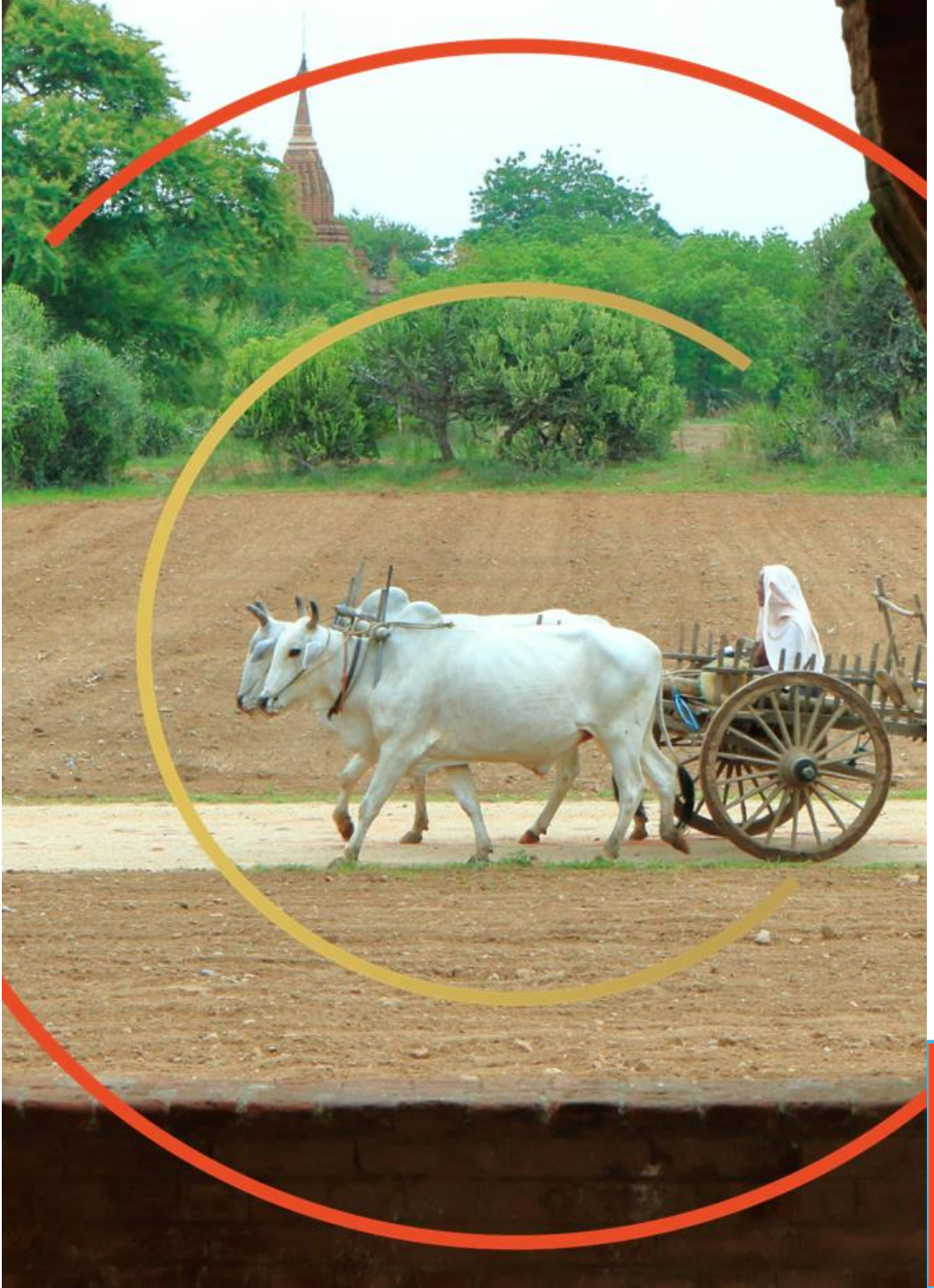


World Organisation for Animal Health

SEACFMD

Poster flash talk

Naree Ketusing

SRR SEA WOAH

28th Meeting of the WOAH Sub-Commission for Foot and Mouth Disease in South-East Asia and China

30 July 2026, Ulaanbaatar, Mongolia

Poster Flash Talk

The aim of the flash talk is to generate interest and encourage participants to visit your poster during the poster session.

Tips for your flash talk:

- **Focus on <u>2–3 key messages</u>** rather than explaining the entire poster.
- Briefly cover the **<u>background, key findings or achievements</u>**, and your **<u>main recommendation</u>** or **<u>takeaway</u>**.
- Use the poster as **<u>a visual aid</u>**, rather than explaining every section.
- Please keep within the **<u>3-minute time limit.</u>**

Order of Presentations

South Asia	1. Bangladesh
	2. Bhutan
	3. Nepal
East Asia	4. Chinese Taipei
	5. Japan
	6. Korea
SEACFMD (non-member)	
	7. Timor-Leste
Partners	8. ACDP
	9. Pak Chong (RRL)

Vaccines	10. Biogenesis
	11. CAVET
	12. India Immunological
	13. MSD
Other regions	
	14. South America
SEACFMD (members)	
	15. Malaysia
	16. Philippines
	17. Vietnam

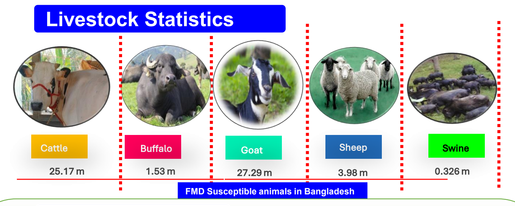
FMD Situation in Bangladesh

Dr. Md. Bayzer Rahman
Director, Administration and CVO
Department of Livestock Services
Ministry of Fisheries and Livestock, Bangladesh

Introduction

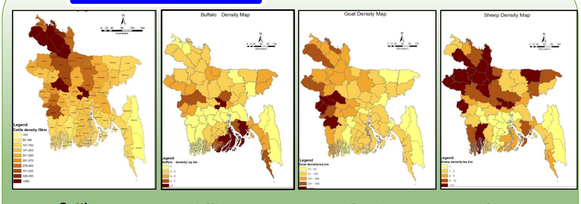
- Bangladesh is one of the most densely populated countries in the world.
- Approximately 75% of the population live in rural areas and depend heavily on livestock as a source of meat, milk and eggs for food and income.
- High density of large ruminants: ~145 large ruminants per sq. km area.
- Foot and Mouth Disease (FMD) is an endemic and economically important disease particularly affecting small- and medium-scale crossbred dairy farms.

Livestock Statistics



FMD Susceptible animals in Bangladesh

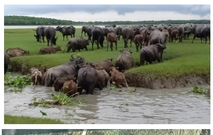
Livestock Densities



Cattle Buffalo Goat Sheep

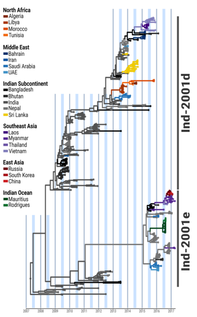
Foot and Mouth Diseases (FMD)

- FMD is a highly contagious and viral disease of domestic and wild cloven-hoofed animals .
- Morbidity is high but mortality is low.
- FMD is prevalent with serotypes O, A, and Asia-1.
- Type O is considered the most dominant followed by Type A.
- Colossal Financial loss due to the disease burden.
- Targeted FMD vaccination in all susceptible animals Manikganj, Sirajganj, Pabna, and Bhola districts.
- Bangladesh has formulated and implemented risk based National FMD disease control strategy (2025-2035).



FMD Molecular epidemiology of Circulating FMD Virus

- FMD caused by FMD virus Serotypes O, A and Asia 1 (Kamruddin et al. 1988; Anwar et al., 2014; Rahman et al., 2018 & Shahid et. al., 2019).
- In the past most (80%) of the infection caused by Serotype O, followed by Asia-1 and A.
- Type C was last reported in 1995 (World FMD Reference laboratory).
- All the serotype O virus belonged to the ME-SA topotype, phylogenetically cluster together with India 2001(Ind2001) under the Middle-east, South Asia (ME-SA topotype).
- Novel linage of Serotype O are Ind2001BD1 and Ind2001BD1 within Ind2001 d sub linage (Siddique MA et al., 2019).
- One Isolate grouped under PanAsia Linage of ME-SA topotype (Shahid et al., 2019)
- Deletion of A/Asia/Iran-o5 in Bangladesh (Kang et. al., 2025).



Serotypes identified

Sample tested	2020	2021	2022	2023	2024	2025
FMD positive samples	200	150	102	204	210	266
Serotypes	34	46	22	33	28	59
Serotypes	FMDV type O(33) and A 91)	FMDV type O(46)	FMDV type O(22)	FMDV type O(31) and A (2)	FMDV type O(28)	FMDV type O(56) and A (2)

- 57 VP1 coding sequences of Foot-and-Mouth Disease virus (FMDV) were identified during 2021–2023.
- Serotype distribution: Type O – 96.5%, Type A – 3.5%; no detection of Asia-1 serotype.
- Three FMDV lineages detected:
  - O/ME-SA/Ind-2001e (n=40; 70.2%)
  - O/ME-SA/SA-2018 (n=15; 26.3%)
  - A/ASIA/Iran-05 (n=2; 3.5%)
- Two samples collected in 2023 were positive for Serotype A, belonging to the A/ASIA/Iran-05 lineage (Sublineage FAR-11) — the first report of this lineage in FMD Endemic Pool-2.
- VP1 sequence analysis showed that isolates A/NAN5/2023 and A/BAN6/2023 were closely related (97.81% nucleotide identity) to a virus detected in Pakistan (Pak/41/2022a), with a common ancestor estimated around March 2022.

Prevention and control initiatives

Vaccine source:

- The Livestock Research Institute (LRI) produced approximately 2 million doses of FMD vaccine annually for immunization in livestock.
- A few private companies locally produce FMD vaccines, while some companies import genetically matched exotic vaccine as a part of livestock immunization totaling around 1.5 million doses.

FMD Control Strategy (risk-based) implemented:

Vaccination all commercial stocks especially medium and large-scale farms all over the country as risk-based vaccination by commercial vaccine + DLS produced vaccine: (2+ 1.5)=3.5 million doses.

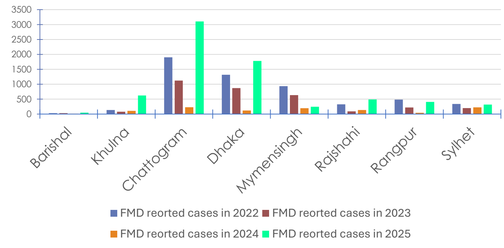
Four districts included (Manikganj, Pabna, Sirajganj and Bhola) under targeted vaccination- by government using imported vaccine.

After mass vaccination number of reported FMD like cases declined exponentially

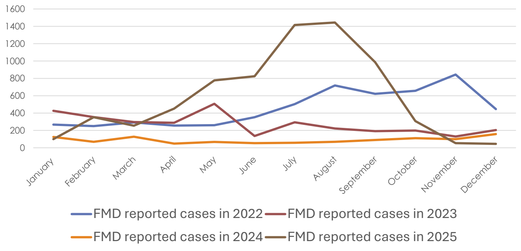
Sero-monitoring FMD vaccination in 3 districts

Name of the districts	Number of Sample collected (n)	Seropositivity Status (%)	
		O	A
Manikganj	92	98	99
Pabna	92	98	97
Bhola	132	98	98

Spatial distribution of FMD like cases identified through BAHIS (2022-25)



Temporal distribution of FMD like cases identified through BAHIS (2022-25)



Challenges

- Animal movement is not effectively regulated.
- Early-stage livestock identification remains inadequate.
- High-density livestock populations pose additional challenges.
- Regional laboratories often lack sufficient capacity to testing the samples.
- Resource limitations, including shortages in manpower, logistics, and vaccines, further constrain operations.

Recommendations

- **Enhance regional collaboration** among endemic countries through coordinated planning, technical exchange, and joint implementation of FMD control strategies.
- **Promote regional vaccine development and matching**, supported by continuous molecular epidemiological surveillance to ensure vaccines remain effective against circulating virus lineages.
- **Strengthen cross-border surveillance and joint monitoring** through harmonized surveillance protocols, coordinated outbreak investigations, and risk-based animal movement management.
- **Establish timely data and sequence sharing mechanisms** to facilitate early warning, rapid risk assessment, and evidence-based decision-making.
- **Advance regional harmonization** of surveillance standards, diagnostic methods, laboratory quality assurance, vaccination strategies, and reporting systems in line with the **Progressive Control Pathway for FMD (PCP-FMD)**.
- **Build sustainable laboratory and workforce capacity** through regional reference laboratories, collaborative research, and regular training programs.

28th SEACFMD Sub-Commission Meeting
Ulaanbaatar, Mongolia (28 – 30 July 2026)

Foot-and-Mouth Disease Prevention and Control Strategy in Bhutan

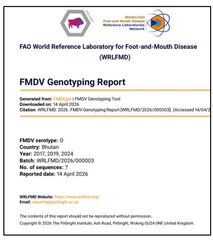
Dr. Tenzin Wangchuk
Principal Veterinary Officer
National Veterinary Hospital, Bhutan

1 Current FMD Situation in Bhutan

Notifiable disease under the Livestock Rules & Regulations 2017. 62% of households depend on livestock. Bhutan is implementing Stage 3 of the FAO/WOAH Progressive Control Pathway (PCP-FMD).

Circulating serotype — genomic evidence (WRLFMD / Pirbright Institute, 2026)

- **Serotype O —** dominant; Pan Asia strain since 2003
- **Serotype A —** periodic; last 2017
- **Serotype Asia 1 —** last case 2002
- **Serotype C —** none since 1991
- **2026 genotyping —** 7 sequences (O), Bhutan, 2017/2019/2024
- **Phylogenetics —** Bhutan isolates cluster with India/Nepal regional strains


FAO World Reference Laboratory for Foot-and-Mouth Disease (WRLFMD)

FMDV Genotyping Report

Generated from: FMDVgss | FMDV Genotyping Tool
Downloaded on: 14 April 2026
Citation: WRLFMD, 2026. FMDV Genotyping Report [WRLFMD/2026/000003]. [Accessed 14/04/2

FMDV serotype: O
Country: Bhutan
Year: 2017, 2019, 2024
Batch: WRLFMD/2026/000003
No. of sequences: 7
Reported date: 14 April 2026

WRLFMD Website: https://www.wrlfmd.org/
Email: reporting@pirbright.ac.uk

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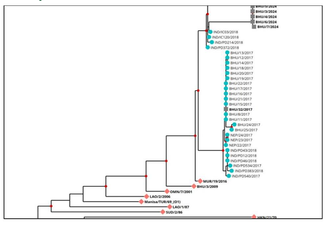
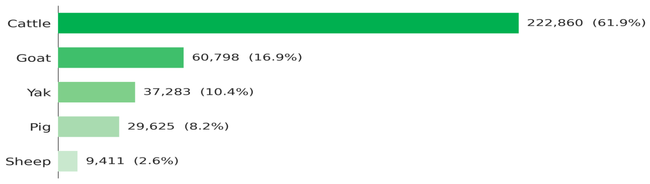


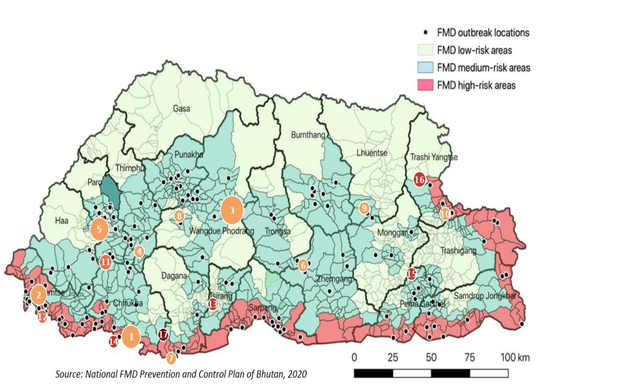
Figure 22: Phylogenetic tree of FMD virus isolates from Bhutan in relation to regional reference strains, showing serotype O lineage clustering.

Source: WRLFMD FMDt ype Genotyping Report [WRLFMD/2026/000003], Pirbright Institute; phylogenetic tree of Bhutan FMDV isolates (serotype O lineage).

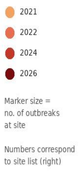
FMD-susceptible livestock population, Bhutan (total: 359,977 animals)



Geographic distribution of outbreak sites, 2021–2026 — traced on Bhutan's national FMD risk-zone map



Source: National FMD Prevention and Control Plan of Bhutan, 2020



District	No. of Outbreaks	Date
1. Chukha	5	Feb 2021
2. Samtse	4	Mar 2021
3. Wangduephodrang	7	Mar 2021
4. Thimphu	1	Apr 2021
5. Paro	5	Apr 2021
6. Zhemgang	1	Jul 2021
7. Dagana	1	Aug 2021
8. Punakha	1	Oct 2021
9. Lhuentse	1	Dec 2021
10. Tashi Yangtse	1	Dec 2021
11. Paro	2	Jan 2022
12. Samtse	1	Jun 2022
13. Tsirang	1	Jan 2024
14. Chukha	1	Nov 2024
15. Mongar	1	Nov 2024
16. Tashi Yangtse	2	Dec 2024
17. Dagana	1	May 2026

2 FMD Prevention and Control Measures

Risk-based vaccination strategy (minimum target: 80% coverage)

Risk zone	Target species	Frequency	Schedule
High	Cattle, yak, buffalo, pig, sheep, goat	Bi-annual	Sep–Oct & Mar–Apr
Medium	Cattle, yak, buffalo	Annual	Sep–Oct
Low	Cattle, yak	Responsive	Only during outbreaks

Outbreak response — Rapid Response Team (RRT), activated within 24 hours

Suspected Report — Farmer → Livestock Extension officer
→ **Confirmation of report by Lab** — Within 24 hours
→ **RRT Activation** — Within 24 hours after confirmation
→ **DOIT Investigates** — Traces source, declares Zones
→ **Clean & Dirty Teams deploy** — Ring Vaccination/Treatment
→ **Zones lifted** — 21 days after last case

Syndromic
Monthly VIS reporting

WAHIS
Event Reporting

Lab
PCR Callahan protocol

Quarantine
15 days at 4 quarantine stations

3 Main Challenges

1. **Seasonal Migration**
   Herds of 8–59 animals move between altitudes
2. **Porous 700 km border with India**
   Shared grazing & watering points
3. **Illegal movement ("Tshethar")**
   Bypasses biosecurity checks
4. **Imported meat ~80% of supply**
   Continuous re-introduction risk
5. **Lack of surveillance in wildlife population**
   Resource and capacity constraint with wildlife sector

4 Recommendations

National level

- **Sustain ≥80%** vaccination coverage
- **Strengthen** border biosecurity at 4 quarantine stations
- **Serotype Detection** and sero-surveillance

Vaccine Matching

- **Progress to** PCP-FMD Stage 4
- **Raise** community awareness (Tshethar)

Regional level (SEACFMD / WOAH)

- **Share** outbreak/serotype data from India, SEACFMD
- **Harmonize** vaccination in shared border zones
- **Support** regional lab / serotyping network
- **Establish** joint outbreak-investigation protocols
- **Sustain** regional technical & resource support

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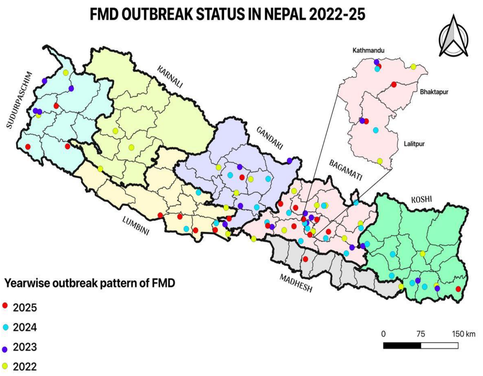
Ulaanbaatar, Mongolia (28 – 30 July 2026)

FMD Status, Control measures and Constraints in Nepal

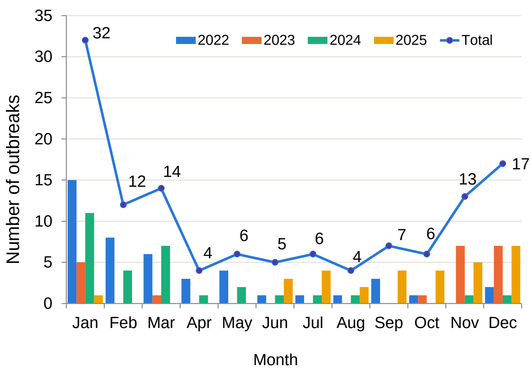
Dr. Umesh Dahal, Director General
Department of Livestock Services, Nepal

FMD SITUATION

Maps - Spatial patterns



Graphs – Temporal patterns



- Existing FMD-PCP stage: 2
- FMD is endemic in Nepal with frequent outbreak mostly in 2017 & 2022 but decreasing in 2023 & 2024.
- Recent outbreaks are more localized with low morbidity & mortality.
- FMD Risk Populations:- 26.4 Million (Cattle-5.1 M, Buffalo-3.3 M, Pig-1.5M, Goat-15.9 M , Sheep-0.6 M). Animal affected: Cattle, Buffalo, Goat, Pig
- Serotype O is Prominent; In 2022: Serotype O & A, In 2023 & 2024: only Serotype-O & in 2025: Serotype O & A.
- Lineage: Serotype O- Ind 2001e, SA-2018 & Serotype A- GVII
- High animal movement, low vaccination coverage, common pasture are the main risk factors.

FMD PREVENTION & CONTROL MEASURES

- Legal Framework: Animal health and livestock services act 1999 & Regulation 2000 listed FMD as one of the Notifiable diseases.
  - FMD Control Strategy 2015-2025.
  - Risk Based Strategic Plan (RBSP).
  - Risk Based Control Measures & National FMD Control program,
  - Declaration of Two FMD free zones in the country (In Koshi & Bagmati Province).
  - Zoning & Compartmentalization Directives.
  - FMD Surveillance Technical Directives.
- Regular risk base surveillance in commercial farms, live animal market, buffer zone area of national parks, wild life reserve & conservation areas.
- Establishment of new BSL 2 plus laboratory for the diagnosis of FMD in the country.
- RRT mobilized during the outbreak time for investigation & control measures.
- Vaccination: Risk base & Ring vaccination. Use of Trivalent inactivated vaccine mostly in Cattle & Buffaloes; 44.5% coverage at the moment.
- Farm Biosecurity, Sanitation & Hygiene, Public Awareness about FMD.
- Strict Quarantine measures & movement control of infected animals.

CONSTRAINTS & SOLUTIONS

- Federal system with poor chain of commands & poor reporting of diseases.
- Expansion & Strengthening of National Veterinary Services at field levels.
- Inadequate trained Human Resource for early detection & response.
- Low vaccination coverage & Geographical difficulty for service delivery.
- High Animal movement.
- Framing of legal provisions as per federal systems for proper chain of commands & effective reporting of diseases eg Infectious Animal Disease Control Bill.
- Increasing human resource in province & Local Levels to increase vet services.
- Organizing FMD Real Time Training for field veterinarians & Molecular diagnosis for FMD-SAT Serotype detection, sequencing & Vaccine Matching test for laboratory veterinarian.
- Mass vaccination against FMD.
- Regulated movement: Mandatory Animal Health Certificate & origin certificate during transport.

MAINTAIN FMD FREE STATUS OF CHINESE TAIPEI

Cheng-Ju Pan, Veterinary Research Institute , Chinese Taipei

①Current FMD Risk Situation

Chinese Taipei is composed of Taiwan, Penghu, Kinmen and Matsu.

Current FMD Status in Taiwan (recognized by WOAH)

➢ **Taiwan, Penghu and Matsu**
- Status: **FMD-free area without vaccination** (since June 2020)
- PCP-FMD: Beyond Stage 5
- Following the cessation of routine vaccination, the livestock population has limited population immunity against FMD. Consequently, any introduction of FMDV could result in rapid transmission and widespread outbreaks.

➢ **Kinmen**
- Status: **FMD-free area with vaccination** (since May 2018)
- PCP-FMD: Between Stage 4 & 5
- Kinmen faces a higher risk of FMDV introduction. Therefore, routine vaccination is maintained to provide frontline immune protection and reduce the risk of virus incursion.

Major risk factors

1.High disease pressure in the region
FMD remains endemic in many neighboring countries and regions. The circulation of multiple virus serotypes poses a constant threat of virus introduction.

2. Multiple introduction pathways
As Chinese Taipei is not connected by land to neighboring countries, the risk of FMD entry comes mainly from maritime and air transport, as well as illegal routes.

3. Risk of illegal meat products
Illegal importation of contaminated cloven-hoofed meat products via international postal parcels, cross-border e-commerce, and the luggage of international travelers constitutes a major risk factor for FMDV introduction.

②Prevention and Preparedness

Legislation and Framework

- Implemented under the Act on the Prevention and Control of Infectious Animal Diseases, its Enforcement Rules, Regulations for the Types and Management of Vaccines Required for Eradicating Classical Swine Fever and Foot and Mouth Disease, and the Standard Operating Procedure for the Control of Foot and Mouth Disease.
- Since 2015, FMD has been included in the Disaster Prevention and Protection Act, establishing a national emergency response mechanism.

Border Quarantine and Enforcement

- Cross-agency collaboration and comprehensive X-ray inspection of passengers' baggage and detector dogs for meat products
- Food waste control for international flights and ferry services.
- Heavy penalties for illegal importation to deter violations


Surveillance

Active Surveillance

On-farm
- Clinical inspections and serological testing
- 600 pig farms and 300 ruminant (cattle and goats) farms monitored annually nationwide

Auction markets & Slaughterhouses
- Daily clinical inspections
- Routine serological testing for NSP antibody
- Over 20,000 samples collected and analyzed across the country each year.

Passive Surveillance
- Clinically suspected cases are traced back to the original farm to conduct
- Movement restriction
- Follow-up clinical, epidemiological, serological and virological investigation.

Vehicle GPS Tracking & Disinfection Enforcement

- Enables real-time movement and trajectory monitoring by the central authority.
  - Applies to all vehicles transporting live cloven-hoofed animals (e.g., pigs, cattle and goats), carcasses, offal, meat product, and rendering waste.
  - Compulsory installation of Global Positioning Systems (GPS).
- Strict Vehicle Cleaning & Disinfection Protocol
  - Mandatory cleaning and disinfection of vehicles before leaving auction markets and slaughterhouses.

Emergency Preparedness

- Regular simulation exercises and drills to maintain rapid response capacity
- Emergency vaccine stockpile (domestic):
  - Type A (A22 Iraq strain)
  - Type O (O1-Campos strain)
  - Type SAT1 (SAT1 BOT/1/77)
- Overseas antigen bank (commissioned to Merial UK): for rapid vaccine production in case of an outbreak
  - Type O (01 Manisa strain) antigen
  - Type A (A22 Iraq strain) antigen

Laboratory Diagnostic Capacity

- The Veterinary Research Institute (VRI) of the Ministry of Agriculture is an ISO/IEC 17025:2017 accredited laboratory (TAF) for:
  - Virus isolation
  - RRT-PCR
  - RT-PCR
  - Ag-ELISA
  - Virus neutralization test (O type)
  - NSP antibody testing

- Agricultural Technology Research Institute (ATRI) is also accredited for FMD NSP antibody testing
- All diagnostic methods follow WOAH recommended or internationally accepted standards.

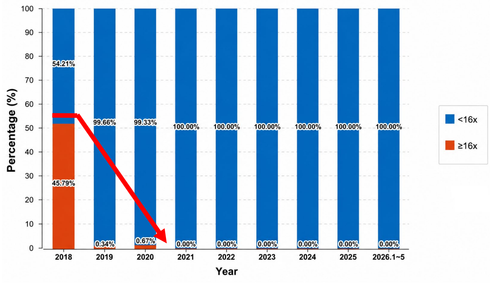


Figure1. Percentage of pig farms in Taiwan (excluding Kinmen) with type O FMD virus neutralizing antibody titers <1:16, based on sampling designed to detect a 1% prevalence at 95% confidence.

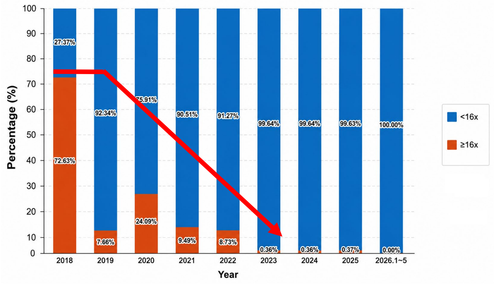


Figure2. Percentage of cattle and goat farms in Taiwan (excluding Kinmen) with type O FMD virus neutralizing antibody titers <1:16, based on sampling designed to detect a 1% prevalence at 95% confidence.

③Main Challenges

Continuous disease pressure and viral evolution
- FMD remains endemic in the Asia-Pacific region and the virus evolves rapidly. Continuous evaluation is needed to ensure that vaccines and diagnostic reagents remain effective against emerging variants.

Illegal importation through unofficial pathways
- Illegal importation by sea or other unofficial channels are highly concealed and can bypass regular quarantine systems. Strong multi-agency enforcement is essential.

Maintaining awareness in an FMD-free environment
- After years without vaccination and without indigenous cases, some stakeholders may become complacent, leading to weakened biosecurity and lower willingness to report. Sustaining Public-Private Partnerships (PPP) is a long-term challenge

④Recommendations

- Strengthen border quarantine and enforcement to deter illegal importation.
- Maintain comprehensive active and passive surveillance, including monitoring of abnormal pig mortality.
- Enforce thorough cleaning and disinfection of livestock transport vehicles to prevent disease spread.
- Strengthen Public-Private Partnerships (PPP): promote awareness, provide regular biosecurity training, and establish positive incentives for early reporting (e.g. no penalty and compensation).

28th SEACFMD Sub-Commission Meeting
Ulaanbaatar, Mongolia (28 – 30 July 2026)

Maintaining FMD-Free Status in Japan: Current Risks, Preparedness and Future Directions

Mayuko NAKAKOSHI
Section Chief Animal Health Division
Ministry of Agriculture, Forestry and Fisheries JAPAN

MAFF
Ministry of Agriculture, Forestry and Fisheries
農林水産省

Current FMD Risk Situation in Japan

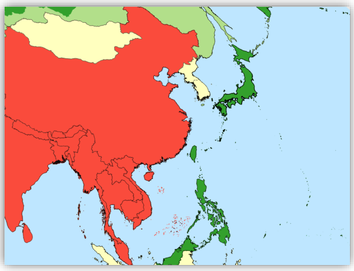
FMD Status

Item	Status
Last outbreak（serotype:O）	**2010** (Miyazaki epidemic **288,470** animals culled)
FMD-free status recovered	2011
Current status	FMD-free without vaccination （WOAH official status）

15 Years without FMD
(2011-2026)

Main risk factors

- Regional FMD circulation
- International travelers
- Animal products and parcels
- Large-scale livestock production systems



Source：WRLFMD

FMD Prevention and Preparedness Measures

Prevention

Border inspection and quarantine operation

for live animal/animal product

- Health certificate issued by competent authorities of exporting countries are needed.
- Import of relevant commodities from FMD infected countries/zones is prohibited.
- Live animals are quarantined for 15 days in animal quarantine premises after arrival.
- Standards for Rearing Hygiene Management

for passenger/traveler

- Interview passenger, inspect belongings and dispose prohibited product.
- Deploy detector dog throughout country.
- Disinfect shoe-sole/belongings.

Preparedness

Early detection and notification

- **Early warning system**
  Immediate reporting to prefectural government
  (reduced compensation in the case of delayed notification)
- **On-site farm inspection by prefectural vets**
  Clinical examination / antigen-capture pen side kit
- **Confirmatory diagnosis**
  by National Institute of Animal Health (NIAH)

Simulation exercise for prompt initial response

- Establishment of movement restriction zone
- Stamping-out
- Disposal of all carcasses (burial/incineration) & Disinfection
- Epidemiological investigation
- Surveillance (including wild animals)
- When necessary, emergency vaccination and pre-emptive culling(vaccine stockpiles)

Main Challenges Encountered

Maintaining vigilance during a prolonged outbreak-free period

- No outbreak for more than 15 years
- Decreasing awareness of FMD among stakeholders

Growing international movement of people and goods

- Increase in the number of travelers
- Increase in the volume of parcels and e-commerce shipments
- Greater inspection workload

Key Recommendation

Sustainable FMD prevention requires continuous investment in border control, early detection, emergency preparedness, and regional cooperation.

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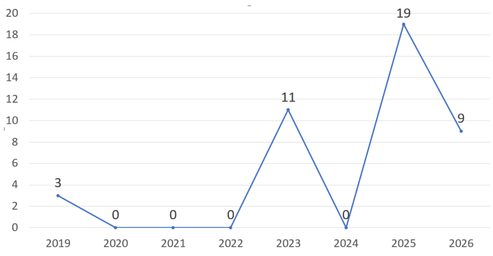
FMD Situation and Control Measures

Ministry of Agriculture, Food and Rural Affairs
Republic of Korea

FMD SITUATION

◆ No. of Outbreaks

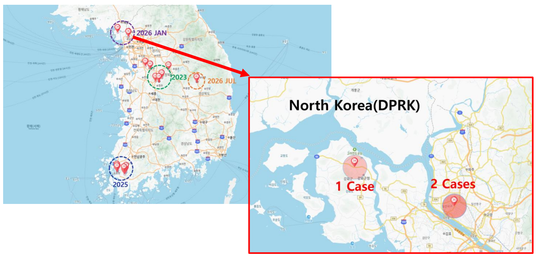


◆ Serotype distribution : O/ME-SA/ind-2001e

- Serotype: O
- Topotype: ME-SA
- Lineage: Ind-2001
- Sub-lineage: e

◆ Recent outbreaks in 2026 JAN

- 3 cases, 626 heads culled



◆ Main risk factors

- The recent outbreaks of FMD in neighboring countries have been characterized by an increase in cases where the virus(genotype) has spread from pool to other regions/countries(pool)

FMD PREVENTION & CONTROL MEASURES

Prevention Activities

- **Vaccination** : Susceptible livestock such as cattle, pigs, goats should be vaccinated under the Act. Each farm must maintain seropositive rate for SP antibody over 80%.
- **Surveillances :** Serological test for SP and NSP antibody is conducted targeting at least 900 thousand animals every year
- **Onsite inspection :** Farms with no purchase records or insufficient purchases of FMD vaccine, compared to the number of animals are regularly inspected
- **Border control** : Animal or livestock products from FMD outbreak countries are prohibited

Control Measures

- **Stamping out** : All susceptible animals in the first outbreak farm in the county will be culled. In case of additional outbreak in the same county, only antigen positive animals will be culled.
- **Emergency Vaccination** : All susceptible livestock animals in the county or country will be vaccinated.
- **Movement Restriction**
  - Immediately after the FMD outbreak, temporary standstill order is issued on vehicles and workers related to all susceptible livestock
  - A management zone is established encompassing the outbreak farm, consisting of two defined areas: the restricted area (within a 500-meter radius) and the protection area (within a 3-kilometer radius). Movement of susceptible animals is strictly regulated within these designated zones

MAIN CHALLENGES

Food and Mouth Disease (FMD) Prevention and Preparedness in Timor-Leste

Dr. Cesarina Alegria, Veterinarian
National Directorate of Veterinary (DNV)

CURRENT FMD SITUATION

Timor-Leste remains free from FMD. However, the country remains at risk due to ongoing FMD circulation in neighbouring countries, cross-border animal movement, limited animal movement control at border areas, and the movement of animals and animal products.

FMD PREVENTION & PREPAREDNESS

- Active surveillance: Conducted continuously since 2023, expanding from border municipalities to all 11 municipalities in 2025, supporting Timor-Leste's continued FMD-free status.
- Passive surveillance: Supported through the Epicollect5 digital platform to improve disease reporting and strengthen national surveillance.
- Animal movement control: Livestock movement monitoring and animal health inspections are implemented to reduce the risk of FMD introduction.
- Veterinary capacity building: Annual training programs strengthen veterinary technicians' skills for early detection and response to FMD.
- Laboratory preparedness: The Veterinary Diagnostic Laboratory has the capacity to perform ELISA testing for FMD confirmation to support surveillance and preparedness.
- Public awareness and biosecurity: Awareness activities, including farmer education, posters, and brochures, promote early reporting and biosecurity practices.

CHALLENGES ENCOUNTERED IN THE PREVENTION

- Limited trained veterinary personnel.
- Continuous capacity building required.
- Imported diagnostic reagents and test kits.
- Limited advanced molecular diagnostic capacity.
- Reliance on reference laboratories for confirmatory testing.
- Remote areas limit surveillance and sample transport.
- Limited animal movement control.
- Informal livestock movement increases FMD risk.
- Limited farmer awareness and biosecurity compliance.
- Limited emergency response resources and contingency funding.
- Need for regular simulation exercises and outbreak preparedness training.
- National contingency plans require periodic review and updating.

RECOMMENDATIONS-National Level

- Strengthen FMD risk assessment and preparedness.
- Enhance surveillance, early warning, and reporting.
- Strengthen veterinary and laboratory capacity.
- Improve animal movement control.
- Maintain public awareness and biosecurity.
- Conduct targeted surveillance, including small ruminants.
- Prepare for WOAH FMD-free status recognition.
- Ensure sustainable investment and long-term funding.

RECOMMENDATIONS-Regional Level

- Strengthen regional collaboration and information sharing.
- Continue joint surveillance and cross-border cooperation.
- Participate in regional training and technical exchanges.
- Strengthen early warning and coordinated response.
- Maintain vigilance due to ongoing regional FMD risk.

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Strengthening FMD Preparedness and Response

Wilna Vosloo, Principal Research Scientist

CSIRO – Australian Centre for Disease Preparedness, Australia

Strengthening FMD Preparedness and Response: *Evidence, Innovation and Tools for Improved Decision Making*

1 Environmental Persistence of FMDV: Effects of Temperature and Relative Humidity

Understanding how environmental factors drive FMDV survival is critical for assessing indirect transmission risk and informing biosecurity strategies.

Approach

Temperatures: 10 °C, 20 °C, 30 °C

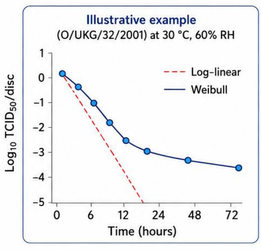
Relative Humidity (RH): 40%, 60%, 80%

Matrix: Filter paper discs

FMDV isolates: O1/Lausanne/SWI/65 O/UKG/32/2001 O/UKG/7/2007

Key Findings

- Temperature is the dominant driver of inactivation.
- Viral decay accelerates markedly with increasing temperature.
- At 10 °C, viability is lowest at 60% RH and higher at both 40% and 80% RH.
- RH has a secondary, modifying effect—most evident at 10 °C.
- Log–linear models overestimate persistence at 30 °C.
- Weibull models best describe non-log–linear (biphasic) decay with tailing.
- Strain differences are modest compared to environmental effects.



D-values (hours) – D_1 ($1-\log_{10}$ reduction) / D_2 ($2-\log_{10}$ reduction)

RH	10 °C		20 °C		30 °C	
	D_1	D_2	D_1	D_2	D_1	D_2
40%	↑	↑	↑	↑	↑	↑
60%	↓	↓	↑	↑	↑	↑
80%	↑	↑	↑	↑	↑	↑

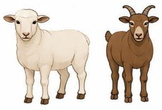
↑ Higher temperature = shorter D–values (faster decay)

FMDV inactivation is strongly temperature–dependent and often non–log–linear. Incorporating temperature– and RH–dependent nonlinear kinetics in models will improve environmental risk assessments and outbreak management.

2 Validation of NSP ELISA Kits for Sheep and Goats: A Bayesian Latent Class Approach

Reliable diagnostics across species are essential for accurate surveillance and control of FMD.

Approach



Two commercial NSP ELISA kits: PrioCHECK™ IDScreen®

Bayesian latent class model with conditional dependence (WOAH validation framework)*

Key Results

PrioCHECK™
DSe: 0.93 (0.85–0.97)
DSp: 0.98 (0.91–1.00)

IDScreen®
DSe: 0.96 (0.87–1.00)
DSp: 0.95 (0.89–0.99)

Agreement Between Assays
Sheep: Weighted κ = 0.91 (0.87–0.95)
Goats: κ = 0.57 (0.37–0.77)

Overall Diagnostic Accuracy
96% (95–97%)

Reproducibility
Cronbach's α > 0.99
Concordance correlation coefficient > 0.99

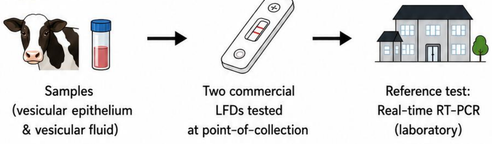
Both NSP ELISA kits show high diagnostic performance and excellent reproducibility in sheep and goats, supporting their use in small ruminants and filling a key validation gap for FMD surveillance.

*WOAH Terrestrial Manual 2023. Chapter 1.1.6. – Principles and methods of validation of diagnostic assays for infectious diseases.

3 Field Evaluation of Lateral Flow Assays for Rapid FMDV Detection in Outbreak Conditions

Rapid, on–site detection is vital for early outbreak control, especially where laboratory infrastructure is limited.

Approach



Samples (vesicular epithelium & vesicular fluid) → Two commercial LFDs tested at point-of-collection → Reference test: Real-time RT-PCR (laboratory)

Sample transport device for nucleic acid extraction

Field team training on biosecure handling and result interpretation

Key Findings

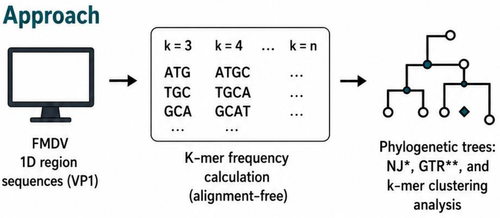
- Results in 15–30 minutes
- High usability and ease of interpretation
- Portable, robust and low–cost
- Slightly lower sensitivity than RT-PCR
- The use of LFDs has limitations in the late phase of an FMD outbreak

Lateral flow assays are valuable point-of-care tools for rapid FMDV detection, enabling timely decisions and outbreak containment. Integration into national FMD control programmes can strengthen early warning systems and reduce response times.

4 K-mer Based Phylogenetic Analysis of FMDV: A Fast and Alignment-Free Approach

K–mer frequency analysis offers a rapid, alignment-free alternative for phylogenetic inference and outbreak investigation.

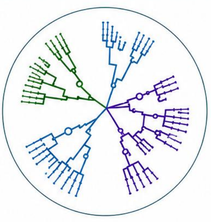
Approach



FMDV 1D region sequences (VP1) → K–mer frequency calculation (alignment–free) → Phylogenetic trees: NJ*, GTR**, and k–mer clustering analysis

Key Findings

- Optimal k–mer size varied by distance metric (selected using gap statistic).
- K–mer trees showed broad concordance with NJ* and GTR** trees.
- Highly effective for small datasets and completed on modest computational resources.
- Eliminates alignment and post–alignment correction—a streamlined workflow.
- Scalable with cloud computing for large datasets and global outbreak investigations.



K–mer based analysis is a fast, accessible and reliable approach for FMDV genetic characterization and rapid epidemiological investigations.

*NJ – Neighbour–Joining; **GTR – General Time Reversible.

Keywords: Foot-and-Mouth Disease, FMD, FMD virus, FMDV, virus inactivation, temperature, relative humidity, model-fitting, NSP antibodies, NSP ELISA, Small Ruminants, Sheep and Goats, lateral flow assay, field diagnostics, outbreak response, point-of-care testing, 1D region sequences (VP1), phylogenetic analysis, substitution models, k–mer clustering analysis

Acknowledgements:

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- Wageningen BioVeterinary Research, 8221 RA Lelystad, The Netherlands
- Chief Veterinary Officer's Branch, Agriculture Victoria, Melbourne, Australia
- Friedrich-Loeffler-Institut, Insel Riems, Germany
- CSIRO – ACDP International Program
- CSIRO-Data61
- Disease Investigating Centre, Wates, Yogyakarta, Indonesia

Four complementary solutions advancing FMD preparedness

UNDERSTAND THE ENVIRONMENT Quantify how temperature and humidity drive virus survival.

TRUST THE DIAGNOSIS Validate and ensure performance of diagnostic tests across species.

DETECT EARLY, ACT FAST Deploy rapid, field-ready tools for timely outbreak response.

TRACE SMARTER Use advanced, alignment-free genomics for faster epidemiological insights.

Use science to advance tools, protect livestock and improve livelihoods.

28th SEACFMD Sub-Commission Meeting
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PROGRESS ACTIVITIES

Regional Reference Laboratory for Foot-and-Mouth Disease in Southeast Asia

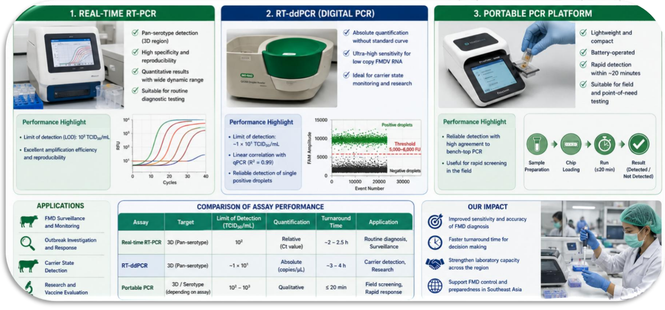
National Institute of Animal Health, Department of Livestock Development, Thailand

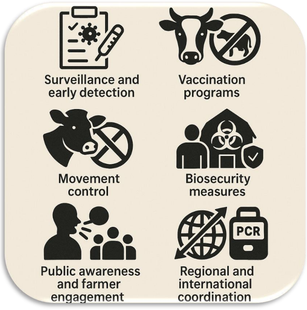
Progress Activities (2024–2026)

The Regional Reference Laboratory for Foot-and-Mouth Disease in Southeast Asia (RRLFMD), under the National Institute of Animal Health (NIAH), Department of Livestock Development (DLD), Thailand, continues to strengthen regional laboratory capacity and technical collaboration for the prevention and control of Foot-and-Mouth Disease (FMD).

Key achievements include:

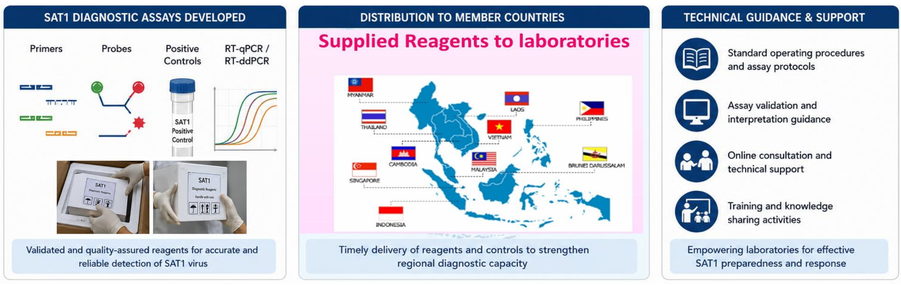
❖ **Enhanced laboratory diagnostic capacity** through implementation and validation of advanced molecular assays, including real-time RT-PCR, RT-ddPCR, and portable PCR platforms.





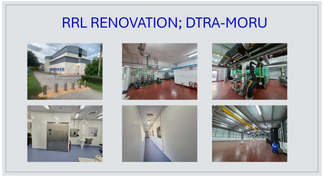
❖ **Regional proficiency testing (PT) programme:** coordinated for National Laboratories and Collaborated in Southeast Asia to improve laboratory quality and harmonization.

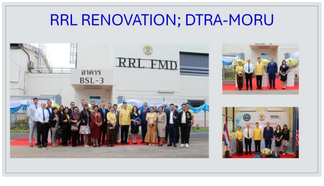
❖ **Support for regional SAT1 preparedness**, including development and distribution of diagnostic primers, probes, positive controls, and technical guidance to member countries.



❖ **Strengthening Quality management systems** by maintaining ISO/IEC 17025:2017 accreditation and expanding the scope of accredited diagnostic methods.

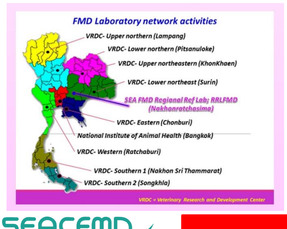
❖ **Advancement of biosafety- biosecurity and Capacity building** including evaluation for preparanes the next commissioning and operational readiness of the upgraded BSL-3 laboratory facility.





❖ **Research and innovation** on FMD virus carrier detection, digital PCR applications, vaccine evaluation, and disinfectants.

❖ **Regional collaboration and networking** to support surveillance, emergency preparedness, laboratory standardization, and knowledge exchange across Southeast Asia.



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Breakthrough in FMD SAT1 Protection:
First independently validated cross-protection against the SAT1 topotype III FMD virus

Romina Scian[1], Aldo Dekker[2], Pilar Mejías[1], Yoenten Phuentshok[3] and Sabrina Cardillo[1]

Introduction

The recent emergence and rapid geographic spread of the SAT1 topotype III foot-and-mouth disease virus (FMDV), including its expansion into the Middle East and Europe, recent incursions into Asia, and its relevance to the current SAT1 FMD situation in South Africa, has highlighted the need for robust evidence of vaccine-induced protection. In regions where livestock populations are largely immunologically naïve to SAT serotypes, the introduction of this virus could have profound consequences for animal health and the livestock industry. To date, publicly available data for this pandemic SAT1 topotype III strain have been largely limited to vaccine-matching studies conducted by international reference laboratories, including the World Reference Laboratory for Foot-and-Mouth Disease (WRLFMD) at The Pirbright Institute. Although these studies provide valuable information on antigenic relationships between field isolates and vaccine strains, they do not directly demonstrate whether vaccination confers cross-protection under challenge conditions. Controlled *in vivo* challenge studies remain the gold standard for evaluating vaccine efficacy against circulating field viruses. **Here, we present the results of an *in vivo* challenge study using a recent SAT1 topotype III field isolate to directly assess the protective efficacy of monovalent SAT1 2020 FMD vaccine.**

Materials and Methods

Site: FAO reference Laboratory for FMD Wageningen Bioveterinary Research (WBVR), Wageningen University & Research, Lelystad, The Netherlands.

Vaccine used: Monovalent SAT1 FMD DIVA vaccine manufactured in Argentina in compliance with GMP, as high-potency, water-in-oil single emulsion containing purified antigen of SAT1 2020 vaccine strain (topotype I)

Challenge virus: SAT1/LEB/8/2025 (SAT1/III) strain isolated from Lebanon in 2025. It was selected based on previous vaccine matching data obtained at WRLFMD showing a r1 value of 0.11 against the vaccine strain.

Trial Design: 16 naive female cattle of 7 months old, were randomly selected and randomly assigned to three groups according to vaccination regimen.

- **Group 1** (n=7) received a single dose (2 ml/dose) on day 0 and was challenged at 21 days post vaccination (dpv).
- **Group 2** (n=7) received a primary dose on day 0 and a booster at 21 dpv (2 ml/dose) and was challenged 21 days after booster (42 dpv).
- **Group 3** (n=2) served as unvaccinated challenged controls.

All cattle were challenged under sedation by intradermolingual inoculation with 10^4 PFU of challenge virus in a total volume of 0.2 mL.

All cattle were inspected under anesthesia for presence of FMDV lesions on feet at 3 and 8 days post challenge (dpc).

The trial was considered valid if both controls developed lesions on more than three feet. Vaccinated animals with lesions on at least one foot were considered non-protected.

Table: Vaccination scheme and challenge along with the protection achieved against SAT1 topotype III virus with SAT1 2020 vaccine after one or two doses

Group	Animals (n)	Vaccination Regimen	Challenge SAT1/LEB/8/2025 10^4 PFU/0.2 mL	Protection Rate (%)
G1	7	1 dose (2 mL) at 0 dpv	21 days post-vaccination	**86%** (6/7)
G2	7	2 doses (2 mL each) at 0 & 21 dpv	21 days post-booster (day 42)	**100%** (7/7)
G3 (control)	2	Unvaccinated	Concurrent with G1 & G2	0% (0/2)

FMD lesions recorded at 3 and 8 days post challenge (dpc).

Results

At 3 days post challenge, all animals exhibited lesions at the site of inoculation (tongue), showing a valid challenge. In G1 (single-dose), one animal developed single lesion in one foot, consistent with disease generalization, whereas no evidence of generalization was observed in animals that received two vaccine doses (G2). In contrast, both animals in G3 (Control) developed severe and widespread lesions involving tongue, gums, nasal region and all four feet confirming the validity of the challenge model.

At the final evaluation, 8 days post challenge, in G1, no further animals showed evidence of foot generalization. Based on these findings, 6 out of 7 animals were classified as protected (86%). In G2, all seven animals remained free of foot generalization and were therefore classified as protected (100%).



Conclusion

To date, publicly available evidence on this pandemic SAT1 topotype III strain has been largely limited to vaccine-matching data (r1-values) generated by global reference laboratories, such as WRLFMD. Although these data provide valuable information on antigenic relationships, they are indirect indicators and do not predict vaccine efficacy on their own. In particular, suboptimal r1 values do not necessarily preclude protection when high-potency vaccines are used.

In this study, monovalent SAT1 2020 vaccine demonstrated strong protection against generalized infection, achieving 86% protection after a single dose and 100% protection following a two-dose vaccination schedule. These findings provide direct evidence of effective cross-protection against SAT1 topotype III despite less-than-optimal vaccine-matching results.

These results are further supported by previous homologous potency studies, in which the same vaccine achieved a potency of more than **128 PD_{50}/dose**, confirming its optimized high-potency formulation.

Key findings

First independently validated heterologous challenge trial demonstrated the efficacy of high potency vaccine containing SAT1 2020 strain as a strategic tool to address the current pandemic threat posed by the SAT1 topotype III virus.

- **86 % PROTECTION AFTER ONE DOSE**
- **100% PROTECTION AFTER TWO DOSES.**

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中农威特生物科技股份有限公司
China Agricultural Veterinary Biological Science and Technology Co., Ltd.

Research Report on FMD Inactivated Vaccine strains

I. Research Background

Foot-and-Mouth Disease (FMD) is a highly contagious transboundary animal disease. Serotypes O, A and SAT1 with various lineages are widely prevalent in Asia, Africa and the Middle East. Wide antigenic variation of FMD viruses brings severe difficulties to regional immunization and disease prevention. Inactivated vaccines that well match circulating field strains act as the key approach to stop virus spread and reduce economic losses. Aiming at mainstream epidemic strains at present, we carried out antigen matching and challenge protection tests on reverse-genetically modified vaccine strains Re-SAT1, Re-A and O/MYA98. Our research data can offer practical support for global FMD prevention. It helps nations upgrade vaccination plans, curb FMD outbreak risks, cut livestock economic losses, advance gradual regional FMD elimination, and bolster the achievement of global FMD control goals.

II. Test Materials

1. Vaccine used: A Reverse-genetically modified vaccine from China

2. Vaccine strains: O/MYA98/BY/2010、Re-A/WH/09、Re-SAT1/2026

3. Test Items: r1Value、PD_{50}、 Population Antibody Positive Rate

4. Test Institution: WOAH/China National FMD Reference Laboratory, Lanzhou Veterinary Research Institute

III. Experimental Results

1. Matching test results

VNTr1,RESULTS

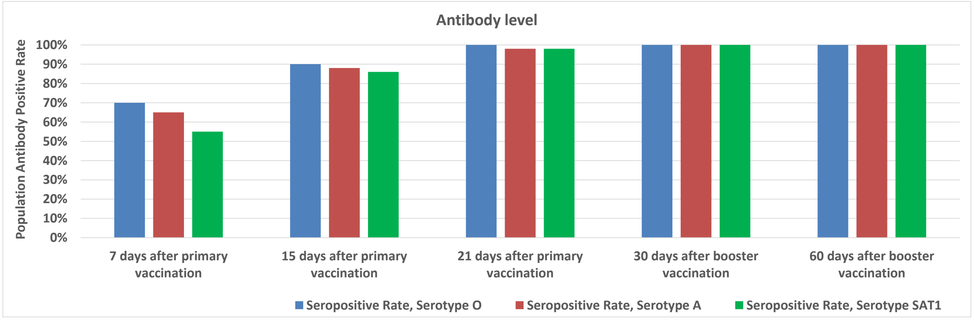
Strain (lineage)	O/17009(O/ME-SA/Ind-2001d/e)	O/11007 (O/ME-SA/PanAsia)	O/10031 (O/SEA/May-98)	A/13029 (A/Asia/Sea-97)	SAT1/2619 (SAT1/III)
O/MYA98/BY/2010	0.9	0.7	1	/	/
Re-A/WH/09	/	/	/	0.9	/
Re-SAT1/2026	/	/	/	/	1

Note: r1 value greater than 0.3 indicates that there are close antigenic relationship between vaccine strain SAT1 and SAT1//III strains, among vaccine strain O/MYA98/BY/2010 and O/MESA/Ind2001d/e,O/MESA/PanAsia,O/SEA/May-98 strains, as well as between the vaccine strain Re-A/WH/09 and the strain A/Asia/Sea-97.The potent vaccine prepared from Re-SAT1/2026,O/MYA98/BY/2010 , Re-A/WH/09 strains can confer protection against these viral strains.

2. Potency test results

Vaccine	vaccinated	vaccinated (ml)	Challenge Strain	Challenge	No.	Protect	PD 50
Foot-and-Mouth Disease O、A、SAT1 trivalent inactivated vaccine(O/MYA98/BY/2010 +Re-SAT1/2026 +Re-A/WH/09)	1 dose	2	SAT1/2619	1000 SID_{50}/3ml	5	5/5	15.59
	1/3 dose	0.67		1000 SID_{50}/3ml	5	5/5	
	1 /9dose	0.22		1000 SID_{50}/3ml	5	5/5	
Control	-	-		1000 SID_{50}/3ml	3	0/3	-
Foot-and-Mouth Disease O、A、SAT1 trivalent inactivated vaccine(O/MYA98/BY/2010 +Re-SAT1/2026 +Re-A/WH/09)	1 dose	1 dose	O/MYA98/BY/2010	1000 SID_{50}/3ml	5	5/5	15.59
	1/3 dose	1/3 dose		1000 SID_{50}/3ml	5	5/5	
	1 /9dose	1 /9dose		1000 SID_{50}/3ml	5	5/5	
Control	-	-		1000 SID_{50}/3ml	3	0/3	-
Foot-and-Mouth Disease O、A、SAT1 trivalent inactivated vaccine(O/MYA98/BY/2010 +Re-SAT1/2026 +Re-A/WH/09)	1 dose	1 dose	A/WH/09	1000 SID_{50}/3ml	5	5/5	15.59
	1/3 dose	1/3 dose		1000 SID_{50}/3ml	5	5/5	
	1 /9dose	1 /9dose		1000 SID_{50}/3ml	5	5/5	
Control	-	-		1000 SID_{50}/3ml	3	0/3	-

3. Field vaccination data



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Phylogenetic and evolutionary analysis of Viral Protein-1 coding sequences of recent FMDV SAT1 strains circulating in Middle East Asia, Central Asia and Mediterranean region

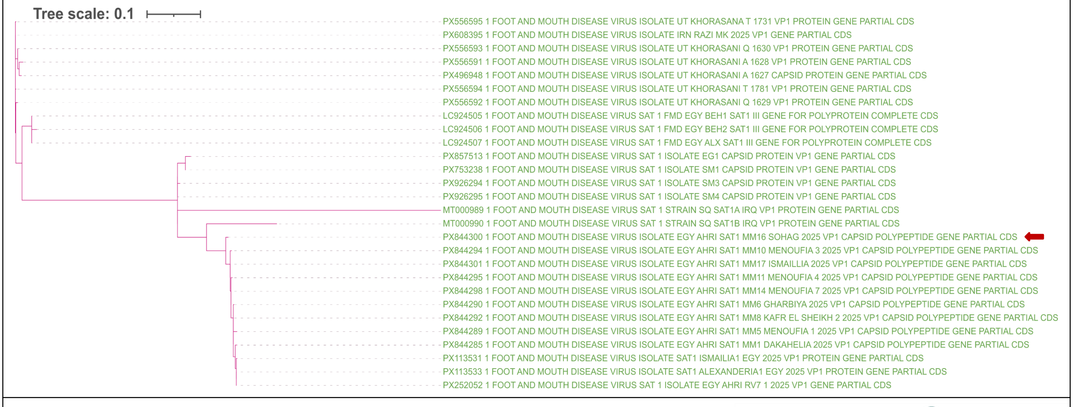
B. Ganguly, **Sarvesh Tayshete***, M. Shashi Kanth, S.B. Ghadage, K. Anand Kumar
Indian Immunologicals Limited, Hyderabad – 500032. India
Email: t.sarvesh@indimmune.com

Introduction: Given the impending risk of FMDV South African Territory-1 (SAT1) incursion in India, a study was undertaken for the phylogenetic and evolutionary analysis of the sequences coding for VP1, published in recent years from in and around the neighboring geographical regions.

Methods: SAT1 nucleotide sequences published between the years 2020 to 2026 from Middle East Asia, Central Asia and Mediterranean region, obtained from GenBank, were aligned with MAFFT, and the alignment was cleaned with HyPhy. Thereafter, the alignment was subjected to sequential analyses with different modules of the DATAMONKEY server to obtain evolutionary insights. The phylogenetic tree was used to estimate the evolutionary rate. The peptide sequence obtained by translation of the consensus nucleotide sequence was used to model the 3D structure in ESMFold and visualise the evolutionary hotspots in iCn3D.

TOOL	KEY FINDINGS FROM PHYLOGENETIC TOOL
Genetic Algorithm for Recombination Detection (GARD)	Q: Is one tree sufficient to explain phylogeny? A: Yes. GARD found no evidence of recombination. A multiple tree model cannot be preferred over the single tree model (evidence ratio > 100)
Branch-site Unrestricted Statistical Test for Episodic Diversification (BUSTED)	Q: Is SAT1 VP1 (as a whole) under diversifying selection*? A: No. It is under purifying selection. 82.46% of the codon are evolving under intense purifying (negative) selection, indicating ***strict functional conservation***. The remaining 17.54% of sites reflect neutral evolution.
adaptive branch-site REL test for episodic diversification (aBSREL)	Q: Are any specific branches under diversifying selection? A: Yes. 1 branch, *viz.* PX844300, shows evidence of selection. Even though this specific viral branch is under massive purifying constraint across 99.02% of its sequence, a tiny fraction of the gene underwent a massive evolutionary explosion [non-synonymous (protein-altering) mutations] at a rate nearly 2,000 times higher than baseline mutations on that branch.
Fast Unconstrained Bayesian AppRoximation (FUBAR)	Q: Which codons are under evolutionary pressure? A: FUBAR identified 1 site evolving under diversifying selection and 111 sites evolving under purifying selection. While the protein is governed by strict, widespread structural conservation across 111 positions, evolutionary adaptation is driven by a highly targeted, **singular molecular hotspot!** Crucially, a single hyper-adaptive codon corresponds with the branch-specific burst of selection captured by aBSREL.
Detect relaxed selection in a codon-based phylogenetic framework (RELAX)	Q: Does the lineage-specific shift identified by FUBAR represent a generalized change in selection intensity? A: No; the adaptive burst was strictly compartmentalized to a minute fraction of the sequence rather than driving a uniform shift in global selection intensity (p = 0.172; likelihood ratio = 1.86).
Single Likelihood Ancestor Counting (SLAC)	Q: Are the findings of FUBAR* valid? A: SLAC detected 35 sites under purifying selection. The 35 negative sites represent **an ultra-conserved core** nested within the 111 positions flagged by FUBAR.
Bayesian Graphical Models for co-evolving sites (BGM)	Q: Are any of the sites co-mutating? A: No co-evolving sites were identified. The absence of high-probability co-evolutionary networks strongly aligns with the rest of the findings because the overwhelming majority of the sequence is heavily restricted by purifying selection.

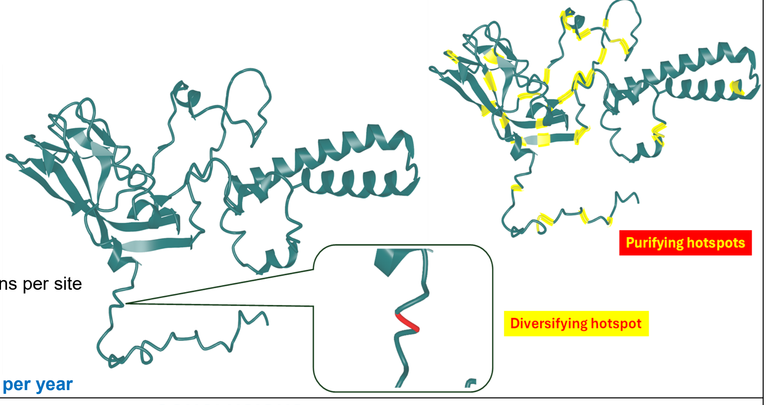
Evolutionary Tree:



Evolutionary Rate Estimation:

∑branch lengths = 1.1434 substitutions per site
Number of unique sequences = 28
Number of years = 6

Evolutionary rate = (1.1434)/ (28*6)
= **6.81 × 10^{-3} substitutions per site per year**



CONCLUSIONS

- VP1 of FMDV SAT1, with probability of entering India, are not under diversifying selection
- Evolutionary rates are typical of FMDV VP1
- Only one diversifying mutational hotspot, likely involved in viral protein interface
- Exposed sites under purifying selection are attractive vaccine targets

(References on request)

28th SEACFMD Sub-Commission Meeting
Ulaanbaatar, Mongolia (28 – 30 July 2026)

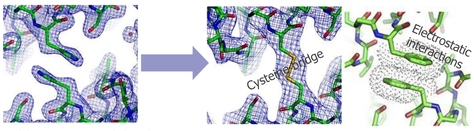
Stabilized SAT1 virus-like particles are thermostable and protect cattle against foot-and-mouth disease

Michel B. Verwoolde[1], Eva Perez-Martin[2], Ranjitha Bommanna[2], Helen M. E. Duyvesteyn[3], Elizabeth Fry[3], Ian Jones[4], Silvia Loureiro[4], Sophie Jegouic[4], Claudine Porta[3], David I. Stuart[3,5], Carina Kahl[1], Undīne Latišenko[1], Erwin van den Born[1], and Bryan Charleston[2]

1 MSD Animal Health, Boxmeer, Netherlands, 2 The Pirbright Institute, Pirbright, Surrey, GU 24 0 NF, United Kingdom, 3 Division of Structural Biology, Wellcome Trust Centre for Human Genetics, Oxford, United Kingdom 4 University of Reading, Health and Life Sciences Building, Reading, United Kingdom 5 Diamond Light Source, Oxford, United Kingdom

Correspondence: erwin van den born@merck com, MSD Animal Health Netherlands

Virus-like particles (VLP) must be stabilized to keep them intact. Only intact capsids can induce a protective immune response. A stabilizing interface is used by introducing amino acid substitutions:

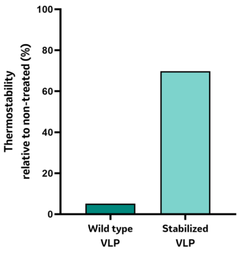


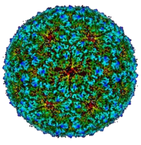
Wild type; not stabilized

Kotecha, A. *et al*., 2015 Nat Struct

Stabilized

SAT1 VLP stabilized with several amino acid substitutions, including VP2-Q093C, were expressed using a recombinant protein expression system and showed increased thermostability at 56°C for 20 min:

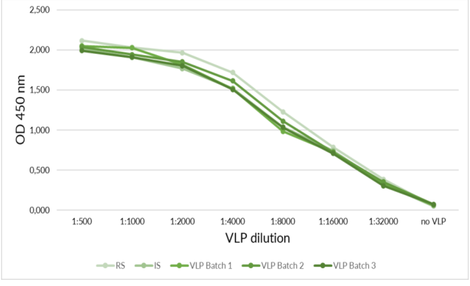




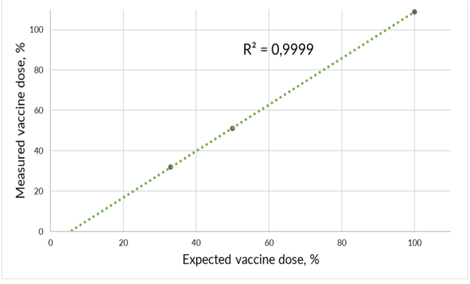
Stabilized SAT1 VLP

A SAT1 specific antibody-based sandwich ELISA is developed and can be applied as quantification method to determine the concentration of protective intact capsids in VLP production batches and vaccine batches.

Titration of SAT1 VLP production

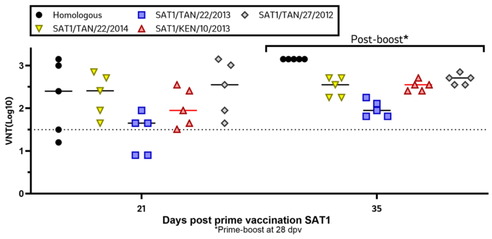


SAT1 VLP vaccine formulations:

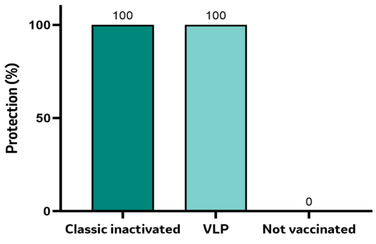


Acknowledgements
This study was financially supported by the Gates Foundation and the Wellcome Trust

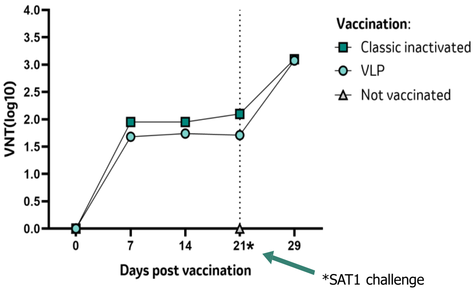
High levels (average >1.5 log10) of homologous and heterologous virus-neutralizing antibody titers (VNT) were induced in cattle by stabilized SAT1 VLP:



In a vaccination-challenge experiment a group of 5 cows received inactivated SAT1 virus (classic inactivated) and another group of 5 cows were vaccinated with stabilized VLP. Two animals served as challenge control animals. All vaccinated animals were protected against homologous challenged at 21 days post vaccination:



The average VNT levels per group of the above study are shown in the graph below. Protective titers were induced by both vaccines. Of note, the VLP vaccine was most likely underdosed compared to the classic inactivated vaccine, explaining the slightly different VNT levels.



Conclusions

- SAT1 specific antibody-based ELISA can be used as a vaccine batch release test.
- VLP derived from a SAT1 strain can be produced using a recombinant protein expression system.
- SAT1 VLP stabilized with several amino acid substitutions in the FMDV capsid proteins are thermostable.
- Stabilized SAT1 VLP protect cattle.
- Stabilized SAT1 VLP elicit robust homologous and heterologous VNT levels, demonstrating their potential for broad protection.
- VLP-based SAT1 vaccines can aid in controlling FMD in regions were SAT1 is circulating.

28th SEACFMD Sub-Commission Meeting
Ulaanbaatar, Mongolia (28 – 30 July 2026)

ERADICATION OF FOOT-AND-MOUTH DISEASE: SUCCESSES AND LESSONS FROM SOUTH AMERICA

Dr. José Carlos Martin C.,
President of the Permanent Veterinary Committee of the Southern Cone (CVP)

South America has reached a historic milestone by achieving a complete absence of foot-and-mouth disease outbreaks, with more than 97% of its continental territory recognized by the World Organization for Animal Health (WOAH) as a disease-free zone. The PHEFA Plan 2026–2030 consolidates this status and provides a guide to sanitary engineering.

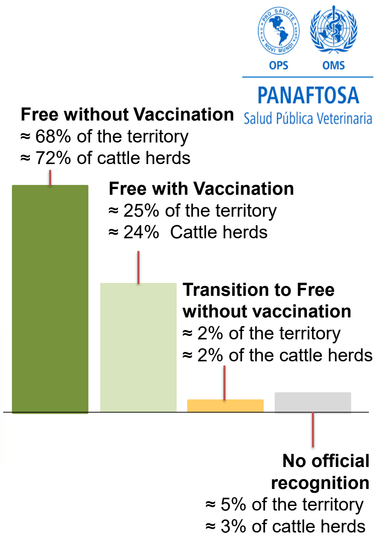
1. CURRENT SITUATION IN SOUTH AMERICA

97% **of South America is officially free of foot-and-mouth disease.**

>85% **of South American livestock is located in vaccination-free zones.**

Venezuela: *the only country on the continent without official status recognized by the WOAH.*

Prolonged absence of virus serotypes



2. PREVENTION AND CONTROL MEASURES: PHEFA PLAN 2026–2030

The 2026–2030 Action Plan of the Hemispheric Program for the Eradication of Foot-and-Mouth Disease (PHEFA) aims to complete the eradication of the disease and sustain that status by strengthening prevention and surveillance.

PHEFA PLAN 2026–2030: Final Consolidation
Focused on completing eradication through the systematic strengthening of prevention, surveillance, and rapid response.

BANVACO: Regional Life Insurance
Establishment of a Regional Vaccine Bank (BANVACO) to provide high-quality biologicals in emergencies.

Science-Based Surveillance:
Systematic serological sampling to demonstrate the absence of viral circulation and evaluate immunity.

3. SOUTH AMERICAN EXPERIENCE IN THE ERADICATION OF FMD: CVP ESTRATEGIC RECOMMENDATIONS FOR ASIA AND THE PACIFIC REGION

High-Quality Infrastructure and Biologicals: Implement high-potency vaccines (DIVA technology) and strengthen the network of official laboratories to ensure rapid diagnostics and genomic characterization in the face of threats from exotic serotypes.

Territorial Management and Surveillance: Adopt regionalization/ zoning strategies (high-surveillance zones at critical borders), risk-based early-warning systems using mathematical models to predict the introduction and spread of diseases, update contingency plans, and conduct rapid-response drills.

Governance, Transparency, and Public-Private Partnerships (PPPs): Promote the reporting of suspected cases, ensure financial sustainability through PPPs, and ensure transparency through immediate notifications via WAHIS/WOAH.

A SHARED FUTURE: GLOBAL ERADICATION

South America's experience shows that the eradication of foot-and-mouth disease is achievable through political leadership, regional cooperation, scientific surveillance, and public-private partnerships.

STRENGTHEN BORDERS, EMPOWER PRODUCERS, AND ACT AS A SINGLE CONTINENT.

28th SEACFMD Sub-Commission Meeting
Ulaanbaatar, Mongolia (28 – 30 July 2026)

Serological Assessment of Foot-and-Mouth Disease Virus Antibodies in Ruminants at the Northern Quarantine Station, Peninsular Malaysia

Dr. Jamaliah binti Senawi & Norzufikal binti Zulkifly
Department of Veterinary Services (DVS) Malaysia

INTRODUCTION:

- Since 2020 to 2024, Malaysia's national livestock self-sufficiency rates (SSR) remained low at 21.72% for large ruminant (IDR > 79%) and 8%–10% for small ruminant (IDR 89%–92%).
- Resulting in high livestock import dependency.
- Between 2020 to 2025, four FMD outbreaks (O/ME-SA/Ind2001e) occurred in the quarantine station affecting cattle.
- This monitoring program assessed FMDV antibody levels in imported ruminants at northern quarantine stations during 2024 and 2025.

OBJECTIVES:

1. To determine the FMDV antibody levels in imported ruminants at three northern quarantine stations.

METHODS:

A total of 403 serum sample collected → Serum tested with NSP ELISA → Negative NSP ELISA tested with VNT (O/ME-SA/Ind2001e & A/ASIA/Sea-97) → Data analysis

Cut-off value:
- Serotype O: $\log_{10}$ ≥1.6
- Serotype A: $\log_{10}$ ≥1.4

(*Barnett et al, 2003*)

FINDINGS:

Table 1: FMD Seroprevalence and NSP ELISA Positive by Species and Quarantine Station

Quarantine Station	Species	No. of sample tested	NSP ELISA positive	Seroprevalence (%)
A	Cattle	263	206	78.3
B	Goats	60	52	86.7
C	Cattle	80	54	67.5

Table 2: Geomean, CV, and 95% CI for Cattle, Quarantine Station A

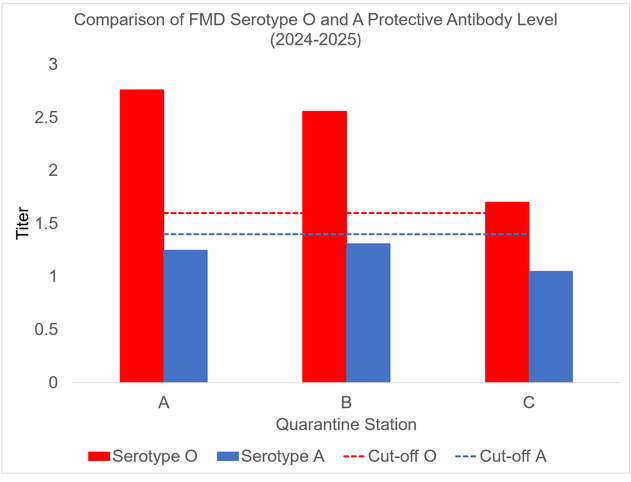
Parameter	Serotype O	Serotype A
Geomean	$\log_{10}$ 2.76	$\log_{10}$ 1.25
Coefficient Variation, CV (%)	12.38	31.05
95% Confidence Interval (CI)	$\log_{10}$ 2.67 – 2.85	$\log_{10}$ 1.15 – 1.35

Table 3: Geomean, CV, and 95% CI for Goats, Quarantine Station B

Parameter	Serotype O	Serotype A
Geomean	$\log_{10}$ 2.56	$\log_{10}$ 1.31
Coefficient Variation, CV (%)	16.64	28.32
95% Confidence Interval (CI)	$\log_{10}$ 2.26 – 2.86	$\log_{10}$ 1.05 – 1.57

Table 4: Geomean, CV, and 95% CI for Cattle, Quarantine Station C

Parameter	Serotype O	Serotype A
Geomean	$\log_{10}$ 1.70	$\log_{10}$ 1.05
Coefficient Variation, CV (%)	40.62	20.76
95% Confidence Interval (CI)	$\log_{10}$ 1.44 – 1.97	$\log_{10}$ 0.97 – 1.13



- A high seroprevalence rate (> 67%) was observed across all three groups.
- Antibody titers against FMDV serotype O exceeded the protective threshold ($\log_{10}$ ≥ 1.6) in all groups.
- None of the Serotype A antibody titers reached the protective cut-off value ($\log_{10}$ ≥ 1.4).
- High variation in antibody titers was observed in both cattle groups (A & C).

Figure 1: Comparison of FMD Serotype O and A Protective Antibody Level

CONCLUSION:

- These results highlight the need for further evaluation of the quality and efficacy of the FMD vaccines used in these imported ruminants.

REFERENCE:

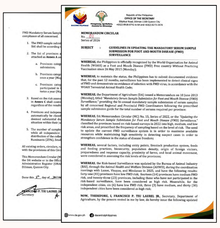
1. Barnett, P.V., Statham, R.J., Vosloo, W., Haydon, D.T., 2003. Foot-and-mouth disease vaccine potency testing: determination and statistical validation of a model using a serological approach. Vaccine 21, 3240-3248.

FOOT AND MOUTH DISEASE (FMD) UPDATES

South-East Asia and China Foot and Mouth Disease (SEACFMD) Campaign Progress, Philippines

KWESI IAN JAY M. JUNSAN, DVM & JOANNA MARIE F. DAVID, DVM
Department of Agriculture, Bureau of Animal Industry

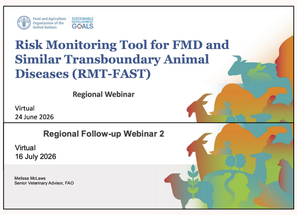
FMD Risk Situation



Department of Agriculture (DA) Memorandum Circular (MC) No. 01, Series of 2026

Guidelines in Updating the Mandatory Serum Sample for Foot and Mouth Disease (FMD) Surveillance

- Updated risk levels for all provinces and independent cities.
- Independent cities were included in the updated risk assessment.
- **Updated Risk Distribution**
  - **Provinces:** 23 High Risk, 14 Medium Risk, 41 Low Risk
  - **Independent Cities:** 29 High Risk, 3 Medium Risk, 6 Low Risk

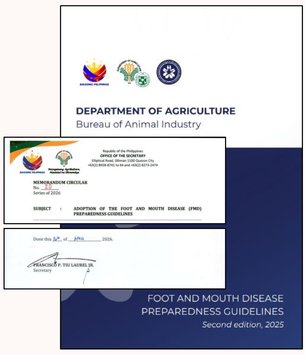


Food and Agriculture Organization (FAO) of the United Nations

Risk Monitoring Tool for FMD and Similar Transboundary Animal Diseases (RMT-FAST) Webinars, *24 June & 16 July 2026*

- DA-BAI participated in the webinars on the use of the RMT-FAST for FMD Serotype SAT-1.
- DA-BAI is currently completing the RMT-FAST assessment for FMD SAT-1 and will submit the accomplished tool to FAO upon completion.
- **Expected submission:** August 2026.

Highlights of FMD Prevention and Preparedness Activities



Department of Agriculture (DA) Memorandum Circular (MC) No. 20, Series of 2026

Adoption of the Foot and Mouth Disease (FMD) Preparedness Guidelines

- The revised FMD Preparedness Guidelines (2025), formerly the FMD Emergency Preparedness Plan (2014), has been approved and signed by the DA Secretary for implementation.
- The guidelines are currently in the layout and printing phase for publication for distribution.
- **Proposed Next Action**
  - Conduct a Simulation Exercise (SimEx) utilizing the updated FMD Preparedness Guidelines (2025).

Prevention | Identification | Response | Recovery | Implementation

Vaccine

Php 14,000,000.00 or USD 226,000.00

Fund allocated for vaccine and maintenance of FMD buffer stocks.

(DA Administrative Order (AO) No. 19, Series of 2011, or the "Lifting of FMD Transport Restriction;" and DA MC No. 20, Series of 2026, or the "Adoption of the Foot and Mouth Disease (FMD) Preparedness Guidelines")

350,000 doses

Total of doses of FMD Serotype O vaccines have already been procured.

The vaccines have a shelf life of 18 months, with one (1) year storage from the supplier.

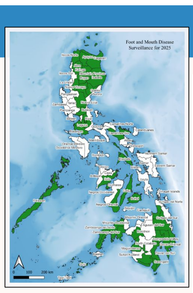
Vaccine expected to be delivered on August 2026.

Bureau of Animal Industry (BAI), Department of Agriculture - Regional Field Offices (DA-RFOs), and Other Livestock Agencies

Animal Health & Welfare Coordinators' Midyear Workshop, *22-26 June 2026*

Key Achievements

- The Philippines has maintained its FMD-free status without vaccination since May 2015.
- Key stakeholders have been identified, and stakeholder engagement remains strong, supported by regular meetings and communication initiatives on FMD.
- Collaboration with development partners on FMD prevention and preparedness continues.
- Ongoing coordination and information sharing with regional partners support discussions on livestock trade and FMD risk management.



Key Challenges and Lesson Learnt

- Achieving indicators may require identifying and accomplishing smaller milestones before attaining broader program goals.
- Some program accomplishments require longer implementation periods, sustaining commitment and patience are important.
- Continued collaboration with stakeholders and partners is essential for the implementation of the FMD program, as they provide not only technical expertise and financial support but also commitment and compliance with program strategies and activities during implementation.
- Maintaining a strong FMD program helps promote vigilance within the local livestock industry.

Proposed Priority Actions

- Conduct a national-level Simulation Exercise (SimEx) using the updated FMD Preparedness Guidelines (2025).
- Implement proficiency testing programs for FMD diagnostic testing involving the Animal Disease Diagnosis and Reference Laboratory (ADDRL) and selected Regional Animal Disease Diagnostic Laboratories (RADDLs).
- Maintain FMD vaccine buffer stocks.
- Strengthen and sustain coordination and collaboration with development partners and regional counterparts, particularly on initiatives related to:
  - Detection and prevention of FMD Serotype SAT-1; &
  - Maintenance of the Philippines' FMD-free status.

28th SEACFMD Sub-Commission Meeting
Ulaanbaatar, Mongolia (28 – 30 July 2026)

FOOT-AND-MOUTH DISEASE SITUATION IN VIETNAM 2025–2026

Name: Hoang Thi Le Phuong
Department of Animal Health and Production-Vietnam

1. DISEASE SITUATION 2025–2026

- **2025:** FMDV serotype O (Mya-98 & Ind2001e lineages).
- **2026 (as of July):** serotype O (Ind2001e) and serotype A (Sea-97). The first re-emergence of serotype A since 2017.

Situation	2025	July- 2026
Outbreaks	19	16
Provinces affected	11	8
Total animals infected	473	198
Animals died & culled	1,316	1,190

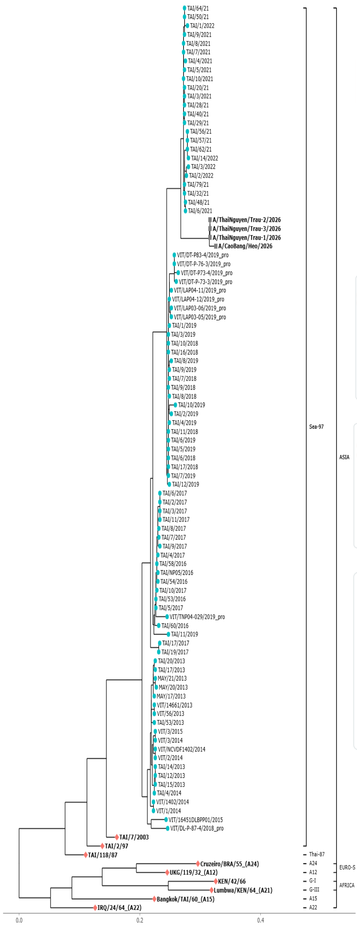
Outbreak in 2025

Outbreak in 2026

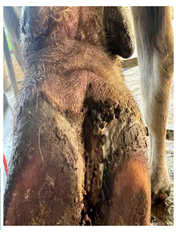
2. GENETIC CHARACTERIZATION FMDV SEROTYPE A (2026)

Topotype ASIA • Lineage Sea-97 (A/ASIA/Sea-97)

- 3 buffalo samples (Thai Nguyen provine) and 1 pig sample (Cao Bang provine): 99–100% nucleotide identity
- 95% identity with FMDV serotype A strain circulating in Thailand during 2021–2022
- Serotype A was last recorded in Vietnam in 2017 re-emerging after 9 years



Phylogenetic tree VP1 sequences of FMDV serotype A strains, 2026



clinical lesions by serotype A in 2026

FMD take sample in the field

3. DISEASE PREVENTION & CONTROL ACTIVITIES

- Control of animal movement between regions/provinces
- Early detection & rapid outbreak response
- Strengthening FMD testing and diagnostic capacity
- Culling policy especially for pig herds and compensation
- Development & assurance of FMD vaccine supply
- Vaccination programme and post-vaccination monitoring
- Farm biosecurity; building disease-free zones/establishments
- Slaughter management & veterinary hygiene inspection
- Community communication and information dissemination
- International cooperation & coordination

4 KEY ACHIEVEMENTS (2021–2025)

27 provinces
active surveillance 63,918 samples tested, 1,630 positive (2.55%)

83.42%
of 4,307 post-vaccination serum samples achieved protective antibody levels

> 219.7 million doses
FMD vaccine supplied (2020 to Jun 2025)

> 44.2 million doses
administered in local mass vaccination campaigns (2021–2024)

856 free zones
certified FMD-free 53 provinces (as of 2025)

Serotype O only
recorded during 2021-2025 (no A/Asia1)

5. CHALLENGES & SOLUTIONS

1. Low vaccination coverage in smallholder, free-range livestock leads to recurring outbreaks.
   -> Raise vaccination coverage to > 80% in high-risk areas.
2. Illegal cross-border animal transport increases the risk of new virus strain introduction.
   -> Strengthen border surveillance, quarantine, transport control, and cross-border information sharing.
3. Early outbreak detection remains limited in remote areas due to delayed reporting and weak field surveillance capacity
   ->Expand risk-based active surveillance, strengthen testing, and implement real-time digital reporting..
4. Grassroots veterinary capacity remains uneven, especially after restructuring of the commune-level veterinary system.
   ->Provide continuous training, ensure sustainable financing, and strengthen frontline veterinary personnel.

6. PRIORITY DIRECTIONS 2026–2030

Short term, Priorities from August 2026 to December 2027

- Rapidly contain serotype O and A outbreaks through outbreak investigation, transport control, and emergency vaccination
- Risk-based surveillance of live animals, imported meat products, and livestock in border provinces for early detection of serotype SAT1
- Import SAT1 vaccine and develop preparedness and response plans for the risk of SAT1 introduction

Long term , Priorities for 2026–2030

- Reduce FMD outbreaks and culled livestock by ≥ 30% compared with the 2021–2025 average
- Achieve compulsory vaccination coverage of > 70% of the eligible livestock population
- Early detection of emerging FMDV strains
- Establish and maintain at least 1,000 FMD-free establishments/zones

7. CONCLUSION

Vietnam maintained effective control of FMDV serotype O during 2021-2025

But the re-emergence of serotype A (Sea-97) after 9 years and the risk of serotype SAT1 introduction present new challenges.

Strengthening molecular epidemiological surveillance, expanding vaccination coverage, and enhancing regional cooperation are key priorities for achieving the goals of Phase 7 of the SEACFMD Programme (2026-2030).

28th SEACFMD Sub-Commission Meeting
Ulaanbaatar, Mongolia (28 – 30 July 2026)