the total GDP of the country by 0.28% (Hsu et al., 2005). Japan has had FMD outbreaks in 2010 with about 290,000 animals having been culled (Muroga et al., 2012). The Republic of Korea experienced an outbreak in 2010/2011 with the destruction of 3.40 million livestock and costs of USD 2.78 billion, while outbreak 2013/2014 spent the cost USD 58.3 million (Yoon et al., 2018). The cost of each FMD epidemic in from 2000 to 2015 varied from 26 billion Korean won (KRW, approximately US\$ 23.6 million) at the lowest to 2,044 billion KRW (US\$ 1.9 billion) at the highest (Yoon et al., 2016). In total USD 20–25 billion has been lost during the 15 years due to major FMD epidemics in countries that were previously free; this equates to about USD 1.5 billion per year (Knight-Jones and Ruston, 2013).

Fifth, social impact. The impact of FMD is not only in the form of animals getting sick or dying slowly. More than that, the sad story on the field is no less sad. Many farmers who lost their jobs because the livestock that served as their source of income died or stopped producing milk. When the livestock dies, the farmer still has to spend hundreds of thousands for the services of burying his livestock. Farmers are also not able to face the intimidation of livestock traders into immediately selling their livestock at a very low price. FMD has shrunk economic activity in rural areas, such as grass and fodder sales, milk delivery, livestock buying and selling, bad debts, unemployment, poverty and so on. FMD also poses a heavy social burden for farmers such as illness, stress, depression, stroke, divorce, and even suicide.

## CONCLUSIONS

There are three factors that can be attributed to the re-emergence of FMD outbreaks in Indonesia, namely the loss of maximum security principles, imports of beef/buffalo meat from India, and economic bioterrorism. FMD will have a negative impact on the economy, namely the cattle population will shrink, imports of cattle and beef will increase, beef consumption will decrease, economic losses are very large, and severe social impacts for farmers such as illness, stress, depression, stroke, divorce, and even suicide.

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## NOVELTY STATEMENT

Taking into account the economic losses due to FMD, this study states that FMD in Indonesia is not simply seen as a disease that infects cloven-hoofed animals, but it can also be suspected of being an act of economic bioterrorism.

## AUTHOR'S CONTRIBUTION

Stw conceived the idea and supervised research work; AW prepared the final manuscript; AM and AH collected data; Syn prepared the initial draft of the study; IDR and ESH analyzed and interpreted the result. All authors read and approved the final manuscript.

## CONFLICT OF INTEREST

The authors confirm that there was no conflict of interest with any financial, personal, or other relationships with other people or organizations related to this paper.

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