

Development of an evaluation framework and assessment tools to assess the foot and mouth disease (FMD) control policies and their implementation in the proposed FMD-free zone in Thailand

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Summary

This paper proposes an evaluation framework and assessment tools for use in the evaluation of the current foot and mouth disease (FMD) control policies in Thailand and their implementation in the eastern region of the country (the proposed FMD-free zone).

To develop the framework and assessment tools this study identified:
a) the essential elements of a successful FMD control programme;
b) stakeholders who are affected by the FMD control programme; and
c) relevant Department of Livestock Development (DLD) regulations

and documents. These regulations and documents were used as the foundation for development of the framework and assessment tools.

The proposed framework includes the essential characteristics of policy design and implementation that should be part of the FMD control programme in Thailand. The assessment tools include assessment matrices, three sets of questionnaires, and interview questions. When applied, the assessment matrices identify shortcomings of policy design, policy implementation, veterinary capacity and stakeholder engagement. Questionnaires and interview questions collect information that examines the consistency of elements of the FMD control programme against criteria in the assessment matrix. This framework and tools are currently being applied to assess the proposed FMD-free zone in Thailand.

Keywords

Assessment – Disease control – FMD-free zone – Foot and mouth disease – Thailand.

Introduction

Foot and mouth disease (FMD) is a highly contagious transboundary animal disease (TAD) and has been recognised as the greatest hindrance to international trade in animals and animal products (1, 2, 3, 4, 5). The disease is endemic in Sub-Saharan Africa and Asia, and is more prevalent in developing countries, including Thailand (6, 7, 8). Serotype A FMD was first detected in Thailand in 1953 (8). Serotypes Asia-1 and O were confirmed in 1954 and 1975, respectively (8). While serotypes A and O are still in circulation, serotype Asia-1 has not been detected in Thailand since 1997 (9).

Efforts to control and eradicate FMD in Thailand started in 1991 under the ‘foot and mouth disease prevention and eradication project’ (8). In 1997, Thailand collaborated with neighbouring countries to prevent, control and eradicate FMD at the regional level under the South-East Asia and China FMD (SEACFMD) Campaign (10, 11).

Thailand has a goal to make the eastern region of the country an FMD-free zone with vaccination (12, 13). In order to achieve this goal, the Department of Livestock Development (DLD), within the Ministry of Agriculture and Cooperatives of Thailand, has been improving the FMD control system by revising laws and regulations related to the FMD control programme. In 2015, Thailand's official FMD control programme was developed for proposal to the World Organisation for Animal Health (OIE) for an endorsement (14).

To ensure that the current FMD control policies and their implementation in the eastern region of Thailand (the proposed FMD-free zone) meet the OIE's requirements, the assessment of the current FMD control system plays a crucial role. For such an assessment to be effective, it is important to develop an appropriate and applicable evaluation framework and tools that can provide accurate and transparent results.

This paper reports on the development of a framework and assessment tools to evaluate the FMD control policies in Thailand and their implementation in the proposed FMD-free zone. The expected outputs from this assessment could support the detection of disparities between the current FMD control policies and their implementation, as well as assisting the DLD in improving the FMD control system.

Methodology

Frieden addressed six key areas for effective public health programme implementation: innovation, technical package, management, partnership, communication and political commitment (15). However, the factors that influence the effectiveness of an animal disease control programme have not been addressed. In order to develop an evaluation framework and assessment tools, this study first identified the essential elements of successful FMD control programmes through a literature review. The initial literature search was conducted on Google Scholar, Wiley Online Library and PubMed Central. Keywords included: factors, effective, successful, programme implementation, policy implementation, disease control programme and health programme, in different combinations. Information related

to animal disease control programmes and effective service delivery drawn from fact sheets and bulletins published by organisations focusing on animal disease management, such as the OIE, were also included.

The second step in this study involved identification of stakeholders who had an interest in, and/or an influence on, the FMD control programme in Thailand. Potential stakeholders were identified based on professional networks and experience. A list of potential stakeholders was reviewed and discussed with DLD officers and private veterinarians. The study also developed a stakeholder identification map in order to define key stakeholders of the FMD control programme in Thailand.

Lastly, the relevant DLD regulations and other documents related to the FMD control programme were identified through a literature search and discussion with DLD officers. These regulations and documents were used as the foundation for the development of the framework and assessment tools.

Results

Essential elements of a successful foot and mouth disease control programme

Reviews of existing literature and field experiences led to the conclusion that FMD control programmes can be successful and sustained if organisations and coalitions effectively address the following elements:

- a) Policy design. Policy in this context refers to laws and regulations related to FMD control programmes. Smart claimed that policy design is an essential component of the policy process and noted that ‘unclear mandates often result in a mismatch between legislative intent and bureaucratic behaviour’ (16). Public problems, whether straightforward or complicated, should be defined and analysed before policies addressing them are made (17). Policy content should clearly

frame the underlying public problems, goals and objectives and identify appropriate solutions (17, 18). Desirable policy should contain unambiguous directives, clearly structure the implementation processes and assign an existing agency for implementation (19).

- b) **Veterinary Services.** Adequate, knowledgeable and well-trained staff are needed for effective service delivery. Veterinary Services play an important role in prevention and control of animal diseases (20). According to the OIE, ‘the effectiveness of animal disease prevention and control policies depends on the good governance and quality of Veterinary Services’ (21).
- c) **Engagement of stakeholders.** Successful policy processes require participation from stakeholders (18). Veronesi & Keasey argue that the quality of national health services is improved with stakeholder participation (22).
- d) **Availability of resources.** Sufficient financial resources, staffing and equipment are needed for effective policy implementation (19). Financial resources should be sufficient to hire staff, develop alternative technologies and conduct technical analyses involved in the development of regulations and alternatives, service delivery and monitoring of target group compliance (19).
- e) **Policy or programme implementation.** Implementation is a ‘set of activities directed toward putting a programme into effect’ (17). Successful implementation depends on programme details, to ensure that policy goals and objectives are met (17). Policy should be implemented completely and as planned.
- f) **Policy or programme evaluation.** Evaluation refers to the process of detecting how the policy or programme was implemented and whether the policy or programme is working appropriately (17, 23, 24). Policy implementation can be

enhanced by ongoing evaluation by internal and external authorities (25). Evaluation should be accurate, transparent, applicable and consistent in order to enable policy to be improved (23, 24). Using evaluation feedback and information on how implementation is progressing allows policymakers and implementers to better revise and correct actions (18).

- g) Political commitment. Overcoming programme constraints and accomplishing programme objectives can be difficult without active political support (19). Political commitment helps to catalyse and sustain successful programme implementation (26). Alternatively, lack of government commitment results in less successful policy implementation (27). Political commitment should come from various levels, especially higher government officials, in order to raise awareness and support effective implementation. Also, the highest level of leadership from the private sector should be involved in this commitment.

The essential elements of a successful FMD control programme are illustrated in Figure 1.



Fig. 1

Essential elements for the success of a foot and mouth disease control programme

FMD: foot and mouth disease

Stakeholder identification

Stakeholders are the people, groups or organisations that can be affected by policy outputs, decisions and operations (28, 29). This study listed potential stakeholders, then reviewed and discussed them with DLD officers and private veterinarians. A comprehensive stakeholder identification map was developed and is illustrated in Figure 2. Given the limitations on time and budget, further exploration of stakeholder involvement in this study focused on three major stakeholders: the DLD officers, private veterinarians and livestock producers (farmers).

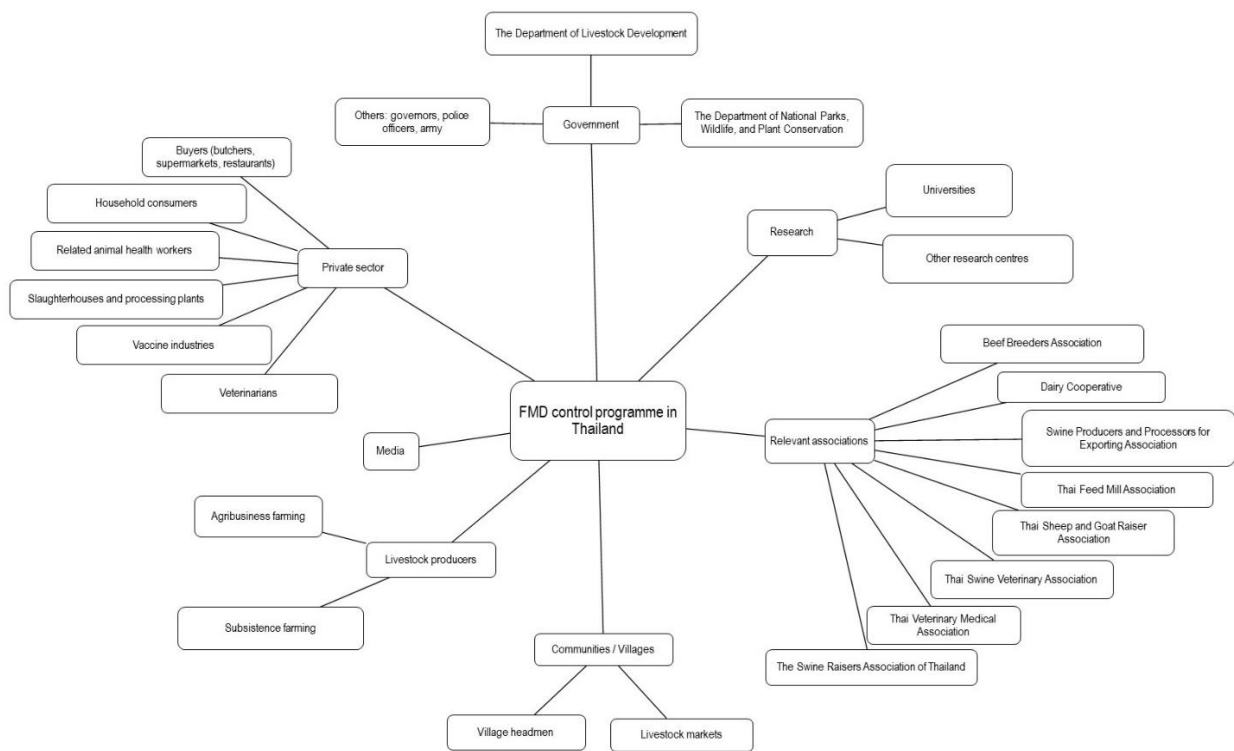


Fig. 2
Stakeholder identification map representing Thai stakeholders with interest in or influence on the foot and mouth disease control programme in Thailand

FMD: foot and mouth disease

a) DLD officers

DLD officers in Thailand can serve at both national and local levels.

- *National level*: includes officers who formulate FMD control policies and have experience with policy implementation, such as those in the disease control unit, the vaccine unit and the animal movement control unit.
- *Local level*: includes officers at provincial and district levels who are in charge of the animal health control programmes. This group includes officers of provincial livestock offices, district livestock offices, animal quarantine stations and dairy herd health units.

b) Private veterinarians

This study focused on private veterinarians who work in the proposed FMD-free zone and whose work is related to the zone. Private veterinarians in Thailand are classified into three groups: *i*) veterinarians who are contracted to, or work for, company-owned farms, *ii*) veterinarians who work as consultants for farms and pharmaceutical companies and *iii*) veterinarians who work in technical sales and sales support (it is uncommon in Thailand for private veterinarians to run their own veterinary clinics or hospitals for livestock).

c) Livestock producers (farmers)

This study includes both subsistence and agribusiness farming systems. The subsistence farms are farms with fewer than 50 head of livestock and their main purpose is for household consumption. The agribusiness farms are farms with more than 50 head of livestock and their main purpose is for trade. While the subsistence farms in the proposed FMD-free zone vary, keeping beef cattle, dairy cattle, buffalos, pigs, sheep or goats, most of the agribusiness farms in the proposed FMD-free zone are pig producers.

Identification of relevant regulations and other documents

Three sources served as the basis for developing the framework and assessment tools: the OIE *Terrestrial Animal Health Code*, the DLD regulations related to FMD, and other official documents related to the Thailand FMD control programme.

a) OIE *Terrestrial Animal Health Code*

The primary chapters of the *Terrestrial Code* used for setting the assessment criteria for this study were:

- Chapter 1.4. Animal health surveillance (30)
- Chapter 1.6. Procedures for self-declaration and for official recognition by the OIE (31)
- Chapter 3.2. Evaluation of Veterinary Services (32)
- Chapter 4.4. Zoning and compartmentalisation (33)
- Chapter 8.8. Infection with foot and mouth disease virus (34).

b) DLD regulations

The DLD revised its regulations in 2013 to improve Thailand's FMD control system and to comply with the OIE's requirements. This study relied on legislation and regulations enacted, written and revised after 2013. The core laws related to the FMD control programme are:

- Animal Epidemics Act B.E. 2558 (2015) (35)
- Control of animal slaughter for the distribution of meat Act B.E. 2559 (2016) (36)
- DLD regulation on animal movement control B.E. 2558 (2015) (37).

The Animal Epidemics Act and the DLD regulation on animal movement control authorise veterinary officers to isolate and quarantine animals for examination, testing, vaccination and depopulation when outbreaks occur. Livestock holders are compensated for destroyed animals at 75% of market value. Veterinary officers also have authority to control, regulate, permit and prohibit animal movement. In order to transport animals to slaughterhouses, veterinary officers need to inspect animals in accordance with the control of animal slaughter for the distribution of meat Act, which mandates that animals must be in good condition, fit to travel and show no clinical signs of disease.

c) Documents related to the Thailand FMD control programme

This study also included review of documents published by the DLD and the OIE that contained information regarding the FMD control programme and Veterinary Services in Thailand. The following documents were reviewed and used for development of the framework and assessment tools:

- National FMD strategic plan of Thailand (12)
- Dossier for OIE official recognition of foot and mouth disease free zone with vaccination in the eastern region of Thailand (13)
- Report of the OIE FMD expert mission to Thailand (38)
- Thailand national FMD plan for OIE endorsement (14)
- OIE Performance of Veterinary Services (PVS) evaluation report (Thailand) (39)
- PVS Gap Analysis mission report (Thailand) (40).

Conditions for development of an assessment system

Based on a review of the documents described above and that were related to the FMD control programme in Thailand it was found that:

- a) the existing testing and diagnosis systems were adequate and rapid and met international standards, as confirmed by the OIE PVS evaluation; and
- b) the existing reporting system was appropriately designed and included networks of farmers, livestock assistants, villagers and officers at the field level.

Therefore, the development of a framework and assessment tools was conducted assuming these two conditions were satisfied.

Evaluation framework

Figure 3 presents the evaluation framework developed to assess FMD control policies and their implementation in the proposed FMD-free zone in Thailand. The framework identifies several essential characteristics of policy design and implementation that should be included in the FMD control programme in Thailand. The framework is divided into two parts: Veterinary Services and stakeholders. For Veterinary Services, six components related to FMD control activities in Thailand need to be assessed: the surveillance system, reporting system, vaccine strategy, animal movement controls, response plans and veterinary capacity. For stakeholders, the assessment focuses on one component: their engagement.

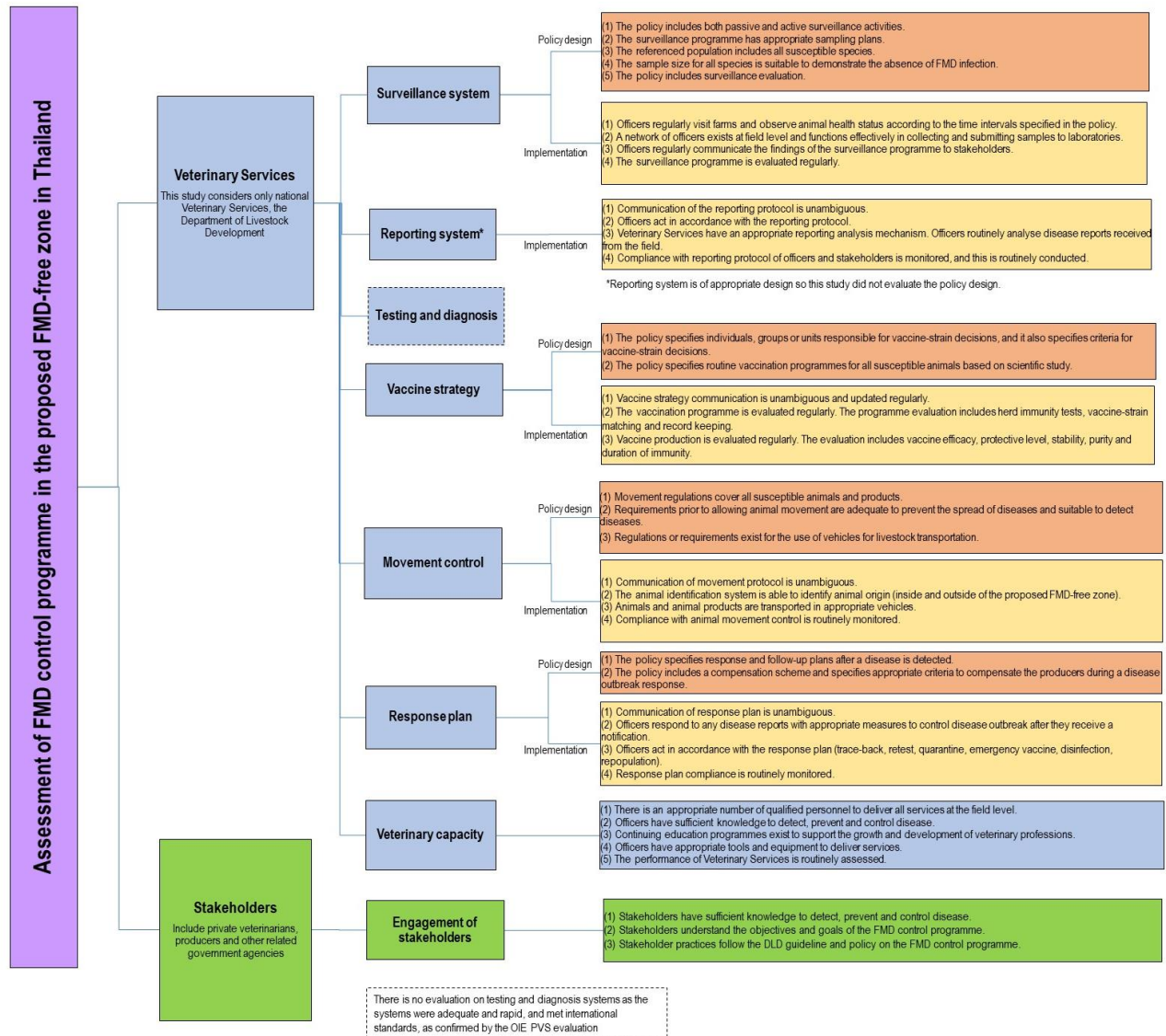


Fig. 3
Evaluation framework for the assessment of the foot and mouth disease (FMD) control policy and its implementation in the proposed FMD-free zone in Thailand

DLD: Department of Livestock Development
 FMD: foot and mouth disease
 OIE: World Organisation for Animal Health
 PVS: Performance of Veterinary Services

The first component under Veterinary Services is the surveillance system. An appropriate surveillance system should include passive and active collection of relevant data with appropriate sampling designs. Veterinary authorities should clearly indicate case definitions of suspected and confirmed cases. The case definitions must be simple, concise and easy to apply. Unambiguous case definitions help to detect more cases for rapid reporting and response. The reference population of the sampling design should include all FMD-susceptible farm animals in the proposed FMD-free zone. Sample size should be sufficient to demonstrate the absence of FMD infection. In order to differentiate natural infection and vaccination, sero-surveillance to detect antibodies to the non-structural protein (NSP) of foot and mouth disease virus (FMDV) should be conducted with appropriate sample size and plans. Appropriate implementation of surveillance should include regular farm visits and animal observation by Veterinary Services officers. Officer networks at the field level should exist and be appropriate to collect and submit samples to laboratories. Sample quality and reliability also should be determined. Veterinary Services should regularly communicate the findings of surveillance programmes to stakeholders, and evaluate the surveillance programmes.

The second component is the reporting system. Appropriate implementation should include unambiguous communication of the reporting protocol to stakeholders. It is important for officers to act in accordance with the reporting protocol. Veterinary Services needs both to have an appropriate reporting analysis mechanism and to routinely analyse disease reports. Officers' and stakeholders' compliance with the reporting protocol should be monitored routinely.

The third component under Veterinary Services is the vaccine strategy. An appropriate vaccine strategy should indicate who vaccinates, who pays for the vaccine, how vaccination is enforced and the plan designed to ensure appropriate vaccine coverage. It should also clearly specify the criteria for making vaccine strain decisions and who is responsible for, and has authority over, such decisions. In addition, routine vaccination programme decisions should be based on

scientific studies. Appropriate implementation of a vaccine strategy should include unambiguous communication of the strategy to stakeholders and regular updating of the vaccine strategy based on evaluation of circulating strains of FMD. Vaccination programmes and vaccine production need to be evaluated regularly to monitor vaccine coverage, including stability and purity of the vaccine, host species, efficiency, efficacy, protective levels of immunity and duration of immunity.

The fourth Veterinary Services component is animal movement control. Appropriate movement regulations need to cover all susceptible animals and products. There also should be appropriate and suitable requirements to detect and to prevent the spread of FMD prior to animal movement. For example, regulations should specify that animals must be tested and have FMD negative results, and that animals must be vaccinated against FMD before transportation. Appropriate implementation of animal movement control should include unambiguous communication of the movement protocol to stakeholders. The animal identification system should be appropriate to identify the animal's farm of origin. Compliance with animal movement control needs to be monitored routinely.

The fifth component is the response plan. An appropriate plan should specify procedures (responses and follow up plans) to be conducted after an outbreak is detected. It should clearly specify how the disease investigations are conducted. It should also trace back and forth the movements of animals and vehicles. Each response to the disease should clearly indicate who should take responsibility. The plan should also include a compensation scheme and specify appropriate compensation criteria. Appropriate implementation should include unambiguous communication of the response plan to stakeholders. Officers need to act in accordance with the response plan, and compliance with the plan should be routinely monitored.

In addition to these requirements, accomplishment of the goals of an FMD control programme will depend upon appropriate veterinary capacity. Appropriate veterinary capacity includes: *a)* a sufficient

number of qualified personnel to deliver services at the field level; *b)* the ability of DLD officers to detect, prevent, control and report disease; *c)* existing continuing education programmes to support the growth and development of all veterinary professionals; *d)* appropriate tools and equipment to allow DLD officers to deliver services; and *e)* routine assessment of the performance of Veterinary Services.

Stakeholder engagement is crucial to success of the FMD control programme. In this context, the term ‘stakeholders’ refers to private veterinarians and livestock producers or farmers. Private veterinarians should have sufficient knowledge to detect, prevent and control disease. Farmers, at a minimum, should recognise the disease, report suspected cases to officers and be able to set up farm biosecurity protocols such as restricting visitors, having a visitor logbook and having a boot disinfection station. Private veterinarians and farmers should receive continuous training on the FMD control programme and on disease detection and prevention. They should be able to understand the objectives of the FMD control programme and their roles and responsibilities. They should recognise and implement FMD control activities, following FMD control guidelines and DLD policies on the FMD control programme.

Assessment tools

In order to evaluate current FMD regulations and their implementation, assessment tools were developed in this study including assessment matrices, questionnaires and interview questions. Three sets of questionnaires and interview questions were developed and will be used to collect data and verify information for input into assessment matrices. The assessment matrices (Appendices 1 and 2) will be used to detect potential shortcomings of current policy design and implementation in Thailand’s FMD control programme. Tables I, II and III summarise the assessment matrix criteria and the OIE’s requirements/recommendations.

Table I

Summary of the OIE's requirements for a region to be qualified as an FMD-free zone with vaccination and the assessment matrix criteria to identify shortcomings of policy design

Sections	OIE's requirements ^(a)	Assessment matrix criteria to identify shortcomings of policy design
1. Surveillance system	<ul style="list-style-type: none"> – Veterinary authority should be responsible for the surveillance system. – A surveillance system should provide an early warning system to report FMD suspected cases. – Surveillance for FMD and FMDV transmission is in operation and in the form of a continuing programme. – Surveillance programme to demonstrate no evidence of FMDV infection and transmission should be carefully designed and implemented to avoid producing results that are insufficient to be accepted by the OIE or trading partners. – Sampling design should incorporate an epidemiologically appropriate design prevalence. – Sample size should be adequate to detect the presence of FMD infection and transmission. 	<ul style="list-style-type: none"> 1.1. Surveillance plan does not include passive surveillance. 1.2. Surveillance plan does not include active surveillance. 1.3. Surveillance programme is not conducted annually. 1.4. The surveillance plan does not cover all susceptible species and/or all levels of animal units such as the industrial level, small scale farmers and government facilities. 1.5. Sample size and sampling strategy are not appropriate**. <ul style="list-style-type: none"> **Inappropriate underlying assumptions for sample size calculation: <ul style="list-style-type: none"> 1.5.1. Sample size is not calculated to demonstrate the absence of FMD infection. 1.5.2. Sample size is not calculated with at least 90% confidence (acceptable level) with sensitivity and specificity of the test at least 90%.

<p>2. Vaccine strategy</p>	<ul style="list-style-type: none"> - Routine vaccination has been carried out for the purposes of the prevention of FMD and carried out following appropriate vaccine strain selection. - Vaccination has been carried out to achieve adequate vaccination coverage and population immunity. 	<ul style="list-style-type: none"> 2.1. Policy does not specify who has authority to make decisions on vaccine strains needed. 2.2. Policy does not specify how vaccine strains are determined. 2.3. Not all susceptible species are included in the overall vaccine plan.
<p>3. Animal movement control system</p>	<ul style="list-style-type: none"> - The control of the movement of susceptible animals and their products into the proposed FMD-free zone has been properly implemented and supervised. 	<ul style="list-style-type: none"> 3.1. Animals (susceptible species) and/or animal products are not covered under movement regulations. 3.2. Requirements (before movement is allowed) are not adequate to detect infection and prevent disease spread. 3.3. There are no regulations or requirements regarding the registration and sanitisation of vehicles for livestock transportation.
<p>4. Response plan</p>	<ul style="list-style-type: none"> - All herds or flocks with at least one laboratory confirmed reactor should be investigated. - The investigation should include reactor animals, susceptible animals of the same unit and susceptible animals that have been in contact with reactor animals. - Seropositive animals should be retested using repeat and confirmatory test with high diagnostic specificity. - The animals sampled should remain in the establishment pending test results and should be clearly identified and accessible. 	<ul style="list-style-type: none"> 4.1. There are no appropriate follow-up plans when a serological test (NSP) is positive. The follow up plan does not include: trace-back to origin, investigation, further serological tests (confirmation), quarantine (herds or animals), quarantine release plan (criteria to release quarantine) and/or requirement to remove animals (slaughter or stamping out). 4.2. Compensation is not included in the response plan.

(a): adapted from the OIE *Terrestrial Code*, Chapter 8.8. 'Infection with foot and mouth disease virus' (34)
 FMD: foot and mouth disease
 FMDV: foot and mouth disease virus
 OIE: World Organisation for Animal Health
 NSP: non-structural protein

Table II

Summary of the OIE's requirements for a region to be qualified as an FMD-free zone with vaccination and the assessment matrix criteria to identify shortcomings of implementation of FMD control programmes ^(a)

Sections	OIE's requirements ^(b)	Assessment matrix criteria to identify shortcomings of implementation
1. Surveillance system	<ul style="list-style-type: none"> – An early detection of FMD has been implemented. – Surveillance for FMD and FMDV transmission is in operation and in the form of a continuing programme. – Surveillance programme to demonstrate no evidence of FMDV infection and transmission should be implemented. – Surveillance system should provide an early warning system to report suspected cases. 	<ul style="list-style-type: none"> 1.1. Officers do not regularly visit farms and observe animals. 1.2. Farmers do not regularly observe abnormalities of their animals. 1.3. Officers do not routinely conduct active serological surveillance. 1.4. There is a lack of communication of findings of the surveillance programme and laboratory results. 1.5. The surveillance programme is not evaluated.
2. Reporting system	<ul style="list-style-type: none"> – A member country should have a record of regular and prompt animal disease reporting. – Farmers, workers who have day-to-day contact with livestock, veterinary paraprofessionals, veterinarians and diagnosticians should report promptly any suspicion of FMD. 	<ul style="list-style-type: none"> 2.1. There is a lack of communication of reporting protocols. 2.2. Reporting protocol is not uniformly implemented at all levels. 2.3. There is no disease report analysis at the local or national level. 2.4. No one is using the disease report analysis for prevention and control of FMD. 2.5. Compliance with reporting protocol is not monitored.

3. Vaccine strategy

- Routine vaccination has been carried out for the purposes of the prevention of FMD and carried out following appropriate vaccine strain selection.
 - Vaccination has been carried out to achieve adequate vaccination coverage and population immunity.
 - Serological surveillance to estimate population immunity and/or immune response elicited by the vaccine used should be conducted 1–2 months after vaccination.
 - Vaccines are produced following the standards described in the *Terrestrial Manual* such as quality control, purity and safety of vaccines.
- 3.1. There is a lack of communication on vaccine strategy (e.g. type of vaccine and adjuvant, species included, vaccine strain and vaccine interval).
 - 3.2. All animal species covered by the policy are not vaccinated.
 - 3.3. There is a lack of vaccination record keeping and other information related to vaccination campaign.
 - 3.4. There is a lack of appropriate sero-monitoring programmes for post-vaccination evaluation.
 - 3.5. There is a lack of vaccine matching monitoring and communication of vaccine matching tests.
 - 3.6. There is a lack of quality control and/or records on efficacy of vaccine production.

4. Animal movement control

- The control of the movement of susceptible animals and their products into the proposed FMD-free zone has been properly implemented and supervised.
- 4.1. There is a lack of communication of movement control protocols.
 - 4.2. Animal identification cannot differentiate between animals originating from inside or outside of the proposed FMD-free zone.
 - 4.3. DLD officers issue movement permits without animal inspection.
 - 4.4. Animals and/or animal products are not transported in appropriate vehicles.
 - 4.5. Animal checkpoints are not sufficient and are not located in appropriate areas to screen animal transportation.
 - 4.6. Veterinary officers and support staff do not appropriately conduct animal inspection at checkpoints.
 - 4.7. Compliance with movement control regulations is not monitored.

5. Response plan

- All herds or flocks with at least one laboratory confirmed reactor should be investigated.
 - The investigation should include reactor animals, susceptible animals of the same unit and susceptible animals that have been in contact with reactor animals.
 - Seropositive animals should be retested using repeat and confirmatory test with high diagnostic specificity.
 - The animals sampled should remain in the establishment pending test results and should be clearly identified and accessible.
- 5.1. There is a lack of communication of response plans.
 - 5.2. Officers do not respond or provide an inadequate response when FMD suspected cases are reported e.g. no tracing back, no re-investigation and no confirmation of serological test.
 - 5.3. Record of positive herds and/or animals is not appropriate to trace back to the origin.
 - 5.4. There is no quarantine when positive animals are found.
 - 5.5. Infected carcasses, by-products and material (fodder, waste manure and bedding) are not adequately disposed of.
 - 5.6. Emergency vaccine is not sufficient for affected animals.
 - 5.7. Compensation is not sufficient when infected animals are slaughtered during an outbreak.
 - 5.8. Local officers and farmers inappropriately restock new animals.

(a): these criteria will be used to evaluate DLD's FMD control programme. The study assumed that the testing–diagnosis system is adequate, provides rapid diagnoses, meets international standards and was confirmed by the OIE PVS evaluation. Thus, the testing and diagnosis system is not included in the assessment system.

(b): adapted from the *Terrestrial Code*, Chapter 8.8. 'Infection with foot and mouth disease virus' (34)

DLD: Department of Livestock Development

FMD: foot and mouth disease

FMDV: foot and mouth disease virus

OIE: World Organisation for Animal Health

PVS: Performance of Veterinary Services

Table III**The OIE's recommendations regarding the quality of Veterinary Services and the criteria to identify inappropriate veterinary capacity and engagement of stakeholders**

Sections	The OIE's recommendations ^(a)	Assessment matrix criteria to identify inappropriate veterinary capacity and engagement of stakeholders
1. Veterinary capacity	<ul style="list-style-type: none"> – The personnel of Veterinary Services should have relevant qualifications, scientific expertise and experience to give them the competence to make sound professional judgements. – The Veterinary Services should be able to demonstrate sufficient financial resources and effective organisation so that they are able to anticipate the requirements for the establishment and application of animal health and animal welfare measures. – Adequate coverage of animal populations should be demonstrated. – Job descriptions of each position within the Veterinary Services should be provided. – Job descriptions should include the requirements for education, training, technical knowledge and experience. – The Veterinary Services should undertake periodic self-evaluation especially by documenting achievements against goals and demonstrating the efficiency of their organisational components and resource adequacy. – Responsible authorities should ensure that adequate resources are made available to implement effectively the above activities. 	<ul style="list-style-type: none"> 1.1. Veterinarians or qualified personnel do not exist or function at the field level. 1.2. Local officers are not available when farmers or private veterinarians need a service. 1.3. Job descriptions of veterinarians and support staff are not defined. 1.4. Job descriptions are not appropriate for veterinarians and support staff to deliver services (veterinarians and support staff are overwhelmed by their workloads). 1.5. Small scale farmers have limited access to reliable and qualified Veterinary Services. 1.6. Training programmes: <ul style="list-style-type: none"> 1.6.1. Training programmes are not provided for veterinary and support staff to improve their performance and update knowledge. 1.6.2. The training programmes are not conducted routinely.

		<p>1.6.3. The training programmes are not standardised and certified by the veterinary council.</p> <p>1.7. Veterinary Services at each level do not have sufficient knowledge to detect diseases.</p> <p>1.8. Veterinary Services (at the local level) do not have sufficient tools/equipment to deliver services for FMD control.</p> <p>1.9. There is no routine assessment of Veterinary Services performance on the following topics:</p> <p>1.9.1. Knowledge about FMD and its control</p> <p>1.9.2. Service delivery</p> <p>1.9.3. Reliability and validity of diagnosis</p> <p>1.9.4. Transparency.</p>
2. Engagement of stakeholders	– There are no OIE recommendations regarding engagement of stakeholders	<p>2.1. Farmers do not have sufficient knowledge to detect or recognise disease.</p> <p>2.2. Farmers and private veterinarians do not have similar understanding of the objectives of the FMD control programme or of the importance of FMD surveillance, early reporting and movement control.</p> <p>2.3. Farmers and private veterinarians do not practise in accordance with DLD FMD control programme.</p>

(a): adapted from the *Terrestrial Code*, Chapter 3.1. 'Veterinary Services' (41)
DLD: Department of Livestock Development
FMD: foot and mouth disease
OIE: World Organisation for Animal Health

The design of the questionnaires (Appendices 3, 4 and 5) includes specific questions for three different target groups: local DLD officers, private veterinarians and livestock producers. The questionnaires are self-reporting and focus on the practices of individuals in the target groups in controlling FMD over the past three years. For example, participants report how often they disinfected vehicles for animal transportation. The questionnaires also focus on getting feedback from stakeholders about the services DLD officers provided.

Interviews were designed to obtain more in-depth information to better understand the FMD control system in Thailand and to further investigate specific details that questionnaires cannot provide. Interview questions (Appendices 6, 7 and 8) address the surveillance system, reporting system, vaccination strategies, response plan, control of animal movement and overall Veterinary Services. The questions are designed for each stakeholder group, with specific questions for subgroups such as DLD provincial officers, DLD district officers and officers of animal movement control units.

Discussion and conclusion

The framework and assessment instruments this paper describes are the first of their kind in Thailand. Other evaluation frameworks such as SuRveillance EVALuation (SERVAL), *Outil d'analyse de systèmes d'information en santé* (OASIS [acronym for the French translation of 'analysis tool for surveillance systems']) have been developed, tested and used in other countries (42, 43). Great Britain developed SERVAL to evaluate animal health surveillance with the inclusion of socio-economic criteria (42). The French Agency for Food, Environmental and Occupational Health and Safety (ANSES) developed OASIS to evaluate surveillance systems for zoonoses and animal diseases in France (43). Although SERVAL includes economic criteria, OASIS does not yet include a cost-benefit analysis (43). In 2019, the surveillance evaluation (EVA) tool was also developed for the evaluation of animal health surveillance systems (44). The EVA tool includes both economic and epidemiological aspects (44). It was developed by the European Union's Seventh Framework funded

project, Risk-based animal health surveillance systems (RISKSUR) (44).

Applications of SERVAL, OASIS and EVA sought to evaluate difference disease surveillance systems. The OASIS tool was tested in ‘FMD, rabies in bats, poultry disease network, antimicrobial resistance in pathogenic bacteria from animal origin, and laboratory network for *Salmonella* detection in the food chain’ (43). The SERVAL system was developed and tested for *Brucella melitensis* in sheep and goats, tuberculosis in cattle and classical swine fever in pigs (42). The EVA tool was applied to evaluate the surveillance of classical swine fever and African swine fever, bovine viral diarrhoea, avian influenza and *Salmonella* in five European countries (44).

The SERVAL tool was designed to overcome several drawbacks of OASIS, including the difficulty in interpreting its outputs and the inflexibility of several restrictive assumptions. Both, however, require similar information in order to evaluate surveillance systems, including the scope and objective of surveillance, operational organisation, surveillance procedures, sensitivity and specificity of diagnostic techniques, data management, interpretation and communication of surveillance data, and the evaluation and correction of the surveillance system (42, 43). The EVA tool was developed to improve the existing evaluation framework, methods and tools (44). It provides practical guidance on how to design integrated evaluation protocols and conduct an evaluation, and how to communicate the findings to facilitate decision-making (44).

In contrast to the framework this study proposed, these existing frameworks were developed solely for evaluating surveillance systems. They did not include other activities related to disease control such as vaccination and response plans, which are also essential components for evaluation of FMD programmes. Nonetheless, the proposed framework and assessment tools have several limitations. For example, Thai government agencies other than the DLD may play roles in the FMD control system, such as the Expressway Authority (Ministry of Transport) and the Department of

National Parks, Wildlife, and Plant Conservation (Ministry of Natural Resources and Environment). If assessment instruments focus on a single organisation, they may miss the larger picture and extensive findings and produce misleading results. Moreover, the proposed framework was not designed to assess either the diagnostic system or the design of the reporting system. Again, it may overlook some important features when assessing the FMD control system.

In order to validate the proposed framework and assessment tools, both are currently being applied to the FMD control system in the proposed FMD-free zone in Thailand. The diagram of the data collection plan is illustrated in Figure 4. The diagram shows where surveys and interviews are conducted during the assessment process. It is expected that the results of the assessment will indicate not only whether the FMD control system in Thailand meets OIE requirements for official recognition of FMD-free status, but also whether implementation of the FMD control programme is sufficient to control FMD. Results of the assessment will be used to make recommendations for Thailand to improve its FMD control system. An expectation from this study is that the DLD and other Thai Animal Health policymakers will use the outputs of these assessments to take action to improve the FMD control programme and will circulate the assessment report to affected stakeholders.

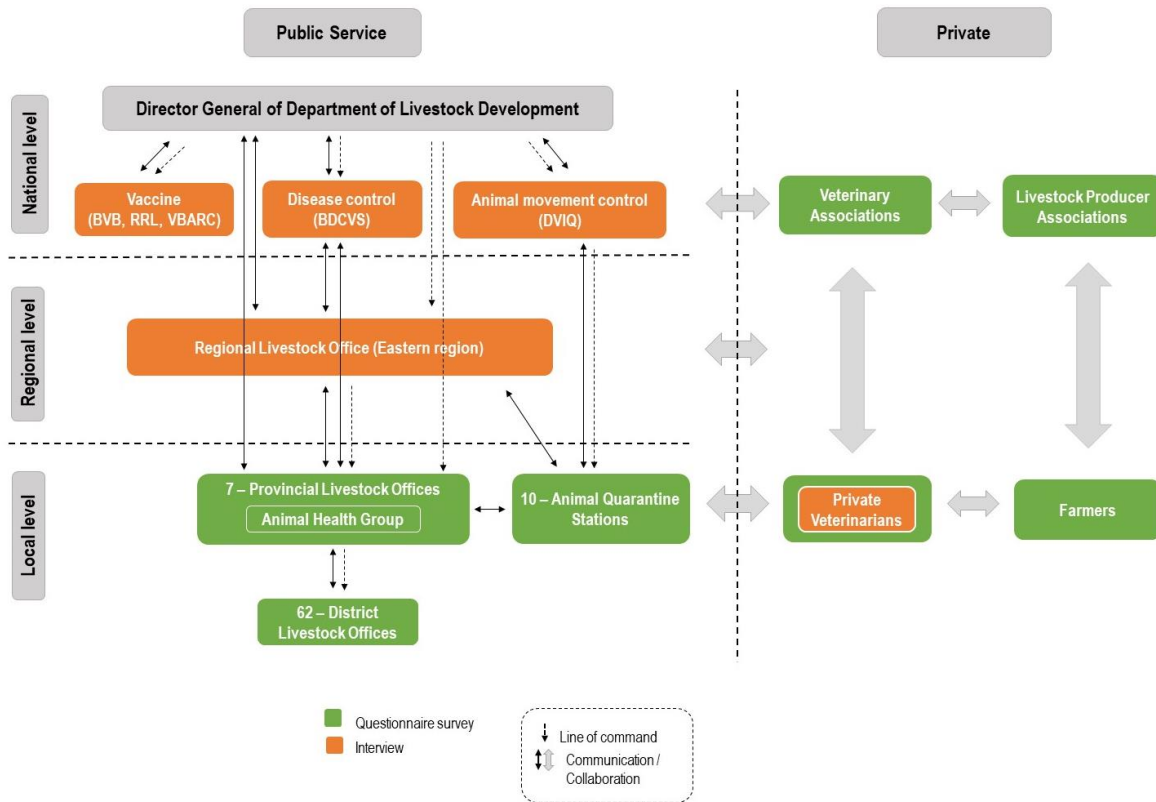


Fig. 4

Data collection plan for the assessment process

- BDCVS: Bureau of Disease Control and Veterinary Services
- BVB: Bureau of Veterinary Biologics
- DVIQ: Division of Veterinary Inspection and Quarantine
- FMD: foot and mouth disease
- RRL: Regional Reference Laboratory for FMD in South-East Asia
- VBARC: Veterinary Biologics Assay and Research Center

As stated, this study developed the first evaluation framework and tools to determine whether the current FMD control system is functioning well and meets the OIE’s requirements. This framework and its tools are currently being applied to assess the proposed FMD-free zone in Thailand. This paper can be used as a model for other countries to help them develop their own evaluation of their national FMD control programme.

Availability of data and materials

All appendices (assessment matrices, questionnaires, interview questions) are available from the corresponding author upon request.

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