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Communal Livestock Farmers' Perceptions of Foot-and-Mouth Disease Control Measures in Mopani District, Limpopo Province

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ABSTRACT

Foot-and-mouth disease (FMD) poses a significant risk to livestock-dependent livelihoods in communal areas of South Africa, where effective management relies on farmer collaboration amid regular livestock movement and reliance on markets. This study analyzed the influence of communal farmers' perceptions of FMD risk and control measures on their reporting and compliance behaviors in the Mopani District of Limpopo Province, aiming to inform effective disease control strategies. A qualitative exploratory design was employed, using semi-structured questionnaires administered to 160 communal livestock farmers. Data were analyzed employing Braun and Clarke's reflexive thematic analysis. Farmers identified significant FMD symptoms but hesitated to report them due to the associated quarantine measures and movement restrictions, resulting in severe livelihood losses. Farmers believed that vaccination and regular dip-tank inspections were effective ways to protect themselves against FMD. In contrast, quarantine and movement restrictions were perceived as shocks to livelihoods, disrupting sales and household cash flow. While information relied heavily on animal health technicians, the absence of acknowledgment and feedback after the farmer interaction frequently eroded trust in the official response. The results show that technically effective control programs can be socially dangerous if they do not adequately consider livelihood costs, procedural fairness, and two-way communication. Improving FMD control requires participatory risk governance, backed by reliable preventive services, established feedback mechanisms, effective risk communication, transparent and timely restrictions with consistent enforcement, and organized farmer engagement through dip-tank platforms.

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Introduction

Foot-and-mouth disease (FMD) poses a persistent threat to livestock-dependent livelihoods worldwide. In regions where cattle and small stock play a crucial role in household survival and social structures, the effects are particularly significant. In the Mopani District of South Africa, communal livestock systems contribute to income generation, food security, customary practices, and the reinforcement of local identity (Kone *et al*., 2025 & Wesley *et al.,* 2025). FMD control is a veterinary priority and a governance and livelihood concern. The effectiveness of control measures depends on the decisions and collaboration of livestock keepers who face tangible constraints (Kerfua *et al.,* 2023). Traditional control measures for FMD include early detection of symptoms, continuous surveillance of livestock, timely vaccination when appropriate, and strict management of animal movement (Al-Hammadi, 2025). Livestock farmers implement these measures. Therefore, farmers should actively look for signs of FMD, report any suspicions promptly, strictly follow quarantine measures, control animal movement, and ensure animals are available for inspection at designated locations, such as communal dip tanks (Ngoshe *et al.,* 2022). The consistency of FMD control practices is influenced by factors such as perceived disease risk, trust in veterinary authorities, the availability and reliability of disease information, and past experiences with enforcement and service provision. Limpopo's legal control framework, especially in designated areas, establishes clear rules and procedures for addressing FMD outbreaks and suspected incidents. Nevertheless, outbreaks and suspected incidents persistently lead to abrupt restrictions that impede mobility, sales, and household cash flow (Ramarumo, 2025). Disruptions may intensify scepticism and decrease cooperation among farmers. This occurs when they feel excluded from decision-making, burdened unfairly, or lack sufficient information about the situation.

FMD is caused by an *aphthovirus* with various serotypes; therefore, the effectiveness of vaccines depends on matching the circulating strain(s), which renders vaccination programs technically and logistically challenging (Adamchick *et al*., 2021 and Mahapatra & Parida, 2018). Technical challenges intensify in communal systems where livestock interact at shared grazing and water points. Practical biosecurity measures, like limited access to veterinary care and quarantine facilities, further complicate the situation. In various African settings, managing FMD effectively faces consistent hurdles, including fragmented control efforts, limited resources, and difficulties in regulating movement within pastoral or semi-communal systems (Souley Kouato *et al*., 2018). In South Africa's protection and interface zones, routine inspections, health checks of livestock, and movement restrictions, such as temporary quarantines, are implemented to contain the spread within high-risk areas (Mogotsi *et al*., 2016). Time costs, opportunity costs, and marketing constraints can significantly burden smallholders who depend on livestock sales to meet urgent household needs (Fana *et al*., 2021). During the confirmed outbreaks in Limpopo in December 2025, actions such as quarantine, movement restrictions, coordination mechanisms, and vaccination campaigns were implemented, accompanied by public requests for collaboration and reporting. Recognising this dual focus underscores a key principle: compliance is not automatic; it requires building trust, ensuring clarity, and maintaining perceived fairness, especially when

livelihoods are affected (Moya *et al*., 2023). The effectiveness of FMD control depends more on human behaviour than technology alone (Sieng *et al*., 2022; Cabezas *et al*., 2022 & Blacksell *et al*., 2019). Compliance is influenced by factors such as perceived risk, benefits, practical barriers, and trust in the controlling institutions (Obaido *et al*., 2026). Farmers usually follow interventions perceived as top-down or punitive only when enforcement is visible. However, they may retract their cooperation if costs rise or their trust in veterinary services wanes (Catley *et al*., 2012). Although African studies have thoroughly explored the epidemiology of FMD and the technical solutions available (Woldemariyam *et al*., 2023), there is a notable dearth of research concentrating on the lived experiences of foreground communal farmers (Sopeju *et al*., 2019).

Farmer perspectives indicate that access to knowledge and information is crucial for timely reporting and surveillance. Delays in reporting can increase the risk of outbreaks when people perceive symptoms as "ordinary sickness" (Railey & Marsh, 2019). This aspect highlights the need to customise communication for local contexts, use reliable messengers, use appropriate languages and channels, and provide feedback showcasing the benefits of reporting. When farmers feel excluded despite bearing the highest livelihood costs, disagreements with stakeholders over FMD control tools can undermine legitimacy and lead to inconsistent compliance (Mehmedi *et al.,* 2025 & Gulwako *et al*., 2025). Effective disease control is crucial for protecting livestock health, ensuring economic stability, and maintaining food security in the region. Analysing how farmers perceive FMD control measures can reveal barriers to compliance and areas for improvement. Continual tensions regarding costs, fairness, and enforcement may undermine compliance efforts and unintentionally increase the risk of outbreaks. Understanding farmers' views on the legitimacy, practicality, and benefits of specific control measures is essential to build trust and promote adoption. This research aims to connect policy and practice by integrating farmers' perspectives. The results aim to create practical FMD strategies that are responsive to farmers' needs, protect livelihoods, and improve disease control outcomes.

Research Problem

Frequent outbreaks and sudden restrictions in Mopani District severely disrupt communal livestock livelihoods, which pose major obstacles to FMD control efforts. Communal factors such as shared grazing, informal movement, inadequate infrastructure, and limited access to timely information hinder the effectiveness of control measures. Although policies often assume compliance, there is a lack of district-level qualitative evidence clarifying farmers' perceptions of FMD risk. Additionally, there is a need to evaluate the legitimacy and effectiveness of control measures. It's also critical to comprehend how trust, communication, and enforcement affect farmers' decisions about reporting and compliance. Delayed communication, inconsistent enforcement, and punitive restrictions can lead farmers to delay reporting or engage in informal movement, thereby increasing the risk of disease spread. The lack of insight into these perceptions and decision-making processes in FMD strategies can lead to social fragility, incomplete compliance, delayed disease detection, and ongoing conflicts.

Objectives

- To examine farmers' comprehension of FMD risk and how this influences reporting intentions.
- To analyze perceptions of key control measures (vaccination, inspections, quarantine, and movement restrictions), including perceived benefits, costs, and feasibility.
- To assess trust and communication dynamics between farmers and veterinary/extension institutions
- To identify farmer-informed recommendations for improving FMD control design and implementation in communal systems

Research Methodology

Study Area

The research was carried out in the Mopani District Municipality, a largely rural area located in the north-eastern part of Limpopo Province, which includes Ba-Phalaborwa, Greater Giyani, Greater Letaba, Greater Tzaneen, and Maruleng. Mopani spans roughly 20,012 km² and is strategically positioned along key cross-border and interprovincial connections, facilitating crucial livestock mobility, marketing, and the enforcement of disease-control regulations, particularly with Mozambique and Zimbabwe, as well as routes to Mpumalanga and nearby Limpopo districts. This strategic location makes it a vital pathway for livestock movement, marketing activities, and the enforcement of disease-control regulations. The district encompasses a distinct escarpment-to-lowveld gradient, characterised by significant seasonal summer rainfall and considerable climatic variability, with annual temperatures ranging from approximately 20 to 24°C and rainfall varying from around 450 mm to over 1200 mm. Governance and service access exhibit significant disparities. Extensive regions, inadequate infrastructure, and considerable distances to services influence the reception of animal-health information and the practicality of compliance during outbreak restrictions. Communal livestock production is structured around collective resources, with regular service hubs like dip tanks playing a central role. These tanks serve as key points for inspection, vaccination, surveillance, and information exchange, essential for the management and well-being of livestock in the community. The district's proximity to conservation and tourism sites, particularly near Kruger National Park and private reserves, underscores the significance of interactions between livestock and wildlife, as research demonstrates. Therefore, this district is ideal for examining how farmers view and respond to measures for controlling FMD.

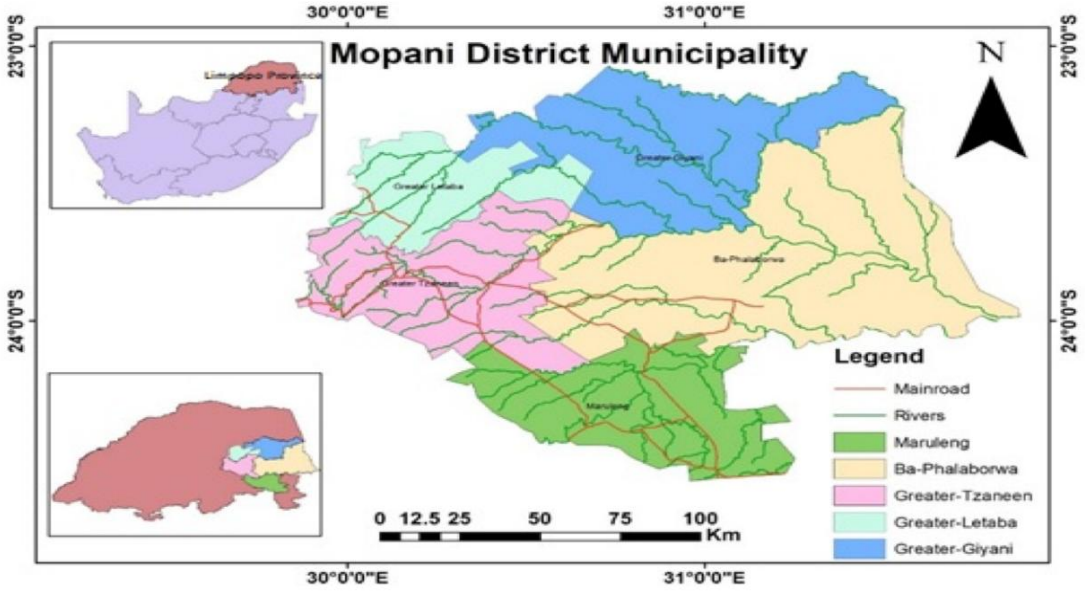

Figure 1. Mopani District Municipality

Research design and Sampling

This study used a qualitative research design with a semi-structured questionnaire to gain insights into how communal livestock farmers in specific districts understand, interpret, and experience FMD control measures in their daily lives. The target population included communal livestock farmers who use the dip-tank system for animal health services, which was recognised as the primary entry point for coordinating key control activities. A deliberate sampling strategy was used to select dip tanks as study sites, including tanks of varying sizes, accessibility, enforcement intensity, and outbreak history to cover a wide range of implementation scenarios. Participants were selected from the designated dip-tank sites through purposive sampling to ensure a mix of traits that could affect perceptions and decision-making. Participants were selected from farmers who expressed a willingness to engage in follow-up discussions and provided informed consent. Data collection involved in-depth interviews, repeated until no new themes emerged, ensuring comprehensive coverage.

Data collection

Dipping tanks were used as key locations for participant recruitment and face-to-face interviews. Before conducting fieldwork, the interview guide underwent pre-testing with 10 livestock farmers to enhance its wording, flow, and clarity. The final dataset included a total of 160 communal livestock farmers from 40 dipping tanks in various municipalities, such as Greater Letaba (5 dipping tanks with 20 farmers), Greater Tzaneen (5 dipping tanks with 20 farmers), Greater Giyani (10 dipping tanks with 40 farmers), Maruleng (5 dipping tanks with 20 farmers), and Ba-Phalaborwa (15 dipping tanks with 60 farmers). Interviews were conducted in the languages preferred by the participants, such as Xitsonga, Sepedi, Tshivenda, and English. Bilingual support was offered

when necessary. Data collection was conducted iteratively and concluded once sufficient information power was achieved, indicating that no significant new insights emerged across different sites and participant groups.

Data Analysis

The data analysis employed Braun and Clarke's reflexive thematic analysis, which conceptualises coding and theme development as an interpretive and reflexive endeavour, rather than merely a mechanical reliability exercise (Braun & Clarke, 2006). Interview transcripts were reviewed multiple times to improve understanding of the dataset by ensuring thorough familiarity with the content. Inductive, data-driven coding was used to identify patterns in farmers' responses to FMD risk and in their engagement with preventive measures. The codes were compared systematically for similarities and differences among participants, then organised into themes to reveal patterns in the data. These themes were carefully assessed against coded extracts and the complete dataset, refined for coherence, consistency, and clear boundaries, and finally named to create the final analytical story.

Results

The findings presented in Figure 2 indicate that communal livestock farmers identified lesion-related signs, as reflected in their knowledge of FMD. The most common signs reported were oral sores (29%), sores on the feet or hooves (27%), lameness (13%), and fever (9%). A smaller proportion of respondents, out of the total surveyed, identified excessive salivation (8%) and sudden death in adults (6%) as significant indicators. Ultimately, 80% of respondents reported a lack of knowledge about FMD signs. Participants had different opinions regarding understanding FMD risk and reporting intentions, with key perspectives outlined in Table 1. Notably, 90% indicated they would report on the same day, 22% within a week, while the majority, 69%, stated they would not report at all. The main obstacles to reporting were fear of movement bans or quarantine restrictions (78%), lack of transport (13%), delayed responses from officials (6%), and lack of airtime (3%).

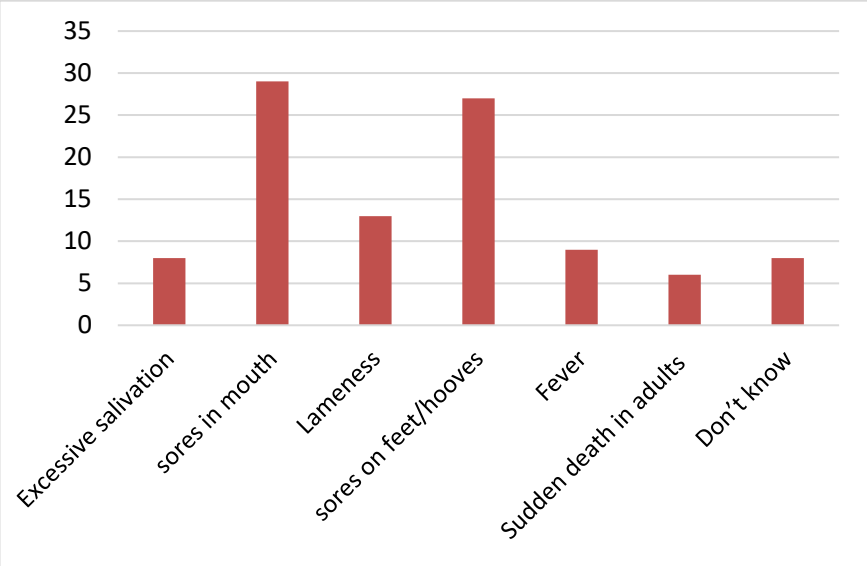

Figure 2. Knowledge of FMD signs

Table 1. Understanding of FMD risk and reporting intention

Item	Response	Frequency(n)	Percentage (%)
Intended reporting	Same day	15	9
time	Within week	35	22
	Not report	110	69
Main Barries	Fear bans	125	78
	No transport	20	13
	No airtime	5	3
	Delay response	10	6

Perceptions of essential FMD control measures indicated varied acceptance, coupled with significant concerns regarding livelihoods, as illustrated in Figure 3. A significant proportion of respondents reported that quarantine results in substantial financial difficulties for their households (85% Yes, 15% No). In addition, opinions on movement restrictions were mostly negative, as 60% disagreed that these measures are essential for controlling FMD, while only 40% agreed. Conversely, 70% of respondents believed that routine dip-tank inspections help in early FMD detection, while 30% disagreed. Moreover, Figure 4 emphasises the widespread belief in the effectiveness of vaccines. Most respondents agreed that FMD vaccination reduces the risk of the disease in livestock, with 70% strongly agreeing and 20% agreeing. A small number of respondents were sceptical: 5% expressed disagreement, and an additional 5% strongly disagreed. Overall, 90% strongly agreed, showing strong confidence in vaccination as a key measure for controlling FMD.

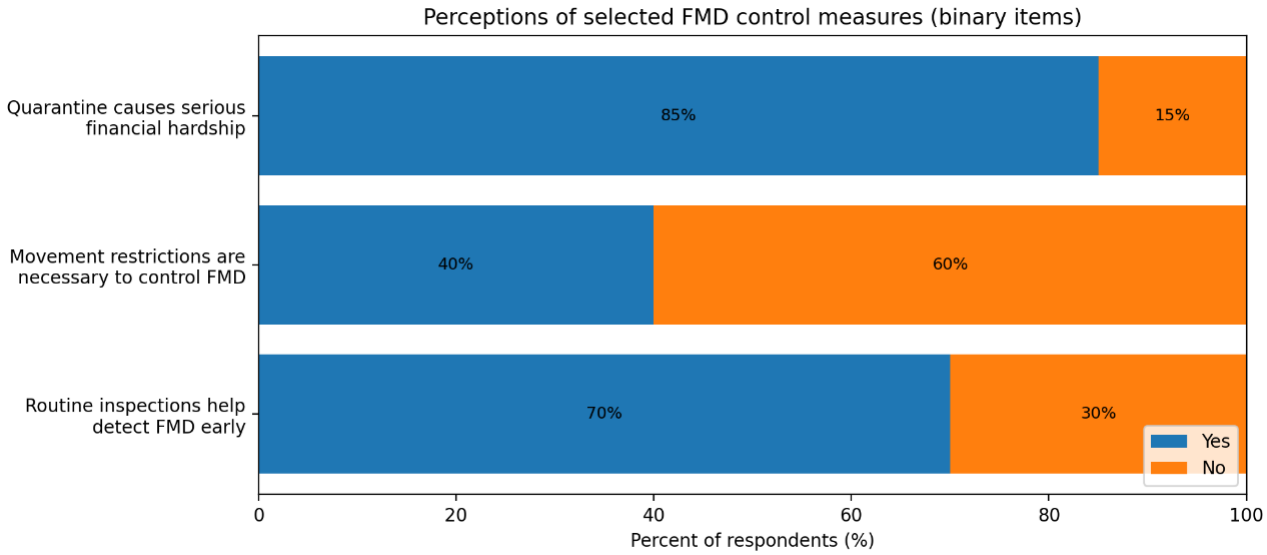

Figure 3. Distribution of responses to binary perception items on FMD control measures

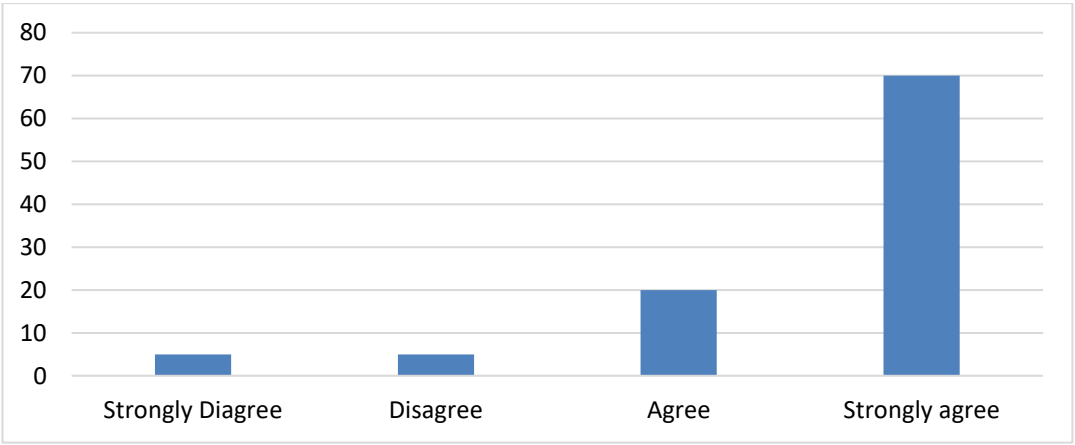

Figure 4. Distribution of agreement levels on the perceived effectiveness of FMD vaccination in reducing risk in the livestock

Farmers expressed various viewpoints on the sources of FMD information, as illustrated in Figure 5, which were primarily influenced by formal animal health services. Animal health technicians were the main providers of FMD information for most respondents (60%), followed by agricultural advisors (15%) and local community health groups (12%) as additional sources. A small percentage of respondents relied on traditional leaders (5%) and friends/peers (5%) as sources, while radio (3%) was the least cited source. According to Figure 6, farmers prioritise the involvement of livestock keepers in decisions to improve FMD control. Most respondents stressed the significance of farmers participating in planning (60%), receiving support during restrictions (25%), ensuring consistent enforcement (10%), and providing early warnings and timely information (5%). Additionally, there

appeared to be limited acknowledgement and feedback from animal health technicians regarding the FMD information. As shown in Figure 7, 40% of respondents reported receiving acknowledgement and feedback after engaging or reporting, whereas 60% reported not receiving any acknowledgement or feedback.

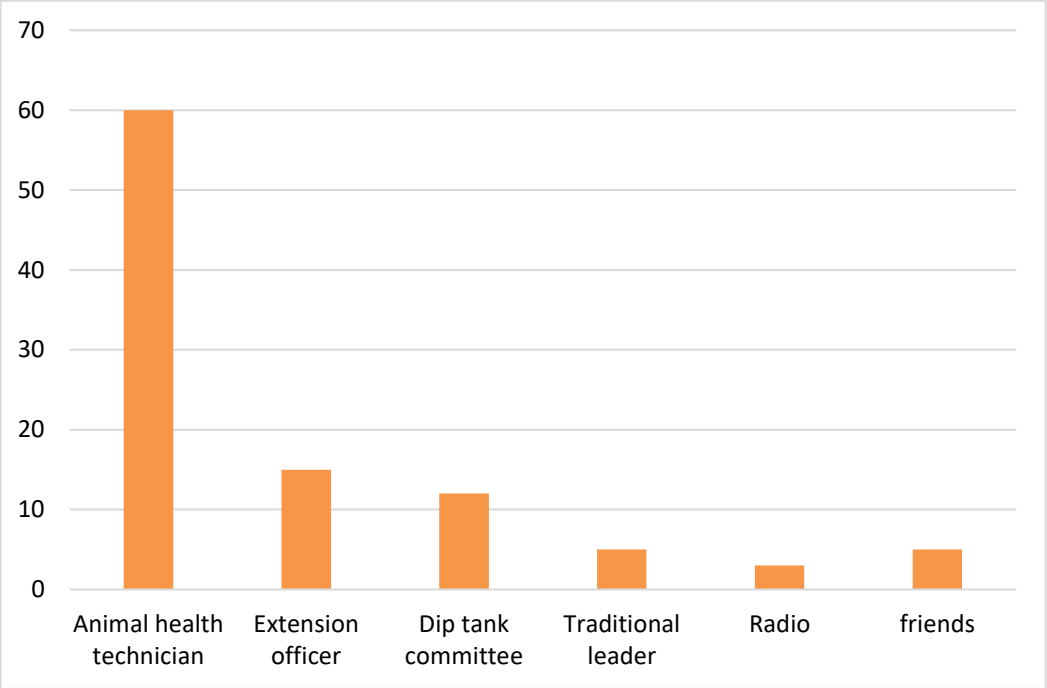

Figure 5. Sources of FMD information

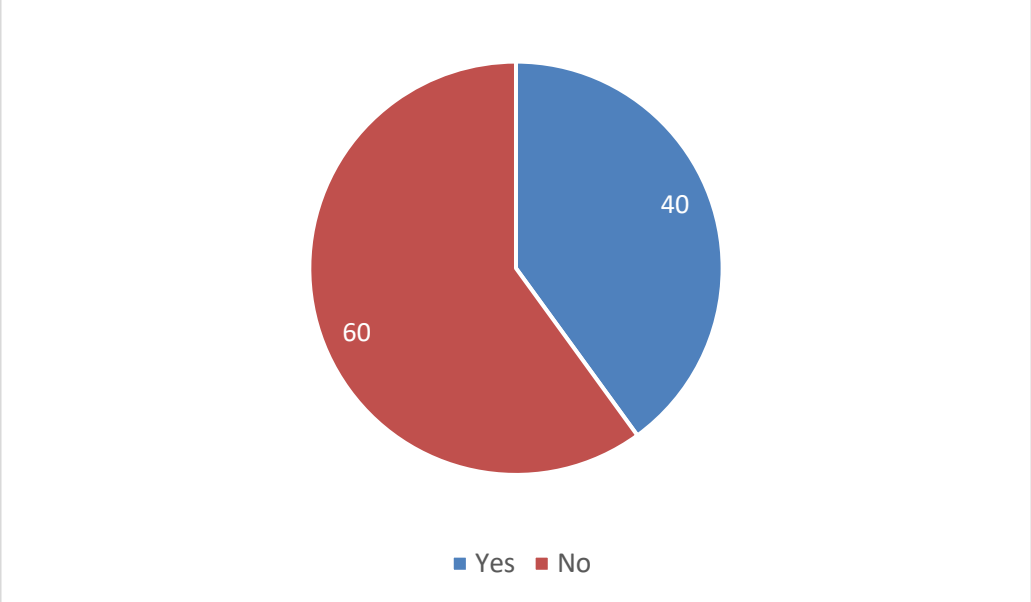

Figure 6. Acknowledgement and feedback from Animal Health Technician

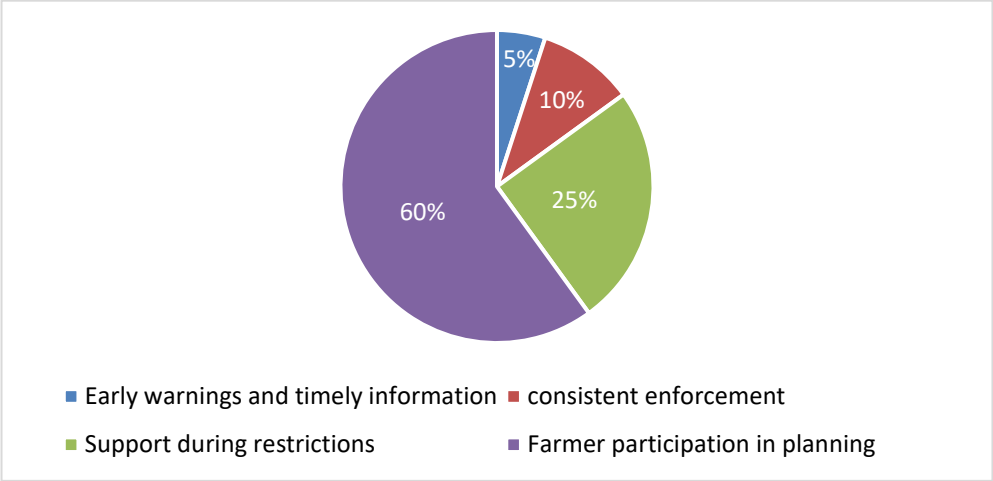

Figure 7. Farmer-informed recommendations to strengthen FMD control

Discussion

Farmers' understanding of FMD risk varied across recognition of causes, clinical signs, and transmission pathways. While many participants viewed FMD as a serious threat to livestock productivity and market access, uncertainty about symptom recognition, especially secondary signs, and confusion about transmission routes emerged as key barriers to timely reporting and early response. This finding aligns with Scutt *et al*. (2023), who note that reporting intentions are shaped by perceived severity and farmers' confidence in identifying the disease, but are also constrained by practical concerns, including fear of movement bans, delays in official responses, and limited access to communication resources.

"*When it starts, you can see the animal drooling a lot, it struggles to walk, and there are sores in the mouth and on the feet. That is when we suspect foot-and-mouth disease.*"

Overall, most participants associated FMD with classical signs such as lameness, excessive salivation, oral lesions, and hoof problems, and many linked outbreaks to increased animal mixing at communal grazing areas and shared water points. These patterns highlight the need for more targeted farmer education that broadens knowledge beyond the most visible signs. This supports the interpretation proposed by Maye and Chan (2020) on the usage of practical demonstrations and culturally appropriate communication to strengthen early detection, reporting, and surveillance in communal livestock systems. Many farmers described a clear "decision threshold" for reporting, where suspected FMD became reportable mainly when symptoms were severe and spreading quickly, neighbouring herds showed similar signs, or veterinary inspections and restrictions intensified. When these triggers were absent, reporting was often delayed. Hesitancy was largely driven by anticipated consequences after reporting, especially fear of quarantine and movement bans, which translate into lost sales and wider social and financial strain. This reluctance was reinforced by practical constraints (limited transport and communication) and perceptions that official responses can be slow or ineffective.

Strengthening FMD surveillance in communal systems will therefore require not only awareness raising, but also faster feedback and response processes, reliable communication channels, and support measures that reduce the economic burden associated with reporting and compliance.

"Sometimes we don't report quickly because once you report, they close the movement and you can't sell. Fellow farmers will also say your animals brought the disease, so you keep quiet until it becomes serious".

"If I see the first signs like drooling or limping, I report immediately to the dip tank/animal health technician, because if we wait, it spreads to the whole herd and even to the neighbours."

Movement-restricting measures such as quarantine and movement bans often provoke resistance because farmers experience them as immediate livelihood shocks, leading to lost income, delayed sales, and heightened household financial strain. By contrast, farmers strongly support practical, service-oriented interventions such as vaccination and routine dip-tank inspections, largely because these measures are seen as protective while allowing everyday production and marketing activities to continue. In essence, farmers differentiate between controls that safeguard herds without destabilising livelihoods and those that manage disease primarily by constraining livelihood options.

"The ban doesn't just control the disease it controls our lives, because cattle are our money."

This pattern offers important lessons for policy design in communal livestock systems. Notably, this extend McLaws et al., (2025) 's conclusions by showing that effective FMD control should prioritise supportive and collaborative strategies that align with farmers' economic realities. Building on the existing trust in preventive measures, particularly vaccination and inspections that are well communicated, respectful, and consistently implemented, can strengthen cooperation, improve compliance, and enhance early reporting. Where restrictive measures are unavoidable, their legitimacy depends on fairness, clarity, and predictability. These findings reinforce the argument that Restrictions should be transparent, time-bound, and applied consistently, with clear criteria for implementation and lifting. In addition, permitting procedures must be straightforward and reliable, and practical mitigation support should be provided to reduce the economic burden on affected households. By anchoring FMD control in trusted services, reinforcing it through timely risk communication and feedback, and designing restrictions that are procedurally fair and livelihood-sensitive, authorities can reduce incentives for informal livestock movement and delayed disease reporting—ultimately strengthening disease management in communal areas.

Communal farmers rely mainly on formal animal-health services for FMD information, with animal health technicians as the dominant channel, supported to a lesser extent by extension officers and dip-tank committees. Informal and mass communication pathways play a limited role, indicating that community-based and broader messaging platforms remain underutilized. While this strong dependence on technicians suggests high trust in veterinary expertise, it also creates a vulnerability when technician contact is irregular or capacity is overstretched.

"*We don't really hear about FMD from radio or other community channels. If the technicians don't come or they are too busy, we end up not getting enough information on time."*

More importantly, the results point to weak two-way communication: many farmers reported receiving little or no acknowledgement and feedback after engaging or reporting, which can reduce confidence in the system, weaken incentives for timely reporting, and undermine sustained cooperation. Overall, the findings highlight the need for a more integrated and responsive risk communication approach. Importantly, this maintains technicians as technical anchors, strengthens feedback and follow-up processes, and better leverages extension services, dip-tank structures, and local leadership to reinforce messaging and improve outbreak responsiveness.
Limited acknowledgement and feedback from Animal Health Technicians and extension officers point to a critical weakness in the *relational and accountability* side of FMD surveillance and control. Most farmers reported that reporting suspected FMD does not lead to acknowledgement or follow-up, turning surveillance into a one-way process that can undermine trust and reduce willingness to report early.
"We report, but no one comes back to tell us what is happening."

Farmer-informed recommendations further reinforce that the challenge is not only technical but also governance and livelihood-related. Farmers prioritized deeper participation in planning and decision-making, signaling a clear demand for co-designed interventions that reflect communal realities such as shared grazing, market dependence, and everyday movement needs. They also highlighted the importance of support during restrictions, underscoring that compliance is often conditional on households' ability to absorb the economic shock caused by bans and quarantines.

Recommendation

Farmers' understanding of FMD risk and reporting behaviour should be positioned as a frontline surveillance resource. This can be achieved by institutionalising short, repeated "recognise–report–respond" sessions at dip tanks in local languages, supported by simple visual aids that explain early signs, transmission in shared grazing and water-point contexts, and practical reporting steps. Delayed reporting can be reduced by formalising community-based event detection through dip-tank committee members. Importantly, reporting should be reframed as protective collective action rather than a trigger for punishment by clearly communicating what happens after a report, expected response timelines, and available mitigation support. Policy should strengthen preventive, service-oriented measures while redesigning restrictive measures to limit livelihood harm. Vaccination programmes need predictable schedules, early mobilisation, and visible quality assurance, including accountability for the cold chain, to sustain credibility. Trust and responsiveness must be strengthened through formal feedback loops. Veterinary services should adopt minimum feedback standards so that every farmer report receives acknowledgement, a reference number, and a clear follow-up window. Risk

communication should be diversified beyond reliance on technicians by coordinating extension officers and dip-tank committees as reinforcement agents, supported by low-cost digital tools to increase speed and reach during high-risk periods. Finally, farmer-informed reforms should be operationalised through participatory governance. Establishing Farmer-Veterinary-Extension planning forums at dip-tank cluster level can enable co-design of vaccination logistics, inspection routines, communication schedules, and restriction mitigation options.

Conclusion

This study demonstrated that FMD control in Mopani District's communal livestock systems is shaped by livelihoods and governance, rather than by veterinary technology alone. Farmers recognized key FMD signs, yet reporting intentions were weak because reporting is linked to household losses from quarantine and movement bans, along with transport barriers, slow response times, and limited feedback. Surveillance, therefore, depends on whether reporting feels safe, worthwhile, and followed by timely action. Farmers distinguished between measures that protect herds without disrupting livelihoods and those that constrain livelihoods. Vaccination and dip-tank inspections were viewed as legitimate and protective, while quarantine and movement bans were experienced as livelihood shocks whose acceptability hinged on fairness, clarity, and practical support. Communication patterns also revealed an over-reliance on animal health technicians, underuse of complementary actors, and weak feedback loops that undermine confidence that engagement leads to a response. Overall, recurring challenges reflect a mismatch between control design and communal realities such as shared grazing and routine livestock mobility. Strengthening FMD control requires participatory risk governance: two-way communication, predictable preventive services, transparent and time-bound restrictions with consistent enforcement, and farmer inclusion through dip-tank platforms. Future research should examine how perceived fairness and respectful enforcement shape compliance and informal coping.

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Conflict of interest

The authors declare that no conflicts of interest exist that could reasonably be perceived as influencing the objectivity or impartiality of the research.

References

1. Adamchick J, K Rich, and A Pérez, 2021. Assessment of the Risk of Foot and Mouth Disease among Beef Cattle at Slaughter from East African Production Systems. Viruses, 13(12): 2407.
2. Al-Hammadi MA, 2025. Current trends and challenges in the management of foot and mouth disease in Saudi Arabia: A review. Open Veterinary Journal, 15(5): 1907.
3. Blacksell SD, J Siengsanan-Lamont, S Kamolsiripichaiporn, LJ Gleeson and PA Windsor, 2019. A history of FMD research and control programmes in Southeast Asia: lessons from the past informing the future. Epidemiology & Infection, 147: e171.
4. Braun V and V Clarke, 2006. Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101.
5. Cabezas AH, NJ Mapitse, P Tizzani, MJ Sanchez-Vazquez, M Stone and MK Park, 2022. Analysis of suspensions and recoveries of official foot and mouth disease free status of WOAH Members between 1996 and 2020. Frontiers in Veterinary Science, 9: 1013768.
6. Catley A, RG Alders and JLN Wood, 2012. Participatory epidemiology: Approaches, methods, experiences. Veterinary Journal, 191(2) :151-160.
7. Fana EM, SW Mpoloka, M Leteane, L Seoke, K Masoba, M Mokopasetso, A Rapharing, T Kabelo, P Made, P and J Hyera, J2021. A Five-Year Retrospective Study of Foot-and-Mouth Disease Outbreaks in Southern Africa, 2014 to 2018. Veterinary Medicine International, 2021(1):7438809.
8. Gulwako MS, JM Mokoele, YB Ngoshe and V Naidoo, 2023. Evaluation of the proper use of medication available over the counter by subsistence and emerging farmers in Mbombela Municipality, South Africa. BMC Veterinary Research, 19(1): 83.
9. Kerfua SD, AF Railey and TL Marsh, 2023. Household production and consumption impacts of foot and mouth disease at the Uganda-Tanzania border. Frontiers in Veterinary Science, 10:1156458.
10. Kone MT, AE Budeli and R Ramaano, 2025. Toward sustainable food system: the role of livestock farming in Matiyani village in the Vhembe Biosphere Reserve, South Africa. Frontiers in Sustainable Food Systems, 9:1637083.
11. Mahapatra M and S Parida, 2018. Foot and mouth disease vaccine strain selection: current approaches and future perspectives. Expert review of vaccines, *17*(7):577-591.
12. Maye D and KW Chan, 2020. On-farm biosecurity in livestock production: farmer behaviour, cultural identities, and practices of care. Emerging topics in life sciences, 4(5), pp.521-530.
13. McLaws M, T Knight-Jones, P Compston, C Bartels, G Limon, MJ Arshed and M Dhingra, 2025. Economic analysis for progressive control of foot-and-mouth disease and other transboundary animal diseases. Food & Agriculture Org.

14. Mehmed B, AM Iatrou, R Yildiz, K Lamont, MR Da Costa, M De Nardi, A Allepuz, T Niine, JK Niemi and C Saegerman, 2025. Economic Perspectives on Farm Biosecurity: Stakeholder Challenges and Livestock Species Considerations. Agriculture, 15(21): 2288.
15. Mogotsi K, OE Kgosikoma and KF Lubinda, 2016. Wildlife-livestock interface, veterinary cordon fence damage, lack of protection zones, livestock theft and owner apathy: Complex socio-ecological dynamics in Foot and Mouth disease control in southern Africa. Pastoralism, 6(1): 21.
16. Moya S, J Navea, J Casal, G Ciaravino, E Yus, FJ Diéguez, B Benavides, F Tirado and A Allepuz, 2023. Government veterinarians' perceptions of routine biosecurity focused on dairy cattle farms in north-western and north-eastern Spain. Frontiers in Veterinary Science, 10: 1043966.
17. Ngoshe YB, E Etter, JP Gomez-Vazquez and PN Thompson, 2022. Knowledge, attitudes, and practices of communal livestock farmers regarding animal health and zoonoses in far northern KwaZulu-Natal, South Africa. International journal of environmental research and public health, 20(1): 511.
18. Obaido G, E Esenogho and C Modisane, 2026. An unsupervised machine learning analysis of stakeholder opinions on foot-and-mouth disease control in South Africa. Discover Applied Sciences.
19. Railey AF and TL Marsh, 2019. A rational explanation of limited FMD vaccine uptake in endemic regions. Pathogens, *8*(4): 181.
20. Ramarumo T, 2025. Resilience of small-scale farmers amidst the COVID-19 Pandemic: a case study of small-scale farmers in Limpopo Province, South Africa.
21. Scutt K, I Walker and I Ernst, 2023. The influence of trust and social identity in farmers' intentions to report suspected emergency disease outbreaks. Preventive Veterinary Medicine, 212: 105855
22. Sieng, S., Patrick, I.W., Windsor, P.A., Walkden-Brown, S.W., Sar, C., Smith, R.G.B. and Kong, R., 2022. Knowledge, attitudes, and practices of smallholder farmers on foot and mouth disease control in two Cambodian provinces. Transboundary and Emerging Diseases, 69(4): 1983-1998.
23. Souley Kouato B, FM Elliot, DP King, J Hyera, NJ Knowles, AB Ludi, V Mioulet, G Matlho, K De Clercq, E Thys and H Marichatou, 2018. Outbreak investigations and molecular characterization of foot-and-mouth disease viruses circulating in South-West Niger. Transboundary and Emerging Diseases, 65(1):146-157.
24. Wesley KL, ZE Mahlengule and LS Simon, 2025. Agriculture Extension Service for Smallholder Livestock Farmers in Communal Land of Mopani District in Limpopo Province. Research in Agriculture Livestock and Fisheries, 12(3): 415-426.
25. Sopeju AE, Onoja G, VT Abiodun and AR Peters, 2025. Foot-and-mouth disease vaccine market survey at agro-veterinary stores in rural and peri-urban areas of Nigeria. Gates Open Research, 9: 40.
26. Woldemariyam FT, CK Kariuki, J Kamau, A De Vleeschauwer, K De Clercq, DJ Lefebvr and J Paeshuyse, 2023. Epidemiological dynamics of foot-and-mouth disease in the horn of Africa: the role of virus diversity and animal movement. Viruses, 15(4): 969.