Research Article

Risk Analysis in Cattle Farmers' Prevention Practices of Anthrax and Foot and Mouth Disease in Yogyakarta Province, Indonesia

Budi Guntoro[1*], Agung Triatmojo[1], Bambang Ariyadi[2], Nguyen Hoang Qui[1]

[1]Department of Livestock Socio-Economics, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, Indonesia; [2]Department of Animal Production, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta, Indonesia.

Abstract | Anthrax and Foot and Mouth Disease (FMD) are the most crucial obstacle on both domestic and international trading which could also cause a consequence to human health. This study aims to evaluate the efficacy of farmer's prevention practices to reduce the risk of Anthrax and FMD. A total of 868 farmers from 4 regions in Yogyakarta Province participated in this study through face-to-face interviews using a multi-stage random sample method and quota sampling. Descriptive statistics were used to analyse primary data from the survey. Farmers were chosen by the criteria of who are staying and raising beef cattle in Yogyakarta. The results showed that farmers had a high experience and more than 50 years old, they worked as a farmer at the farm with low income from cattle production (less than 100$). Farmers had more than 8 years of education and raised their cattle under breeding system (68.55%). Besides, most farmers had a good knowledge of Anthrax and FMD. The risks analysis was performed by the great knowledge of farmers (65.7% and 77.9% respondents) to Anthrax and FMD and the dissemination of knowledge for FMD as well as a positive attitude for both Anthrax and FMD. However, the knowledge of Anthrax dissemination was risk (65.01% farmers had inappropriate practices). It could be concluded that Yogyakarta's cattle farmers are susceptible pose a risk from FMD prevention practices. Besides, farmers' Anthrax knowledge should be enhanced, as their knowledge and practices were poor.

Keywords | FMD, Anthrax, Risk, Prevention practices, Farmers.

Received | November 23, 2022; **Accepted** | February 20, 2023; **Published** | May 10, 2023
***Correspondence** | Budi Guntoro, Department of Livestock Socio-Economics, Faculty of Animal Science, Universitas Gadjah Mada, Yogyakarta Province, Indonesia; **Email:** budiguntoro@ugm.ac.id
Citation | Guntoro B, Triatmojo A, Ariyadi B, Qui NH (2023). Risk analysis in cattle farmers' prevention practices of anthrax and foot and mouth disease in yogyakarta province, Indonesia. Adv. Anim. Vet. Sci. 11(6): 987-997.
DOI | http://dx.doi.org/10.17582/journal.aavs/2023/11.6.987.997
ISSN (Online) | 2307-8316

INTRODUCTION

Beef cattle farming is an economic activity that provides rural communities with employment opportunities, generates demand (in the form of farm machinery and equipment) and raw materials to industry, and satisfies the dietary needs of the population. In developed and developing economies, perceptions of risk and risk management measures among livestock farmers are seen as crucial (Hayran et al., 2021). All the cattle on farms would be wiped off by disease waves, especially if producers' prevention measures are not maintained. Currently, Anthrax and FMD are becoming a greater issue in Indonesia as the number of cattle killed by Anthrax and FMD increases continuously. In details, Anthranx and FMD is one of the most significant animal diseases producing considerable economic losses in susceptible cloven-hoofed animals at the present time (OIE, 2018). Anthrax is a zoonotic bacterial disease caused by *Bacillus anthracis* (Hugh-Jones, 2009) while FMD is a highly contagious disease caused by *Aphthovirus*.

The serious problems caused by Anthrax and FMD are

from fast dissemination and low biosecurity protocol. Animal disease outbreaks in a specific region are primarily influenced by ecological, demographic, and sociocultural variables (Sitali et al., 2018). Evidence from Cambodia, a tropical nation, demonstrated that a lot of smallholder farmers use traditional husbandry practices to raise their livestock, with cattle constituting a vital part of the diets of rural smallholder farmer households. Most cattle are often fed natural grasses and rice straw in a cut-and-carry system that involves most household members, including women and children (Siang et al., 2021). These become a problem of virus dissemination if the biosecurity practices are not doing in a good way. For example, the research of Sweeney et al. (2011) showed that *B. anthracis* is typically found in the soil, and its spores can survive in the environment for several years under favourable conditions, transmitting to animal hosts through grazing, typically through ingestion or inhalation. In addition, smallholder farmer cattle management systems are often rudimentary, and many smallholder farmers have a limited comprehension of disease risks and recommended techniques for controlling illnesses (Nampanya et al., 2012). Several nations throughout the globe have taken diverse strategies and measures to control the spread of Anthrax and FMD, including vaccination, movement restrictions and biosecurity, enhanced surveillance, public awareness efforts, and in certain instances, the annihilation of affected animals (Siang et al., 2021). It seems to be ineffective since government and farmers must cooperate to implement the control program.

Farmer's prevention practices are the crucial factor to control disease. However, the application of best practices at small farms still presents risks. Farmers typically treat diseased animals before and after infection without isolation procedures, poor awareness of disease transmission and biosecurity, a low FMD vaccination rate, and an emphasis on treatment contribute to the recurrence of FMD outbreaks in these communities. (Siang et al., 2021). In the case of Anthrax, insufficient monitoring, surveillance, disease reporting, lack of public knowledge, unrestricted movement, poor management, and vaccination regimens are the most important variables in determining an effective control approach (Mondal and Yamage, 2014). Moreover, Balkhy et al. (2010) showed that when creating and executing disease control and prevention programs, it is crucial to understand the knowledge, attitudes, and behaviours of farmers. Sied et al. (2020) observed that education level, residence, health education on anthrax prevention, and attitude toward the disease were substantially associated with prevention activities.

Farmers' collection of data on animal infectious diseases is a crucial step towards the control and elimination of diseases like Anthrax and FMD. The awareness and prevention strategies of livestock farmers are crucial to the control of the disease in both humans and animals (Sied et al. 2020). There haven't been any research that could provide current knowledge about the precautions cattle farmers should take to eradicate Anthrax in the area and the surrounding area. Consequently, the findings of this study would aid in the creation of appropriate and practicable treatments by providing pertinent data to relevant organizations. Therefore, the purpose of this study was to evaluate the prevalence of Anthrax prevention practices among livestock owners in Yogyakarta Province, Indonesia.

MATERIALS AND METHODS

Location

The study was conducted in Yogyakarta Province, Indonesia which consists of 4 regions including Bantul, Gunungkidul, Kulon Progo and Sleman Regency. Yogyakarta were chosen as research study since the majority of farmers have focused on agricultural sector. As a centre of Java Island, Yogyakarta is also a centre of animal movements, transportation from the eastern to the western Java where there are a lot of FMD cases recorded. Besides, Anthrax is known as an endemic disease in Yogyakarta Province.

Data collection and data quality control

The survey was carried out between September and October 2022, when the number of daily cases had passed the peak point. A multi-stage random sampling was used to collect data at the surveyed areas. According to the study of Sied et al. (2020), there was a lack of information on prevention practices for diseases, so the sample size was calculated based on the assumption of a 50% prevalence, 95% confidence interval, 5% margin of error, and a 10% non-response rate, yielding 844 respondents. Besides, by quota sampling, the study was recorded the data of 217 cattle farmers per district to make the results more precise and robust. Thus, a total of 868 farmers involved with the study by interview. Besides, all the questions were check validity and reliability following Pearson correlation (0.1495-0.5934) and Cronbach's alpha (0.8499). The criteria of respondent were cattle farmers who are staying and raising cattle in Yogyakarta region.

The data collection was separated into two sections with the questionnaires in local language (Indonesian). The first section was the data of social-economic status. The second section was the data of risk factors including knowledge, attitude, practices at farm towards Anthrax and FMD. Farmers were interviewed following the questionnaire which was conducted face-to-face.

Firstly, the data of social profile including social-demographic profiles such as gender, age, family member, oc-

cupation, formal education, informal education, and cattle population. Secondly, the data was about farmer's knowledge on Anthrax and FMD disease, knowledge of disease transmission, the attitude of farmers towards Anthrax and FMD and the best practices that farmers do at their farms to prevent diseases. The information was asked by the statements relating to these indicators. Ended question and Likert scale were used to assess these indicators.

Data quality control was following English version of questionnaire. The data first prepared in English and then translated to Indonesian by expertise in the field of livestock social economics. The information was checked by translators and expert before launching to make sure the clarity and consistence between English and Indonesian. The collected data were inspected daily by the study's supervisors.

Data Definitions

The study consisted of 11 variables which was showed in Table 1 below.

Survey Questions

Knowledge: For knowledge towards Anthrax and FMD showed in 5 yes/no questions: "Do you know the disease called Anthrax/FMD?", "The symptoms such as staggering, trembling, breathing difficulty, convulsions, and death are not related to anthrax/FMD?", "Do you know Anthrax/FMD cannot cause death for your cattle?", "Do you know this disease can cause significant economic loss?", "The prevention methods such as vaccination, isolation, biosecurity methods cannot be used to prevent Anthrax/FMD?". For knowledge towards Anthrax and FMD dissemination, there were 6 yes/no questions involved: "Do you know the ways of Anthrax/FMD transmission?", "Do you know Anthrax cannot transmit from Anthrax/FMD death animal, fluid, spores, human?", "Do you know Anthrax/FMD cannot be transmitted from animal to human and vice vera?", "How many years that Anthrax/FMD spores can survive in the ground?", "Can we use, slaughter, and making feed from meat from Anthrax/FMD suspected animals?", "Do you know Anthrax/FMD can transmit from animal products such as beef, milk, processed products?". By the methods of Cakmur et al. (2015) and Sied et al. (2020) stated if respondents were able to correctly answer the questions of each variable from more than 50% or just equal to 50%, it was determined as appropriate knowledge and vice vera.

The attitude of farmers towards Anthrax and FMD consisted of 6 questions with Likert scale for the answer including strongly agree, agree, natural, disagree, and strongly disagree: "Anthrax is not a serious epidemic", "Anthrax is not prevented through vaccination?", "Biosecurity at farm such as disinfectant, control visitor, control movement can prevent Anthrax transmission", "Anthrax can be controlled by treatment and isolation of sick animals", "Burning dead and don't slaughter suspected animals, can control Anthrax transmission", "Consuming beef, milk, processed product from Anthrax death animals leads health risks". If respondents were able to correctly answer the questions of each variable from more than 50% or just equal to 50%, it was determined as appropriate attitude and vice vera (Cakmur et al., 2015; Sied et al., 2020).

Farmers' prevention practices involved yes/no questions: "Do you know any treatment and control methods of the diseases in your farm?", "Do you burn or bury animals that died from Anthrax/FMD?", "Do you use traditional medicine such as herbal medicine to treat sick animals?", "Do you seek treatment at a veterinary facilities if anthrax/FMD is suspected?", "Do you vaccinate animals to prevent anthrax/FMD?", "Do you do hand washing after handling animal?", "Does your farm have drainage system of farm?", "Personnel/visitor access?", "Water source separate for animals and human". The correctly answers for each question, from more than 50% or just equal to 50% were determined as appropriate prevention practices and vice vera (Cakmur et al. (2015) and Sied et al. (2020)).

From 4 variables, the risk towards prevention practice was determined by the methods of Cakmur et al. (2015) and Sied et al. (2020): if respondents were able to correctly answer the questions of each variable from more than 50% or just equal to 50%, it was determined as non-risk at prevention practice and vice vera.

Data analysis

Data were analyzed by STATA 16.0 and Excel from Office 365. The data of social profile, knowledge towards Anthrax and FMD, knowledge towards Anthrax and FMD dissemination, attitude of farmers towards Anthrax and FMD, prevention practices was illustrated by descriptive statistics through the percentage of available questions.

RESULTS

The descriptive of farmer's social profile relating to Anthrax and FMD

According to Table 2, the respondents from this survey was around 50-60-year-old and most of respondent are male, who involved with cattle production. Most of farmers were joined in cattle production activities (more than 50% of candidates) with around 3-4 members per household. Farmers have completed junior high school following Indonesian education levels. Besides, small-scale farm was the status of most farmers in Yogyakarta with only 2-3 heads per farm. Yet, they own a great experience in raising the cattle with more than 20 years. Furthermore, farmers

Table 1: The operational definitions of independent variables

No	Variables	Definitions	Data types
1	Age	The age of respondent who joined in the interview and replied to the questionnaire	Number
2	Gender	It indicates that respondents are male or female	Male, female
3	Family member	The total of member in their family	Number
4	Occupation	Main job status that they are currently working	Farmer, agricultural service, others
5	Education	The highest educational level that a respondent had	Number
6	Beef cattle population	The number of beef cattle owned by a respondent at farm	Number
7	Income status	The money earned by farmers from beef cattle production	100$, 100-200$, 200$
8	Experience	How many years that farmers have worked in cattle farming aspect	Number
9	Farm size	Total lands that farmers used for raising cattle	Number
10	Pasture size	Total lands that farmers used for pasture	Yes, no
11	Cattle raising method	Regarding to the purpose and method that farmers raise their cattle	Rearing, breeding, fattening

Table 2: The information of farmers in Yogyakarta province - case of Anthrax and FMD

No	Variables		Unit	Respondent	Results
1	Age		Years	868	54.18
2	Gender				
		Male	%	668	76.96
		Female	%	200	23.04
3	Family member		People	868	3.71
4	Occupation*				
		Farmers	%	463	53.34
		Agricultural service	%	134	15.44
		Others	%	271	31.22
5	Education		Years	868	8.52
6	Beef cattle population		Heads	868	2.26
7	Income**				
		<100$	%	696	80.18
		100-200	%	123	14.17
		>200$	%	49	5.65
8	Experience		Years	868	24.96
9	Farm size		m^2	868	69.6
10	Pasture field				
		Yes	%	695	80.07
		No	%	173	19.93
11	Cattle raising method				
		Rearing	%	138	15.90
		Breeding	%	595	68.55
		Fattening	%	135	15.55

*: Other occupation is an agricultural job that not related to beef production activities.
**: 1$ is equal to Rp. 15.000

Table 3: Knowledge of farmers in survey area towards Anthrax and FMD

Question variables	Answer	FMD		Anthrax	
		Res.	%	Res.	%
Q1: Do you know the disease called anthrax/FMD?					
	Yes	710	81.80	485	55.88
	No	158	18.20	383	44.12
Q2: The symptoms such as staggering, trembling, breathing difficulty, convulsions, and death are *not* related to anthrax/FMD?					
	Yes	442	50.92	253	29.15
	No	426	49.08	615	70.85
Q3: Do you know anthrax/FMD *cannot* cause death for your cattle?					
	Yes	453	52.19	362	41.71
	No	415	47.81	506	58.29
Q4: Do you know this disease can cause significant economic loss?					
	Yes	794	91.47	716	82.49
	No	74	8.53	152	17.51
Q5: The prevention methods such as vaccination, isolation, biosecurity methods *cannot* be used to prevent anthrax/FMD?					
	Yes	570	65.67	455	55.42
	No	298	34.33	413	47.58

Table 4: Knowledge of farmers in survey area towards Anthrax and FMD dissemination

Question variables	Answer	FMD		Anthrax	
		Res.	%	Res.	%
Q6: Do you know the ways of Anthrax/FMD transmission?					
	Yes	467	53.80	280	32.26
	No	401	46.20	588	67.74
Q7: Anthrax/FMD *cannot* transmit from death animal, fluid, spores, effected human?					
	Yes	443	51.04	367	42.28
	No	425	48.96	501	57.72
Q8: Anthrax/FMD *cannot* be transmitted from animal to human and vice vera?					
	Yes	270	31.11	327	37.67
	No	598	68.89	541	62.33
Q9: Anthrax/FMD spores can survive in the ground?					
	Yes	134	15.44	183	21.08
	No	734	84.56	685	78.92
Q10: Can we use, slaughter, and making feed from meat from Anthrax/FMD suspected animals?					
	Yes	237	27.30	98	11.29
	No	631	72.70	770	88.71

Q11: Anthrax/FMD can transmit from animal products such as beef, milk, processed products?					
	Yes	422	48.62	380	43.78
	No	446	51.38	488	56.22

Table 5: The attitude of farmers toward Anthrax and FMD in survey area

Questions	SD	D	N	A	SA
Attitude toward FMD					
Q12: FMD is not a serious epidemic?	1.15	4.84	6.11	65.55	22.35
Q13: FMD is not prevented through vaccination?	13.38	33.33	7.37	35.18	10.38
Q14: Biosecurity at farm such as disinfectant, control visitor, control movement can prevent FMD transmission?	2.31	3.58	5.31	68.63	20.18
Q15: FMD can be controlled by treatment and isolation of sick animals?	1.96	3.23	3.58	71.74	19.49
Q16: Burning dead and don't slaughter suspected animals, can control FMD transmission?	6.81	24.25	6.70	46.54	15.70
Q17: Consuming beef, milk, processed product from FMD death animals leads health risks?	3.81	16.05	5.31	52.42	22.40
Attitude toward Anthrax					
Q12: Anthrax is not a serious epidemic?	1.73	3.69	7.27	59.05	28.26
Q13: Anthrax is not prevented through vaccination?	13.86	31.18	11.43	33.60	9.93
Q14: Biosecurity at farm such as disinfectant, control visitor, control movement can prevent anthrax transmission?	2.89	3.93	7.98	66.36	18.84
Q15: Anthrax can be controlled by treatment and isolation of sick animals?	2.66	4.16	6.24	69.17	17.78
Q16: Burning dead and don't slaughter suspected animals, can control anthrax transmission?	6.60	22.25	8.69	46.70	5.76
Q17: Consuming beef, milk, processed product from anthrax/FMD death animals leads health risks?	3.47	11.92	7.41	53.94	23.26

Table 6: Farmer's prevention practices towards Anthrax and FMD in survey area

Question variables	Answer	FMD		Anthrax	
		Res	%	Res	%
Q18: Do you know any treatment and control methods of the diseases in your farm?					
	Yes	432	49.88	231	26.71
	No	434	50.12	634	73.29
Q19: Do you burn or bury animals that died from anthrax/FMD?					
	Yes	524	60.37	483	55.65
	No	344	39.63	385	44.35
Q20: Do you use traditional medicine such as herbal medicine to treat sick animals?					
	Yes	344	60.37	240	27.65
	No	524	39.63	628	72.35
Q21: Do you seek treatment at a veterinary facilities if anthrax/FMD is suspected?					
	Yes	734	84.56	651	75.09
	No	134	15.44	216	24.91

Q22: Do you vaccinate animals to prevent anthrax/FMD?					
	Yes	643	74.16	528	60.97
	No	224	25.84	338	39.03
Q23: Do you do hand washing after handling animal?					
	Yes	813	93.66	755	86.98
	No	55	6.34	113	13.02
Q24: Does your farm have drainage system of farm?					
	Yes	503	57.95	464	53.46
	No	365	42.05	404	46.54
Q25: Personnel/visitor control?					
	Yes	596	68.66	554	63.97
	No	272	31.34	312	36.03
Q26: Water source separate for animals and human					
	Yes	693	79.84	670	77.19
	No	175	20.16	198	22.81

Table 7: Risk Analysis in Cattle Farmers' Production Practices

No	Criteria	Respondent	Risk analysis	
			FMD	Anthrax
1	Knowledge towards Anthrax and FMD			
		Appropriate	65.78	77.19
		Inappropriate	34.22	22.81
2	Knowledge towards Anthrax and FMD dissemination			
		Appropriate	52.07	34.79
		Inappropriate	47.93	65.01
3	The attitude of farmers towards Anthrax and FMD			
		Appropriate	95.97	96.31
		Inappropriate	4.03	3.69
4	Farmers' prevention practices			
		Appropriate	77.93	63.92
		Inappropriate	22.07	36.08

did not own a large land or pasture for cattle production, that is also a reason their income from raising cattle is low (less than 100$ per month). As finally presented in Table 2, breeding method accounted for high proportion with 2/3 of total cattle production.

Knowledge of farmers

Knowledge of farmers towards Anthrax and FMD: As per (Table 3), a significant 80 % of smallholder farmers know FMD very well but they lacked information on Anthrax when they were asked the question "whether they know FMD/Anthrax or not". In contrast, farmers are not aware of the symptoms of FMD, but they know that staggering, trembling, breathing difficulty, convulsions, and death might be signs of Anthrax infection (accounted for more than 70% of respondents). Anthrax and FMD causes deaths of farm animals. However, only 50% of the farmers understand its impact and some of them also do not know vaccination can prevent Anthrax (almost 50%) and FMD (1/3 respondents). Although farmers might well be confused by the symptoms and vaccine advantages of FMD and Anthrax, farmers are aware of the economic losses

caused by Anthrax and FMD.

Knowledge on Anthrax and FMD dissemination: Disease transmitting is the serious problem in animal pathology. In the present (Table 4), farmers do not know how Anthrax transmit to other animals (>60% do not know). FMD can be transmitted from death animal, fluid, spores, effected human is the answer of more than 50% respondents. Mostly, farmers did not know Anthrax had the same way of transmitting (>60%). Improper knowledge of farmers regarding disease transmission was also identified. Farmers did not know spores can survive in the ground (around more than 80%), animal products can be disease sources (>50%). Farmers were aware of processing suspected animals which can cause disease (more than 70% for FMD, more than 4/5 of respondents for Anthrax).

Attitude of farmers toward Anthrax and FMD: Table 5 showed the attitude of beef cattle farmers to Anthrax and FMD. Each participant was asked 6 questions and mostly they though that FMD and Anthrax is not a serious problem at the farm (more than 80%). Most farmers gave incorrect answer regarding "vaccine is not a good choice for preventing Anthrax and FMD at farms". Nonetheless, farmers knew how to implement biosecurity method to control these diseases with more than 80% farmers give the answer "agree" and "strongly agree" to biosecurity question. Almost every cattle farmer practiced treatment and isolation for sick animals. The two last questions for recording farmer's attitude showed that less than 20% farmers did not consume products from death animals to protect their health. Nearly 50% of farmers concur that burning livestock can prevent FMD and Anthrax.

Farmer's prevention practices to Anthrax and FMD

The prevention practices from farmers were recorded through (Table 6). The farmers (more than 70% of farmers) indicated that they were unaware of any treatment or control methods for Anthrax disease on the farm. 524 farmers (FMD question) and 483 (Anthrax question) in the total of 868 farmers showed that they performed burning and burying death animals. The herbal medicine was practiced in case of FMD (>60% farmers) but surprisingly they did not practice it for Anthrax disease (>70% farmers). More than seventy-five percent of respondents found treatment for their livestock in veterinary clinics whenever they suspected cases of Anthrax and FMD. Vaccination was also implemented in cattle farm, clearly in case of FMD. Handwashing after handling animals, and water source control were also performed in more than 80% of farmer's farm. Drainage and visitor access were also practice at the farm. However, the practice ratio was not high (around 60%).

Table 7 showed that farmers performance was non-risk in case of Anthrax and FMD for examined factors. Through Table 7, farmers lacked adequate Anthrax information. An inappropriate knowledge was from disease dissemination, available in 65% farmers for Anthrax disease. Most farmers failed in the question of knowledge towards disease dissemination due to lack of information. Nearly 50% of farmers indicated incorrect information on FMD transmission. The attitude of farmers towards Anthrax and FMD showed the highest proportion in four examined factors which was more than 90% of appropriate in both FMD and Anthrax risk analysis. Comparing FMD to Anthrax, more appropriate prevention practice was performed in case of FMD.

DISCUSSION

The study showed that social profile of beef cattle farmers was in line with the study of Guntoro et al. (2016). The social profile should be examined carefully to identify the appropriate practice at the farm. Based on the data of Indonesian farmer population, the majority of farmers were more than 39 years old (BPS, 2020). It correlates to the current study that most farmers were more than 50 years old. Farmers were older since it is probably that the younger generation is reluctant to work as a farmer at home (Leonard et al., 2017). Age can impact land-use decisions such as farm size, industrial composition, and intensification. The physical capabilities of the farmer to engage in farming operations related to starting the farm business, pursuing new goals, and increasing production intensity can also be influenced by the farmer's age (Burton, 2006), and can therefore impact both management decisions and the choice to leave farming (Gale, 2003). Besides, low farm size and pasture field might be a reason from high years old (Brown et al., 2019). Gender relations include gender roles and women's and men's abilities to negotiate these roles (Verhart et al., 2016). In this study, male accounted for high proportion in surveyed participants. Although it is frequently asserted that women have better control over smaller animals (such as chickens and small ruminants) and men tend to have greater control over larger animals (Ransom et al., 2017). Farmers with low education was not likely to know prevention practices for animal diseases. In this study, average formal education of farmers was approximately 8 years, it could prove that farmers are capable of comprehending and implementing basic preventative methods at their farm. Education helps owners become more aware, which makes it easier for them to change bad habits and terminate the disease. This shows that educating people is the most important thing to do to get more livestock farmers to take the right steps to prevent Anthrax disease (Seid et al., 2020). Certain professions involving animal interactions, such as livestock farming, provide a risk of disease transmission. Those who raise cattle are par-

ticularly vulnerable to animal risks. Livestock farmers who lack fundamental information, disregard biosecurity procedures, and neglect their own health can also contribute to the emergence and spread of animal diseases (Cediel et al., 2012). Due to the limited number of cattle on their farms, cattle farmers did not earn a substantial income from farming. Akouegnonhou and Demirbaş (2021) stated that livestock farmers make most of their money from selling animals, which usually happens at livestock markets. The amount of money their family earns relies on the number of cattle they own. Safa (2005) found that agroforestry farmers with animals had a higher family income than those with fewer or no animals. Nevertheless, farmers' income was not high, even though they had a lot of experience. It was because the only source of income in this study was raising beef cattle. Hence, farmers with a lot of experience would be better at making decisions. Farmers in rural areas who have extensive experience producing animals can earn significantly more in revenue. It means that a lot of experience with cattle farming could lead to considerable household income (Akouegnonhou and Demirbaş, 2021). The difference seen could be because the settings are in different socioeconomic situations (Seid et al., 2020). The responses of farmers in this study clearly illustrated their knowledge. Farmers were aware of the severity of Athrax and FMD. It is crucial to identify the symptoms of illnesses that might be transmitted during the incubation period, such as foot-and-mouth disease and anthrax. In addition, to keep animals secure from disease, daily inspections must be conducted, and the effectiveness of inspections depends on the level of knowledge of clinical disease indicators and the actions performed when such symptoms are observed (East et al., 2016). It is also crucial to maintain reliable animal health records, since they can assist uncover trends of disease or mortality (Hernández-Jover et al., 2019). Moreover, livestock owners are frequently aware of the disease's clinical manifestations in both their own and neighbouring herds (Sieng et al., 2021). This is certainly relevant for cattle, where the clinical symptoms of FMD are more prominent (Thornley and France, 2009; Aftosa, 2014; Osmani et al., 2021). Farmers answered that animals should be quarantined, and some biosecurity was applied at surveyed areas. Osmani et al. (2021) demonstrated that animal movement, particularly the introduction of new animals into cattle herds, was regarded to be the primary cause of FMD's introduction into their cattle herds. It is commonly acknowledged that animal movement is the most important factor in the transmission of FMD (Alexandersen et al., 2003). Additionally, routine immunization is one of the most effective methods for preventing and controlling anthrax (Kasradze et al., 2018; Mwakapeje et al., 2018; Traxler et al., 2019) or other diseases such as FMD. The study areas are endemic for anthrax and FMD but the vaccination status in the answers were not satisfactory. This is one of the reasons that FMD and Anthrax are still available in Yogyakarta Province. Deficient coverage of anthrax vaccine and FMD in livestock contributed to the outbreak's animal diseases (Dutta et al., 2021). Farmers seem to have more knowledge on FMD, compared to Anthrax through the survey. It can be explained by the fact that cattle farmers had a high level of knowledge about FMD, likely due to the effect of mandatory vaccination campaigns targeting this disease, applied to all cattle by the government, and that it was more prevalent on social media, which can be a useful communication channel for animal disease information (Qui et al., 2021).

Typically, rural cultures consume raw milk, meat, and animal blood. Sociocultural activities such as slaughtering sick animals, consuming, or handling meat from infected animals, and dumping carcasses in the open have contributed to the transmission of anthrax and FMD in Southeast Asian nations (Islam et al., 2013). However, the data showed that farmers did not consume these products. It might be because this is a culture of Indonesian. Concerns regarding Anthrax and FMD transmission precede the disposal of animal carcasses. The preferred method of disposal of anthrax and FMD in this study were burned and buried. It is also recorded in Dutta et al. (2021), most developing countries are using these methods for disposal animals. However, it can be a source of disease dissemination. Carnivores and birds play a crucial role in spreading Anthrax spores by dragging tainted meat across affected areas. Dog is resistant to anthrax but serves as a mechanical vector from the field to the home (Turnbull, 1998). In addition, a good attitude toward disease prevention was revealed as one of the primary characteristics significantly associated with anthrax and FMD preventative practices. This may be attributable to the fact that human behaviour is impacted by perceptions and attitude, which are the driving forces behind actions (Seid et al., 2020). The methods of treatment from farmers were not clear, especially for Anthrax disease. Most farmers asked the assistances from veterinarians and using traditional treatment. However, if the conventional therapy is ineffective, it could be a risk factor for the expansion of FMDV in endemic locations by releasing the virus (Dukpa et al., 2011).

Finally, in both knowledge and attitude of farmers, the present of inappropriate practices was not performed. It was also the same in the study of Dutta et al. (2021). The explanation could be as follows: (1) they truly have a positive attitude toward Anthrax and FMD, which is why they did not consume these products; (2) farmers hid the truth, especially where they were negatively affected or involved with inappropriate activities such as slaughtering of sick animals and subsequent sale and consumption of meat from a suspected carcass, or even did not report the cases to

the appropriate authority (Dutta et al., 2021).

CONCLUSION

Beef farmers in Yogyakarta province completed their junior high school, was over 50-year-old and had a good experience in raising cattle. Most of farmers were male and joined in 3-4 members join in cattle production activities. Small-scale farmers with less than 3 heads were still available and farmers did not receive many profits from cattle production. By the information on knowledge, attitudes, and prevention practice in Anthrax and FMD, FMD's prevention practice of farmers at Yogyakarta province was good but Anthrax knowledge was not. It is probable that Yogyakarta's cattle farmers are vulnerable to FMD prevention practices. Furthermore, farmers' Anthrax knowledge should be improved, as their knowledge and practices were inadequate. It could be suggested that disease control program planning, execution, and assessment can be aided by information on farmer's knowledge, attitudes, and behaviours. In addition, identifying knowledge gaps and cultural and behavioural variations between groups may be effective in disease prevention strategies.

ACKNOWLEDGEMENTS

This project was funded by the Matching Fund Kedai Reka, Ministry of Education, Culture, Research, and Technology Indonesia 2022.

CONFLICT OF INTEREST

Authors declare that there are no conflicts of interest.

NOVELTY STATMENT

To our best knowledge, the paper provided information for both Anthrax and FMD disease in Yogyakarta during the emerging of these pandemics.

AUTHORS CONTRIBUTION

B.G., B.A.: made a conceptual framework and design for the study; A.T. did survey and analysis data; N.H.Q. wrote and revised the manuscript. All authors accepted for the final manuscript.

REFERENCES

Aftosa F (2003). Foot and Mouth Disease; Iowa State University: Ames, IA, USA, 2014. Agricult. Econ. 25(1): 168-186.

Akouegnonhou O., Demirbaş N (2021). Factors Affecting the Income of Farmers Participating In Traditional and Modern Livestock Markets: Case Study from Benin Republic. Selcuk J. Agricult. Food Sci., 35(3): 210-217. https://doi.org/10.15316/SJAFS.2021.250

Alexandersen S., Zhang Z., Donaldson A.I., Garland A.J (2003). The pathogenesis and diagnosis of foot-and-mouth disease. J. Comparat. Pathol., 129:1-36. https://doi.org/10.1016/S0021-9975(03)00041-0

Balkhy H.H., Abolfotouh M.A., Al-Hathlool R.H., Al-Jumah M.A. (2010). Awareness, attitudes, and practices related to the swine influenza pandemic among the Saudi public. BMC Infect. Dis., 10: 42. https://doi.org/10.1186/1471-2334-10-42

BPS (2020). Statistical Yearbook of Indonesia 2020. BPS-Statistics Indonesia: Jakarta.

Brown P., Daigneault A., Dawson J (2019). Age, values, farming objectives, past management decisions, and future intentions in New Zealand agriculture. J. Environ. Manag., 231: 110-120. https://doi.org/10.1016/j.jenvman.2018.10.018

Burton R.J (2006). An alternative to farmer age as an indicator of life-cycle stage: The case for a farm family age index. J. Rural Stud., 22(4): 485-492. https://doi.org/10.1016/j.jrurstud.2006.02.005

Cakmur H., Akoglu L., Kahraman E., Mustafa A (2015). Evaluation of farmers' knowledge-attitude-practice about zoonotic diseases in Kars, Turkey. Kafkas J. Med. Sci., 5(3): 87–93. https://doi.org/10.5505/kjms.2015.83436

Cediel N., Conte V., Tomassone L., Tiberti D., Guiso P., Romero J., Villamil L.C., De Meneghi D (2017). Risk perception about zoonoses in immigrants and Italian workers in Northwestern Italy. Rev. de Saúde Públ., 46: 850-857. https://doi.org/10.1590/S0034-89102012000500012

Dukpa K., Robertson I.D., Edwards J.R., Ellis T.M. (2011). A retrospective study on the epidemiology of foot-and-mouth disease in Bhutan. Trop. Anim. Health Prod., 43: 495–502. https://doi.org/10.1007/s11250-010-9722-z

Dutta P.K., Biswas H., Ahmed J.U., Shakif-Ul-Azam M., Ahammed B.M.J., Dey A.R. (2021). Knowledge, attitude and practices (KAP) towards Anthrax among livestock farmers in selected rural areas of Bangladesh. Vet. Med. Sci., 7(5):1648-1655. https://doi.org/10.1002/vms3.561

East I., Martin P., Langstaff I., Iglesias R., Sergeant E., Garner M. (2016). Assessing the delay to detection and the size of the outbreak at the time of detection of incursions of foot and mouth disease in Australia. Prevent. Vet. Med., 123: 1–11. https://doi.org/10.1016/j.prevetmed.2015.12.005

Gale H.F. (1978-1997). Age-specific patterns of exit and entry in US farming, 1978–1997. Review of

Guntoro B., Prasetyo A. F., Sulastri E. (2016). Cattle Farmers' Participation in Rural Development Program in Bantul Yogyakarta. Anim. Prod., 18(3): 181-192. http://dx.doi.org/10.20884/1.jap.2016.18.3.537

Hayran S., Külekçi M., Gül A. (2021). Perception and risk management strategies for ranchers and their determinants: a case study from Turkey. Ciência Rural., 51(6): e20200456 https://doi.org/10.1590/0103-8478cr20200456.

Hernández-Jover M., Hayes L., Woodgate R., Rast L., Toribio J-ALML. (2019). Animal Health Management Practices Among Smallholder Livestock Producers in Australia and Their Contribution to the Surveillance System. Front. Vet. Sci., 6: 191. https://doi.org/10.3389/fvets.2019.00191

Hugh-Jones M., Blackburn J. (2019). The ecology of Bacillus anthracis. Molecu. Aspects Med., 30(6): 356–367. https://doi.org/10.1016/j.mam.2009.08.003

Islam M.S., Hossain M.J., Mikolon A., Parveen S., Khan M.S., Haider N., Chakraborty A., Titu A.M., Rahman M.W., Sazzad H.M., Rahman M., Gurley E.S., Luby S.P. (2013). Risk practices for animal and human anthrax in Bangladesh: An exploratory study. Infect. Ecol. Epidemiol., 3(1): 21356. https://doi.org/10.3402/iee.v3i0.21356

Kasradze A., Echeverria D., Zakhashvili K., Bautista C., Heyer N., Imnadze P., Mitrskhulava V (2018). Rates and risk factors for human cutaneous anthrax in the country of Georgia: National surveillance data, 2008– 2015. PLoS One. 13(2): e0192031. https://doi.org/10.1371/journal.pone.0192031

Leonard B., Kinsella A., O'Donoghue C., Farrell M., Mahon M. (2017). Policy drivers of farm succession and inheritance. Land Use Policy., 61: 147–159. https://doi.org/10.1016/j.landusepol.2016.09.006

Mondal S.P., Yamage M. A. (2014). Retrospective Study on the Epidemiology of Anthrax, Foot and Mouth Disease, Haemorrhagic Septicaemia, Peste des Petits Ruminants and Rabies in Bangladesh, 2010-2012. PLoS One., 9(8): e104435. https://doi.org/10.1371/journal.pone.0104435

Mwakapeje E.R., Høgset S., Fyumagwa R., Nonga H.E., Mdegela R.H., Skjerve E. (2018). Anthrax outbreaks in the humans-livestock and wildlife interface areas of Northern Tanzania: A retrospective record review 2006–2016. BMC Pub. Health., 18(1):106. https://doi.org/10.1186/s12889-017-5007-z

Nampanya S., Khounsy S., Rast L., Windsor P. (2014). Promoting transboundary animal disease risk management via a multiple health and husbandry intervention strategies in upland Lao PDR. Trop. Anim. Health Prod., 46: 439–446. https://doi.org/10.1007/s11250-013-0511-3

OIE (2018). Foot and Mouth Disease (Infection with Foot and Mouth Disease Virus). In OIE Terrestrial Manual 2017; The World Organisation for Animal Health (OIE): Paris, France. pp. 1–32.

Osmani A., Habib I., Robertson I.D. (2021). Knowledge, Attitudes, and Practices (KAPs) of Farmers on Foot and Mouth Disease in Cattle in Baghlan Province, Afghanistan: A Descriptive Study. Animals., 11: 2188. https://doi.org/10.3390/ani11082188

Qui N.H., Guntoro B., Syahlani S.P., Linh N.T. (2021). Factor Affecting the Information Sources and Communication Channels toward Pig Farmer's Perception of African Swine Fever in Tra Vinh Province, Vietnam. Trop. Anim. Sci. J., 44(2): 248-254. https://doi.org/10.5398/tasj.2021.44.2.248

Ransom E., Bain C., Halimatusa'diyah I. (2017). Livestock-livelihood linkages in Uganda: the benefits for women and rural households? J. Rural Social Sci., 32: 37–68.

Safa M.S. (2005). socio-economic factors affecting the income of small-scale agroforestry farms in hill country areas in Yemen: a comparison of ols and wls determinants. Small-scale Forest Econ. Manag. Policy, 4(1): 117-134. https://doi.org/10.1007/s11842-005-0008-7

Seid K., Shiferaw A.M., Yesuf N.N., Derso T., Sisay M. (2020). Livestock owners' anthrax prevention practices and its associated factors in Sekota Zuria district, Northeast Ethiopia. BMC Vet. Res., 16: 1-8. https://doi.org/10.1186/s12917-020-2267-0

Sieng S., Patrick I.W., Windsor P.A., Walkden-Brown S.W., Sar C., Smith R.G.B., Kong R. (2021). Knowledge, attitudes and practices of smallholder farmers on foot and mouth disease control in two Cambodian provinces. Transbound. Emerg. Dis., 69(4): 1983–1998. https://doi.org/10.1111/tbed.14182

Sitali D.C., Twambo M.C., Chisoni M., Bwalya M.J., Munyeme M. (2018). Lay perceptions, beliefs and practices linked to the persistence of anthrax outbreaks in cattle in the Western Province of Zambia. Onderstepoort J. Vet. Res., 85(1): 1–8. https://doi.org/10.4102/ojvr.v85i1.1615

Sweeney D.A., Hicks C.W., Cui X., Li Y., Eichacker P.Q. (2011). Anthrax infection. American J. Respirat. Crit. Care Med., 184(12): 1333–1341. https://doi.org/10.1016/j.jinf.2011.04.052

Thornley J.H., France J. (2009). Modelling foot and mouth disease. Prevent. Vet. Med., 89: 139–154. https://doi.org/10.1016/j.prevetmed.2009.02.019

Traxler R.M., Napetvaridze T., Asanishvili Z., Geleishvili M., Rukhadze K., Maghlakelidze G., Broladze M., Kokhreidze M., Maes E.F., Reynolds D, Salman M., Shadomy S.V., Rao S. (2019). Knowledge, attitudes, and practices related to anthrax and animal care: A case-control study in Georgia. PloS One., 14(10): e0224176. https://doi.org/10.1371/journal.pone.0224176

Turnbull P.C. Guidelines for the surveillance and control of anthrax in humans and animals. World Health Organization (1998). Department of Communicable Diseases Surveillance.

Verhart N., van Den Wijngaart A., Dhamankar M., Danielsen K. (2016). Bringing Agriculture and Nutrition Together Using a Gender Lens. KIT Working Papers. Netherlands Development Organisation (SNV) and the Royal Tropical Institute, Amsterdam (KIT).