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Knowledge, attitude and practice (KAP) of smallholder farmers on foot-and-mouth disease in Cattle in West Kazakhstan

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Abstract

Background: This study was performed to assess the knowledge, attitudes and practices (KAPs) of farmers and veterinary professionals towards foot-and-mouth disease (FMD) in the area studied.

Methods: The study was based on a comprehensive questionnaire administered through face-to-face interviews. Between January and May 2022, 543 households and 27 animal health practitioners (AHP) were visited in 4 provinces of the West Kazakhstan region to assess their KAPs towards FMD.

Results: A large proportion of herd owners (84%) had known the name of the disease, and nearly a half (48) of respondents had heard of FMD cases on farms in the neighbourhood. Oral mucosa lesions were the most consistent with clinical sign characteristic of FMD among farmers (31.4%), followed by hoof blisters (27.6%) and excessive salivation (18.6%). Farmers reported that new animal introduction was potentially the main factor associated with FMD occurrence in their herds. Over half of farmers (54%) interviewed prefer not to purchase livestock from unknown or potentially epidemiologically disadvantaged areas.

Conclusion: All AHPs (27) reported that in their zone of veterinary responsibilities, vaccination against FMD is not practised because the area investigated possesses FMD-free status. However, in the past few years, numerous FMD outbreaks have been detected throughout the region. For this reason, immediate actions need to be taken to prevent further FMD occurrences by giving the region a status of an FMD-free zone with vaccination. The current study demonstrated that inadequate quarantine controls

of imported animals, absence of regular vaccination and unrestricted animal movement within the country were the primary obstacles in controlling and preventing FMD in the investigated area.

KEYWORDS
foot-and-mouth disease, KAP, Kazakhstan, livestock, smallholder farmers

1 | INTRODUCTION

Foot-and-mouth disease (FMD), caused by the FMD virus (FMDV), an RNA virus in the family Picornaviridae, is a highly contagious infectious and economically devastating disease of cloven-hoofed animals (Carrillo et al., 2005; Perez et al., 2011). Cattle, sheep, goats and pigs are the most susceptible animals to FMD infection. Clinical signs can be characterized by fever, blisters in the oral cavity, excessive salivation and blisters on the feet that cause lameness (Stenfeldt et al., 2014; Udahemuka et al., 2020). FMDVs are divided into seven serotypes with several genetically and regionally distinct subgroups, which makes vaccine development and use complex and often ineffective (Knowles & Samuel, 2003).

In developing countries such as Kazakhstan, the agriculture sector plays a vital role in the livelihood of rural communities. In Kazakhstan, rearing livestock is the primary source of income and economic asset among smallholder farms (Orynbayev et al., 2021). A recent study reported that smallholder farmers in Kazakhstan practised basic management systems and possess poor knowledge of animal disease risks and biosafety (Issimov et al., 2022). A previous study demonstrated a stable seasonal pattern of FMD outbreaks built on the basis of annual data collected between 1955 and 2013 (Abdrakhmanov et al., 2018). Another study reports a similar seasonal pattern of FMD occurrence in Kazakhstan (Tyulegenov et al., 2022).

Throughout the world, animal disease outbreaks pose significant limitations on livestock production mainly due to restriction on marketing and export. In developing countries, the effect of animal diseases on the population in terms of markets, poverty and livelihoods are adverse (Rich & Perry, 2011; Sieng et al., 2021). For this reason, gathering information pertaining to animal infectious diseases from farmers is an essential step for the prophylaxis, control and eradication of diseases such as FMD. When developing and introducing disease control and prevention programmes, it is vital to evaluate farmers' knowledge, attitudes and practices (KAPs) (Balkhy et al., 2010). Accordingly, to ensure that farmers are aware of the disease, communication between the farming communities and veterinary authorities is critical.

To the best of our knowledge, no KAP studies have been conducted relating to outbreaks of FMD in West Kazakhstan or other regions of Kazakhstan. Therefore, the objectives of this study were to: (1) describe smallholder farmers' KAPs associated with FMD; (2) describe local animal health practitioners' (AHP) perceptions and practices towards FMD in the area investigated.

2 | MATERIALS AND METHODS

2.1 | Study area

The study area was located in the west part of Kazakhstan (51°38′–55°57′N, 46°9′–46°4′E) – Atyrau, Aktobe and West Kazakhstan oblast. According to the national census, the population of the West Kazakhstan region is about 3 million people in an area of 736,241 km^2. The livestock population in the same region is about 2.17 million heads. Most of the farms practised a sedentary lifestyle. People who raised livestock were the participant of this study.

Current study was conducted between January and May 2022 in three districts of Kurmangazy, three districts of Oiyl, three districts of Syrym and three districts of Zhanibek province.

The map was developed using ArcGIS Pro 2.8 (ESRI, CA, USA) (Figure 1). The coordinate system used was WGS 1984 Web Mercator (Auxiliary Sphere). The basemap was generated using Land use/cover map (Abdi, 2020).

2.2 | Study design and study population

This research study was carried out in three large oblasts of the West Kazakhstan region. This region was purposively selected due to the high concentration of livestock and the history of frequent FMD outbreaks within the study area between 1955 and 2013 (Abdrakhmanov et al., 2018). Additionally, the West Kazakhstan region has several major highways (Aktobe–Orsk, Aktobe–Orenburg, Atyrau–Astrakhan, Oral–Saratov, Oral–Samara) passing through these districts connecting the region with the Russian Federation (RF). These highways are also used for cattle import and export from /into RF.

For smallholder farmers, a comprehensive questionnaire was designed to assess their KAP regarding FMD in herds. A questionnaire containing open questions was grouped into two sections. The first section contained questions related to the knowledge and awareness of FMD. The second section contained questions about attitudes and perceptions towards FMD and its prevention methods. Before interview commencement, farmers were given a thorough description of the clinical signs of FMD; additionally, images of FMD-affected animals were provided to avoid confusion among participants. The survey was conducted at the farm site in the presence of a local veterinarian.

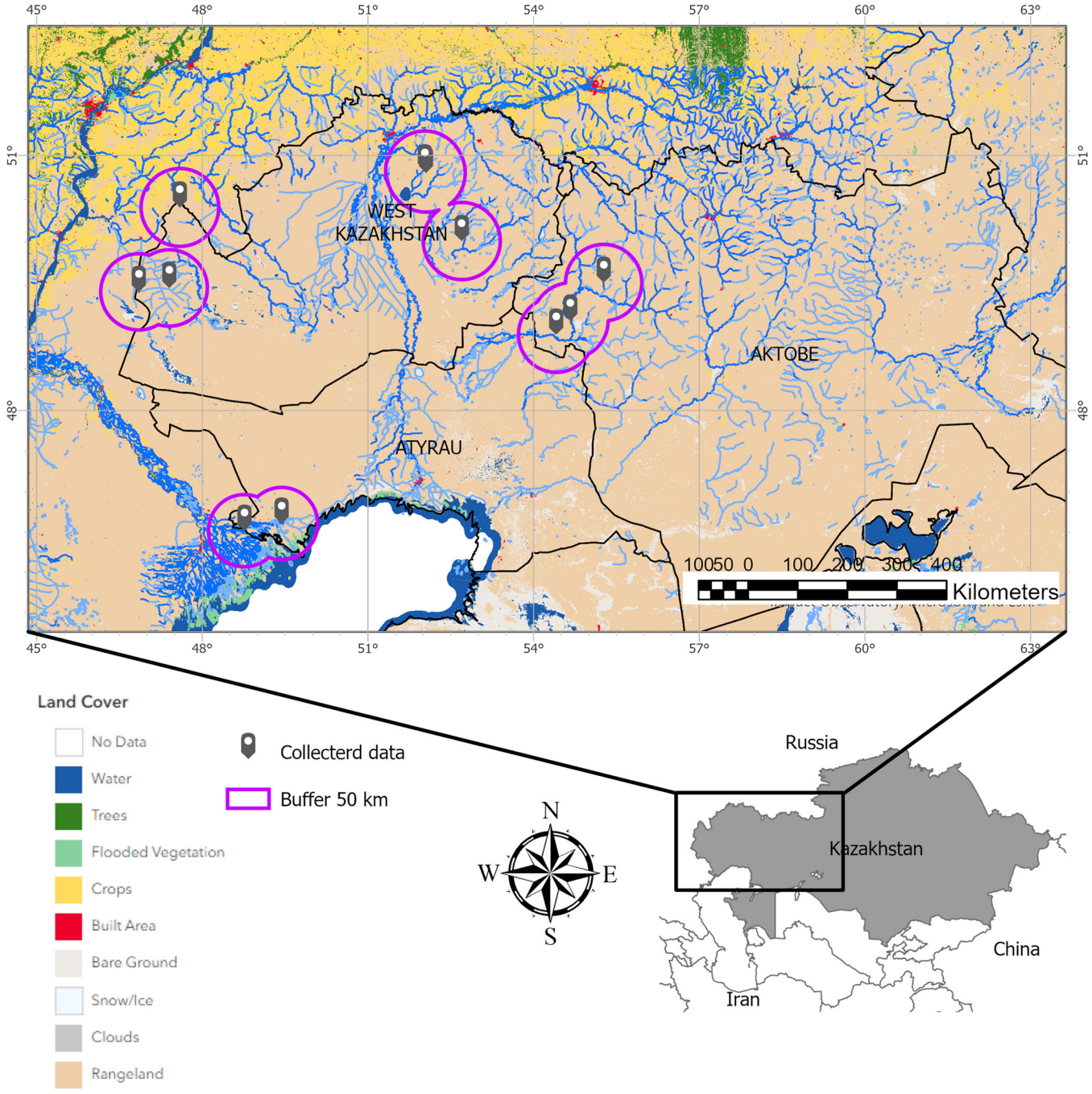

FIGURE 1 Selected districts of Atyrau, Aktobe and West Kazakhstan oblasts for knowledge, attitude and practice (KAP) study. The black box is an overview map of cattle distribution ([FAO] Food and agriculture organization).

For AHP, a questionnaire was administered to define their perceptions and practices associated with FMD control. According to the District Veterinary Office (DVO) regulation, each district was serviced by one veterinarian and two or more veterinary technicians. In total, 9 veterinarians and 18 veterinary technicians were involved in this survey.

The questionnaire was piloted and modified after five interviews to improve clarity and refine questions. Herd owners and veterinary workers were interviewed using Kazakh and Russian languages depending on participants' preferences.

2.3 | Sample size determination and sampling

The sample size was calculated by considering a confidence level of 95% and a required precision of 5%. The method described by

Thrusfield (2018) was utilized to generate sufficient data on the KAPs regarding FMD among smallholder farmers in the area studied. Accordingly, the total number of participants required for the study was 384. However, for consideration of clustering and non-response rates, approximately 70% of the sampling units were appended, which produces a total sample size of 543 participants.

Farmers were involved and surveyed based on their desire to participate in the study. When the selected farm owner decline to participate in the study, another farm owner was opted to replace them. The participation rate was 90%. Interviews were run on the farm, and all interviewers were trained in using the survey.

2.4 | Data analysis

Data were analysed with SPSS version 25 and Microsoft Excel software. A value of $p \leq 0.05$ was designated statistically significant. For each variable of interest, descriptive statistics were generated. Pearson's homogeneity χ^2 test and their 95% confidence intervals were calculated to define the extent of the participants' knowledge and practices towards FMD in their herds and the statistical significance variation. Logistic regression was utilized to determine odds ratios between factors and yes/no of the dependent variable. Questions on knowledge were applied to define the participants' (farmers) general knowledge about the disease, clinical signs, and modes of transmission. Questions on attitudes and practices were applied to evaluate farmers' and veterinary workers' perceptions on disease prevention and control measures. Variables associated with FMD incidence were shortlisted for consideration in the final multivariate logistic regression. The pair-wise interaction test was used to define the effects of interactions between all factors in the final multivariable logistic model. The likelihood ratio test was used to evaluate the model suitability. The model was evaluated according to the Hosmer and Lemeshow (2000) methodology.

3 | RESULTS

3.1 | Knowledge, attitude and practices of farmers regarding foot-and-mouth disease

A summary of farmers' KAPs ($n = 543$) towards FMD is illustrated in Table 1. Most farmers (56%) acquired information about FMD from their village AHPs. Approximately 84% of farmers were familiar with the name of the disease, and approximately half of the respondents (48%) had heard of FMD cases among livestock in their community.

Of the study population, 43% of farmers believed that new animal introduction into their herd is a primary cause of FMD outbreaks. About 69% of farmers interviewed reported readiness to apprise local veterinary practitioners if FMD cases occurred in their herds. One third of farmers (33%) reported that veterinary officials did not respond promptly to prevent and control the disease during the early stage of

TABLE 1 Knowledge, attitude and practices of participants (farmers) ($n = 543$) towards control of foot and mouth disease (FMD).

Variables	Frequency	Percentage (95% CI)
Source of information about FMD		
Friends	56	10.3 (7.7–14.3)
Neighbours	111	20.4 (17.8–24.6)
Animal health practitioners	304	56 (41.5–69.0)
Media	72	13.2 (9.4–16.1)
Farmers familiar with the disease name		
Yes	459	84.5 (78.7–92.4)
No	84	35.3 (16.8–57.2)
Knowledge about symptoms of FMD		
Blisters in the oral cavity	171	31.4 (23.7–38.2)
Lesions on the gums	79	14.5 (9.0–20.2)
Blisters on the hooves	150	27.6 (19.6–33.7)
Lesions on the udder a teats	42	7.7 (3.9–12.3)
Excess salivation	101	18.6 (12.8–25.1)
Farmers had heard of FMD cases in their village (anytime in the past)		
Yes	261	48 (26.7–69.8)
No	282	52 (33.4–72.6)
The clinical signs of FMD were noticed by farmers in the most recent outbreak		
Lesions on the gums	91	16.7 (9.7–21.5)
Blisters on the hooves	167	30.7 (22.9–40.0)
Blisters on the tongue of cattle	104	19.1 (10.6–28.4)
Salivation	181	33.3 (21.9–44.2)
Type of grazing		
Communal pasture	412	76 (59.8–91.6)
Nomadic	12	2 (0.4–4.7)
River plains	119	22 (11.6–39.2)
The potential source of FMD		
New animal introduction	234	43 (34.7–49.8)
Neighbouring herds	162	29.8 (21.6–37)
People, vehicles entering from infected areas	107	19.7 (16.5–25.2)
Contaminated feed	40	7.3 (3–12.3)
What would you do if your herd had FMD?		
Report immediately	376	69.2 (60.3–74.7)
Treat the affected animals (using antibiotics)	114	21 (16.6–27.3)
Do nothing	12	2.2 (0.6–5.7)
Sell the cattle	9	1.6 (0.3–4.4)
Slaughter cattle for meat	18	3.3 (1.0–6.9)
Other	14	2.5 (0.8–6.0)

(Continues)

TABLE 1 (Continued)

Variables	Frequency	Percentage (95% CI)
What do you think is necessary to prevent or control FMD?		
Early FMD detection by local veterinary workers	181	33 (25.6–40.4)
Regular visits by the veterinary authorities	109	20 (17.6–26.1)
Quarantine of new animals introduced to herd/village	88	16.2 (11.4–21.7)
Control of infected animal movements	61	11.2 (6.6–15.2)
Reduce contact between herds	52	9.5 (4.9–12.7)
Provide compensation for farmers	38	7 (2.8–11.5)
Do not know	14	2.5 (0.8–6.0)
How do you currently protect your herd from FMD?		
Not buying cattle or other livestock from risky sources	293	54 (44.9–60.6)
Not doing anything	121	22 (16.8–28.4)
Other	81	15 (10.7–21.4)
Disinfecting animal premises regularly	48	8.8 (4.6–14.7)
Are you interested in receiving further information on FMD?		
Yes	440	81 (74.3–90.4)
No	103	19 (12.8–26.8)
What specific information on FMD would you like to receive?		
How to prevent the disease	301	55.4 (48.3–61.4)
How to treat diseased animals	137	25.2 (20.7–29.5)
Basic knowledge about the disease	105	19.3 (13.2–22.7)

Abbreviation: 95% CI, 95% confidence intervals.

the outbreak. Over half of herd owners (54%) reported that to prevent FMD incursion into their herds, they prefer not to purchase livestock from unknown or suspicious sources.

3.2 | Practices and Perceptions of animal health practitioners on FMD in their workplace region

AHPs' practices and perception towards FMD in their workplace region is demonstrated in Table 2. The majority of the AHP declared that they would notify FMD cases to the DVO as a routine part of their work duty. Illegal animal trading and moving in the area (29.6%), direct contact of FMD affected and susceptible animals in common grazing areas (22.2%), lack of vaccination (18.5%) and rapid dissemination of the pathogen (14.8%) were regarded to be the factors that contributed the most to the frequency of the disease occurrence in the study area and other parts of the country.

4 | DISCUSSION

Gathering information on the KAPs of smallholder farmers can be significant when planning, implementation and evaluation of programmes aimed to control and prevent infectious diseases. Moreover, these data are valuable for identifying knowledge gaps and cultural and behavioural differences between communities tested that could negatively affect project feasibility as well as bias from both farmers and authorities (Zahedi et al., 2014).

In the area investigated, the survey administered shed light on the awareness and approaches of a selected group of farmers towards FMD. The present study provided practical information in determining KAPs among livestock farmers and veterinary service practitioners for the first time in Kazakhstan. It was found that almost all respondents interviewed were familiar with FMD.

The findings of this study demonstrate knowledge and attitude gaps that could hinder the FMD total elimination from the area studied if not managed.

According to the data obtained, a significant proportion of farmers (84.5%) were aware of the disease's existence. The proportion of interviewees who could recognize clinical signs characteristic of FMD varied between 7.7% and 31.4%, similar to those reported in Sri Lanka, Kenya and Afghanistan, where disease status is endemic (Athambawa et al., 2021; Nyaguthii et al., 2019; Osmani et al., 2021). Similarly, Jost et al. (2007) reported that farm owners are usually aware of the apparent clinical signs of the disease in both their own and neighbouring livestock.

It refers mainly to cattle, where the clinical signs of FMD are prominent, whereas other livestock species, for example, sheep and goats, exhibit mild or asymptomatic signs of the disease (Kitching & Hughes, 2002; Thornley & France, 2009). This implies that the close association between farmers and the small number of livestock owned increases the probability of FMD detection on its emergence (Fukai et al., 2020).

Herd owners reported that new animal introduction is one of the main reasons for the FMD occurrence on their farms. It is generally recognized that unrestricted movement of infected animals can significantly contribute to FMD propagation within the region and interregional scale (Alexandersen et al., 2003). Moreover, it is reported that cattle and sheep can be a source of infection up to 5 days prior to the manifestation of characteristic clinical signs (Burrows, 1968). This means that virus can be introduced to the country by imported live animals or on their contaminated products owing to the neglected veterinary examination (Pharo, 2002). The results of this study indicated that farmers notify disease occurrences to the local veterinary officers when their cattle manifest FMD signs.

From personal communication, it was revealed that currently, there are no routine vaccination programmes carried out by the government in the study area. This could be explained by the fact that several regions in Kazakhstan received FMD-free zone status (without

TABLE 2 Practices and perceptions of animal health practitioners ($n = 27$) about foot and mouth disease (FMD) in the area studied.

Variables	Frequency	Percentage (95% CI)
Animal species involved in the most recent outbreak of FMD?		
Sheep	4	14.8 (9.5–21.4)
Cattle	23	85.1 (79.9–91.3)
Goats	–	–
Who do you report to if you have FMD outbreak?		
I don't report the outbreak	–	
District Veterinary Office	27	100 (83.2–100)
What type of diagnostic methods are available at the local veterinary service?		
Clinical diagnosis	27	100 (83.2–100)
Do you have a FMD vaccination programme in your area?		
Yes	–	–
No	27	100 (83.2–100)
How often the vaccination programme run against FMD in your area?		
Every 6 months	–	–
Annually	–	–
During outbreak	27	100 (83.2–100)
What type of vaccination programme utilized in your area		
Protective (ring, targeted and buffer vaccination)	–	–
Suppressive (vaccination of selected groups of animals)	27	100 (83.2–100)
What type of FMD vaccine supplied?		
Trivalent inactivated (Russian origin) was available in the market and used for three detected subtypes (A, O and Asia-1) in the provinces)	27	100 (83.2–100)
What are the main obstacles to the control or prevention of FMD outbreaks in Kazakhstan?		
Illegal animal trading and movement of animals in the country	8	29.6 (22.5–33.7)
Poor import controls and quarantine	2	7.4 (2.2–12.6)
Direct contact between animals in common grazing areas	6	22.2 (17.6–26.9)
Lack of vaccination	5	18.5 (12.1–23.3)
The rapid dissemination of the FMDV	4	14.8 (9.2–17.8)
The short-term immunity induced by the vaccines	2	7.4 (2.2–12.6)
Poor hygiene and sanitary practices	1	3.7 (1.9–6.4)
What do you think impede the eradication and control of FMD in Kazakhstan?		
Lack of well-defined zones (infected zones, surveillance zones and FMD-free zones)	7	26 (23.2–32.7)
Lack of well-trained personnel (vaccination team etc.) and access to necessary financial and other resources (equipment, materials etc.)	3	11 (7.0–13.5)
Lack of coordinated actions by the State veterinary service to combat FMD	6	22.2 (16.8–27.5)
Lack of capabilities to stamp out infected animals and compensate farmers	2	7.4 (2.2–12.6)
Lack of knowledge about the circulating FMD serotypes and strains throughout the course of vaccination campaign	2	7.4 (2.2–12.6)
Lack of political commitment to control FMD and FMD type infections	3	11 (7.0–13.5)
Lack of accurate serological tests in government laboratories	5	18.5 (12.1–23.3)
Lack of disease surveillance systems to monitor the effectiveness of vaccination and to detect remaining FMD foci	2	7.4 (2.2–12.6)

Abbreviation: 95% CI, 95% confidence intervals.

vaccination) in 2015, according to the (OIE, 2015) resolution. These regions are Akmola, Kostanay, Mangystau, Pavlodar and North Kazakhstan, including Karaganda, where the latest FMD outbreak was registered in 2022 (Tyulegenov et al., 2022) and West Kazakhstan, where the KAP study has been administered. Vaccination against FMDV with the inactivated virus is widely applied, and its importance was highlighted in several previous studies as an efficient measure to control and eradicate the disease (Arjkumpa et al., 2020; Belsham et al., 2020; Saiz et al., 2002). The disease spread can be controlled and eradicated from herds if total stamping out is implemented within the area when localized outbreaks occur (Keeling et al., 2003; Parent et al., 2011). However, this approach is not applicable for developing countries due to low income and limited resources in the form of compensation.

The present study revealed that farmers would not purchase livestock from unknown sources or areas with backgrounds suspicious to FMD. Previous studies have identified that purchasing livestock from animal markets is the most critical factor contributing to the swift spread of FMD as the animals are restrained in close contact with animals from other herds/flocks that are destined for different locations (Blacksell et al., 2019; Smith et al., 2015).

Farmers also reported that antibiotic treatment (300 mg oxytetracycline, 20.0 mg flunixin meglumine, Nitox Forte, NITA-FARM, Russia) was utilized to treat symptomatic FMD. An antibiotic was inoculated intramuscularly for adult animals averaging 350 kg. Moreover, systemic antibiotics were used as preventive tools to halt disease spread. The use of antibiotics by farmers could be explained by the reported quick recovery of cattle exhibiting FMD clinical signs. From personal communication, herd owners who did not use antibiotics to treat their livestock reported severe disease manifestation, secondary complication cases and slow recovery. Additionally, a few farmers stated that they would treat FMD-affected animals by feeding them with boiled wheat porridge and rinsing affected areas using potassium permanganate.

The current study found that local AHPs are closely associated with the farming community and serve as farmers' principal providers of information. These findings further support the idea that farm biosecurity can be achieved by improving producer knowledge (Azbel-Jackson et al., 2018; Barrett et al., 2011). Disease surveillance plays a crucial role in animal health management (Robertson et al., 2010). In the case of FMD surveillance in the study area, however, local AHP were uncertain about the proportion of herds that were FMD positive. Accordingly, increased herd-level surveillance and comprehensive knowledge of disease are required for Kazakhstani FMD control. These requirements, if followed, will contribute to biosecurity and navigate the control and prevention of infectious diseases in herds.

The main part of the current survey was to collect information on the perceptions of AHP about FMD in the area studied. The study group (AHP) have identified the following concerns that might be linked to the failure to eradicate FMD in the country. These are uncontrollable and illegal animal movements, inadequate quarantine measures, determining disease zones and poor disease monitoring systems. It is considered that uncontrollable animal movements are the primary factor that is significantly associated with the pathogen introduction to new areas (Ellis-Iversen et al., 2011; Nampanya et al., 2012). From personal communication with AHP, it was revealed that in the study area, passive serological surveillance of FMD without vaccination is being practised. Moreover, vaccination with the Russian Trivalent Adsorbed Liquid Inactivated vaccine is used only in the case of reported outbreak. However, they stated that this approach is inefficient for timely detection of susceptible populations and prevention of outbreaks. Instead, systematic biannual serological monitoring with vaccination should be applied to maintain the disease-free status of the region (Sultankul, 2022).

Although valuable information collected, this study has several limitations that need to be acknowledged. First, the major constraint was the reliability of data obtained from households. Farmers could misrepresent data, and in search of benefits, they might have the propensity to overstate their losses. Second, due to the sporadic nature of outbreaks, farmers remember events differently. They may have had recall bias on the disease occurrence, resulting in failure to provide the exact date or season of the last FMD occurrence in their farms or communities. As a result, the information provided cannot be ruled out. Notwithstanding these limitations, the findings of this study have demonstrated the significance of future serological studies to evaluate FMDV prevalence among the livestock population in Kazakhstan.

5 | CONCLUSION

This research has shown that smallholder farmers and AHP provided essential data on FMD that can be applied for disease eradication measures within the region. One of the more significant findings to emerge from this study is that although the study area is located in FMD-free zone, the majority of farmers were aware of FMD and were able to identify or recognize the disease cases based on the manifestation of clinical signs. The second significant finding of this survey was that farmers demonstrated a willingness to register their herds to receive regular vaccination against FMD. It is also worth noting that farmers were eager to acquire knowledge about disease control and prevention.

AUTHOR CONTRIBUTIONS

Supervision; conceptualization; methodology; writing – original draft: Arman Issimov. *Data analysis; validation*: Svetlana Bayantassova. *Funding acquisition; validation; resources; conceptualization; methodology; investigation*: Alma Temirzhanova, Zhauynbay Kenzhegaliyev, Assylbek Zhanabayev, Nadezhda Byrambayeva and Abeldinov Rustem. *Software; formal analysis*: Kaissar Kushaliyev, Altay Ussenbayev, Assel Paritova, Gulnara Baikadamova, Lyailya Bauzhanova and Mereke Tokayeva. *Resources; conceptualization; methodology; funding acquisition; data curation; formal analysis; validation; investigation*: Temirlan Bakishev, Aitpayeva Zukhra, Askar Terlikbayev, Nurbolat Akhmetbekov, Spandiyar Tursunkulov and Izimgali Zhubantayev. *Investigation; writing – review and editing*: Marat Aisin. All authors have contributed significantly and agree with the content of the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

The purpose and methods of the current study were thoroughly explained to all participants, and informed oral consent was obtained and documented in the questionnaire. The protocol was approved by the Human Ethics Committee of the West Kazakhstan Marat Ospanov State Medical University (permit number: 01-05-07-21-2020).

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