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# The Adoption Process to Technology Biosecurity and Vaccination in the Dispersal of Foot and Mouth Disease Bone Regency, South Sulawesi Province

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Adopting biosecurity and vaccination technology is one of the steps that can be taken to overcome and minimize FMD disease in beef cattle farming. This study aims to analyze the farmer's adoption of biosecurity and vaccination technology in the spread of FMD. The research was conducted from November to December 2023 in Bone Regency, South Sulawesi Province. The sample size was 99 farmers whose animals were infected or not infected with FMD. Data collection methods began with observation and interviews using a questionnaire. The data analysis used was qualitative descriptive analysis using a rating scale. Research variables in the adoption process include knowledge, persuasion, decision, implementation, and confirmation. The results showed that the technology adoption process at the knowledge stage was categorized as moderate, the persuasion stage was categorized as high, the decision stage, the implementation stage, and the confirmation stage were categorized as moderate. The average difference from the stages of the technology adoption process of implementing biosecurity and vaccination as a whole is categorized as moderate with a score of 2.15.
**Keywords:** Adoption technology, biosecurity, breeders, disease, vaccination, Bone Regency, farmer adoption.

## INTRODUCTION

Beef cattle are a leading commodity in the livestock sector which is currently widely cultivated in South Sulawesi with a population of 1,483,709. The largest supplier area of cow cut in South Sulawesi is in Bone Regency, where the population is the largest, at 452,347 heads in 2022. Nevertheless, some large-scale cow-cut ownerships among the general population remain relatively modest. This is because the business is conducted on a sporadic basis and is primarily driven by the need for capital, which is often required for specific purposes and is not necessarily tied to the maintenance of the animals. The system maintenance cow cut was conducted in a manner that encompassed extensive, semi-intensive, and intensive approaches. The methodology was grounded in scientific principles and the system provided feed twice daily, either in the morning and evening or through grazing in an open field, to locate food naturally. This approach was described by Wiyatna *et al.* (2012). The system maintenance type cage is employed in a variety of ways, including as a breeder cover, individual cage, group cage, stud drum, cage for calving, and cage for quarantine. The management cage can serve as a foundation for the development of a business livestock operation, while simultaneously preventing the emergence of various potential disease threats that could harm the breeders (Zaenal, 2020). As stated by Indika (2020), the application of biosecurity represents a potential means of preventing the emergence of various diseases. This viewpoint aligns with Swacita's (2017) assertion that biosecurity is a crucial element in the control and prevention of disease, which can result in mortality. One of the exotic diseases affecting Indonesia is Foot and Mouth Disease (FMD) caused by a virus of the genus Aphthovirus. This virus is widespread in various parts of the world, including Indonesia, and can cause widespread epidemics in cattle and pigs. The disease is usually highly contagious and detrimental to all-legged animals (Nuradji *et al.*, 2017). FMD can cause significant economic losses, including reduced milk production, reduced livestock weight gain, and increased mortality in infected animals. At a global level, FMD outbreaks often result in international trade restrictions, as affected countries face export bans on animal products, which has a direct impact on local and national economies. In Indonesia, FMD poses a serious threat to the livestock sector, especially in areas that depend on livestock

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production, such as the Bone District in South Sulawesi Province. Bone District is known as one of the major cattle breeding centers in Indonesia. However, the high livestock population and animal mobility in this area increases the risk of FMD spread. The disease not only threatens the welfare of livestock, but also has a direct impact on the economic well-being of farmers and local communities, most of whom depend on the livestock sector as their main source of livelihood. Foot and Mouth Disease (FMD) has a long history in Indonesia, playing an important role in shaping livestock policies and practices in the country. FMD was first detected in the early 20th century and has caused several major outbreaks that significantly impacted the livestock industry. In 1986 Indonesia was officially free of foot and mouth disease (FMD). Various efforts have been made to maintain the country's free status (Silitonga *et al*., 2016). This FMD-free status provided a major boost to livestock product exports and increased international market confidence in Indonesian animal products. However, in early April 2022, areas in Indonesia were again affected by FMD outbreaks which were later designated as a transmitted epidemic disease by the Ministry of Agriculture on May 7, 2022. Initial reports of FMD cases on farms in Indonesia were first detected in East Java, and by the end of September 2022, the disease had spread to 24 provinces in 34 provinces in Indonesia, including South Sulawesi. Technology adoption by farmers is an important factor in the development of beef cattle farming (Abdullah, 2016). To prevent the spread of animal diseases in remote locations, it is important to apply control measures and disease prevention techniques (Amir, 2023). Vaccination is one of the effective ways to prevent diseases in livestock, including foot and mouth disease (Sarsana and Merdana, 2022). This is in accordance with the opinion of Zahid (2022) who stated that vaccination programs and the application of biosecurity in livestock areas are the most effective ways to control FMD. The implementation of biosecurity and vaccination technology among cattle farmers in Bone Regency faces a number of challenges and obstacles that need attention. One of the main challenges is farmers' moderate level of awareness and understanding of the importance of these technologies in preventing and controlling FMD. A lack of knowledge and understanding can reduce farmers' motivation to adopt new technologies, especially if they do not immediately see the benefits. In addition, limited resources, such as access to appropriate vaccines, biosecurity equipment, and technical support, can also be a significant barrier. Socio-cultural factors, including entrenched customs and beliefs, may also influence farmers' attitudes toward innovations, making them more likely to maintain traditional practices. Faced with this challenge, the government and farmers in Bone Regency need to adopt effective prevention measures, including the implementation of biosecurity and vaccination technologies. It is important to understand how the adoption of these technologies occurs among farmers, as well as the factors that influence their successful implementation. By doing so, more appropriate strategies can be developed to control the spread of FMD, reduce its economic impact, and protect the welfare of farmers in the Bone Regency. A similar situation exists in the United States, where biosecurity improvements are generally low, although the implementation of biosecurity practices is highly recommended for improvement during FMD outbreaks (Pudensz, 2021). Whereas in southern Africa, these efforts combine disease control with fencing, livestock vaccination, control of movement of animals and hoofed products, and surveillance activities (Roberts, 2018). Based on the above, this current study aims to analyze the process of technology adoption among farmers, with a specific focus on the spread of foot and mouth disease.

## MATERIALS AND METHODS

***Source of data*:** This research will be conducted from November to December 2023. This research will be conducted in the Patimpeng, Salomekko, Tonra, and Mare subdistricts. The research location was selected purposively because these sub-districts were the first to be infected with FMD in the Bone Regency and spread to surrounding sub-districts. The actors in this study are farmers whose livestock are infected or not infected with FMD in Bone Regency, South Sulawesi, and the activities are the process of adopting biosecurity and vaccination technology.

***Population and research sample*:** The population in this study were beef cattle farmers whose cattle were infected or not infected with Foot and Mouth Disease (FMD) totaling 8,268 farmers, including 3,125 farmers in Patimpeng District, 934 farmers in Salomekko District, 1,110 farmers in Tonra District and 3,099 farmers in Mare District. (Primary data, 2023). The sample of respondents in this study with a significance of $\alpha = 0.1$, the number of samples needed is 99 respondents consisting of 4 sub-districts, namely Patimpeng sub-district as many as 37 farmers where this area is the first area infected with FMD disease then spread in surrounding kecematans such as Salomekko sub-district with a sample size of 11 people, Tonra sub-district as many as 17 farmers, and Mare sub-district as many as 38 people.

The methods used to collect data in this research are

1. Observation is a direct observation to beef cattle farmers in four sub districts namely Patimpeng sub district, Salomekko sub district, Mare sub district and Tonra sub district.
2. Interviews are a method of data collection to obtain data and information provided orally, interviews are conducted face-to-face directly with resource persons, namely beef cattle farmers in Bone Regency. To facilitate the interview process, a questionnaire or list of questions addressed to beef cattle farmers was used. The questionnaire development process began by formulating

questions that were in line with the research objectives, namely understanding the adoption process of biosecurity technology and FMD vaccination among beef cattle farmers. These questions were organized based on the main research variables, such as knowledge, persuasion, decision, implementation, and confirmation. Once the questionnaire was formulated, it was validated to ensure that the instrument measured what it was supposed to measure. Validation was done by asking the research supervisor to review the questionnaire, ensuring that each item was relevant to the variables to be measured and that no important aspects were missed.

3. Documentation is looking for data in the form of records, reports, tables, photos, and so on related to the object of research. In this study, the data obtained in the form of photos together with the community as respondents.

***Data Analysis*:** The data analysis employed in this research is a descriptive qualitative analysis utilizing a rating scale. In the rating scale model, respondents are required to provide a qualitative answer to one of the provided options, as well as a quantitative answer to the same question. Consequently, the rating scale is more flexible and not limited to a single measurement attitude. It can also be used to measure respondents' perceptions of a phenomenon (Sugiyono, 2018). The interval calculation for the category is based on the subtraction of the highest score (3) from the lowest score (1), with the resulting value then being shared with the amount from the category. In the context of category measurement, the following can be observed:

1. Height: 2.34 - 3.00
2. Currently: 1.67 - 2.33
3. Low: 1.00 - 1.66

## RESULTS

***Deployment Case Disease Mouth and Nails in Bone Regency*:** The Distribution of Foot and Mouth Disease Cases in Bone Regency can be seen in Table 1.

Table 1 indicates that the FMD case has already spread across 18 sub-districts in Bone Regency. This suggests that the prevention and treatment of FMD disease is not yet being carried out to the fullest extent by the breeder. It can be posited that the breeder's level of knowledge and experience may influence their ability to effectively manage their business. The experience of those engaged in the cattle industry can influence their approach to problem-solving, the acceptance of new technologies, and their physical abilities (Astuti, 2021).

***Adoption Process*:** The research that has been conducted aims to determine and analyze the adoption process of beef cattle farmers in the application of biosecurity and vaccination technology in the spread of FMD in the farm area. The data collection process is by using a questionnaire with 5 (five) sub-variables starting from knowledge, persuasion, decision, implementation, and confirmation.

**Table 1. Cases deployment disease mouth and nails in Bone Regency.**

| Sr. | Subdistrict | Population (Tail) | | | Total Cut Conditional |
|---|---|---|---|---|---|
| | | Total Pain | Total Recovered | Total Dead | |
| 1. | Libureng | 27 | 25 | 0 | 2 |
| 2. | Kahu | 101 | 72 | 2 | 27 |
| 3. | Patimpeng | 1.062 | 863 | 40 | 159 |
| 4. | Mare | 229 | 195 | 27 | 7 |
| 5. | Tonra | 192 | 173 | 19 | 0 |
| 6. | Salomekko | 127 | 112 | 15 | 0 |
| 7. | Palakka | 7 | 7 | 0 | 0 |
| 8. | Barebbo | 3 | 1 | 2 | 0 |
| 9. | Tellu Limpoe | 1 | 1 | 0 | 0 |
| 10. | Dua Boccoe | 48 | 48 | 0 | 0 |
| 11. | Sibulue | 15 | 15 | 0 | 0 |
| 12. | Cenrana | 44 | 42 | 2 | 2 |
| 13. | Awangpone | 132 | 132 | 0 | 0 |
| 14. | Tellusiattinge | 272 | 272 | 0 | 0 |
| 15. | Ajangale | 7 | 7 | 0 | 0 |
| 16. | Tanete Riattang Barat | 6 | 6 | 0 | 0 |
| 17. | Amali | 3 | 3 | 0 | 0 |
| 18. | Tanete Riattang | 10 | 10 | 0 | 0 |
| | Bone | 2286 | 1984 | 107 | 195 |

Source: Livestock Service Regency Bone 2023

***Knowledge*:** This stage of the adoption process begins when the breeder first encounters new ideas, information, and technology. It signifies that the breeder is still seeking or accepting information about technology. The knowledge of the breeders at this stage of the adoption process can be observed in the following picture.

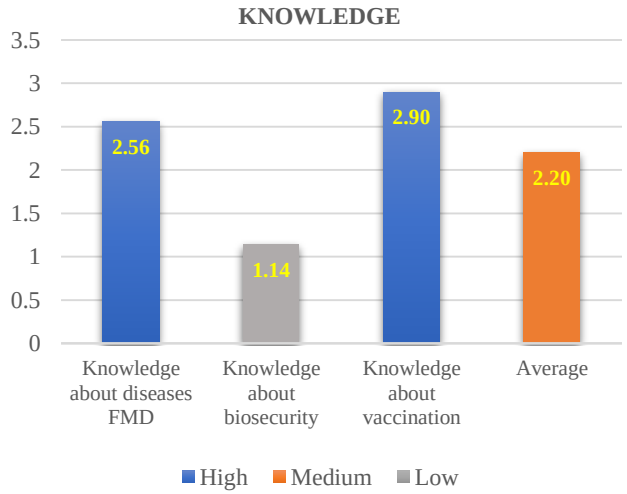


**Figure 1. Knowledge breeder cow cut from stages of the adoption process technology on FMD in Bone Regency in 2024.**

***Persuasion*:** The process of persuasion in the context of adoption is a challenging endeavor. It requires the exertion of influence to persuade breeders to accept innovations, which are new offerings from the instructor. The stages of the adoption process, as depicted in the subsequent image, demonstrate the potential for technology to facilitate the spread of FMD in the Bone Regency region.

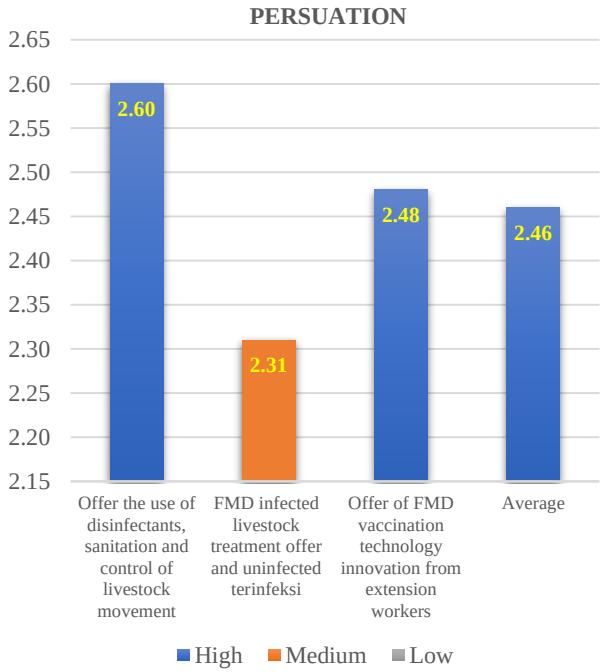


**Figure 2. Stages Persuasion in the adoption process technology on FMD in Bone Regency in 2024.**

***Decision*:** This decision was made by a breeder who was already aware of and had a working knowledge of the new technology. After gathering information from various sources, including observing the results of the technology in action, the breeder began to assess and evaluate the potential of the innovation. After determining the impact of the technology, the breeder was then able to decide whether to adopt or reject the innovation. The decision to deploy the technology for the treatment of Disease Mouth and Nails in Bone Regency can be observed in the subsequent image.

***Implementation*:** Implementation is the process by which a breeder applies or adopts technology in a manner that is both individual and collective. In addition, breeders ensure that the technology is adopted in an effective manner, thereby ensuring that the anticipated benefits are realized. The implementation of technology in the spread of Disease Mouth and Nails in Bone Regency can be observed in the accompanying image.

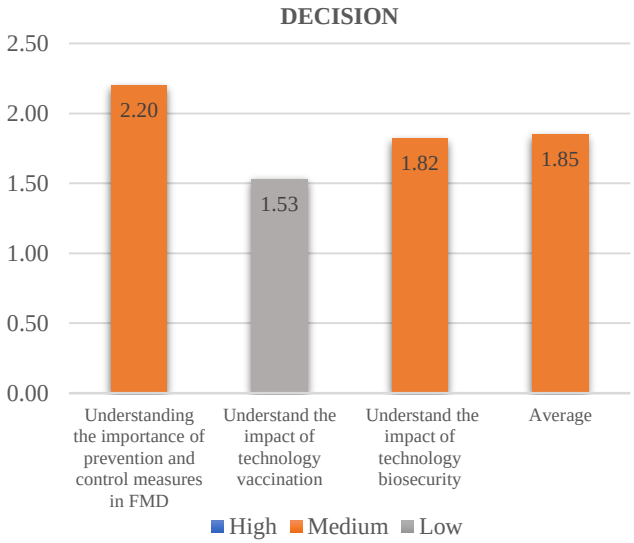


**Figure 3. Decision from stages of the adoption process technology on FMD in Bone Regency in 2024.**

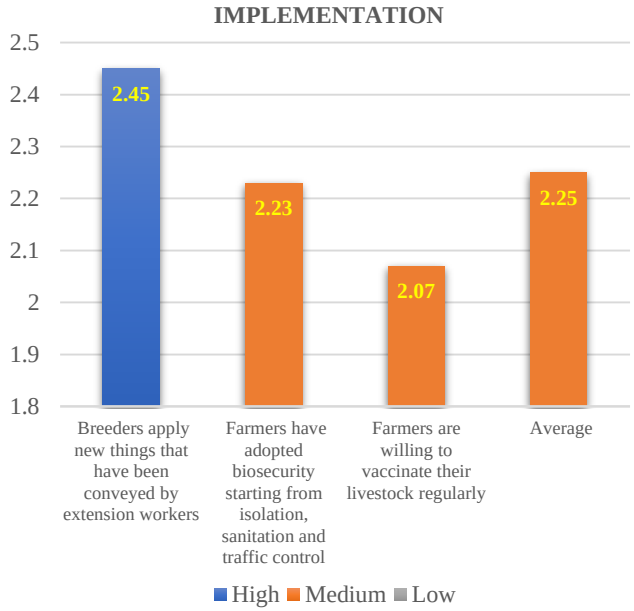


**Figure 4. Implementation from stages of the adoption process technology on FMD in Bone Regency in 2024.**

***Confirmation*:** The confirmation stage is where the breeder can determine whether the technology in question will yield the desired results and benefits. Breeders also conduct evaluations to ascertain the suitability of technology for use. These evaluations are conducted over a range of timeframes, from the short term to the long term, and are designed to ensure that the technology is fit for purpose in the future. The confirmation of the adoption process of technology in the

spread of Disease Mouth and Nails in Bone Regency can be observed in the subsequent image

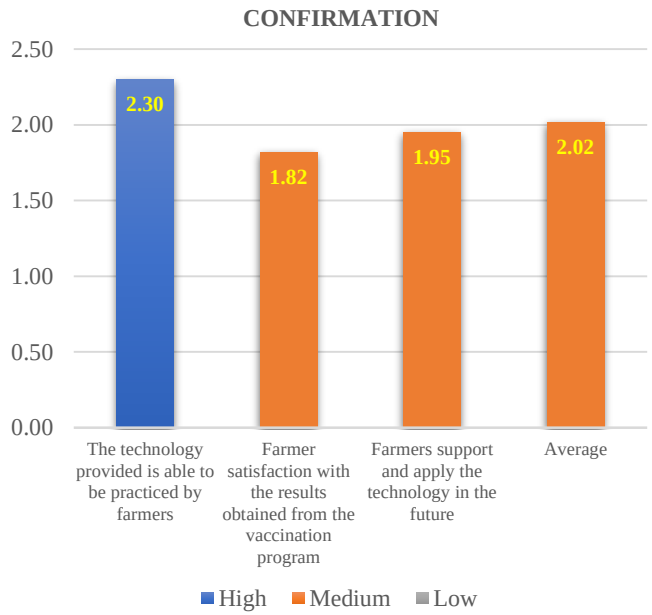


**Figure 5. Confirmation from stages of the adoption process technology on FMD in Bone Regency in 2024.**

## DISCUSSION

***The outbreak of disease in the mouth and nails of cattle in Bone Regency*:** The outbreak of disease in the mouth and nails of cattle in Bone Regency began with the entry of buffalo from Flores NTT, which were brought by traders into Toraja Land. One breeder in the village of Massila Subdistrict Patimpeng purchased the animals, but neither the traders nor the breeder were aware of the potential infection of the buffalo with FMD. In fact, the buffalo were not intentionally released and were instead moved to a village located next door. Ultimately, direct contact between the breeder and livestock infected with FMD occurred. Over several days, the disease spread from animal to animal, eventually infecting several villages in the area. Local breeders and officers promptly initiated a preventative and treatment process for livestock infected with FMD, due to the high rate of transmission. The majority of breeders opted to care for the infected cows in their respective areas.

Infected livestock will display clinical symptoms, including sores on the mouth and feet, fever, foamy saliva, and decreased appetite. Several cattle were successfully treated and recovered. Nevertheless, there are instances where infected livestock exhibit severe symptoms until the extension officer or inseminator recommends that the animal be slaughtered to prevent the further spread of the disease and to reduce the breeder's losses. In addition, the condition of the environment on farms that lack proper hygiene and sanitation, as well as access to adequate care and handling, can result in high mortality rates among livestock.

***Knowledge*:** The results of the research conducted on the data presented in Figure 1 show that the highest knowledge of farmers is in the knowledge of vaccination (2.90). The majority of farmers (89%) often heard the term "vaccination" and had experience in vaccinating their animals before the FMD outbreak occurred. This is similar to the findings of Athambawa *et al*. (2021) which showed that the majority of farmers in Sri Lanka had good knowledge about FMD and good vaccination behavior. As many as 54% of the surveyed farmers had vaccinated their livestock before the FMD outbreak occurred. In contrast to the findings of MacPhillamy *et al*. (2022) who stated that the majority of farmers in Laos have an awareness of the importance of vaccination. However, the application of vaccination was limited, and many farmers did not routinely vaccinate their animals before the outbreak.

The high knowledge of the FMD epidemic (2.56), is evidenced by about 66% of farmers often hearing about FMD from their surroundings, even though they see the symptoms experienced by their livestock they immediately report it to local officials for treatment assistance. However, what was found in Kazakhstan was higher, namely, there were 84% of farmers knew FMD disease from surrounding farms (Bayantassova *et al*., 2023). Meanwhile, Osmani (2021) in his findings showed that 48.5% of farmers have heard or know the name FMD and that immediate reporting of animal diseases by farmers is very important to control and eradicate this disease by local and regional authorities.

There is still a lack of knowledge among farmers regarding biosecurity. Indeed, a recent survey revealed that 87% of respondents had never heard of the term "biosecurity". But without realizing it, most of them have implemented at least one element of biosecurity, namely sanitation. This is evidenced by the fact that every day the farmers clean their cages of feces as well as feed and water containers. This is similar to the findings of Mutua *et al*. (2021) that some farmers in Kenya have implemented biosecurity practices such as sanitation, but other practices are still limited due to personal preferences, limited veterinary services and lack of necessary infrastructure. This shows the complexity of implementing biosecurity in a rural environment with limited resources. Whereas in Australia, biosecurity knowledge has a positive influence on the implementation of biosecurity measures (Paquette *et al*., 2020).

***Persuasion*:** Figure 2 illustrates the results of the study, which indicate that the most effective stage of persuasion is the offer of disinfection, sanitation, and control. The next step is to cross cattle with a score of 2.60. The Animal Husbandry Department of the Bone Regency has distributed one 1-liter jar to breeders in the FMD distribution area. This was done by each inseminator on duty. In addition to this, the

department has provided education, sanitation, housing, and control. The cattle have been crossbred as a method of disease prevention. This is because vehicles pose a risk of introducing disease if they enter the livestock area too frequently. This matter is in accordance with the opinion of Swacita (2017), which states that the objective of disinfection is to eradicate seeds that remain sick within the cage, as well as on the floor and in the air. The optimal cage is one that is done optimally. The offer of FMD vaccination technology innovation from extension workers is also high (2.48), which indicates that the existence of this innovation can influence the beliefs, attitudes and behavior of farmers to increase knowledge and skills and consider accepting ideas or new things that have been conveyed by extension workers. This is in accordance with the opinion of Pateda (2010) that agricultural extension workers act as mission carriers who will convey ideas, and new things to the users, namely farmers along with their families. The more active the extension workers promote an innovation, the higher the level and speed of adoption of the innovation is expected. Sirajuddin *et al*. (2017) in their findings state that people need time to make a decision to accept or reject an innovation, which is influenced by several factors, namely the innovation itself, the nature of the target, decision-making, communication channels used, and information sources. It is recommended that treatment be given to both FMD-infected and uninfected livestock, as well as feed management (2,31) interpreted as local instructors who have educated farmers on possible steps to overcome FMD outbreaks. These steps include immediately separating infected livestock from healthy livestock to prevent the spread of the disease. In addition, farmers must ensure that the feed given to infected animals is sufficient to ensure adequate nutrition, which will facilitate the recovery process. As stated by Cabezas *et al*. (2021) in their findings that stopping the movement of livestock between sick and healthy has proven effective in controlling the spread of FMD on farms. Adequate nutrition is also important for the recovery of infected livestock.

***Decision*:** A study of the results indicates that the decision-maker is still currently unaware of the importance of action in the prevention and control of FMD disease. Only 46% of breeders have the capacity to take appropriate action for the first instance of infection in their livestock, which is typically treated with a traditional drug. In addition, some breeders give their livestock a mixture of ingredients, including ginger, turmeric, and orange peel, which is believed to have a beneficial effect. There are also instances of direct administration of coconut water, although this is not yet the preferred method. Finally, contact with a local officer is sought for assistance in the FMD treatment process. Research conducted by Osmani (2021) indicates that farmers employ traditional methods to treat animals exhibiting clinical signs, including placing the animal in a pen with running water or applying a paste of crystal alum, locally referred to as "Zamj," to the infected area. The lack of understanding of the term "biosecurity" among farmers is a significant barrier to the effective application of technology in animal husbandry. This is evident from the 70% of farmers who do not have adequate knowledge on this subject, resulting in a lack of awareness and information among farmers. Mashur (2022) argues that farmers who are unaware and fail to implement recommended control measures, or who are not enrolled in control programs, may be involved in disease prevention in an unintentional manner. It is important to understand the impact of technology-based vaccination on the health and economy of cattle farmers. Only 39% of farmers recognize that vaccination can protect livestock from potential disease hazards. Another 57% were still not convinced due to rumors among farmers that vaccination would negatively impact cattle productivity. Compared to another study conducted in Laos by Nampanya (2018) showed that more than 86% of farmers indicated that FMD vaccination was an excellent preventive measure because their livestock were protected from foot and mouth disease through vaccination.

***Implementation*:** A study of the results indicates that the implementation rate is highest at around 55% among breeders who have applied the new techniques and knowledge imparted by the instructor or officer at the local level. These include an understanding of the importance of biosecurity, the treatment and vaccination of FMD in livestock, and the reduction of pain and mortality. This matter is in accordance with the opinion of Djati (2023), who stated that the implementation of vaccination in cattle increases immunity and prevents death, as well as strengthening biosecurity with the support of innovative technology as a means of preventing reinfection. Approximately 36% of breeders have already adopted biosecurity practices, which begin with isolation, sanitation of the cage, and control measures. These are then extended to livestock areas. Conversely, 51% of breeders have not yet implemented all elements of biosecurity due to a number of influencing factors, including a lack of awareness and understanding of the importance of these practices. Additionally, some breeders believe that this program requires investment in time, money, and resources. Others lack the capacity to implement these practices. Mehmet and Nuri (2014) observed that only a select few small manufacturers employ biosecurity practices, particularly those that are inexpensive and straightforward. These practices must be enhanced among small-scale producers. The breeder is willing to administer vaccinations to livestock on a periodic basis. The vaccination regimen is moderate (2.07). A significant proportion of breeders (41%) are highly willing to vaccinate their livestock on a periodic basis, while 26% are moderately willing to do so. This willingness is accompanied by a desire to adopt vaccination as a means of protecting their livestock, as well as a willingness to consider the results of previous FMD vaccination programs. In the event of negative results, 33% of breeders are willing to

abandon the practice. The government has implemented a program of mass vaccination, conducted in a gradual and regionally distributed manner, on three occasions. This approach aligns with the findings of Singh's (2019) research, which indicates that India has employed a strategy of controlling FMD through the use of a systematic, nationwide vaccination program (FMDCP). The implementation of the adoption process in stages can be obtained on average, namely 2.25, in the context of an enthusiastic breeder who has been confirmed as a No Can breeder. This breeder does not require a No Can instructor to carry out an FMD vaccination program for livestock, and cow cuts. However, extension workers and inseminators attempt to influence and direct breeders to obtain counseling about technology vaccination. This is done in order to inform them of the importance of vaccination for cattle and to prevent FMD disease. This matter is in accordance with the opinion of Lamarang *et al.* (2017), who stated that existing breeders attempt to adopt technology because they have received counseling about technology-assisted animal husbandry from extension workers and other breeders who have already adopted technology. They believe that it is important for them to adopt technology because they can obtain profits from their farms. Confirmed by Richens *et al*. (2015) who stated that in the UK the role of veterinarians in providing and recommending vaccinations is highly valued by farmers, which influences their vaccination decisions.

***Confirmation*:** The results are presented in Figure 5 which shows that the technology can be effectively utilized by farmers who have reached a high level of proficiency (2.30). Farmers' demonstration of the technology delivered by the instructors shows that the technology has been successfully integrated into practice by 50%, starting from the application of biosecurity and FMD vaccination judging from the enthusiasm of beef cattle farmers in the four sub-districts. A farmer may choose to vaccinate, even in the absence of FMD, if they perceive a net benefit from the vaccine and want to compare results between vaccinated and unvaccinated animals. This is in accordance with the opinion of Lamarang *et al*. (2017) who stated that farmers who have tried technology are counseling on livestock technology by extension workers and farmers who have applied technology because they know the importance of livestock technology. Farmers' satisfaction with the results of the vaccination program was moderate (1.82). The proportion of farmers who were satisfied with the results of the vaccination program was 61%, while those who were dissatisfied were 28%. This indicates that the program has not provided significant results in terms of reducing morbidity and side effects when the next day after being vaccinated, the animals could not walk, had no appetite, and even had swollen eyes. However, some animals recovered and resumed eating after one month of vaccination. This is similar to the findings of *Robi et al.* (2023) which showed that farmers in Ethiopia with better knowledge of vaccination tended to be more satisfied with the results. About 60% of farmers were satisfied with the vaccination program, although challenges in access and implementation still exist. Whereas the findings of Nuvey *et al*. (2023) in Ghana showed that the use of vaccination services was low with only 16% of farmers having vaccinated their livestock and farmers' satisfaction depended on the availability and effectiveness of vaccines and interactions with veterinary officers.

The farmers in question are supportive and have demonstrated the ability to apply the technology in the medium term, with an estimated score of (1.95). The number of farmers willing to participate in the program is high, with 56% indicating a willingness to participate and 29% indicating a very high willingness to participate. This shows that farmers realize the importance of disease protection for their health and business success. With this program, the entry of disease in the livestock area can be minimized. As stated by Osmani (2021), the most effective way to control and eradicate FMD in the future is through the application of vaccination in emergency situations in areas where epidemics are likely to occur. The adoption process until it reaches the last stage shows that farmers can be considered as a medium for implementing biosecurity and vaccination technologies. Therefore, veterinary extension officers and farmers can engage in further communication and participate in planning and improvement activities to address any shortcomings in the program. This will help increase the level of farmer satisfaction with the biosecurity and FMD vaccination programs. based on the findings of Dione *et al*. (2020) which showed that in the Ugandan region, participatory training can improve farmers' knowledge and attitudes towards biosecurity however, changes in biosecurity practices require time and ongoing support from extension and research. This study has significant implications for FMD control efforts and improving livestock health and productivity in Bone District. By understanding the process of biosecurity and vaccination technology adoption by farmers, relevant parties, such as local government and livestock extension workers, can formulate more effective and targeted strategies in educating and supporting farmers. If the adoption of biosecurity and vaccination technologies can be increased, the potential spread of FMD in the region can reduce the number of infected livestock, which in turn will reduce livestock mortality and associated economic losses. In addition, with better FMD control, overall livestock health will improve, which will have a positive impact on livestock productivity.

The success in controlling FMD in Bone Regency can also serve as a model or reference for other regions facing similar challenges, thus having a positive impact on animal disease control at the national level. Ultimately, improved livestock health and productivity will contribute to the economic welfare of farmers and communities in the region, as well as increase the competitiveness of local livestock products in the

wider market. The results of this study provide a basis for future research directed at further exploring the factors that influence the level of involvement of farmers in the technology adoption process, especially in the early stages. One of the challenges identified was the moderate level of awareness and understanding at the beginning of the process, indicating the need for more effective approaches in educating and informing farmers about new innovations. Further research could focus on developing communication methods and extension strategies that are more adaptive and responsive to farmers' needs, including the use of more interactive media or a more personalized approach.

***Conclusion*:** The results of this study found that the adoption process of biosecurity and vaccination technologies among beef cattle farmers in Bone District experienced increased engagement from the knowledge stage to implementation and confirmation. Although initial awareness levels were moderate, as the persuasion stage progressed, farmers showed higher acceptance of these technologies, with around 50% understanding how to apply the new techniques. This finding is significant as it shows that effective extension at the persuasion stage is critical in influencing farmers' decision to adopt new technologies. This highlights the need for more intensive and adaptive extension approaches to increase acceptance of technologies that can help control FMD, improve livestock health and ultimately, support the economic sustainability of farmers in the region.

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