NATIONAL FOOT AND MOUTH DISEASE PREVENTION AND CONTROL PLAN - 2020

National Centre for Animal Health
Department of Livestock
Ministry of Agriculture & Forests
Royal Government of Bhutan

National Food and Mouth Disease Prevention and Control Plan 2020

(NFMDPCP 2020)

Fourth edition

National Centre for Animal Health
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Phone: 975-2-351083/351093
Email: ncah2013@gmail.com
Website: www.ncah.gov.bt

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First Edition, 1996

By Late Dr JB Gurung

Second Edition, 2005

1. Dr Pasang Tshering, National Centre for Animal Health (NCAH)
2. Dr Kinzang Drukpa, NCAH

Third Edition, 2016

3. Dr Tenzin, Dy. Chief Veterinary Officer, NCAH, Serbithang
4. Dr Kinzang Dukpa, Programme Director, NCAH, Serbithang
5. Dr Karma Rinzin, Chief Veterinary Officer, AHD, DoL, Thimphu
6. Dr RB Gurung, Principal Livestock Health Officer, NCAH, Serbithang
7. Dr Vijay Raika, Principal Livestock Health Officer, NCAH, Serbithang
8. Dr Basant Sharma, Animal Health Specialist, RLDC, Tshimasham
9. Mr. Lokey Thapa, Livestock Production Officer, NCAH, Serbithang
10. Mr. Bakta Bdr Gurung, Laboratory Technician, DVH, Paro

Fourth Edition, 2020

1. Dr RB Gurung, Program Director, National Centre for Animal Health, Serbithang
2. Dr Karma Rinzin, Chief Veterinary Officer, Department of Livestock
3. Dr Pelden Wangchuk, Sr. VO, DPCU, National Centre for Animal Health, Serbithang
4. Dr Sangay Rinchen, Head, DPCU, National Centre for Animal Health, Serbithang
5. Dr Karma Wangmo, Sr. VO, Regional Livestock Development Centre -Khangma
6. Dr Kinley Penjor, Sr. RQO, BAFRA-Thimphu
7. Dr Tshewang Gembo, Sr. VO, TVH & SL, Gelephu
8. Ms. Karma Pelden, Pharmacist, National Centre for Animal Health, Serbithang

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FOREWORD

Foot and Mouth Disease (FMD), a contagious livestock disease that affects all the cloven-footed animals and is associated with devastating socio-economic losses and serious damage to the livelihoods, food security and nutrition of the farmers. FMD is a notifiable disease as per the Livestock Rules and Regulations of Bhutan 2017. Given its severe economic consequences, it is important to control the disease and achieve elimination to enhance livestock production to improve livelihood and alleviate poverty.

Although there is a good prevention and control mechanism in Bhutan, as part of the global effort to eradicate the disease, the earlier edition of plan has been updated incorporating the progressive control pathway (PCP). With the endorsement of this official control plan, Bhutan will achieve stage 3 of the progressive control pathway. This document clearly outlines strategies and activities to gear Bhutan's progress towards next stage.

Livestock development is a dynamic process with emerging challenges, especially animal diseases. Therefore, I am happy to note that the National Centre for Animal Health (NCAH), Animal Health Division, Department of Livestock (DoL) has taken the lead in revising and updating the National FMD-PCP. I would like to extend my appreciation to all individuals who have contributed towards revising and updating this very important document.

I hope this document (fourth edition) will be useful as a ready reference to all those involved in the prevention and control of FMD in the country. I am confident that this plan will directly contribute in bringing down the incidence of FMD in the country thereby improving the livelihood of the rural population.

Dr. Karma Rinzin
(Officiating Director General)

ABBREVIATIONS AND ACRONYMS

AHD	Animal Health Division
BAFRA	Bhutan Agriculture and Food Regulatory Authority
DoFPS	Department of Forests and Park Services
DoL	Department of Livestock
DPCU	Disease Control and Prevention Unit
Dzongkhag	District, an administrative division composing of a group of Gewogs
FAO	Food and Agriculture Organization
FMD	Foot and Mouth Disease
FMDV	Foot and Mouth Disease Virus
GDP	Gross Domestic Product
Gewog	Sub-district, an administrative division composing of a group of villages
GF-TADs	Global Framework for the Progressive Control of Transboundary Animal Diseases
IEC	Information, Education and Communication
MoAF	Ministry of Agriculture and Forests
MoF	Ministry of Finance
NCAH	National Centre for Animal Health
NCC-FMD	National Committee for the Control of FMD
NFMDPCP	National Foot and Mouth Disease Prevention and Control Plan 2020
NGO	Non-Governmental Organization
NSB	National Statistics Bureau
OIE	World Organization for Animal Health
PCP	Progressive Control Pathway
PVS	Performance of Veterinary Services
QS	Quarantine Station
RLDC	Regional Livestock Development Centre
TAD *info*	Transboundary Animal Disease information system
TAHC	Terrestrial Animal Health Code 2019
Tshethar	Practice of freeing animals from imminent slaughter and death
TVH & SL	Thromde Veterinary Hospital and Satellite Laboratory
TWG-FMD	Technical Working Group for control of FMD
VO	Veterinary Officer
VPP	Veterinary paraprofessional
VS	Veterinary Services
WRLFMD	World Reference Laboratory for Foot and Mouth Disease

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1 INTRODUCTION

1.1 Background

Nestled in the Himalayas and sandwiched between China to the north and India to east, west and south, the Kingdom of Bhutan is a small landlocked country with an area of 38 394 km^2 stretching approximately 160 km north-south and 240 km east-west. The geolocation of the country is defined by 26° 40'– 28° 20' northing and 88° 45' – 92° 70' easting. The current human population of Bhutan is 727,145 (NSB, 2018). As a result of the remarkable variations in altitude in a small area, the country experiences diverse climatic conditions from wet sub-tropical in the south and temperate to alpine in the north. About 71% of land is under natural forest cover (NSB, 2019). Bhutan is administratively divided into 20 districts, 205 sub-districts and 4340 villages (ECB, 2008) and is essentially an agrarian country with about 57% of the population engaged in agriculture for their livelihood (DoE, 2014). Livestock farming forms an integral part of the agricultural system with about 62% of the households rearing livestock (NSB, 2013).

Foot and Mouth Disease is a highly contagious viral disease that affects domestic cloven-hoofed animals (cattle, swine, sheep, and goats) and wild animals (deer, bison and feral swine). The disease is characterized by fever, vesicular (blister-like) lesions and subsequent erosions (ulcers) on the surfaces of mouth, tongue, nostrils, muzzle, feet and teats. It is considered the most contagious disease of livestock and is of high priority for the Department of Livestock in Bhutan. FMD causes crippling socio-economic consequences through loss of young stock, decreased production and trade.

The disease is endemic in Bhutan and as per the annual livestock census 2019, there are 434,612 FMD susceptible livestock species in Bhutan of which 70% comprises of cattle. FMD is the most important disease affecting livestock production in Bhutan and it is a notifiable disease as per the Livestock Rules and Regulations of Bhutan 2017.

This plan encompasses information on organizational set up for animal health, the nature of the disease, principles and strategies for its prevention and control. Besides organizational setup, it also identifies approaches for early preparedness and response, the monitoring and evaluation mechanism that are required for effective implementation of the outlined activities.

Provisions in the OIE International Animal Health Code and Progressive Control Pathway for FMD stages and principles guided in preparing the document.

1.2 Goal

The goal is to progressively increase the level of control through 6 stages of PCP in achieving FMD free country status with vaccination.

1.3 Purpose

- To inform policy makers and stakeholders on the nature and objectives of the FMD control programmes at national, regional and district levels.
- To provide field professionals and relevant stakeholders with strategic directions to progressively decrease the outbreak incidences.
- To determine the national FMD PCP stage and provide direction to progress to next stage.

1.4 Scope

The document covers the prevention and control plan for FMD at all levels. The document outline measures that will be considered in control of FMD and is periodically tested through simulation/exercise and updated from time to time as per the need.

2 NATURE OF THE DISEASE

2.1 Disease and causative agent

Foot and mouth disease is caused by the FMD virus (FMDV) which is a non-enveloped RNA virus belonging to the Aphthovirus genus of the family Picornaviridae. The FMDV has seven clinically indistinguishable serotypes: O, A, C, Asia 1, SAT 1, SAT 2, SAT 3. These serotypes do not induce cross protection against each other and therefore vaccination against one serotype will not provide protection against other serotypes.
The FMDV is excreted in several body secretions and excretions including saliva, milk, semen, urine, faeces, nasal discharges and exhaled air. The infected animals usually start excreting virus at least 24 hours prior to the development of clinical signs. Amongst the domestic animals, pigs are known to be the “amplifier hosts” with a capacity to release 3000 times more virus than cattle or sheep.
The virus is most stable near a neutral pH at pH 7.5, it is rapidly inactivated at a pH below 5 or above 11. The virus can be rapidly inactivated by acids and alkalis, including citric acid, phosphoric acid, sulphuric acid, lactic acid, hydrochloric acid, sodium carbonate and sodium hydroxide.

2.2 Transmission

The most common route of entry of FMDV is through the respiratory tract although, less commonly, the virus can gain entry through abrasions in the epithelium of the oral cavity, feet or teats. Cattle are the most susceptible species to be infected by the inhalation route owing to their large inspiratory capacity compared to other susceptible domesticated species. Most common mode of transmission occurs as follows;

- Direct contact between infected and susceptible animals.
- Direct contact of susceptible animals with contaminated inanimate objects (hands, footwear, clothing, vehicles).
- Consumption (primarily by pigs) of untreated contaminated meat products (swill feeding).
- Ingestion of contaminated milk (by calves).
- Artificial insemination with contaminated semen.
- Inhalation of infectious aerosols.
- Airborne, especially temperate zones (up to 60 km overland).

2.3 Incubation period

The incubation period in cattle can range from 2 to 14 days depending on the infecting dose, the virus strain, the route of infection and the degree of host immunity.

2.4 Clinical signs

Affected animals will initially exhibit pyrexia, lasting for one or two days, followed by development of vesicles on the tongue, hard palate, dental pad, lips, gums, muzzle, coronary band and interdigital space. Infected animals have excessive salivation and a nasal discharge. Signs of lameness are exhibited by frequent stamping of the feet. Depending on the severity of the disease, lactating animals can develop vesicles on teats. There is a significant drop in milk production. The vesicles in the mouth usually rupture within 24 hours of formation, leaving shallow erosions surrounded by shreds of epithelium. The disease morbidity can reach up to 100%, especially in a non-immune population, however, mortality is usually restricted to young animals that can develop viral myocarditis ("tiger heart").

Being able to determine the age of lesions, especially when FMD is first recognized in a herd, is a useful aid in determining the approximate time of first infection and thus in tracing back to the origin of infection. The figure below gives some indicators as to the appearance of lesions at various phases of their development. Clinical signs are more apparent in cattle as compared to other domestic species

Approximate age of lesion	Appearance of lesions
1-day	Unruptured vesicles containing some fluid, early signs of necrosis in overlying epithelium
1-2 days	Unruptured, fluid-filled vesicles, overlying epithelium necrotic
1-3 days	Vesicles ruptured, erosions present and ragged pieces of epithelium adhering to the margins of the lesions. In the earlier phase, the exposed centre of the lesion is bright red; later the redness begins to change as fibrin deposition occurs
4 days-1-week	Erosions with little epithelium attached, margins of lesions becoming "smoother" (no longer ragged) because of early healing with regrowth of epithelium at the edge of the lesion
7-10 days	Healing advanced with fibrous tissue formation

Figure 1 Determining the age of Foot and mouth disease lesions

3 SITUATIONAL ANALYSIS

3.1 Livestock demographic and production systems

As per the livestock statistics 2018, there are 338,000 heads of cattle (cattle, buffalo and yak) in the country with numbers fluctuating from 300,000 to 338,000 heads since 1994 (Figure 2). However, small ruminants and pig population has been decreasing over the years due to religious and social taboos.

The livestock production systems in Bhutan are broadly categorized as transhumant and sedentary. A typical transhumant system involves migration of animals and herding on the traditional grazing land during summer and autumn seasons. Yak herding in pastoral system is more common in the highland regions of the country. Forest grazing is also

considered as more traditional farming practices. On the other hand, the sedentary system is defined as crop-cattle system where each household manages few cattle in their homestead. Under this system, there is an increasing trend of providing improved housing and feeding and with improved breeds of animals. The geographic distribution of susceptible livestock population is given in Figure 3.

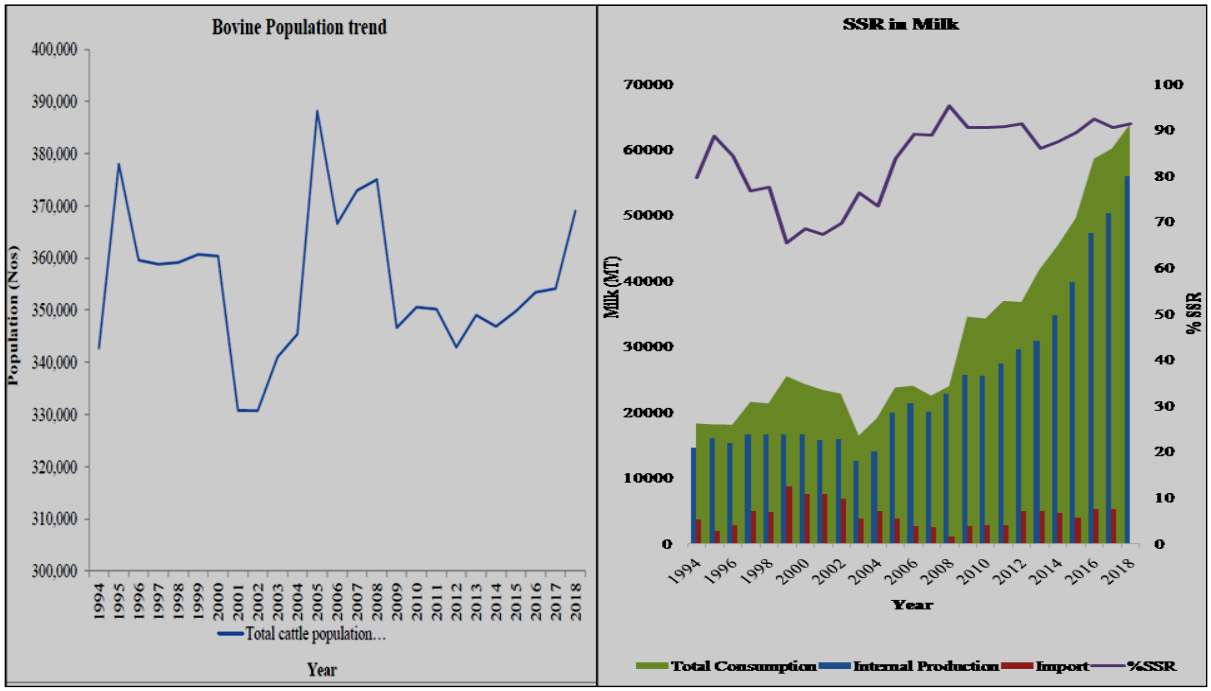


Figure 2 Bovine population trend and milk self-sufficiency in Bhutan, 1994-2018

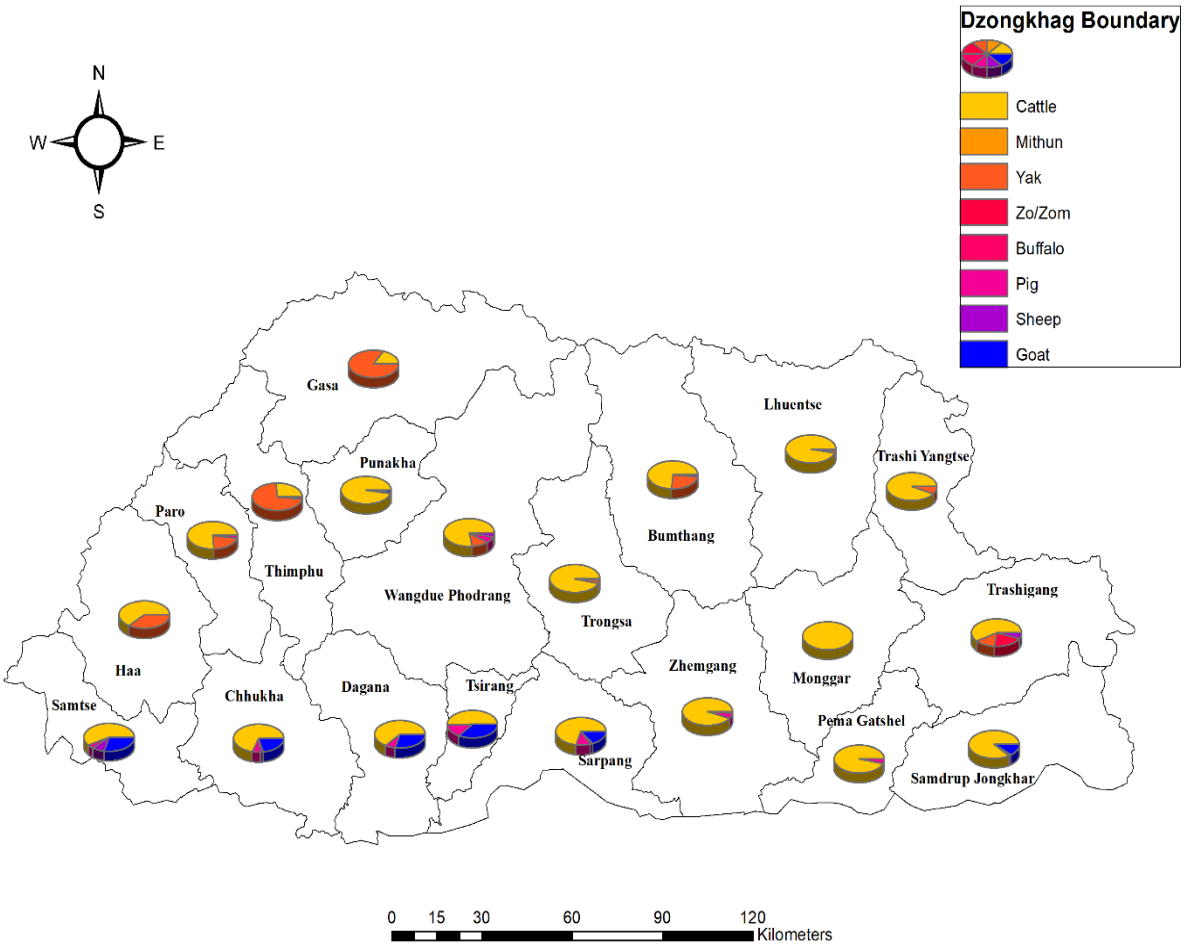
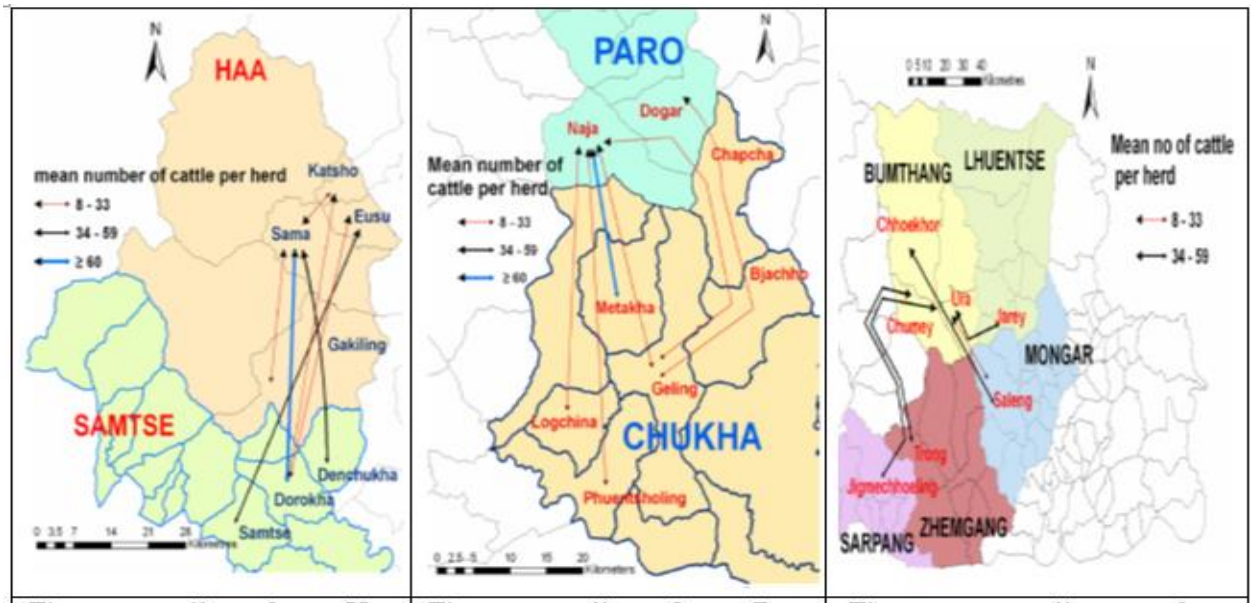


Figure 3 Geographic distribution of susceptible livestock animals in the country, 2019

Excepting few organized dairy farms, where stall feeding is practiced, majority of the animals are let out for free grazing in the forests during daytime. Mixing of animals between different herds within and between villages occur at the grazing and watering points, thus transmitting and spreading diseases, particularly FMDV. There is also mixing of animals along the border between Bhutan and India which could be an important determinant for the frequent incursion and persistence of FMD. But due to the government policy to promote improved breeds through breed intensification programme, many farmers have adopted stall feeding system increasing the milk production from 14,637 MT in 1994 to 55907 MT in 2018. The country has reached the milk self-sufficiency to 87.53 % in 2018 (Figure 2) with an annual growth rate of 5 % and import reduction by 1 % over the years (RNR Strategy 2040).

3.2 Cattle migration system

In the central and western part of Bhutan, the age-old tradition of seasonal migration of cattle herds persist (Figure 4 and 5) and (Table 1), resulting into spread of FMD. The migration usually takes place in September – October from high altitude to lower altitudes and return in April – June to higher altitudes. This is commonly practiced in Paro, Haa and Bumthang. The size of migratory herds ranges from 8-59 animals and it takes 5-10 days for migration.



The pastoralists from Haa district migrate to the sub-tropical areas of Samtse district and to other warmer places within Haa district during winter, and return back during summer.	The pastoralists from Paro district migrate to the sub-tropical areas in Chhukha district during winter and return back during summer.	The pastoralists from Bumthang district migrate to the villages located in the sub-tropical areas of Sarpang, Trongsa, Zhemgang, Lhuentse and Monggar districts during winter and return back during summer.

Figure 4 Traditional migratory patterns and routes in three major districts of Bhutan

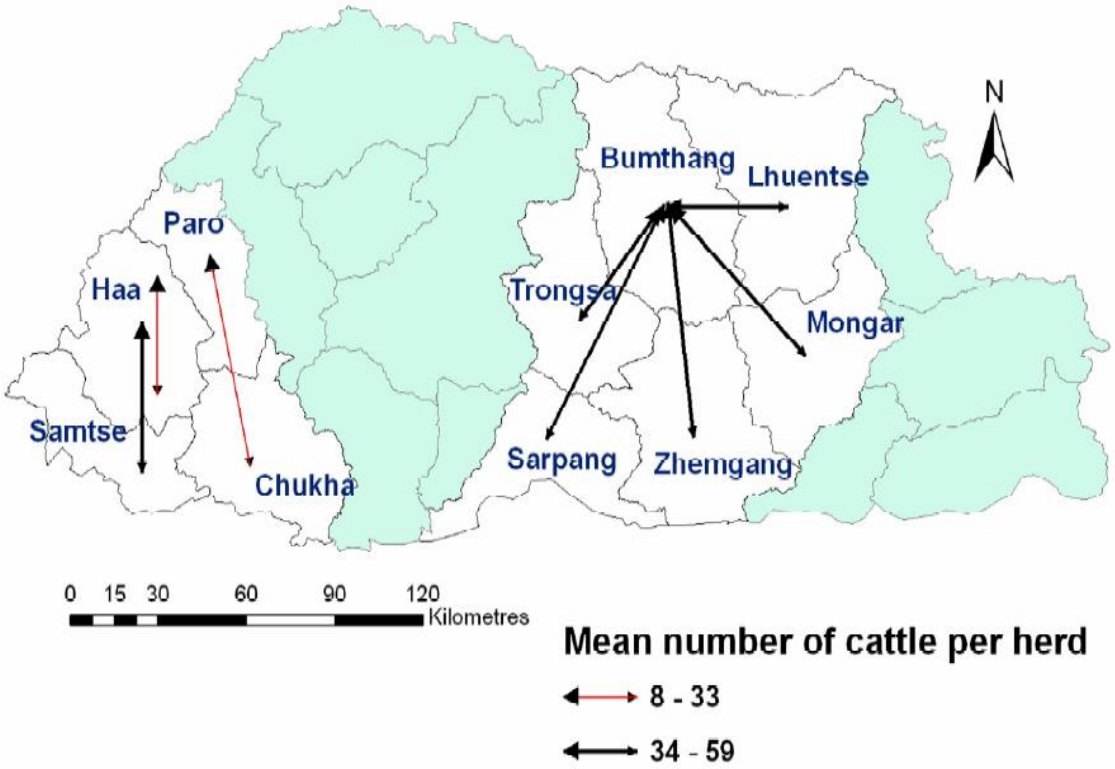


Figure 5 Major cattle migration pattern in Bhutan

Table 1 Duration and months of migration in Bhutan (only major cattle migration)

Districts	Median number of days taken for migration (range)	Months migration commenced	Months of return to the original resident villages
Haa	5.0 (2.0-20)	September-October	May-June
Paro	5.5 (1.0-7.0)	September-October	April-May
Bumthang	10.0 (3.0-30.0)	September-October	April-May

3.3 Livestock trading within the country

Some districts act as an animal trading hub in the country. The animals are traded mainly for breeding purpose, while few trading from north to south districts may be for marketing across the border for slaughtering.

During the 10th (2008-2013) and 11th (2013-2018) five-year plans of Bhutan, a total of 2,053 animals (cattle) were procured from within the country and distributed to various Dzongkhags – through government subsidy and government farms (Figure 6 & 7).

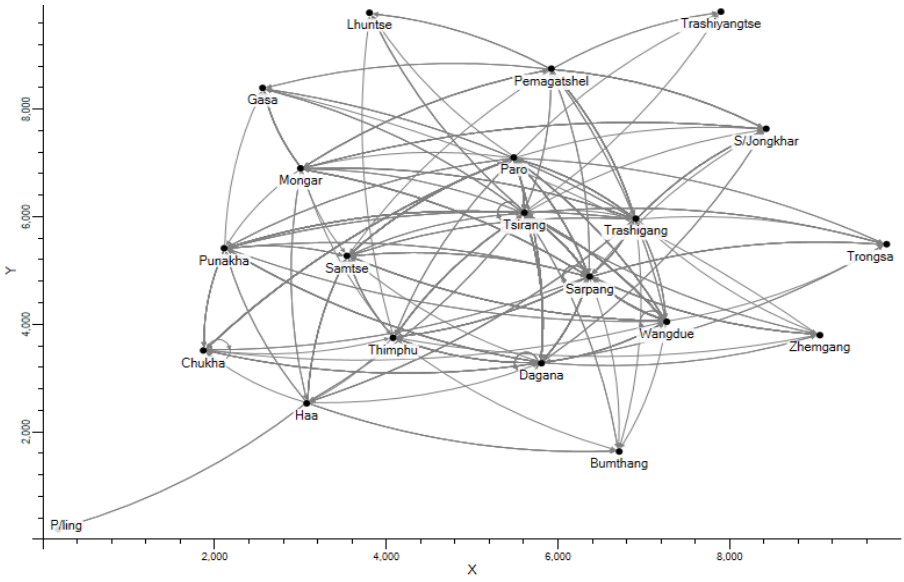


Figure 6 Formal animal trading network between districts (data 2014-2015)

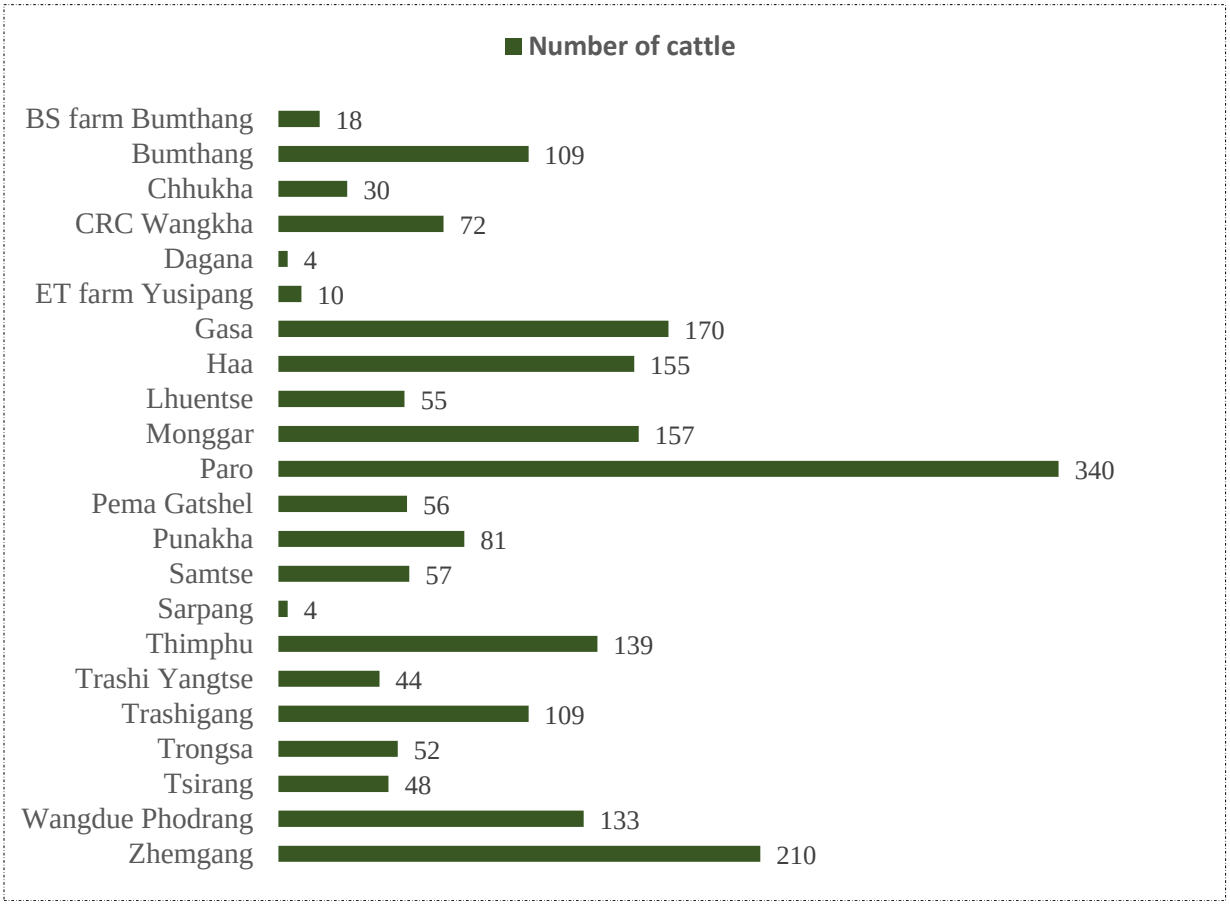


Figure 7 In-country cattle sourcing, 2008-2018 (Source: NDRDC, DoL, Thimphu)

3.4 Import of Livestock and its products

Ex-country sourcing of improved cattle breeds has been in practice since few decades to improve dairy production. Between 2008 and 2018, a total of 2,832 cows were procured and distributed to various Dzongkhags and government farms across the country (Figure 8), for a value more than 86.5 M Bhutanese Ngultrum. All these cattle were imported from various states of India; North-eastern states of India being the major source.

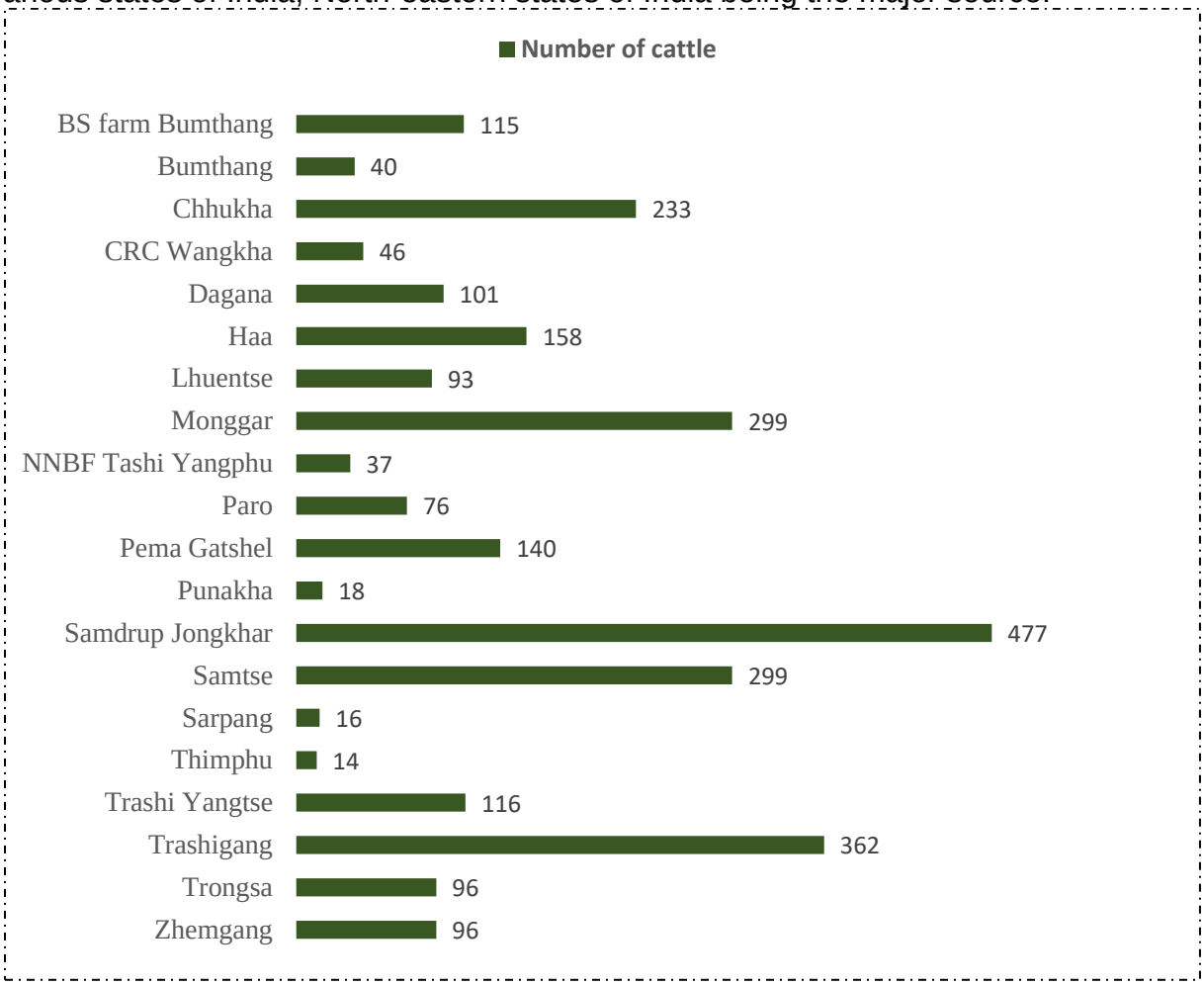


Figure 8 Ex-country cattle sourcing and distribution to Dzongkhags and farms, 2008-2018 (Source: NDRDC, DoL, Thimphu)

In addition to the import of animals, Bhutan continues to import dairy and meat products into the country. The availability of cheap synthetic wool and higher losses due to wildlife depredation were the contributing factors for decrease in sheep population in Bhutan. Nevertheless, meat (beef, pork and chevon) import between 2010 and 2018 were consistently high, contributing to about 80% of the total consumption (Figure 9).

Due to people's preference over different types of value-added dairy products, overall import figure for dairy products over the period was high, in comparison to the domestic production (Figure 9).

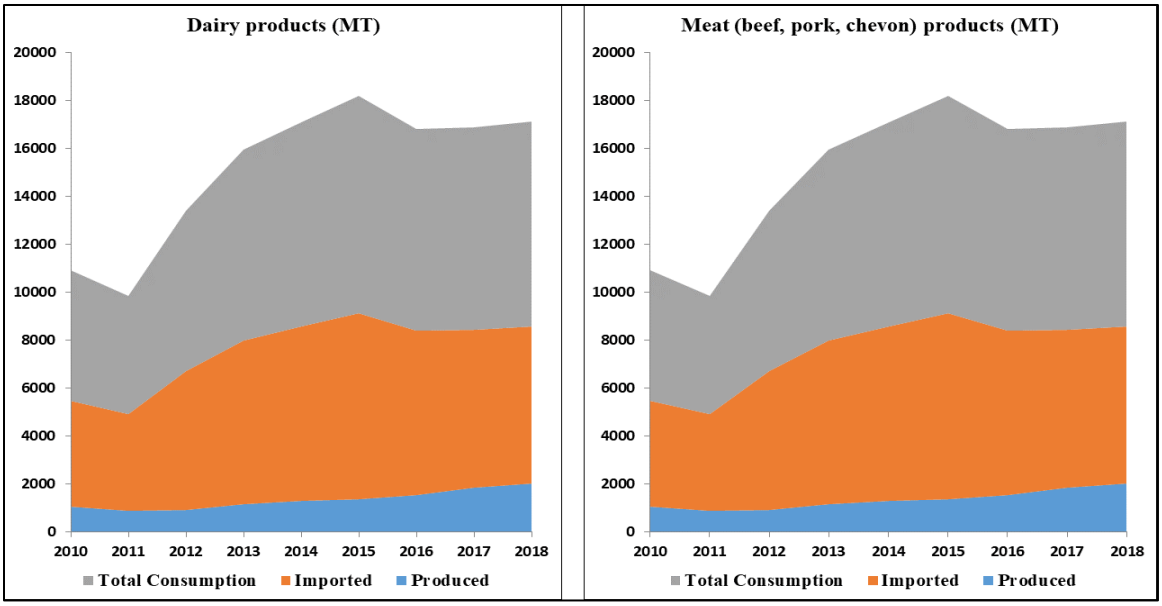


Figure 9 Dairy products and meat (beef, pork and chevon) production and import data, Bhutan, 2010-2018 (Source: Bhutan Trade Statistics, MoF, and Annual Livestock Statistics, MoAF)

3.5 Susceptible animal population

In 2019, there were approximately 434,612 FMD susceptible domestic animals distributed across 20 Dzongkhags, including government farms. The cattle population (69.6%, n = 302,589) was the highest followed by goat (11%, n = 47,735), yak (9.7%, n = 41918), pig (4.6%, n = 20,070), sheep (2.6%, n = 11,466), Zo-Zom (2.3%, n = 9,904), buffalo (0.11%, n = 477) and Mithun (0.10%, n = 453) (Figure 10).

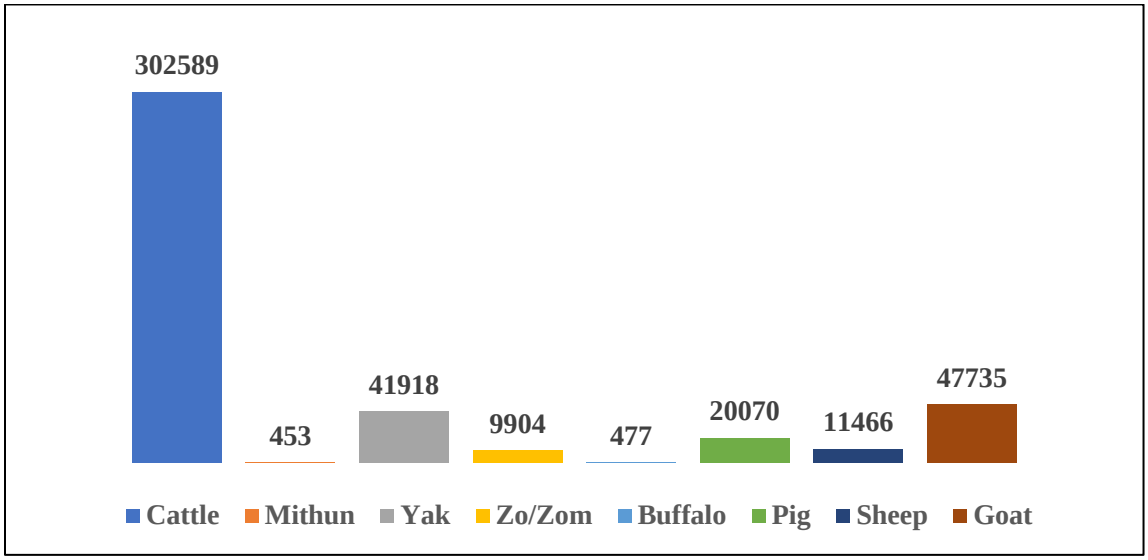


Figure 10 FMD susceptible livestock species in Bhutan (Source: Annual livestock statistics of Bhutan, DoL)

3.6 Herd/Flock density and geographic distribution

In Bhutan, majority of the household rears livestock for livelihood purpose. The cattle are reared across the country for draught and milk purpose. The semi-commercial and commercial dairy farms are predominately located in the districts which has good market and large settlement. As per the on-farm biosecurity survey conducted by Bhutan Agriculture and Food Regulatory Authority (BAFRA), the districts in Samdrup Jongkhar, Chhukha, Samtse, Tsirang and Trashigang have the highest commercial and semi-commercial farms. The average herd size of the farmer is 8 cattle with range of 80 cattle (BAFRA, 2018).

Goats and pigs are predominantly found in the southern region of the country bordering India where transboundary animal diseases are of concern. The animals are mainly reared for meat purpose. With the government policy on economic stimulus plan to boost livestock production in the country, the farmers have switched from backyard farming to semi-commercial and commercial farms. The inputs such as piglets are provided by the National Piggery Research and Development Center (NPiRDC).

3.7 Susceptible wildlife demography

Wildlife species usually affected by FMD belong to the order Artiodactyla (Cloven-hoofed animals), however, the FMDV also affect a wide range of mammal species including elephants hedgehogs, and rodents. FMD susceptible wild mammals in Bhutan are given in the Table 2.

Table 2 FMD susceptible wildlife species in Bhutan

Order: Artiodactyla (even-toed ungulates)				
Family	**Subfamily**	**Genus**	**Species**	**Common name**
Suidae	Suinae	*Sus*	*S. salvanius*	Pygmy hog
			S. scrofa	Wild pig
Moschidae		*Moschus*	*M. chrysogaster*	Himalayan musk deer
			M. fuscus	Black musk deer
Cervidae	Cervinae	*Axis*	*A. axis*	Chital
			A. porcinus	Hog deer
		Cervus	*C. elaphus*	Red deer
			C. ducauceli	Swamp deer
			C. unicolor	Sambar
	Muntiacinae	*Muntiacus*	*M. muntjak*	Indian muntjac
	Bovinae	*Bos*	*B. frontalis*	Gaur
		Bubalus	*B. bubalis*	Wild Asian water buffalo
		Budorsas	*B. taxicolor*	Takin

Bovidae	Caprinae	*Hemitragus*	*H. jemlahicus*	Himalayan thar
		Nemorhaedus	*N. goral*	Himalayan goral
		Capricornis	*C. thar*	Himalayan serow
		Ovis	*O. ammon*	Argali
		Pseudois	*P. nayaur*	Bharal

3.8 Slaughter house/abattoir

Currently, there is only one authorized slaughter house in the country. The slaughter house is a private property which falls under the category C designed for the slaughter of cattle only. Usually, the unprodective animals are collected individually at the farms level across the country and transported in the vehicles after getting the approval from BAFRA for the movement of animals. The approval for movement are granted after passing the biosecurity checks. At the slaughter house, the ante-mortem and post-mortem are conducted by BAFRA and certification is issued for human consumption. The pig and goat are usually slaughtered at farm which has basic facility for processing and disposal.

3.9 Epidemiology of FMD in Bhutan

3.9.1 Spatial distribution of FMD

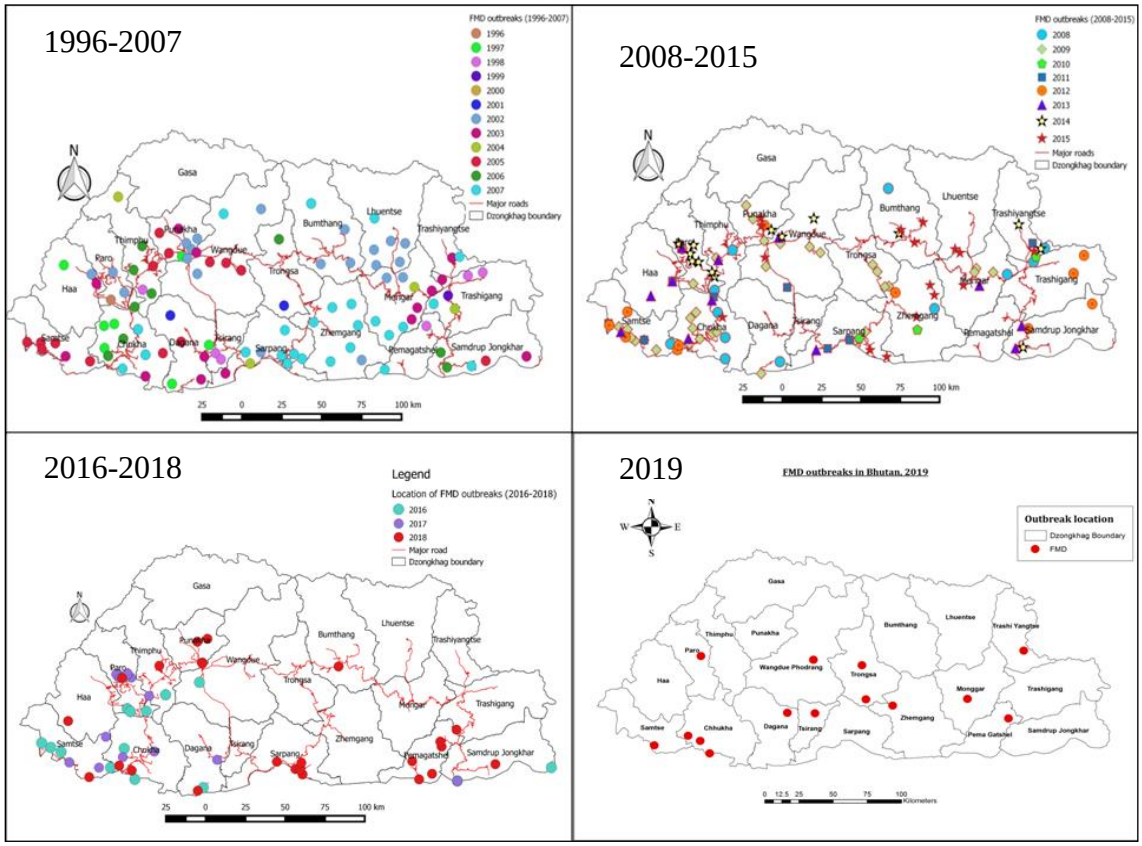


Figure 11 FMD outbreaks distribution in Bhutan: 1996-2019

Foot and mouth disease is endemic in Bhutan and are more frequently reported from the areas sharing borders with India. Outbreaks have also been reported in some of the interior parts of the country following movement of animals. In the recent year, more outbreaks have occurred in western part of Bhutan as in Figure 11.

3.9.2 Temporal distribution of FMD

Between 1996 and 2019, a total of 316 separate outbreaks of FMD were recorded in Bhutan, with an annual average of 13 outbreaks (Figure 12). There is no defined seasonal pattern of FMD outbreaks in Bhutan.

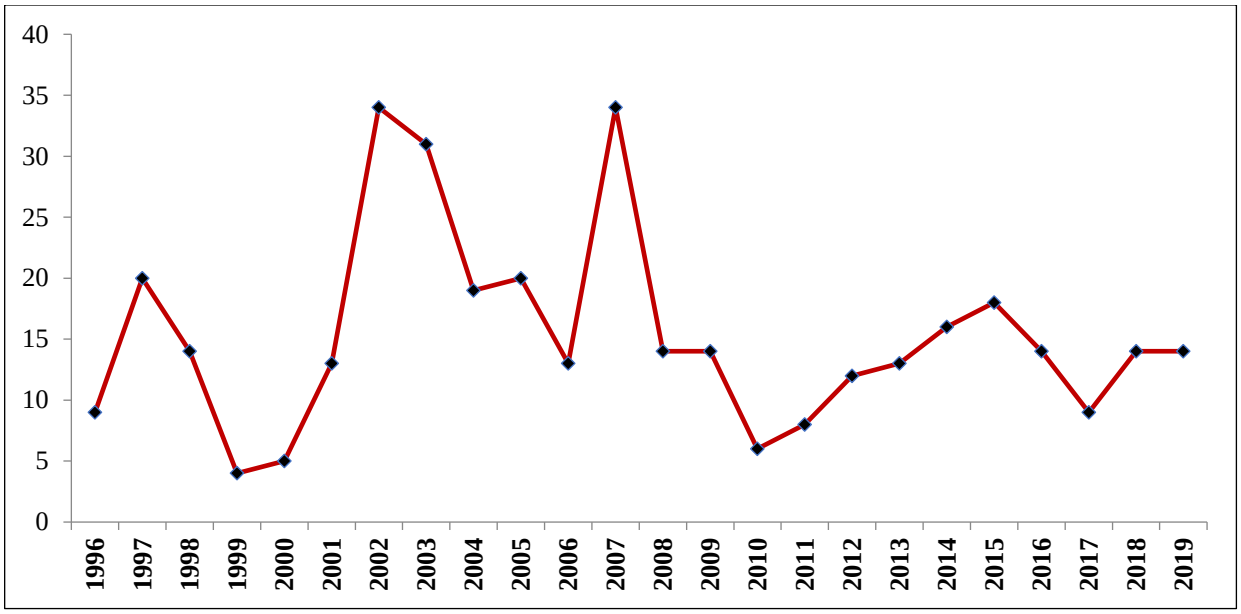


Figure 12 FMD outbreaks trend in Bhutan, 1996-2019 (Source: DPCU, NCAH)

3.9.3 Livestock Species affected

Between 2011 and 2019, a total of 5,485 livestock species were affected, of which 88 % were cattle. Fewer outbreaks have been observed in other species such as pig, sheep and goat (Table 3).

Table 3 Livestock species affected by FMD in Bhutan, 2011 - 2019 (Source: DPCU, NCAH, 2019)

Species	Numbers affected	Numbers died
Cattle	4814	107
Yak	42	0
Buffalo	14	0
Pig	596	1
Sheep	14	0
Goat	5	1

3.9.4 Virus serotypes and strains

As per the review of laboratory reports from World Reference Laboratory for FMD (WRLFMD), Pirbright, UK, the temporospatial distribution of FMD serotypes in Bhutan are summarized below.

- *Serotype O is the* most commonly recorded serotype in the country. The Pan Asia strain of the Middle East–South Asia (ME–SA) topotype of type O is reported since 2003. The recent outbreak was in Samtse in February 2017 and in Paro again in 2017 and both were associated with serotype O

- *Serotype A* was identified in Bhutan in 1982 and 1984, and again in 2002-2003. It was also identified in 2017 from Dungna, Chhukha and Samdrup Jongkhar.
- *Serotype Asia I* was identified in Bhutan in 1986 and then in 2002.
- *Serotype C* was last identified in Bhutan in 1991

3.9.5 FMD Sero-prevalence

The first NSP sero-survey was conducted in 2009 in four districts in Sarpang (South), Trongsa (Central), Chhukha (West) and Trashigang (East) in Bhutan with 1909 sera samples collected from cattle, goat, sheep and pigs (Dukpa et al., (2011). Key findings from the sero-survey are summarized below:

- The prevalence of NSP-antibodies varied significantly between districts for cattle ($P<0.0001$, $\chi2 = 66.3$, $df = 3$) and between species ($P<0.0001$, $\chi2 = 40.9$, $df = 3$) with the highest test/apparent prevalence being recorded in cattle (17.5%, 265/1516) followed by goats (12%, 13/108), sheep (12%, 3/25) and pigs (2.3%, 6/260).
- The sero-prevalence of FMD in the migratory herds (24.8%, 95% CI: 20.6, 29.5) was significantly higher than in the sedentary herds (17.5%, 95% CI: 15.6, 19.5) thus underlining the significance of the livestock production system for the disease's epidemiology.
- The sero-prevalence of FMD for cattle increased with age and this increase was apparent in all the districts
- Local breeds of cattle were 1.67 times more likely to be seropositive than improved breeds
- The odds of being seropositive was 3.6 times more likely in herds with known outbreaks than those originating from herds with no history of FMD.
- The sub-districts sharing border with India were 1.3 times (95% CI: 1.03, 1.73) more likely to have seropositive animals than those not sharing a border with India.

3.10 Risk assessment

3.10.1 Identification of risk hot spots

In order to establish the risk zone, it is important to identify the risk hotspots for FMDV entry and spread in Bhutan:

3.10.1.1 Districts bordering India

The districts sharing border with India are risk hotspots, as there are frequent movement of live animals and animal products across the border.

3.10.1.2 Quarantine stations

There are four Quarantine Stations (QS) located along the India-Bhutan border: Gelephu QS, Samdrup Jongkhar QS, Phuentsholing QS and Samtse QS. These are the main entry points for formal import of livestock in the country (Figure 13).

It is common to detect FMD during the quarantine period as majority of the cattle are sourced from FMD endemic areas in India. Further, although the animals are certified as vaccinated against FMDV, they are often detected positive during the quarantine period.

3.10.1.3 Districts that practice cattle migration

Most of the outbreaks of FMD in the country and its spread to new areas are linked with migration of livestock herds.

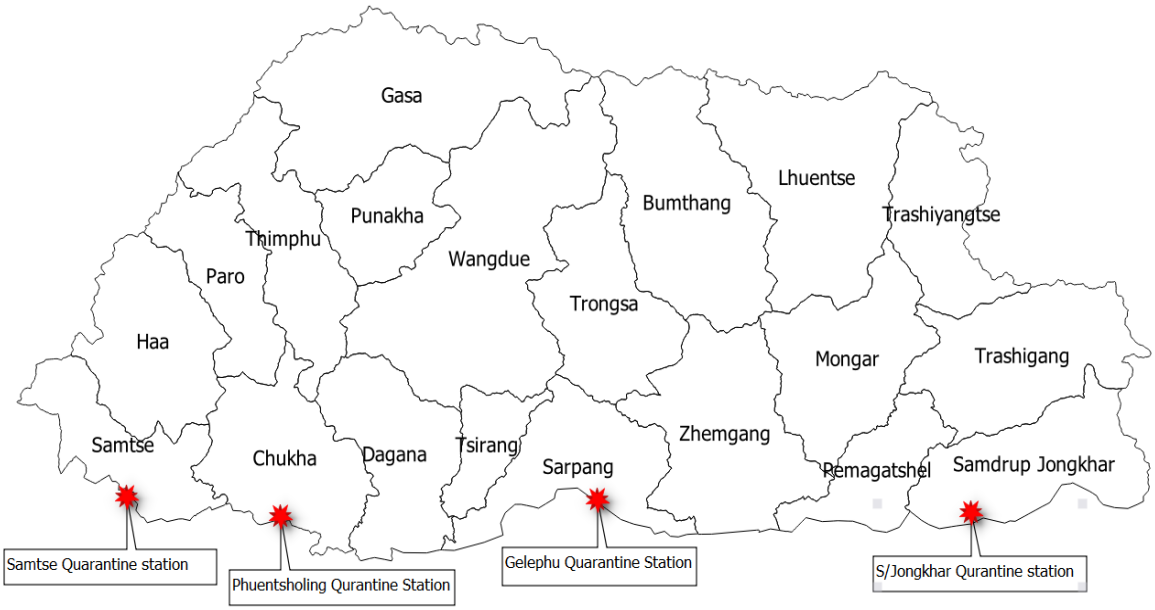


Figure 13 Four quarantine stations located along the southern border of Bhutan

3.10.2 Other FMDV incursion routes

Other routes for incursion of the virus into the country are as follows:

3.10.2.1 Live animals

Bhutan shares a long porous border stretching about 700 kilometres with India in the south and east. There is constant mixing of animals (Indian and Bhutanese animals) along the borders through common grazing grounds and water points, which pose risk of introducing FMDV in the country. Animals are also brought into the country through legal and illegal means which may contribute to introduction of the virus. Not having strong regulation in place and the practice of 'Tshethar' favours illegal movement of animals into Bhutan.

3.10.2.2 Animal products

In Bhutan, there is only one officially recognized slaughterhouse for cattle – in Tsirang district. However, there exist local slaughterhouses in Indian border towns where live animals from India, Bhutan and Nepal are slaughtered. There is no system of ante-

mortem and post-mortem inspection and certification at the slaughterhouse to rule out FMD infection.
Another suspected entry mechanism is through exchange of animal products like butter/cheese and also dried meat (Yak meat) in eastern Bhutan with people from India. Barter system of trade is still practised in these parts of the country and Bhutanese livestock owners often trade with Indians across the border.

3.10.2.3 Fomites

Fomites can be another mechanism of entry of FMDV as large numbers of Bhutanese and Indian traders, visitors and tourists enter Bhutan from India. Their clothing, belongings, vehicles and equipment creates risk for the introduction of FMDV into Bhutan.

3.11 Distribution and spread of FMDV

Distribution and spread of FMDV after introduction occur mainly through:

- Mixing of animals through sharing of common grazing area.
- Trade of live animals and animal products within the country
- Poor management practices
- Inadequate regulatory system and
- Seasonal migration of livestock.

3.12 Risk zone identification

As per the PCP-FMD, the risk zone identification and categorization are imperative for defining the strategies in each zone and establish disease status in the country. The country is divided into three risk zone (High, Medium and Low) based on the disease epidemiology, proximity to neighboring countries and FMD outbreaks data (2011-2019) (Figure 14).
The disease risk zones will be used in guiding the strategies for surveillance, vaccination and animal movement regulation. However, the risk zones should be reviewed periodically based on the disease status to increase the efficiency of the prevention and control programme.

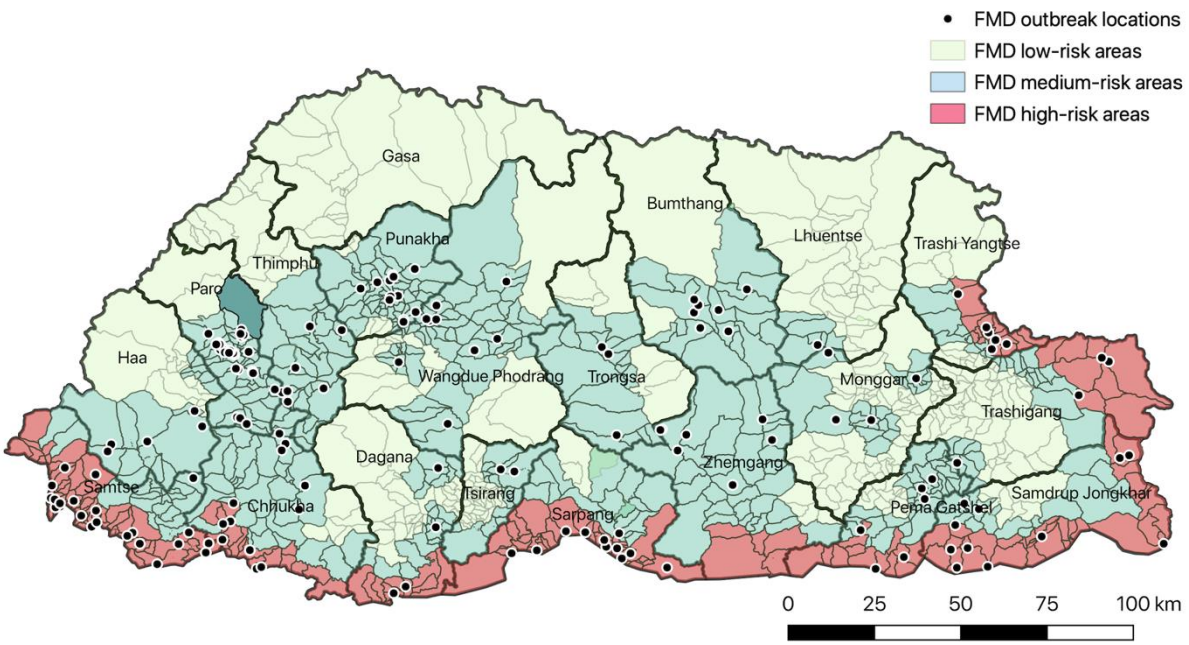


Figure 14 Risk zoning for Foot and mouth disease in Bhutan

3.13 Veterinary Services organization for prevention and control of FMD

3.13.1 Veterinary Services

The VS of Bhutan is entirely a public sector entity and are delivered to farming communities through the network of various Livestock extension centres (Veterinary hospitals, livestock extension and RNR Centres). Technical and laboratory supports are provided through National Centre for Animal Health (NCAH), National Veterinary Hospital (NVH), Regional Livestock Development Centres (RLDCs), Satellite Veterinary Laboratories (SVLs) and Dzongkhag Veterinary Hospitals (DVHs). Regulatory services with regard to quarantine, animal movement and animal product movement are provided by BAFRA. All VS activities are currently provided free of cost to livestock owners as a national policy to support food security and poverty reduction. The roles of different institutions involved in FMD prevention and control are detailed in the Operational Plan of this document.

3.13.2 Performance of Veterinary Services (PVS) analysis

The OIE fielded series of missions to carry out the evaluation of the performance of veterinary services in Bhutan. The first PVS mission was fielded in June 2008 followed by Gap Analysis Mission in November 2009 and a follow-up mission in March 2015. The OIE also fielded Laboratory Mission in January 2016 and legislation mission in 2018.

Results show that notable improvements have been made in physical and human resources, as well in some activities. The most important progress has been the recruitment of veterinarians at the district levels.

Bhutan Agriculture and Food Regulatory Authority has a well-defined and comprehensive mandate that provides a way forward to develop inspection processes for food safety and

has made progress in improving meat hygiene. Drug Regulatory Authority has successfully started to regulate veterinary medicines and vaccines and requires that the national production of vaccines fulfils international standards. However, few observations and recommendations were made regarding continuing education, chain of command, operation funding, regulation and inspection, residue testing and animal feed safety.
See Annexure 3 for the summary of OIE PVS evaluation results.

4 RATIONALE

4.1 Prioritizing importance of FMD-control in relation to other animal diseases

FMD is a notifiable disease as per the livestock rules and regulation of Bhutan, 2017. All notifiable disease whether it is a suspect or a confirmed must have an official control plan in place and accordingly implement control measures as mandated by law. It is also a disease of high economic impact and affects multiple livestock and wildlife species making it challenging to contain outbreaks.

4.2 Benefit of FMD Prevention and Control

4.2.1 Livelihood and food security

At least 62% of Bhutanese household depends on livestock for their livelihood (NSB, 2013). Smallholders and mixed farming practices are predominant and are characterized by a complex, integrated relationship among animals, crops and farming families. Therefore, occurrence of any livestock disease in this setting has huge implication on livelihood and food security of communities. Milk and other dairy products form main source of nutritional input and income for majority of the rural communities. Therefore, prevention and control of FMD has direct link to securing livelihood and food security. Food and Mouth disease prevention shall result in prevention of loss of livestock production, animals and draft power.

4.2.2 Public sector

Livestock contributes 7% to the national GDP, and it has been estimated that about 22% of rural household income is produced from the rearing of livestock (MoA, 2009). The livestock sector has made substantial progress towards achievement of livestock products self-sufficiency during 11th FYP. The self-sufficiency in milk has increased from 68% to 84 % during 11th FYP (2013-2018). Although, there is lot of social stigma in the meat sector, there was a substantial increase in the pork production (20%) and 34% in Chevon production.
On an average, 51% of the total budget for livestock vaccines (ruminants, pets and poultry) has been spent for procurement of FMD vaccine, besides the cost of vaccination and containment of outbreaks. Reduced incidences of FMD outbreaks through implementation of this prevention and control plan will boost the production and encourage state investment into dairy sector, thus contributing more to the gross domestic product of the country.

4.2.3 Improved financial conditions of private stakeholders

Public-Private-Partnership and State-Owned Enterprises are two emphasis in development model of Bhutan. Implementation of a strategic control programme of FMD

will ensure venture security, thus attracting private individuals to invest into livestock farming and related enterprises.

4.2.4 Prevention and control of other major diseases of livestock

Major portion of Animal Health Division's budget is allocated for prevention and control of infectious diseases. Implementation of FMD control strategy will also facilitate in prevention and control of other animal diseases through improvement of laboratory facilities and veterinary services in the country. Further, a parallel human resource capacity development for its implementation will help to achieve provision of more specialized and enhanced services in other diseases.

4.2.5 Trade

There is no significant export of livestock and its products from Bhutan currently. However, with the increasing trend of prioritization and investment into agriculture sector development, it is likely to fetch export in future. Livestock and its related products are traded between regions and districts within Bhutan. Bhutan imports dairy products worth Nu. 800 million annually (Bhutan Trade Statistics, 2018). The reduced loss of production through control of FMD incidences will facilitate total or partial substitution of these imports and also open up opportunities for export.

4.2.6 Regional and international communities

Implementation of this plan will complement the regional and international efforts to control FMD, thus substantially saving the investment related to FMD prevention and control done by regional and international communities. This will facilitate focusing and investing into prevention and control of other livestock diseases.

5 PROGRESSIVE CONTROL PATHWAY FOR FOOT AND MOUTH DISEASE (PCP-FMD) PRINCIPLES

PCP-FMD has been developed by FAO (Food and Agriculture Organization of the United Nations) and EuFMD (European Commission for the Control of Foot-and-Mouth Disease) to assist and facilitate FMD endemic countries to progressively reduce the impact of the disease and the load of FMD virus. The PCP-FMD approach has been adopted by FAO and OIE (World Organisation for Animal Health) as a working tool in the design of FMD country (and some regional) control programmes.

The PCP-FMD is a set of FMD control activity stages that focuses on first identifying and then addressing the risks for FMD introduction and spread. If adequately implemented, the activities should enable countries to progressively increase their level of FMD control to the point where an application for OIE endorsement of a national official control programme will eventually lead to the OIE recognition of an FMD free status with or without vaccination in accordance to the requirements of the OIE *Terrestrial Animal Health Code*. The PCP-FMD consists of two distinct domains: (i) a Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs) pathway from Stage 0 up to and including stage 3 and (ii) an OIE pathway beyond Stage 3 (Figure 15).

The PCP approach is based on the following principles

- Understanding the epidemiology of FMD and active monitoring for FMD virus (FMDV) transmission pathways are the foundation of a control programme, and therefore the activities to meet these requirements are common in all stages. FMD monitoring and evaluation system should be in place at Stage 2 and higher to measure the effectiveness of the control programmes;
- Activities are conducted to mitigate the disease risk and reduce virus transmission in the susceptible domestic animal population, as appropriate for the particular PCP Stage;
- In each PCP Stage, activities and their impacts are measurable, comparable between countries and generate information of benefit to national as well as international stakeholders;
- Available resources are optimised by targeting control measures to specific critical control points along the value chains where their impact is greatest. Critical control points may be production systems and/or husbandry practices and/or particular geographic locations where the risk of FMD entry, spread and/or consequences is highest.

Table 4 Stage progression in the PCP

Domain	Stage	Description
GF-TAD	**STAGE 0**	A country in PCP Stage 0 has **little** to **no** reliable information about FMD, and any FMD control measures are not targeted according to risk.
	SATGE 1	Stage 1 focuses: To gain an understanding of the epidemiology of FMD in the country and develop a risk-based approach to reduce the impact of FMD
	To progress to STAGE 2	A written Risk-Based Strategic Plan (RBSP) that has the aim of reducing the impact of FMD in at least one zone or husbandry sector is developed.
	STAGE 2	Stage 2 focuses: To implement risk-based control measures such that the impact of FMD is reduced in one or more livestock sectors
	Top progress to STAGE 3	A written Official Control Programme aiming at eliminating virus circulation in the domestic susceptible animal population from at least a zone of the country is developed
	STAGE 3	Stage 3 focuses on: Progressive reduction in both outbreak incidence and virus circulation in at least one zone of the country.
OIE	**To progress to STAGE 4**	The country has received endorsement of its Official Control Programme from the OIE

	STAGE 4	OIE endorsement: Stage 4 focuses: To continue to implement the endorsed national official control programme and achieve OIE recognition of freedom with vaccination.
	Beyond STAGE 4	• OIE Official Status of freedom with vaccination • OIE Official Status of freedom without vaccination

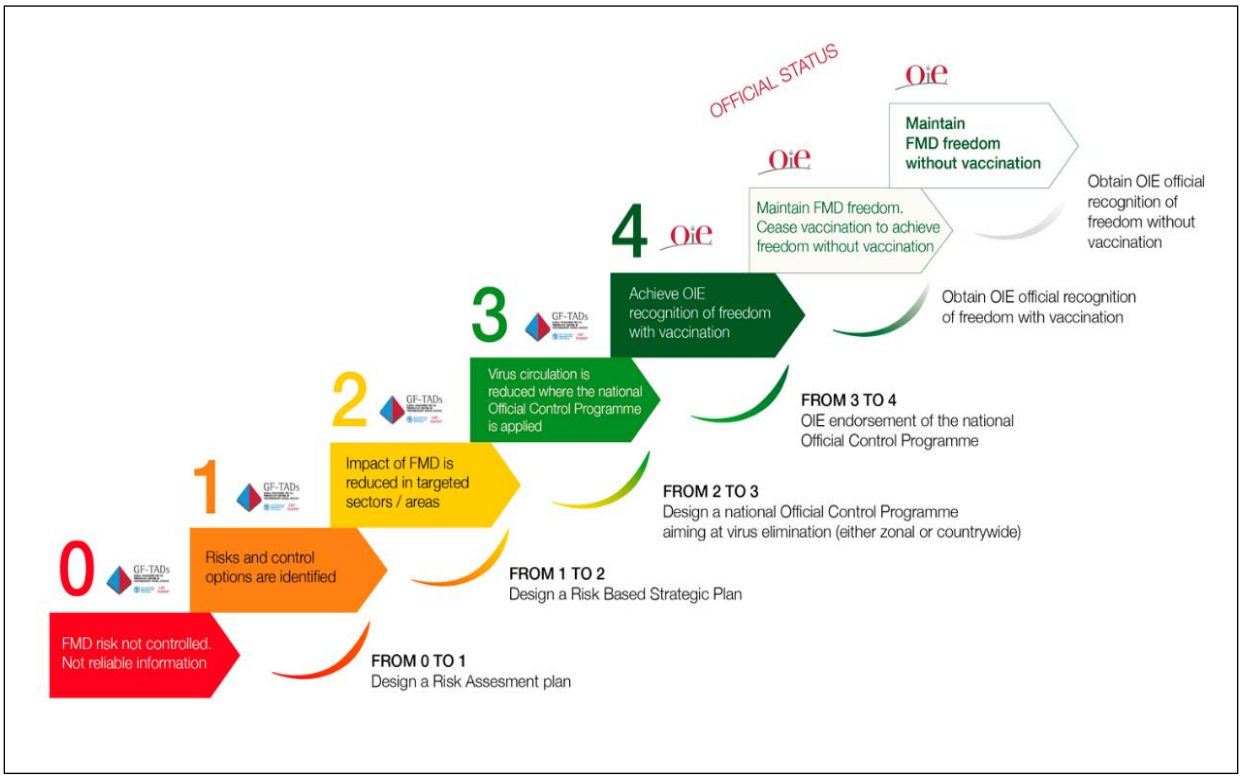


Figure 15 PCP-FMD stages

6 OPERATIONAL PLAN

6.1 National Committee for Control of FMD (NCC-FMD)

A National Committee for Control of FMD (NCC-FMD) with representation from the relevant agencies shall oversee the implementation of FMD progressive control pathway in the country. The committee shall constitute following members:

1. Secretary, Ministry of Agriculture and Forests (MoAF)
2. Head, Department of Livestock, MoAF
3. Head, Bhutan Agriculture and Food Regulatory Authority, MoAF
4. Head, Department of Forests and Park Services, MoAF
5. Head, Animal Health Division, DoL
6. Head, National Centre for Animal Health, DoL
7. Head, Plant and Animal Biosecurity Division, BAFRA

8. Representative, Legal services of MoAF

Roles of NCC-FMD

- To oversee and guide the implementation of FMD control pathway guided by NFMDPCP
- To enhance coordination among different stakeholders
- To facilitate resource mobilization
- To make policy decisions related to implementation of FMD progressive control pathway
- To endorse recommendations of the technical working group for FMD control
- Managing awareness and general publicity programmes, including press releases, and creating a public relations centre to liaise with the media.

Meeting and Procedures

- The NCC-FMD will be chaired by Secretary of MoAF
- The CVO, AHD, DoL shall serve as the member secretary
- The committee shall meet at least once a year or as and when required

6.2 Technical Working Group for Control of FMD

A Technical Working Group on FMD (TWG-FMD) comprising of experts from different sectors will advise and provide technical recommendations to the concerned agencies and to the NCC-FMD and field offices for implementation of FMD progressive control pathway.

TWG will be composed of:

1. Head, Animal Health Division, DoL
2. Head, Plant and Animal Biosecurity Division, BAFRA
3. Head, National Centre for Animal Health, DoL
4. Head, Laboratory Service Unit, NCAH
5. Head, Disease Prevention and Control Unit, NCAH
6. Head, Regional Livestock Development Centre, DoL (1 representative)
7. Head, BAFRA from affected Dzongkhags
8. Veterinary Officer from FMD affected Dzongkhag (1 representative)

Roles & Responsibilities

- To oversee and evaluate the activities of FMD progressive control pathway
- To recommend solutions for technical issues/challenges in implementation FMD control
- To provide technical guidance/advice to the NCC-FMD and concerned agencies
- To review and develop guidelines, SOPs, IEC materials related to FMD control
- To develop training materials and provide training to DoL and BAFRA officials
- To manage database on FMD, conduct analysis, prepare and submit report to NCC-FMD and other relevant key stakeholders
- To identify research needs, review research proposal, coordinate and supervise operational research related to FMD
- To review and propose amendments on regulations related to FMD control plan

- To prepare dossier for validation and for acquiring stage 3 following the stepwise approach for FMD progressive control pathway.

Meeting and Procedures

- The Head of AHD will be the Chair of the committee and Head, DPCU will be the member secretary to coordinate the TWG activities
- The Technical Working Group will meet bi-annually, or as and when called upon to convene by the NCC-FMD.

6.3 Roles and Responsibilities of technical stakeholders

6.3.1 Department of Livestock

The Animal Health Division (AHD) at the Department will oversee policy formulation related to Foot and mouth disease prevention and control in the country. The specific roles include the following:

- Mobilize resources including fund for FMD control programme in the country
- Liaise with different stakeholders/agencies/international organizations (e.g. FAO, OIE, SAARC) for facilitating better implementation and ensuring success of the control programme
- Collaborate with BAFRA to enable better enforcement of the Livestock Acts and By-laws of the country
- Collaborate with relevant national agencies (DoFPS, DDM, NGOs) for ensuring and mobilization of support required for FMD control
- Coordinate border harmonization meetings with the Indian counterparts at the state and central levels.

6.3.2 National Level

The NCAH shall function as the national focal agency for the overall planning, coordination and implementation of the National Foot and Mouth Disease Prevention and Control Plan (NFMDCP) in the country. The responsibilities for the national focal agency should be to:

- Coordinate the overall implementation of the NFMDPCP in the country
- Mobilize resources at the national level in terms of supply of vaccine and equipment
- Support the activation of rapid response team (RRT) in the event of disease outbreak
- Liaise with different stakeholders/agencies for facilitating better implementation and ensuring success of the control programme
- Coordinate conduct of epidemiological research on FMD in collaboration with national, international diagnostic and research institutions
- Production of IEC materials and make available for wider circulation for advocacy campaign
- Ensure maintenance of database on FMD control programme (e.g. vaccination coverage), analysis and dissemination of information/progress report to the Department/Ministry/other stakeholders regarding the progress of the control programme
- Conduct FMD coordination workshops at national level to review and realign the control programme

- Coordinate the conduct of field simulation exercise among RRT
- Monitor and evaluate the control programmes implemented by the field units
- Ensure vaccination coverage as per the risk zones
- Declaration of risk zones/compartments for FMD
- Maintenance of the status of these zones / compartments by regular surveillance and monitoring
- Standardization of protocol for diagnosis of FMD and ensuring uniformity across diagnostic laboratories in the country

6.3.3 Regional Level

The Regional Livestock Development Centres (RLDCs) would function as regional focal agency for FMD control programme. The main roles of the regional focal agency should be to:

- Coordinate the overall implementation of the NFMDPCP at the regional level
- Coordinate the activation of rapid response team (RRT) in the event of disease outbreak
- Provide support and coordinate logistics arrangement at the regional level
- Liaise with the BAFRA at the regional level for facilitating better enforcement of the Livestock Acts and By-laws
- Monitoring and evaluation of the control programmes in their respective regions
- Ensure prompt reporting of outbreak and updating the disease status in TADinfo database.
- Ensure maintenance of database on FMD control programme (e.g. vaccination coverage), and submit progress report to the NCAH
- Monitor and evaluate the control programmes implemented by the field units

6.3.4 Dzongkhag Level

At the Dzongkhag level, the Dzongkhag Veterinary Hospital (DVH) would function as the focal agency for implementation of the FMD control programme. The Dzongkhag focal agency should carry out the following tasks:

- Implement the NFMDPCP in the field
- Arrange logistics at the Dzongkhag level and assist the Gewog staff with their logistics
- Liaise with the BAFRA at the Dzongkhag level for facilitating better enforcement of the Livestock Acts and By-laws
- Support the activation of rapid response team (RRT) in the event of outbreak
- Mobilize manpower in the Dzongkhag for routine and ring vaccination programme
- Ensure prompt reporting of outbreak and updating the disease status in TAD*info* database.
- Ensure maintenance of database on FMD control programme (e.g. vaccination coverage),
- Submit monthly reports to the RLDC regarding status of the disease in the Dzongkhags.
- Receive the inputs from the NCAH/RLDC and maintain inventory in the Dzongkhags

6.3.5 Gewog Level

The Livestock Extension Centre/RNR Extension Centres/Veterinary hospitals at Gewogs should be the focal agency for that Gewog. They would play crucial role in the implementation of the FMD control programme in their respective Gewogs.

The main roles of the Gewog focal agency are as follows.

- Implement the FMD control programme in the field as per the NFMDPCP.
- Ensure prompt reporting of outbreak through FLASH report and updating the disease status on weekly basis
- Implement provisional emergency control measures in the locality in the event of outbreak
- Ensure maintenance of proper recording of vaccinated herds and other records
- Liaise with the BAFRA at the Gewog level for facilitating better enforcement of the Livestock Acts and By-laws
- Liaise with the Gewog administration (GT), Gups, other local leaders and farmers for facilitating proper implementation of the programme in the field
- Play lead role at the time of vaccination campaign and disease outbreak investigation in their respective Gewogs
- Conduct regular disease awareness campaign for the farmers and other clients

6.3.6 Bhutan Agriculture and Food Regulatory Authority

Bhutan Agriculture and Food Regulatory Authority (BAFRA) as a Regulatory Authority under MoAF is mandated to enforce and implement the Livestock Act and By-laws and its regulations. Some of the important activities are as outlined below:

- Enforcement of Livestock Act of Bhutan 2001 and Livestock Rules and Regulations 2017
- Enforcement of movement ban of livestock and livestock products in and out of the FMD outbreak areas
- Quarantining of infected animals in the affected areas.
- Monitor the livestock movements from one Dzongkhag to others.
- Inspection and certification of suspected livestock products
- Carry out bio-security measures during the outbreaks (segregation, disposal, cleaning and disinfection)
- Border vigilance on the illegal movement of livestock & livestock products during peace period.
- Others (as per the Livestock Act of Bhutan 2001 and Livestock Rules and Regulations 2017)

6.3.7 Other relevant agencies/organization

The prevention and control of FMD require joint effort at various level including the regional and international organizations.

6.3.7.1 Department of Forests and Park Services (DoFPS)

The livestock graze freely in the forest where there is a possibility of mixing domestic animals with wild ruminants. There may also be disease transmission (FMD) at the domestic-wild life interface since most of the villages in the country are surrounded by forests. Therefore, collaboration between livestock and forestry sectors is important for disease surveillance, sharing of disease outbreak information and prevention and control programme.

6.3.7.2 Dzongkhag Administration

The Dzongkhag, Dungkhag and Gewog administration support is important for coordinating FMD prevention and control activities including management in the event of outbreak in their areas. Local government support is crucial for strict implementation of NFMDPCP at the village and community level.

6.3.7.3 Royal Bhutan Police

The Royal Bhutan Police (RBP) support is necessary for enforcement of FMD control measures and regulations especially in the event of large-scale outbreak.

6.3.7.4 Ministry of Finance

The Ministry of Finance (MoF) should provide adequate fund for implementation of NFMDPCP in the country. The additional fund support should be sought from MoF if the existing budget is not enough at the different levels during implementation and in emergency situation.

6.3.7.5 International Organizations

It is important to build linkages with the international organizations such as the Food and Agriculture Organization (FAO), World Organization for Animal Health (OIE) and other institutes for seeking fund and technical support, human resource development, and referring of samples for laboratory diagnostic services.

The SAARC Regional Support Unit should play an important role in helping with developing coordinated programme for FMD control in the SAARC countries and also sharing facilities like laboratory services, disease information centre, and facilitate in quality vaccine procurement.

6.3.7.6 Cross-border harmonization

Coordination meetings with the state veterinary departments of the adjoining Indian states (Assam, West Bengal, and Arunachal Pradesh) are needed to help with common understanding and the development of collaborative efforts for disease control in both countries.

The Ministry of Agriculture and Forests should interact with the Department of Animal Husbandry and Dairying, Government of India for bringing about understanding between the two countries and to revitalize the border harmonization meetings with the Indian

counterparts. The Department of Livestock shall coordinate Border harmonisation meetings (BHM) with support from relevant agencies.

7 PREVENTION AND CONTROL STRATEGY

7.1 Regulatory Framework

7.1.1 International Legislation

The OIE standards on Veterinary legislation as described in Chapter 3.4 of the Terrestrial Code and OIE International Animal Health Code, Chapter 2.1.1 recommends that FMD disease be made notifiable throughout the country. It also provides guidelines for the safe importation of live animals, meat and other animal products including germplasm and other risk materials from FMD-free and infected countries and zones. It requires that the import quarantine conditions should be negotiated with exporting countries for the safe importation of the above, based on the OIE Code which may include pre-export testing and quarantine, animal health certification and any necessary post-arrival inspection, testing and quarantine.

7.1.2 National Legislation

The Livestock Act 2001 and Livestock Rules and Regulations 2017, Chapter IV have listed FMD as a notifiable disease. Any suspected case of FMD must be mandatorily reported to the higher authorities by the law for official control measures implementation. Furthermore, the Chapter IV of the Livestock Rules and Regulation 2017 empowers the concerned offices with following authorities for prevention and control of FMD:

- Designation and control of notifiable diseases
- Destruction of animals, animal products and feed posing risk
- Ban on shows and sale of livestock and its products during the outbreaks
- Quarantine of imported animals and their products
- Restriction on animal movement
- Restriction of certain food waste as animal feeds

The Bhutan Health Code for Import of Animal 2018 clearly underlines the import conditions to be met for the import of animals and their products including germplasm.

7.2 Disease surveillance

Surveillance is a continuous collection, collation and analysis of data that enables the prompt dissemination of the information to take appropriate action. Surveillance is needed to understand the health status of the animals in the country, so that problems can be identified, and actions taken. For an appropriate surveillance activity to be performed, there should be a clear objective and understanding of the need. . The surveillance for FMD should serve following four general purposes:

- Demonstrating freedom from disease
- Early detection of disease
- Measuring the level of disease
- Finding cases of disease

Surveillance is a key element of the NFMDPCP and will become even more important as Bhutan works to move along the Progressive Control Pathway for FMD. The surveillance

should be undertaken in line with the provisions of OIE Terrestrial Animal Health Code 2019, Chapter 8.8 Infection with FMD virus, Article 8.8.40 General Principles of Surveillance and Article 8.8.41 Method of Surveillance.

7.2.1 Clinical surveillance

7.2.1.1 Syndromic surveillance

This surveillance will be conducted through monthly reporting system (Veterinary Information System, an online database) on the absence or presence of FMD in the country. Each livestock centres including central farms should collect information on FMD status in animals from their respective areas (Village/Chiwogs and farms). The reporting should be done from Gewog to Dzongkhag office. The Dzongkhag Livestock Sector should then submit the report to NCAH and RLDCs of FMD syndromic surveillance (see Form 2). The NCAH shall maintain national data, perform analysis and provide feedbacks to all the stakeholders in the country annually. The analysed report shall support validating GF-TAD/OIE PCP for FMD in Bhutan and determine Bhutan's FMD-PCP stage.

7.2.1.2 Surveillance during outbreak

Once the FMD outbreak is confirmed by the disease outbreak investigation team, continuous surveillance should be carried out in the infected and protection zone by RRT. The update on the disease status shall be submitted on weekly basis to RLDC and NCAH. Information should be updated in the online TAD*info* database. When the outbreak is effectively contained, imposed ban shall be lifted, that is, 21 days after reporting of the last case.

7.2.2 Laboratory surveillance

7.2.2.1 Sero-surveillance (structured population-based survey)

A structure-based survey shall be conducted when required to determine sero-prevalence of FMD virus in animals using NSP antibody ELISA (NCAH SOP SERIES: SERO-014). The study findings shall demonstrate the success of NFMDPCP. Simultaneously, NSP antibody rapid test kit shall be employed to detect antibody developed due to infection.

Additionally, similar survey shall be conducted to determine immune profile developed due to vaccination. An LPB antibody ELISA (NCAH SOP SERIES: SERO-016) shall be employed to test samples collected from vaccinated animals in addition to NSP antibody ELISA. All the reactive samples in NSP ELISA shall be excluded and immune profile developed only due to vaccination is deduced. These findings shall determine the success rate of vaccination programme.

7.2.2.2 Virological surveillance

During FMD outbreak, samples such as epithelium, vesicle/vesicle fluid, milk and serum should be collected and tested using RT-PCR test (NCAH SOP SERIES: SERO-020) to detect the presence of virus. Samples should be collected from affected animals around the time of infection or while exhibiting clinical signs. Once the virus is detected in the tested sample (NCAH SOP SERIES: SERO-015), serotype should be determined using serological test. The positive samples will be further referred to World Reference Laboratory for FMD, Pirbright, UK for virus characterization.

Another sampling procedure shall be employed to understand the carrier status of the animals by collecting oropharyngeal fluid using probang cup after 28 days of infection. Samples should be subjected to RT-PCR (NCAH SOP SERIES: SERO-020) to detect virus and to understand the role of carrier animals in FMD outbreak.

7.3 Diagnostic capability

The FMD Control Programme should be supported by diagnostic facilities with adequate capability and capacity. Samples for diagnosis should be collected and transported in accordance with Chapter 1.1.2 Collection, submission and storage of diagnostic specimens – and Chapter 1.1.3 Transport of specimens of animal origin of the OIE Manual of Diagnostic Tests and Vaccines for Terrestrial Animals (Terrestrial Manual). Diagnostic tests should follow the specific requirements in Chapter 1.1.6 on principles and methods of validation of diagnostic assays for infectious diseases and the disease specific recommendations in the Terrestrial Manual. Diagnostic facilities should be under a quality assurance scheme coordinated by the National Veterinary Laboratory at NCAH, Serbithang. The NCAH should establish communication with OIE reference Laboratories for the FMD at OIE Regional Reference Laboratory at Pakchong, Thailand and World Reference Laboratory at Pirbright, UK, and conduct proficiency test for FMD diagnosis and characterize FMD virus. The Regional and Satellite Veterinary Laboratory should ensure that diagnostic results are communicated to the Veterinary Authority as appropriate to the situation. The NCAH is also needed to provide independent and impartial quality control of vaccines. Besides, NCAH should develop facilities to characterize FMD virus. The NCAH should submit samples to OIE reference laboratories for confirmation of findings and detailed analysis. The Department of Livestock should strengthen the diagnostic capacity for FMD at national, regional, satellite and district laboratories through development of HR capacity on the FMD sampling and diagnosis.

7.4 Vaccination Programme

7.4.1 Vaccine procurement and supply

The NCAH should procure vaccine and supply as per the annual indents submitted by the Dzongkhags. The total FMD vaccine doses requirement in each Dzongkhag should be calculated based on the susceptible animal population, risk zone and 80% coverage target during each campaign. A vaccine bank at the regional level should be established at RLDC, Kanglung, TVH/SL, Gelephu and TVH/SL, Phuentsholing for emergency supplies during outbreaks.

7.4.2 Vaccine strain and quality

For the routine vaccination programme, oil-adjuvant trivalent FMD vaccine containing serotypes O, A and Asia-1 with ≥ $3PD_{50}$ potency should be used. Emergency or ring vaccination programme should use vaccine containing serotypes O, A and Asia-1with ≥ $6PD_{50}$ potency. However, the use of ≥ $6PD_{50}$ potency vaccine largely depend on its availability in the market and its cost. If not available or not affordable the emergency vaccination programme shall use vaccine with ≥ $3PD_{50}$ potency similar to routine vaccination programme. The quality of vaccine should be monitored through periodic vaccine efficacy study and vaccine matching tests.

7.4.3 Cold chain maintenance

The quality of vaccine should be maintained throughout the cycle (storage, transportation and handling of vaccine at all levels). The maintenance of optimal temperature during the supply of vaccine by the supplier to NCAH should be monitored by Biological Production Unit (BPU) and storage at BPU should be monitored by Programme Director, NCAH. The distribution of vaccines from the BPU to the field should be done in a refrigerated van to the RLDCs and the Dzongkhags. During the distribution of vaccine, it should be ensured that the optimal temperature is maintained in the refrigerated van by use of temperature data logger, which should be monitored by BPU. At RLDCs and Dzongkhags, the concerned staff should record the temperature of the refrigerators daily and maintain the data at all levels using standard form (see Form 1) which should be checked and monitored by the RLDC. It is the responsibility of the concerned Gewog in-charges to ensure that vaccines are kept under proper cold storage during the entire phase of the vaccination programme. Vaccine should be carried to field in cool-boxes using ice-packs.

7.4.4 Target species for vaccination

All cloven-hoofed domestic animals: cattle, yak, buffalo, pigs, sheep and goat are to be covered in high risk zone. In the medium risk zone cattle, yak, and buffalo shall be vaccinated whilst in the low risk zone, only cattle and yaks should be vaccinated. The target species shall be reviewed from time to time depending on the disease epidemiology. However, all target species shall be vaccinated in all government farms irrespective of the zone the farm falls under. Target species in the villages located in the vicinity of the government farms should also be vaccinated. Owner and animal details should be recorded during vaccination as per Form 4.

7.4.5 Age for vaccination

All target species of 3 months and above should be vaccinated against FMD (see calf hood vaccination). In the endemic areas, booster vaccination should be done after a month of primary vaccination to all the animals

7.4.6 Time of vaccination

Mass vaccination campaigns should be carried out in the month of September-October followed by second vaccination in March-April in the high-risk zones. However, this practice should be for the animals that received calf-hood and a booster vaccination. In the medium and low risk zones vaccination should be done during September-October.

7.4.7 Frequency of vaccination

In the high-risk zone, vaccination should be carried out every six months (bi-annual) to ensure maximum coverage and protection. In high risk zone, booster vaccine shall be provided one month after primary vaccination. Thereafter, animals that received booster vaccine shall receive vaccine on six monthly bases. Bi-annual vaccination also covers animals along national highways and near towns and migrating animals. All types of vaccination should aim at covering at least 80% coverage in susceptible population (see corridor vaccination). In the low and medium risk zone, vaccination should be done annually.

7.4.8 Vaccination of migratory animals

Migrating cattle and yaks should be vaccinated twice a year and at least three to four weeks before the animals migrate in either direction (down-stream or up-stream). This applies for all zones. All owners are required to obtain vaccination certificate from concerned livestock official and then the migration permit from BAFRA before their animals are moved. Checkpoints should be established in an appropriate location along the migration route and manned by BAFRA officials. Migratory herds shall be allowed to proceed on further journey only 21 days after vaccination except under certain justifiable reasons (sudden unknown disease outbreak). This is to ensure movement of immunized herds only.

7.4.9 Calf-hood vaccination

Calf-hood vaccination shall be carried out along with the bi-annual vaccination. The primary vaccination in the calves should be given at 3 months of age and a booster should be compulsorily given one month after the primary vaccination. Thereafter, vaccination should be repeated every six months.

7.4.10 Corridor vaccination

Due to vaccination practice that will be followed based on the risk zones, corridor vaccination shall not be practiced unless required.

The 'corridor' is an area of approximately 1 km or the selected list of villages on either side of the migratory routes, major motor highways, Dzongkhag roads and periphery of the towns. All FMD susceptible animals that falls in the corridor area should be vaccinated twice in a year to create immune buffer zone.

7.4.11 Risk-based zonation for vaccination campaign

To prevent FMD effectively and efficiently, the areas for routine vaccination shall be selected based on the past outbreaks and the risk of outbreaks. The calf hood vaccination, booster vaccination after one month and thereafter biannual vaccination will be practiced in these areas with a target to achieve at least 80% of the livestock population in these selected areas. The concern Dzongkhag shall take lead in conducting the vaccination campaigns. The DPCU shall take charge in identifying the FMD high risk areas in each Dzongkhag and advise the Dzongkhags accordingly for vaccination campaign. The concerned Dzongkhag may seek support from RLDCs/NCAH during such campaign.

- Target species in all government farms irrespective of the zone shall be vaccinated.
- In the high-risk zone, booster vaccination shall be carried out after a month of primary vaccination to all the animals (see calf-hood vaccination). Thereafter, the animals should be vaccinated every 6 months. Vaccination campaigns should be carried out in the month of September to October followed by second vaccination in March-April (for the high-risk zone only).
- In the medium-risk zone, susceptible animals shall be vaccinated annually while in low-risk zones, animals shall not be vaccinated. However, responsive vaccination will be carried out in the face of new outbreaks in the low-risk zones.

- Migrating animals (migrating from high or medium risk zone to low risk zone and vice-versa) shall be vaccinated at least three to four weeks before migration. This is to ensure movement of immunized herds only.

7.4.12 Barrier/ring vaccination

In the face of an outbreak, ring vaccination around the foci of infection (protection zone) should be carried out to prevent further spread of the disease. All susceptible animals within an imaginary ring measuring about 10 km radius around the foci of outbreak or identified villages based on the geographical settings and epidemiological features should be included for ring vaccination to create an immune belt around the foci of infection. The vaccination team should move from the periphery of the ring inward till they reach animals in close contact with infected animals (see Figure 16 and Annexure 5).

Table 5 FMD Vaccination programme in different risk zones

Risk zone	Target species	Age	Frequency	Time	Remarks
High risk	Cattle, yak, buffalo, pigs, sheep and goat (as applicable based on the area)	>=3 months	Bi-annual	1. September-October 2. March-April	Booster vaccination after one month of primary
Medium risk		>=3 months	Annual	September-October	

Vaccination programme	Target species	Age	Frequency	Time
Calf-hood vaccination	Calves	3 months and above	First vaccination at 3 months and then booster vaccination after 1 month	
Barrier or ring vaccination	All species (cattle, yaks, pigs, sheep, goats)	All ages except animals below 3 months of age	One time at the time of outbreak	At the time of outbreak
Corridor vaccination	All species (cattle, yaks, pigs, sheep, goats)	All ages except animals below 3 months of age	Bi-annual	Sep-Oct March-April

Vaccination of migratory herds	All species (cattle, yaks, sheep, goats)	All ages except animals below 3 months of age	Bi-annual	3-4 weeks before migration

7.5 Traceability

An effective traceability system is imperative for the identification of affected animals, herds or flocks during the event of FMD outbreak. It significantly improves the effectiveness of activities such as the management of disease outbreaks, early warning response and notification system, vaccination programmes, surveillance, animal husbandry, zoning or compartmentalization, animal movement and their products at all levels.

7.5.1 Traceability system

Currently, BAFRA has Bhutan Bio-security System (BBSS) which is a web-based portal system to manage the import of animals and their products movement within the country as a part of the traceability system. The system captures the information on animal population parameters such as species, breeds, numbers, distribution, types of production, animal movement patterns, trade in animals and animal products. The BBSS should generate up-to-date and timely information on the movement of animals and their products with regard to import and movement within the country leading to efficient movement control and collation of data. Such data should be shared among other stakeholders such as National Centre for Animal Health under Department of Livestock.

7.5.2 Animal Identification system

On the animal identification system, the National Dairy Research and Development Centre (NDRDC), Yusipang, Thimphu has the animal identification system but limited to cattle and dairy hubs in the country. The information system is paper and electronic based for the collection, compilation, storage and retrieval of information when required. Similar animal identification system should be extended to the other ruminants and swine animals in the country in future to support in the following areas:

- Animal health (disease surveillance and notification; detection and control of disease; vaccination programmes)
- Public health (surveillance and control of zoonotic diseases and food safety)
- Management of emergencies e.g. natural calamities or man-made events
- Trade support for inspection and certification activities of veterinary services
- Aspects of animal husbandry such as animal performance and genetic data

7.6 Biosecurity measures

Provisions under Section 9 of the Livestock Act of Bhutan 2001 require the implementation of robust biosecurity measures to prevent and control the spread of livestock diseases. The animal biosecurity is a strategic and integrated approach to analysing and managing relevant risks to human health, animal health and associated risks to the environment. Robust biosecurity measure plays an integral part in disease

prevention and control measures both during peace and outbreak time. Robust biosecurity measures encompass a continuum along the disease risk pathway from a disease source outside Bhutan's border, through the border, and to the farm (post-border) where disease outbreaks may occur and have significant impact.

7.6.1 Biosecurity measures at the Pre - border

Since FMD is a transboundary disease, any import of animals and their products including germplasm of cloven-hooved animals shall be accompanied with prior import permits approved by BAFRA. The import permits shall clearly define import conditions as per the Bhutan Health Code for Import of Animal 2018 or after carrying out science-based risk analysis following OIE standards.

7.6.2 Biosecurity measures at the border

As empowered by the Livestock Rules and Regulation 2017, BAFRA has six designated animal quarantine stations at the borders with facility for animal quarantine and inspection of animal products to prevent the entry of diseases and other hazards of animals into the country. All animals imported into the country have to undergo 15 days mandatory quarantine period. During the quarantine period, the samples are collected and tested for screening of exotic, notifiable, and zoonotic disease.

In case of the import of livestock products, the necessary documentation such as health certificates are verified and validated at the border. If required, the samples are collected and send for testing.

7.6.2.1 Import of live animals

As per Bhutan Health Code for Import of Animal, for the importation of domestic ruminants and pigs, an official veterinary certificate must be attested certifying that the animals:

- Showed no clinical sign of FMD on the day of shipment;
- Origin did not have FMD outbreak in past three months (within ten-kilometre radius of establishment of origin);
- Were vaccinated using FMD vaccine (oil-adjuvant trivalent vaccine containing serotypes O, A & Asia1) at least 21 days or not more than 6 months prior to the shipment day;
- Were permanently identified and the identification number stated in the certificate.

The inspector at the border shall verify the necessary documents required by the import condition in the import permit which only on fulfilment shall be allowed inside the country for quarantine.

Procedures to be followed on arrival at the quarantine station:

- The animals shall be mandatorily quarantined for 15 days. During the quarantine period, animals shall be tested for non-structural protein (NSP) antibodies after 2 days upon arrival at the quarantine station. If the herd NSP test result comes out positive, all animals shall be closely examined for any clinical signs and lesions of FMD daily until the end of the quarantine period. The animals can be released if no clinical signs or lesions of FMD are shown irrespective of NSP test result;

- In the event of an outbreak during quarantine, animals shall be subjected to further quarantine for another 21 days from the date of first case on the basis of maximum 14 days of incubation period. However, on the 21st day of quarantine, all the animals need to undergo a thorough physical/clinical examination for any fresh cases/healing status before the animals are released. Final laboratory confirmation with serotyping (sandwich ELISA and/or PCR) needs to be done to support the clinical diagnosis;
- All animals upon completion of quarantine period shall be vaccinated against FMD with trivalent vaccine (serotypes O, A and Asia 1) minimum of 7 days prior to release except in case of confirmed clinical cases during the quarantine;
- After release into the respective destination, animals should be kept under observation for a period of one month. Observation at final destination should be done by concerned Livestock extension staff.

7.6.2.2 Import of livestock products

FMD is a transboundary disease that can be introduced by movements of meat and dairy products and biological products. Regulation of the movement of animal products requires a coordinated approach. Following requirements are must for importation of livestock products originating from ruminants and pigs:

- Should originate from a source that did not report FMD prior to purchase and slaughter
- The importer should produce valid import certificate to regulatory authority on demand
- The importer should produce ante-mortem inspection certificate to regulatory authority on demand to ensure:
    - Animals were free of clinical signs associated with FMD
    - Animals were healthy and fit for slaughter
- The importer should produce a post-mortem inspection certificate to regulatory authority on demand to ensure:
    - Animals were slaughtered in a facility with standard hygiene performance
    - Slaughtered animals did not have any lesions concurrent to FMD

The inspector at the border shall verify the necessary documents required for the import conditions in the import permit which only on fulfilment shall be allowed inside the country for sale or consumption.

7.6.2.3 Inspection and monitoring of illegal movement of animals and their products

Bhutan shares a porous border with India in the south and China in the north. The rampant movement of animals across international borders especially in south presents a serious problem from an animal health perspective as few outbreaks of FMD in the past have been linked to the illegal import of animals from across the border. In such a situation, an external coordination mechanism between the animal health authorities, livestock importers, regulatory authority, and law enforcement agencies (revenue and customs, immigration and police) developed from national to local level to curb such issues. This should include an education campaign on the direct and indirect impact of FMD outbreaks through such practices to the target population. The cooperation leading to simple, practical quarantine and disease surveillance procedures should be encouraged.

On the other hand, BAFRA should strengthen the risk-based border vigilance surveillance to intercept the illegal movement of animals and their products supported by the legislative framework. The quarantine facilities at the border should have the capacity to intercept illegally imported animals and products. The illegal import of live animals anticipated should be quarantined and any confiscated risk materials should be disposed of safely by deep burial or incineration.

7.6.3 Biosecurity measure at post-border

Biosecurity measures at post-border are important during the peace period and outbreak time. During the peace period, the regulatory authority shall implement stringent biosecurity measures in the farms and movement of animals and products within the country. BAFRA has developed an online Processing System of In-Country Movement Permit for Live Animals and biosecurity checklist for commercial dairy farms in the country. The document should continue to reflect a mutual agreement on the best practices for livestock biosecurity so that the 'biosecurity message' is clear and regularly reinforced to all livestock farmers. As mandated by the Livestock Rules and Regulation 2017, the regulatory authority shall carry out inspection and monitoring of on-farm biosecurity in livestock farms on a periodic basis for continuous improvement during the peace period.

In the country, outbreaks of FMD in the past have been linked with the import of animals for Tshethar practices. Accordingly, to mitigate such outbreaks, the guideline on animal Tshethar Practices 2018 was developed by which import of animals for Tshethar practices is prohibited. Furthermore, the biosecurity measures in the animal shelter in Tshethar animals shall be regulated as per the guidelines.

7.6.4 Biosecurity measures during the outbreak

7.6.4.1 Ban on the movement of livestock and livestock products

Ban on the movement of all cloven-footed animals into and out of the affected area and their products (such as milk, meat, butter, cheese, hides, etc.) both into and out of the affected areas should be strictly implemented to prevent spread of the infection to other places. BAFRA should mobilize their staff to attend the check posts and entry points and to strictly control the movement of livestock and livestock products in and out of the outbreak area.

7.6.4.2 Zoo-sanitary measures

The carcass of animal died due to FMD should be properly disposed to avoid spread of virus through contamination (Refer SOP for carcass burial). All the staff and motor vehicles exiting the infected areas should be properly disinfected as it leaves the affected areas following the procedures described in SOP for zoo-sanitary and personal hygiene.

7.7 Role of Research in support of FMD Control Programme

Research will be necessary to provide the information to develop strategies to reach Stage 3 and 4 on the GF-TAD/OIE PCP. Further, research is needed to identify and characterize new strains of virus, test vaccine efficacy, target high-risk areas,

demonstrate free-zones and to continue evaluation and refine vaccination strategies. Economic loss due to disease and its control methods should be assessed. The role of wildlife in the epidemiology of FMD in Bhutan needs to be clarified.

Data from clinical surveillance and farm areas that had not reported FMD for a considerable period of time should be analysed to categorise provisionally free of FMD. This will aid in validating GF-TAD/OIE PCP qualifying to Stage 3. The surveillance programme shall focus more on areas that continue to report FMD. Specifically, the following research activities shall be carried out:

- Conduct sero-surveillance
- Identify the risk hot spot (zones) for FMD
- Determine the serotypes of FMDV in animals
- Conduct post-vaccination evaluation
- Conduct risk analysis along the livestock value chain (introduction, migration, transmission)
- Estimate the benefit-cost of prevention and control programme
- Estimate the socio-economic impact of FMD on different stakeholders

7.8 Training and capacity building

All staff should be thoroughly trained in their roles, duties, and responsibilities to respond to an FMD emergency. More intense training will obviously need to be given to those in key positions. Backup staff should, therefore, be trained for each position.

7.9 Regional and international cooperation

7.9.1 Border harmonization

Coordination meetings with the state veterinary departments of the adjoining Indian states (Assam, West Bengal, and Arunachal Pradesh) are needed to help for common understanding and the development of collaborative efforts for disease control in both countries. The Ministry of Agriculture and Forests should interact with the Department of Animal Husbandry and Dairying, Government of India for bringing about understanding between the two countries and to revitalize the border harmonization meetings (BHM) with the Indian counterparts. The Department of Livestock shall coordinate BHM with support from relevant agencies.

7.9.2 Regional and international effort

FMD is a transboundary animal disease and requires a regional approach in its prevention and control. Since neighbouring countries often have similar socio-economic, epidemiological and livestock production systems, there is similar risks for livestock diseases. Bhutan in this situation shall well consider sharing resources in FMD prevention and control plan to the extent possible. Considerable mutual benefits can be derived from neighbouring countries which can be done through informal networking or more formally, through existing regional organizations: OIE, the Animal Production and Health Commission for Asia and the Pacific (APHCA) and the Association of Southeast Asian Nations (ASEAN) in Asia; and EuFMD in Europe. A regional approach with well-coordinated programme is far more likely to succeed and will reduce the subsequent risk for Bhutan to a greater extent than proceeding alone. The potential areas for collaboration include:

- Joint risk assessments leading to the harmonization of import quarantine policies and other disease prevention strategies in the region in relation to FMD;
- Joint coordination of disease surveillance, quarantine, vaccination and other methods in the region;
- Information exchange on disease occurrences, etc. at national level and local level;
- Making arrangements for the development of laboratory diagnostic capabilities and establishment of international vaccine banks;
- Joint training on field exercises, workshops and other training programmes;
- Where possible, Bhutan should act to harmonize disease control programmes.

7.9.3 Advocacy and awareness/ social participation

Public awareness and education campaigns should be seen as integral and important elements of successful disease prevention and control plan. These campaigns should be mainly targeted at the livestock farmers and animal traders that will be affected by the disease and FMD control actions. The most appropriate means of getting the message across to specific communities should be used, such as radio broadcasts and village meetings. The latter are particularly suitable since they give people the opportunity to ask questions and material (such as pamphlets and posters) can be disseminated that will reinforce the information given. Campaigns should inform people of the nature of the disease and what to do if they see suspected cases; what they can and cannot do during the outbreak and why; and the benefits of keeping away from FMD outbreaks. Public awareness material that is targeted specifically at all stakeholders should be prepared. Additionally, the material should be prepared for politicians, senior bureaucrats and the press. There may also be a need for publicity campaign directed at consumers to reduce unnecessary buyer resistance to animal products, based on perceived public health risks. Following are the awareness programmes to be implemented during the prevention phase:

- Awareness on FMD and its economic impact on affected animals and the farmers
- Awareness on benefit of vaccination and vaccination coverage
- Awareness through trainings of stakeholders (farmers, traders, meat vendors, livestock officials) on disease and control measures

Following are the awareness programmes to be implemented during the outbreak phase

- Awareness on regulation of movement of livestock and livestock products
- Awareness on timely reporting of disease outbreak
- Awareness on ring vaccination
- Awareness on safe disposal of animals that died of FMD

8 PREPAREDNESS AND EARLY RESPONSE

8.1 Conduct simulation exercise on FMD outbreak containment approaches

Simulation exercises are extremely useful for testing and refining Bhutan National FMD Prevention and Control Plan which can be taken up as either field (mock/real) or desktop (paper exercise) or combining both approaches based on the availability of resources. Simulation exercise is done to test the latest version of FMD prevention and control plan in the field by simulating an FMD outbreak with field veterinarians including livestock professionals and technicians. This is also done to test their skills in FMD control. Realistic

disease outbreak scenarios shall be developed for the exercises, using real data where possible (e.g. for livestock locations, populations) preferably in the disease-endemic areas. A simple field-based outbreak scenario may cover one or more-time phases during the outbreak, with a range of possible outcomes. The outcome could be on one component of the document or on the whole document. At the completion of each simulation exercise, a “post-mortem” of the results shall be conducted by the identified observers. Such a review will identify areas where plans have to be modified as well as further training needs. A full-scale disease outbreak simulation exercise shall be conducted after individual components of the disease control response have been tested and proved. In our situation the plan can also be tested during real outbreak situation by involving all the relevant players involved during the outbreak containment.

8.2 Early Warning System

Early warning of the outbreaks and the capacity for prediction of spread to new areas is an essential pre-requisite for the effective containment of animal disease epidemics. As experienced throughout much of the globe, weaknesses of disease surveillance systems and inability to control at their source have contributed to the spread of diseases across the borders. Early Warning and Response is based on the concept that dealing with a disease epidemic in its early stages is easier and more economical than having to deal with it once it is widespread.

National Centre for Animal Health shall relay the FMD outbreaks information to field colleagues and relevant stakeholders, thus, reminding them to prepare for early response. Currently, real-time update of disease outbreaks situation is shared through fortnightly e-bulletin via email and on the NCAH webpage. The information can also be accessed through online TAD*info* database. The NCAH shall explore other methods of rapid information sharing mechanism like development of user-friendly mobile applications to enhance disease outbreak reporting system.

9 CONTROL STRATEGY

9.1 Early detection and confirmation of FMD outbreak

Since FMD is a notifiable disease, the livestock owners/farmers should immediately report even a mere case of suspicion to the Gewog Livestock official(s) or to the Gewog administration. The Gewog Livestock Office should immediately investigate all suspected clinical cases of FMD and should be declared as “suspected FMD outbreak” if the affected animal shows typical signs of FMD (Table 6: case definition for FMD). Following this, the concerned Gewog livestock staff should immediately report to the Dzongkhag Veterinary Hospital, Regional Livestock Development Centre and National Centre for Animal Health using Flash Report Form (Form 3) and/or through phone call – in case of which flash report shall be submitted later towards end of the day. The DVH/RLDC should send Disease Outbreak investigation team to investigate the suspected case immediately (refer SOP for disease outbreak investigation) and inform BAFRA. This team should undertake comprehensive epidemiologic assessment in the field to confirm the case as well as to collect appropriate samples. The clinical diagnosis should be further confirmed with laboratory diagnosis at NCAH including sero-typing of the virus. Samples should be also referred to OIE designated reference laboratories for characterization of the FMD virus.

The disease outbreak investigation team should also update the detail of the outbreak through online TAD*info* database followed by weekly update of the disease outbreak situation.

9.1.1 Declaration of Provisional Infected Zone

When FMD is suspected, Gewog Livestock Staff should immediately quarantine the suspect infected place (farm or a village) and the surrounding area (based on risk assessment) as a Provisional Infected Zone. The geographical limits of the Provisional Infected Zone should be determined after due consideration of the epidemiological risk and natural geographical settings. The Provisional Infected Zone should be declared by the Gewog Livestock Office.

The following control measures should be implemented in the Provisional Infected Zone to prevent spread of the suspected disease.

- Immediate segregation of affected animals including separate management (feeding, watering, milking etc.)
- Symptomatic treatment of the affected animals as per the SOP.
- Disinfection/Decontamination of the contaminated premises as per the SOP.
- Provisional ban on the movement of cloven-footed animals and their products from the infected premises.
- Awareness and education of the livestock owners in the affected village on zoo sanitary measures.

9.1.2 Declaration of the Infected Zone and FMD outbreak

If the case definition of FMD is met, the area where the disease has occurred within a radius as decided by disease outbreak investigation team should be immediately declared as Infected Zone. The geographical limits of the infected zone should be determined after due consideration of the epidemiological risk and natural geographical settings. The disease outbreak investigation team should also declare vaccination zone within certain radius of infected zone where immediate ring vaccination in the surrounding villages should be carried out to prevent further spread of the disease. Based on the recommendation of the disease outbreak investigation team, the Dzongkhag Administration should issue the disease outbreak declaration order with information to the Gewog Administration, DoL, BAFRA, NCAH, RLDC and DVH.

All the provisional control measures should be continued with reinforcement of the efforts in the required areas once the disease outbreak is officially declared. If the disease suspected is not FMD, all the provisional control measures that are being implemented should be immediately discontinued and the alternate measures specific to that disease should be undertaken with guidance in the available disease specific plan.

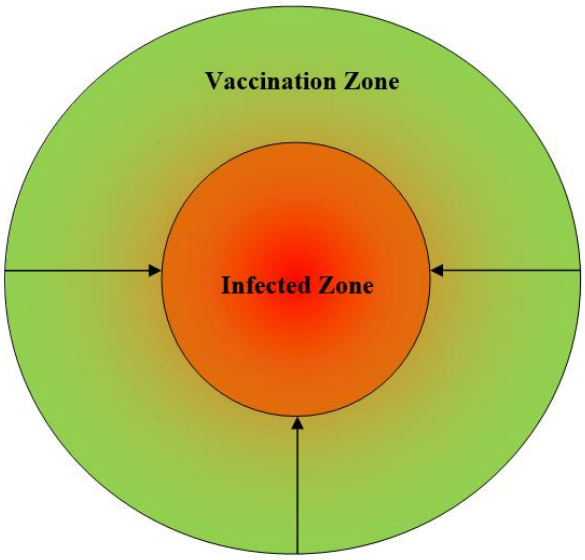


Figure 16 Declaration of infected and vaccination zone; arrows indicate the direction in which the vaccination team should move

9.2 Outbreak Investigation

An outbreak investigation is a systematic procedure to identify the source of infection with a view to control and prevent possible future occurrence. Outbreak investigation is an important responsibility to ensure that preventive and control measures are applied. Investigations help to identify changes in the agent, environment or events that may be beyond the scope of a disease control programme. It is important to maintain records of outbreak investigations including those in which the disease was not confirmed as this demonstrates the effectiveness of the surveillance system. The outbreak investigation will be done as per the flowchart process shown in Figure 17.

The main steps of outbreak investigation include:

- Preparation for field work
- Confirmation of the report triggering the investigation
- Confirmation of diagnosis
- Epidemiological follow-up and tracing
- Collection and analysis of data including the animals involved and the spatial and temporal distribution
- Implementation of control and preventive measures
- Documentation and reporting

Detail outbreak investigation process shall follow the steps as mentioned in the previous section: Early detection and confirmation of FMD .

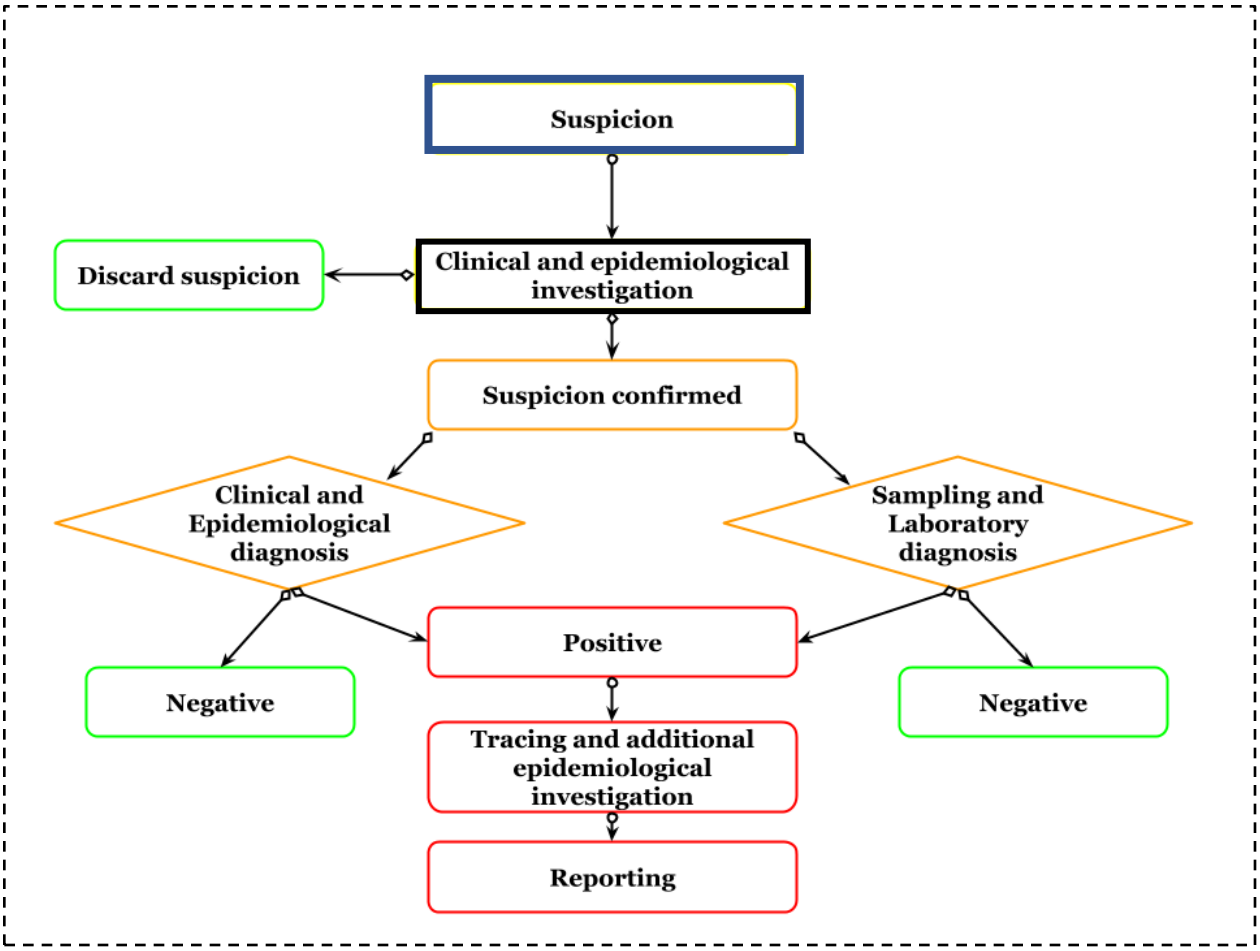


Figure 17: Flowchart of the outbreak investigation process

9.3 Activation of the Rapid Response Team

Once the FMD outbreak is confirmed by the disease outbreak investigation team and substantiated by laboratory confirmation, Rapid Response Team (RRT) should be activated immediately to contain the disease without allowing it to spread to other places. The RRT should mainly constitute of four main groups to effectively implement disease control measures:

i. Vaccination team
ii. Treatment team
iii. Outbreak investigation team
iv. Quarantine and movement control team

The Department of Livestock should be responsible for disease outbreak investigation, treatment of sick animals, ring vaccination, surveillance and logistic supply. BAFRA should be responsible for quarantine and movement control of susceptible livestock and livestock products from the infected zone. The roles of various teams under the RRT are described in Annexure 4.

Following activities should be implemented by the RRT to effectively control the FMD outbreak.

i. Isolation and treatment of affected animals

All the affected animals should be isolated and provided symptomatic treatment to prevent mortality and to enable faster recovery (refer SOP). The separate team (preferably the livestock staffs who already had contact with the sick animals) should be fully involved in treatment of the sick animals as well as for implementing the zoo sanitary measures in the affected areas.

ii. Zoo-sanitary measures

The carcass of animal died due to FMD should be properly disposed to avoid spread of virus through contamination (refer SOP for carcass burial). All the staff exiting the infected areas should strictly disinfect themselves while leaving the affected areas following the procedures described in SOP for zoo-sanitary and personal hygiene.

iii. Ring vaccination

The main objective behind ring vaccination is to prevent the spread of the disease to non-affected areas. By doing so, the risk of disease spread is minimized and thereby infection is extinguished within the outbreak area. Ring vaccination should be done by separate team (Vaccination Team) who has not been in contact with the infected animals. Ring vaccination in the nearby villages should be carried out considering the geographical barriers, common grazing areas, water source and proximity to the affected area. The vaccination should start from the periphery to the inside (focus of infection) until the infected area is reached and should be completed as soon as possible (within one week (refer SOP for ring vaccination).

iv. Ban on the movement of livestock and livestock products

Ban on the movement of all cloven-footed animals including their products (such as milk, meat, butter, cheese, hides, etc.) both into and out of the affected areas should be strictly implemented to prevent spread of the infection to other places. BAFRA should mobilize their staff to attend the check posts and entry points and to strictly control the movement of livestock and livestock products in and out of the outbreak area.

v. Surveillance and weekly follow-up

The RRT should also carry out the clinical surveillance in the infected zone and vaccination zone on the occurrence of any new cases as well as to monitor any mortality of the FMD infected animals. An update on the disease outbreak situation should be done as follow-up report on weekly basis through TAD*info* online system.

vi. Logistic support

In order to implement the successful containment of FMD outbreak by RRT adequate logistic support should be mobilized. There is need to mobilize additional manpower, vaccines, mobility and fund to carry out the activities by RRT.

9.4 Lifting of disease control zones and movement control bans

Lifting of disease control zones (Infected Place, Protection zone and Surveillance Zone) and the movement control bans should be done three weeks after the last detected case and satisfactory completion of zoo-sanitary and biosecurity measures. Once the disease control zones are lifted, movement of livestock and sale of livestock products can resume. Routine surveillance and prevention activities will be implemented once the disease control zones and ban on movement control zones are lifted.

10 PROGRAMME FINANCING/FUND MOBILIZATION

The NFMDPCP will need to develop annual operational plan which includes clear specification of the physical requirements and the estimated costs of the work for every subsequent year. The required budget should be proposed to Ministry of Finance each year by AHD, DoL based on the roles and activities required to be executed by respective agencies. It will also need clear specification of the output, key performance indicator, responsibility and timeline.

11 MONITORING AND EVALUATION

At the national level, NCAH should monitor and evaluate the progress of the FMD prevention and control programme using the data submitted by Dzongkhags. Regional centres should monitor and evaluate the progress in their respective regions. Field visits by authorities from the NCAH and AHD should be made to physically validate the progress. The plan may be amended periodically based on the monitoring and evaluation findings.

12 ANNEXURE

Annexure 1: Risk-based action plan: Logical framework

Goal and Purpose	Description	Performance Indicator	Means of verification	Assumption	Time frame
Goal	1. To progressively increase the level of control through 6 stages of PCP in achieving FMD free country status with vaccination.	Reduction in number of outbreaks of FMD with vaccination.	Report to OIE the number of outbreaks and the trend annually	Policy support for vaccination.	
Purpose	1. To provide field professionals and relevant stakeholders with strategic directions to progressively decrease the outbreak incidences. 2. To determine the national FMD PCP stage and provide direction to progress to next stage.	Incidence of FMD reduced annually	Assessment report through rapid detection, monitoring the control measures and response to all the outbreaks.	National and international partnership in place	

Diagnostic System

	Description		1. **Performance indicator**	1. **Means of verification**	**Assumption**	**Time frame**
Diagnostic system	**Outcome**	1. Laboratory system works with a higher level of efficiency than in Stage 2. The laboratory system is further improved by introduction of bio-molecular techniques. 3. The laboratory starts to develop a quality assurance system (stage 4)	2. Molecular analysis of FMD samples are handled at the National Laboratory for advanced level of diagnosis. 3. Test performed at National laboratory is in compliance with OIE diagnostic standards	2. Laboratory progress report 3. Laboratory quality assurance assessment report	Continuous support from policy directives, FAO and OIE	
	Activities	Introduce molecular test technique at national laboratory	No. of samples processed and tested for FMD	Laboratory results and report	Resource support in place	
		Training of laboratory staffs on molecular techniques	No. of staff trained and competent to conduct the test	Training report; Laboratory results		
		Participate in proficiency testing scheme with reference laboratories in the region	Number of proficiency test	Proficiency test certificate; Production of concurrent results between the laboratories in the region	Availability of participating laboratories in the region	
		Strengthen/establish linkages with regional and world reference laboratories	Number of institutional linkages established; Number of samples referred and tested	MoU, correspondence, Laboratory result/report		

		Continue implementing a laboratory quality control and assurance system in the central laboratory and its laboratory network	Good Laboratory Practices (GLP) manual/SOP developed and implemented	Valid test results		
		Strengthening of regional and district laboratories	Number. of pen side test kits distributed; Number of staff trained	Invoice; Training report		

Surveillance System

		Description	**Performance Indicator**	**Means of verification**	**Assumption**	**Time frame**
Surveillance system	**Outcome**	1. The surveillance system is further strengthened, mainly in its passive component 2. The surveillance system is further enhanced by conducting active surveillance with focus on population at higher risk to improve early warning-early detection-early response; 3. Enhance surveillance to prove the reduction of FMD outbreak incidences	Number of samples submitted; Number of cases reported; Number of surveillance sites covered; Number of active surveillance/disease search conducted	Surveillance results/ report; maps of risk zone		Continuous support from policy directives, FAO and OIE
	Activities	1. Develop FMD focused epi-networks	Number of agency/individuals in the epi-network	Database/records and reports of the network		
		2. Conduct training of regulatory and field livestock officials on detection of FMD	Number of staffs trained	Training report		

		3. Conduct passive and active surveillance to monitor the prevalence, distribution and detection of new outbreaks	Number of surveillances conducted	Surveillance report		
		4. Conduct FMD surveillance in wildlife in collaboration with Department of Forests and Park Services	Number of surveillances conducted	Surveillance report		
		5. Conduct import risk analysis on FMD in collaboration with BAFRA	Number of import risk analysis conducted	Risk analysis Reports		
		6. Establish regional and international epidemiological network	Number of networks established	Report		
		7. Develop mobile application system for reporting and strengthen disease information system	Mobile apps developed and operationalized	Mobile apps in use for reporting disease outbreaks		
		8. Data analysis and publication of report	Number of reports	Publication report		

Prevention and Control System

		Description	**Performance Indicator**	**Means of verification**	**Assumption**	**Time frame**
Prevention and control system	**Outcome**	1. Risk based vaccination campaign is implemented and additional measures in place to ensure success of the vaccination campaign. 2. Stringent preventive measures are put in place to reduce FMD outbreaks.	1. Vaccination protocol (risk zonation) developed and implemented. 2. Number of vaccination campaigns 3. Number of high-risk districts/areas covered	Vaccination reports or report from VIS.		

	Activities	Formulate and design risk-based vaccination programme	Document developed	Document		
		Procure and distribute FMD vaccines	Number of doses of vaccine procured and distributed	Invoice; Distribution orders		
		Procure and distribute equipment for cold chain maintenance of FMD vaccine	Number of equipment (refrigerators, cool boxes) procured and distributed	Invoice; Distribution orders		
		Vaccinate susceptible species in the high-risk areas	Number of animals vaccinated	Vaccination records		
		Conduct post-vaccination evaluation	Number and quality of evaluation study conducted	Report		
		Implement contingency plan in the event of outbreak	Number of FMD outbreak(s) contained successfully	RRT reports		
		Conduct farmers awareness programme on FMD	Number of farmers made aware	Reports		
		Conduct cross-border harmonization meetings	Number of cross-border meeting conducted	Minutes of the meeting	Policy approval	

Legal Framework

		Description	**Performance Indicator**	**Means of verification**	**Assumption**	**Time frame**
Legal framework	**Outcome**	Legal framework is supportive of the prevention and control activities	Livestock legislation revised and amended	Revised Livestock Act and Livestock Rules and Regulation		
	Activities	Revise and amend Livestock Act and Livestock Rules and Regulation to incorporate	Livestock legislation revised and amended	Revised Livestock Act and Livestock Rules and Regulation		

		section(s) on prevention and control of TADs				
		Prepare FMD control plan	Plan developed	Print copies of National FMD Control Plan	Plan endorsed	

Stakeholders Involved

		Description	**Performance Indicator**	**Means of verification**	**Assumption**	**Time frame**
Stakeholder involved	**Outcome**	Stakeholders contribute to the control programmes in Stage 3 through formal mechanisms of consultations	National FMD Control Committee is established and functional	Minutes / resolutions of the meeting(s)		
	Activities	Establish National FMD Control Committee	National FMD Control Committee is established and functional	Minutes / resolutions of the meeting(s)		
		Establish Technical working group on FMD Prevention and Control.	Technical working group on FMD Prevention and Control	Minutes / resolutions of the meeting(s)		
		Establish organization set up of FMD prevention and control with appropriate TOR for various stakeholders	Number of stakeholders identified and involved in FMD prevention and control Programme	Stakeholders identified in National FMD Prevention and Control Plan.		

Annexure 2: FMD risk zones, gewog specific: High - H, Medium - M, Low - L

Dzongkhag	Gewog	Risk	Dzongkhag	Gewog	Risk
Bumthang	Chhoekhor	M	S/Jongkhar	Gomdar	M
Bumthang	Ura	M	S/Jongkhar	Wangphu	M
Bumthang	Chhumig	M	S/Jongkhar	Martshala	M
Bumthang	Tang	M	S/Jongkhar	Lauri	M
Chhukha	Doongna	M	Samtse	Norgaygang	H
Chhukha	Maedtabkha	M	Samtse	Tendruk	H
Chhukha	Loggchina	H	Samtse	Pemaling	H
Chhukha	Phuentshogling	H	Samtse	Tashichhoeling	H
Chhukha	Geling	M	Samtse	Namgyalchhoeling	H
Chhukha	Sampheling	H	Samtse	Sang-Ngag-Chhoeling	H
Chhukha	Darla	H	Samtse	Yoseltse	H
Chhukha	Bongo	H	Samtse	Ugyentse	H
Chhukha	Getana	M	Samtse	Norboogang	H
Chhukha	Bjagchho	M	Samtse	Samtse	H
Chhukha	Chapchha	M	Samtse	Phuentshogpelri	H
Dagana	Tseza	M	Samtse	Tading	H
Dagana	Largyab	L	Samtse	Dophuchen	M
Dagana	Khebisa	L	Samtse	Doomtoed	L
Dagana	Tshangkha	M	Samtse	Duenchhukha	L
Dagana	Drukjeygang	M	Sarpang	Senggey	H
Dagana	Tashiding	M	Sarpang	Shompangkha	H
Dagana	Tsenda-Gang	M	Sarpang	Dekiling	H
Dagana	Nichula	H	Sarpang	Samtenling	H
Dagana	Karmaling	H	Sarpang	Gelegphu	H
Dagana	Lhamoi Dzingkha	H	Sarpang	Chhuzanggang	H
Dagana	Kama	M	Sarpang	Serzhong	H
Dagana	Gesarling	L	Sarpang	Umling	H
Dagana	Dorona	L	Sarpang	Tareythang	H
Dagana	Gozhi	M	Sarpang	Jigme Chhoeling	H
Gasa	Laya	L	Sarpang	Chhudzom	M
Gasa	Lunana	L	Sarpang	Gakiling	H
Gasa	Khamaed	L	Thimphu	Soe	L

Gasa	Khatoed	L	Thimphu	Lingzhi	L
Haa	Gakiling	L	Thimphu	Darkarla	L
Haa	Sangbay	L	Thimphu	Ge-nyen	M
Haa	Bji	M	Thimphu	Maedwang	M
Haa	Samar	L	Thimphu	Chang	M
Haa	Uesu	M	Thimphu	Kawang	M
Haa	Kar-tshog	M	Thimphu	Naro	L
Lhuentse	Kurtoed	L	Trashiyangtse	Khamdang	H
Lhuentse	Gangzur	M	Trashiyangtse	Boomdeling	M
Lhuentse	Khoma	M	Trashiyangtse	Yangtse	M
Lhuentse	Minjey	M	Trashiyangtse	Tongmajangsa	M
Lhuentse	Maenbi	M	Trashiyangtse	Jamkhar	M
Lhuentse	Maedtsho	L	Trashiyangtse	Ramjar	M
Lhuentse	Jarey	M	Trashiyangtse	Toetsho	H
Lhuentse	Tsaenkhar	M	Trashiyangtse	Yallang	H
Monggar	Gongdue	L	Trashigang	Yangnyer	M
Monggar	Jurmed	L	Trashigang	Sagteng	H
Monggar	Silambi	L	Trashigang	Phongmed	M
Monggar	Saling	M	Trashigang	Radi	M
Monggar	Tsamang	M	Trashigang	Bidoong	M
Monggar	Tsakaling	M	Trashigang	Bartsham	M
Monggar	Shermuhoong	M	Trashigang	Samkhar	M
Monggar	Chhaling	M	Trashigang	Shongphu	M
Monggar	Monggar	M	Trashigang	Kanglung	M
Monggar	Drepoong	M	Trashigang	Udzorong	M
Monggar	Ngatshang	M	Trashigang	Khaling	M
Monggar	Balam	L	Trashigang	Lumang	M
Monggar	Na-Rang	M	Trashigang	Thrimshing	M
Monggar	Dramedtse	M	Trashigang	Kangpar	M
Monggar	Chagsakhar	M	Trashigang	Merag	H
Monggar	Khengkhar	L	Trongsa	Nubi	M
Monggar	Thang-Rong	L	Trongsa	Draagteng	M
Paro	Tsento	M	Trongsa	Tangsibji	M
Paro	Doteng	M	Trongsa	Langthil	M
Paro	Dopshar-ri	M	Trongsa	Korphu	L
Paro	Hoongrel	M	Tsirang	Patshaling	M
Paro	Wangchang	M	Tsirang	Barshong	L
Paro	Lamgong	M	Tsirang	Mendrelgang	M
Paro	Loong-nyi	M	Tsirang	Rangthangling	M

Paro	Sharpa	M	Tsirang	Tsholingkhar	M
Paro	Dokar	M	Tsirang	Gosarling	M
Paro	Nagya	M	Tsirang	Semjong	L
P/Gatshel	Norboogang	H	Tsirang	Tsirangtoed	L
P/Gatshel	Chhoekhorling	H	Tsirang	Sergithang	M
P/Gatshel	Dechhenling	M	Tsirang	Phungtenchhu	L
P/Gatshel	Dungmaed	L	Tsirang	Doonglagang	L
P/Gatshel	Chhimoong	L	Tsirang	Kilkhorthang	M
P/Gatshel	Yurung	L	Wangdue Phodrang	Kazhi	M
P/Gatshel	Chongshing	L	Wangdue Phodrang	Saephu	M
P/Gatshel	Khar	M	Wangdue Phodrang	Dangchhu	M
P/Gatshel	Shumar	M	Wangdue Phodrang	Nyishog	M
P/Gatshel	Zobel	M	Wangdue Phodrang	Bjenag	M
P/Gatshel	Nanong	M	Wangdue Phodrang	Gangteng	M
Punakha	Goenshari	M	Wangdue Phodrang	Phobji	M
Punakha	Kabisa	M	Wangdue Phodrang	Athang	L
Punakha	Chhubu	M	Wangdue Phodrang	Darkar	L
Punakha	Toedwang	M	Wangdue Phodrang	Gase Tshowongm	M
Punakha	Shelnga-Bjemi	M	Wangdue Phodrang	Gase Tshogongm	M
Punakha	Dzomi	M	Wangdue Phodrang	Nahi	M
Punakha	Lingmukha	M	Wangdue Phodrang	Rubesa	M
Punakha	Barp	M	Wangdue Phodrang	Thedtsho	M
Punakha	Guma	M	Wangdue Phodrang	Phangyuel	M
Punakha	Talog	M	Zhemgang	Pangkhar	M
Punakha	Toedpaisa	M	Zhemgang	Trong	M
S/Jongkhar	Langchenphu	H	Zhemgang	Nangkor	M
S/Jongkhar	Serthig	M	Zhemgang	Shingkhar	M
S/Jongkhar	Samrang	H	Zhemgang	Bardo	M
S/Jongkhar	Pemathang	H	Zhemgang	Goshing	M
S/Jongkhar	Phuentshogthang	H	Zhemgang	Ngangla	H
S/Jongkhar	Dewathang	H	Zhemgang	Bjoka	M
S/Jongkhar	Orong	H			

Note: Some of the villages under medium and low risk zones (e.g. near towns, along the highways, Dzongkhag roads, villages practicing migration), villages near government farm, and all government farms should be considered as high risk zone and animals be vaccinated bi-annually covering minimum of 80% during each schedule/campaign irrespective of whether in high, medium and low risk zone.

Annexure 3: Summary of OIE PVS evaluation, 2015

PVS summary results of VS of Bhutan	Previous 2008	Gap target 2009	PVS 2015
I. Human, physical and financial resources			
I.1.A. Staffing: Veterinarians and other professionals	2	4	4
I.1.B. Staffing: Veterinary paraprofessionals and other	4	4	3
I.2.A. Professional competencies of veterinarians	3	4	3
I.2.B. Competencies of veterinary paraprofessionals	4	4	3
I-3. Continuing education	3	4	2
I-4. Technical independence	3	3	3
I-5. Stability of structures and sustainability of policies	4	4	3
I-6. A. Internal coordination (chain of command)	3	4	3
I-6. B. External coordination	n/d	n/d	3
I-7. Physical resources	2	4	3
I-8. Operational funding	3	3	2
I-9. Emergency funding	3	3	3
I-10. Capital investment	2	3	2
I-11. Management of resources and operations	n/d	n/d	2
II. Technical authority and capability			
II-1. A. Access to veterinary laboratory diagnosis	3	4	5
II-1. B. Suitability of national laboratory infrastructures	n/d	n/d	2
II-2. Laboratory quality assurance	1	2	2
II-3. Risk analysis	3	4	2
II-4. Quarantine and border security	2	2	2
II-5.A. Passive epidemiological surveillance	5	5	3
II-5.B. Active epidemiological surveillance	3	4	2
II-6. Emergency response	3	4	4
II-7. Disease prevention, control and eradication	2	3	2
II-8.A. Regulation, authorisation and inspection of establishments	n/d	n/d	1
II-8.B. Ante and post mortem inspection	n/d	n/d	1
II-8.C. Inspection of collection, processing and distribution	n/d	n/d	1
II-9. Veterinary medicines and biologicals	2	4	4
II-10. Residue testing	1	3	1
II-11. Animal feed safety	n/d	n/d	2
II-12.A. Animal identification and movement control	n/d	2	2
II-12.B. Identification and traceability of animal products	n/d	n/d	1
II-13. Animal welfare	n/d	n/d	2
III. Interaction with interested parties			
III-1. Communication	3	4	3
III-2. Consultation with interested parties	4	4	2

III-3. Official representation	3	3	3
III-4. Accreditation/authorisation/delegation	1	1	1
III-5.A. Veterinary Statutory Body Authority	1	4	1
III-5.B. Veterinary Statutory Body Capacity	n/d	n/d	1
III-6. Participation of producers and other interested parties in joint programmes	3	4	2
IV. Access to markets			
IV-1. Preparation of legislation and regulations	3	4	3
IV-2. Implementation of legislation and regulations and compliance thereof	3	4	3
IV-3. International harmonisation	3	3	2
IV-4. International certification	2	2	2
IV-5. Equivalence and other types of sanitary agreements	2	2	3
IV-6. Transparency	4	4	3
IV-7. Zoning	2	n/a	n/a
IV-8. Compartmentalisation	n/a	n/a	n/a

Note:

1. n/d: not done
2. n/a: not applicable

Annexure 4: Rapid Response Team (RRT)

Background and Rationale

Foot and Mouth disease is highly contagious viral disease which spreads rapidly if not controlled promptly. Such infectious disease needs to be controlled immediately at source without allowing for further spread. Therefore, the Rapid Response Team (RRT) should be formed to respond against the outbreak of FMD with the following objectives: The RRT should be formed within 24 hours of the suspected FMD outbreak.

- To conduct thorough investigation of disease outbreaks and to identify the source(s) of infection.
- To contain and prevent the disease spread
- To create awareness to the public on risk of the disease and its immediate control measures.
- To coordinate with different stakeholders in responding to the disease outbreak.

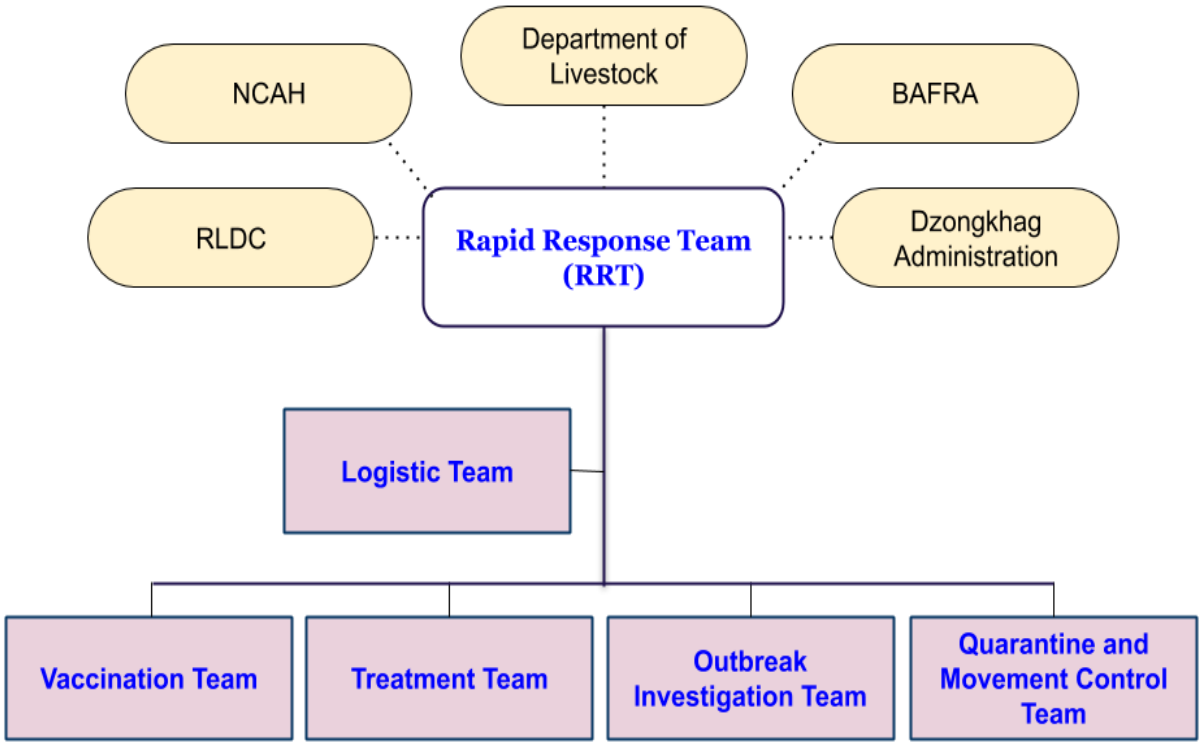


Figure 18: Rapid response team during FMD outbreak

Team Members for RRT comprises of following officials:

1. Head of Animal health section, RLDC-Team Leader
2. Laboratory Technician of RLDC
3. Livestock Health Supervisor, RLDC
4. Dzongkhag Livestock Officer, DLS
5. Veterinary Officer, DVH
6. Concerned Regulatory Official from BAFRA

7. Concerned In-charge of LEC/RNR-EC of the affected Gewog
8. Mangmi/Tshogpa of the affected Gewog/ Chiwog
9. Epidemiologist/Expert from NCAH, Serbithang.
10. Laboratory Officer/Sr. Lab. Technician, NCAH, Serbithang
11. Livestock staff from nearby Gewogs or DVH if required

Note: the team composition shall vary depending on the magnitude of the outbreak which will be decided by RLDC.

Roles of RRT are as follows:

- Conduct a thorough investigation of the suspected outbreak.
- Recommend Dzongkhag Administration to issue outbreak notification.
- Declare infected and vaccination zones.
- Implement ban on the movement of livestock and livestock products.
- Isolation and treatment of affected animals.
- Disinfection of infected premises using appropriate disinfectants.
- Collect samples from sick animals and refer samples to NCAH.
- Carry out ring vaccination in the designated areas (vaccination zone).
- Conduct surveillance and awareness in high risk areas
- Daily recording of the disease outbreak status and vaccination coverage
- Mobilize different teams for actions as per their roles.
- Submit the weekly follow up report on the disease status to Dzongkhag/ RLDC/NCAH/DOL/ BAFRA.

Roles of different teams under RRT

The RRTs should be divided into different groups as per the mandate of the respective technical sectors involved for the disease control measures The livestock sector will be mainly responsible for surveillance, vaccination, treatment, outbreak investigation and logistic support, while BAFRA will be responsible for the quarantine and movement control of susceptible livestock and products. In case there is the requirement of RBP to maintain law and order, their support will be sought by the team leader of RRT as and when required.

i. Disease Outbreak Investigation Team (DOIT)

The DOIT shall be responsible for conducting disease outbreak investigation which includes identifying the source of infection, risk assessment and confirming the outbreak. They should be responsible for the identification and establishment of infected premises and declaration of infected and vaccination zones and make key recommendations to improve the control activities based on the disease situation in the area (Refer SOP for DOIT). The team is also responsible for the weekly reporting of the disease status to RLDC NCAH/DoL.

The DOIT shall be constituted of following members:

1. Epidemiologist/Veterinary Officer
2. Laboratory Technician
3. BAFRA official

ii. Vaccination Team

The vaccination team (clean team) is responsible for conducting ring vaccination of the susceptible livestock population against FMD in the vaccination zone as per the directives from the team leader of RRT and as per the details mentioned in SOP (refer ring vaccination SOP). Simultaneously, this team will also carry out the surveillance activities.

The vaccination team shall be composed of following members:

1. Veterinary Officer (Team Leader)
2. Para veterinarians (number will be decided by RRT Team leader)
3. Laboratory Technician
4. Mangmi/Tshogpa

iii. Treatment Team

The members of the treatment team are the “dirty team” who are responsible for the treatment of FMD affected animals in the infected zone. They will undertake the task as per the SOP (refer Treatment SOP). Their movement should be restricted within the infected zone and should not mix with other teams. Any member or vehicle leaving the infected zone should be strictly disinfected following the procedures described in the SOP.

The treatment team shall consist of following members:

1. Para veterinarian
2. Laboratory Technician (for sample collection)

iv. Quarantine and Movement Control Team

The Quarantine and Movement Control Team shall be responsible for enforcement of quarantine and movement control in and out of the infected zone to control and prevent the spread of disease. Detailed procedure on enforcement of quarantine and movement control measures shall be done as per the Livestock Rules and Regulations of Bhutan 2017 by BAFRA.

The Quarantine and movement control team will be composed of following members:

1. Livestock Regulatory and Quarantine Officer, BAFRA
2. Police personals (optional)

v. Logistic Team

The main roles and responsibility of the Logistic team is to ensure that all necessary logistic facilities like PPE, materials and equipment, food/refreshment and transportation are made available to RRT and to ensure availability of all essential supplies.

The logistic team shall be composed of following members:

1. Dzongkhag Livestock Officer
2. Livestock Supervisor
3. Mangmi/Tshogpa

Logistic facilities required are as follows:

- *Manpower:* Mobilize additional staffs from nearby centres, RLDCs, NCAH, Department and other Dzongkhags.
- *Vehicle:* Mobilize from Dzongkhags, RLDCs, NCAH, projects and other central programmes (not ruminant and pig farms) if required.
- *Diagnostics:* RLDC/NCAH should facilitate rapid diagnostic kits and other sampling equipment.
- *Communication equipment*: Recharge vouchers should be provided to the members
- *Vaccines:* NCAH shall arrange the required quantity of vaccines during the emergency in consultation with RRTs.
- *Fund:* The fund required for the purchase of vaccines and consumables should be made available by NCAH. The fund for payment of DSA to team members should be met from the respective Dzongkhags/RLDCs/Centres. Expenses for the working lunch/refreshment during the disease containment programme should be arranged by RLDC and Dzongkhag. If there are no fund provision or insufficient fund, NCAH and Department should provide required fund support to RRT.

Working Modalities

Following the report of disease outbreak, RLDC will advise on the activation of RRT at the dzongkhag level. RLDC and NCAH will provide technical and logistic support if it is not in the capacity of the dzongkhag.

RLDC should decide on the activation of the RRT based on the disease situation, and if required, RRT should be activated in the field within 24 hours. RLDC should seek the support of NCAH and Department of Livestock as and when required.

Once the ring vaccination is completed, the RRT Team Leader should decrease the number of members involved in FMD control activities as the main activities of the remaining team will be on the surveillance in the vaccination zone and other nearby areas. The final deactivation of RRT will be after two weeks of the last case of FMD. The response activities in the event of an outbreak of FMD will need to be undertaken as per the timeline given in Figure 19.

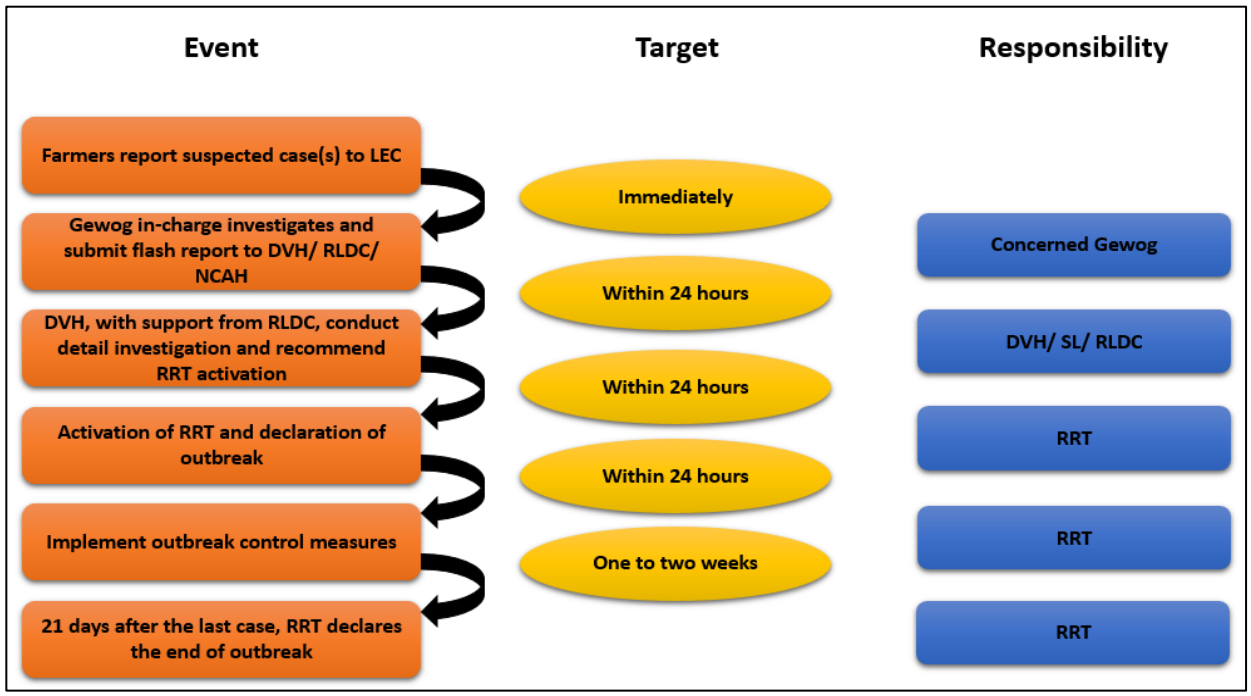


Figure 19: Timeline for major activities following an outbreak of FMD

Annexure 5: Standard Operating Procedures (SOP)

1. SOP for Disease outbreak investigation

As per terrestrial animal health code 2019, an outbreak is defined as the occurrence of one or more cases in an epidemiological unit. An epidemiological unit is defined as a group of animals with a defined epidemiological relationship that share approximately the same likelihood of exposure to a pathogenic agent. This may be because they share a common environment or because of common management practices. Usually, this is a herd or a flock. However, an epidemiological unit may also refer to groups such as animals belonging to residents of a village, or animals sharing a communal animal handling facility. The epidemiological relationship may differ from disease to disease, or even strain to strain of the pathogenic agent.
In our context, an outbreak can be considered as separate outbreak if the case(s) occur in a herd or a village separated from other herds or villages by geographical barriers and/or occurs after one month apart in the same village.

An outbreak investigation is a systematic procedure to identify causes and sources of a suspected disease outbreak

Purposes
- To identify the cause and source of disease outbreak
- To control and contain the existing disease outbreak
- To identify measures to prevent further spread of disease

Scope
- This SOP outlines the general principles and steps for investigation of Foot and mouth disease (FMD) in the field.

Users or targets
- Veterinary Officers and Veterinary paraprofessionals of DOIT

Team composition
1. Veterinary Epidemiologist or Veterinary Officer (Team Leader)
2. Laboratory technician
3. Field Veterinary paraprofessionals
4. BAFRA officials

Materials and equipment
- Disposable gloves
- Gumboot
- Apron
- Shoe covers
- Scissors
- Forceps
- 50% PBS glycerine saline

- Cotton
- Vacutainer with anticoagulant
- Vacutainer without anticoagulant
- Adapter for blood collection
- 16G needles
- Marker pen
- Cool box
- Bio-hazard bags
- Disinfectant (e.g. Virkon-S or bleaching powder)
- Antiseptic hand wash
- Ice pack
- GPS device
- Disease outbreak investigation form
- Laboratory sample submission form
- Written Instructions/SOP Printouts
- Notebook and pens
- Ziplock bag

Steps for Investigation

i. Preparation
    - Formation of investigation team and planning the response
    - Assign each person in the team with a responsibility.
    - Arrangement of materials and logistics (refer materials and equipment requirement)
    - Epidemiological materials: Investigation form, notebook, GPS device
    - Laboratory: swabs, needles, cool box, viral transport medium
    - Decontamination materials: disinfectant and power spray
    - Mobility - vehicle
    - Protective gears

ii. Gather preliminary information

Following information needs to be collected by the team prior to their departure

- Farmers name and phone number
- Name of village, Gewog, Dzongkhag
- Type of farm (commercial, semi commercial, backyard) and number of animals (cattle, yak, sheep, goat, pig, others)
- Date and time of report of outbreak from farmer to LEC/ DVH
- Date and time of report from LEC/ DVH to RLDC/NCAH
- Date and time of visit by veterinarian or field staff
- Name of contact field staff, address and phone number
- Provide information about the team’s visit to outbreak area
- Date and time of visit

iii. Field investigation

Background information to collect:

- Farm and village background information

- Different animal categories and numbers
- Farm type and husbandry practices
- Collect XY coordinates (using GPS device/ mobile phone), altitude, road network
- Number of herds and households affected, population at risk, livestock population in the surrounding areas
- Clinical signs of the affected animals, morbidity and mortality in the affected herds.

Information on:

- Introduction of any new animals
- Migration route and time
- Buying and selling of any livestock and livestock product
- Any recent local festival or gathering in the village/locality
- frequency of movement of people in an out of the outbreak area

Bio-security arrangements

- Describe bio-security measures practiced in the farm, e.g. disinfectant foot wash, perimeter wall/fence (applicable to only Government and commercial farms);
- Mixing of different groups or species of animals, e.g. Contact between cattle, sheep, goat and pigs.

Feeding and management

- Describe the grazing system (cattle, sheep, goat) followed including whether the animals are grazed in their own private pasture or in shared community pastures and tsamdros.
- Describe feed sources/s including whether the animals are fed with swills.
- Describe the housing type and the bedding materials used in the shed.
- Describe water source/s and including whether the affected animals are deliberately made to dip their footing the river or stream.

Wild animals

- Information on the presence of any cloven-footed wild animals in the area
- Information on any suspected FMD cases in the cloven-footed wild animals in the vicinity.

Vaccination history

- Analysis of the vaccination history of the animals in the affected village.

Laboratory investigation

Laboratory investigation in the field (refer specific SOP for sampling, packaging and transportation to the laboratory and rapid field test)

- Put on proper PPE (apron, gloves, gumboots and shoe cover)
- Carry out physical examination of the sick animals and check whether the animal has foot and oral lesions.
- Collect vesicles fluid/ tissues from the oral lesions in 50% Glycerine saline and blood samples and transport to the laboratory (refer SOP).
- Carry out rapid diagnostic test for FMD on blood in the field (refer SOP).

Laboratory diagnosis (refer specific SOPs for laboratory diagnosis). Tests conducted at different laboratories.

- Rapid tests – field and DVH
- Sandwich ELISA for FMD virus detection (serotyping) - RLDC/NCAH
- Polymerase Chain Reaction tests for detection of FMD virus - RLDC/NCAH
- Liquid phase blocking ELISA for detection of antibodies - RLDC/NCAH
- NSP ELISA for DIVA - RLDC/NCAH

iv. Establish or verify the outbreak

- Provisional diagnosis made on clinical signs, epidemiological pattern, and gross pathology.
- Provisional disease control measures should be in place before the confirmatory diagnosis is made.
- Establish the case definition for FMD as follows:

1. Clinical case definition

FMD should be suspected if the affected animal(s) show few or all of the following clinical signs:

- Lameness
- Salivation (drooling)
- Smacking of the jaws, grinding of the teeth
- Vesicle/ lesions in the mouth
- Significant drop in milk production

2. Post-mortem case definition

The affected animals show following lesions:

- Vesicles or blisters on the tongue, gums, cheeks, lips, nostrils, muzzle, coronary bands, teats, udder.
- Erosion on rumen pillars
- Necrosis of the myocardium in young animals of all species (“tiger heart”)

3. Epidemiological trend

- Epidemiologically the FMD has high morbidity and low mortality

4. Laboratory or confirmed FMD

- Demonstration of FMD virus antigen using indirect ELISA and PCR
- Demonstration of FMD non-structural antibodies using ELISA

v. Describe outbreak in terms of time, animal and place

Time (draw epidemic curve by plotting cases against the time from available data-preferably time series)

- When was the index case?
- What is the exact period of outbreak?
- Given the diagnosis what is probable period of exposure?
- Is the outbreak most likely to be point source or propagated or both?

Animal (attack rates, risks etc.)

- Any differences in the attack rates among different herds, species, etc.
- Which groups (cattle, pig, sheep, goat) have the highest and which have the lowest attack rate?
- Any difference in the attack rate among different age group of the susceptible animals?

Place (plot the location of outbreak on a map with physical characteristics such as road, water bodies, mountains, infrastructures etc.)

- What are the geographical distributions of the cases?
- What is the pattern of the cases among different livestock species in different management system?
- Whether case farm is close to the international borders, national highways, migratory routes or other spatial risk factors?

Develop hypothesis based on the pattern of disease (animal, time and place)

- Mode of transmission
- Source of disease outbreak-forward and backward contact tracing
- Whether the outbreak is a common source or propagating
- If a common source, whether it is point or multiple exposure
- What are the risk factors associated with problem?

Zonation

i. Declaration of Provisional Infected Zone

When FMD is suspected, the Gewog Livestock Staff should inform DVH/DLO. Further the DVH should inform the concern RLDC, NCAH, DOL and BAFRA. The suspect infected place and the surrounding areas (based on the risk assessment) should be quarantined immediately and declared as Provisional infected zone. The geographical limits of the provisional infected zone should be determined after due consideration of the epidemiologic risk and natural geographical settings. The Provisional Infected Zone should be declared by the Gewog Livestock Office and Gewog Administration after consultation with DVH and RLDC.

All places with susceptible livestock species within the Provisional Infected Zone shall be considered at-risk/suspect and should be visited to establish their infection status.

Movement of livestock and livestock products out of the infected zone should be restricted. The farm equipment, vehicles and farm gears should be washed and disinfected thoroughly (refer SOP for disinfection and decontamination)

ii. Declaration of Infected zone

If the case definition of FMD is met, the area within a radius as decided by risk assessment team/ Disease Outbreak Investigation Team should be immediately declared as infected zone. The geographical limits of the infected zone should be determined after due consideration of the epidemiologic risk and natural geographical settings.

Once the outbreak is confirmed by the Disease Outbreak Investigation Team (DOIT) and officially declared by the Dzongkhag Administration, RRTs should be immediately

activated. Movement of livestock and livestock products out of the infected zone should be banned (refer SOP for quarantine and movement control).

iii. Declaration of Vaccination Zone

In order to create buffer zone around the infected zone, vaccination zone should be declared by the DOIT. The geographical limits of the vaccination zone should be determined after due consideration of the epidemiologic risk and natural geographical settings. RRT should carry out ring vaccination and other containment activities on all the properties/villages within the vaccination zone based on the direction of disease outbreak investigation team (refer specific SOPs). Public awareness and strict surveillance should be undertaken within the vaccination zone.

Reporting

- Document the findings of the investigation: background on the outbreak, investigation procedures, epidemiological and laboratory findings; economic impact etc.)
- Provide recommendations to all the relevant stakeholders (farmers/ producers; Managers; DoL, BAFRA and other agencies)
- Submit the final report

Surveillance and monitoring

It shall be done by the treatment and vaccination team.

Following evaluations should be carried out:

- Is the frequency of the disease remaining constant; increasing or decreasing?
- Is the control program effective?
- Does the disease have any impact on productivity or profitability?

2. SOP for Ring vaccination

Purpose: The purpose of this SOP is to effectively carry out ring vaccination in the vaccination zone so as to prevent the spread of disease to non-infected area.

Scope: This SOP describes the procedures for ring vaccination in vaccination zone thereby preventing spread of disease from the infected zone to other places.

Users: VOs/VPPs/RRT

Manpower

1. VO — 1 no.
2. VPP — Number will be decided by RRT Team Leader
3. Laboratory Technician — 1 no.

Materials/Equipment

- FMD vaccine
- Coolbox
- Auto-syringe
- Syringe and needle
- Vaccination form
- PPE (hand gloves, gum boots, apron etc.)
- Disinfectants/ antiseptics

Procedure

- Put on the required PPE (gloves, apron and gumboots)
- All susceptible livestock falling within the vaccination zone are required to be vaccinated against FMD in order to create an immune belt around the foci of infection.

The vaccination should start from the periphery to the inside, towards the periphery of demarcated zone of infection (see Figure 16) and vaccination should be completed as soon as possible, preferably within one-week time. The members of this team should not visit the “infected” area nor mix with the members of Treatment Team. This team should be solely involved in ring vaccination. This team will also act as a surveillance team and should examine and assess whether there are any cases of FMD in animals at the time of vaccination. The details of animals vaccinated should be recorded in vaccination form. The team should thoroughly disinfect themselves as well as vehicle and equipment after completing the day’s work.

3. SOP for the treatment of FMD affected animals

Purpose: The purpose of this SOP is to effectively treat FMD affected animals for the faster recovery and to prevent death of the animals

Scope: The treatment guidelines describe the different treatment approaches to undertake symptomatic treatment of the FMD affected animals

Users: Veterinarians and Veterinary paraprofessionals

Manpower
Veterinary paraprofessionals and Veterinarians

Materials/ Equipment

- Antibiotics
- 10% Formalin
- Potassium Permanganate powder
- Needle and syringes
- Cotton
- Scissors
- Forceps
- Scalpel blade with handle
- Gumboots
- Disposable hand gloves
- Biohazard bags
- Chlorhexidine
- Kidney/Instrument trays
- Povidone Iodine
- External ointment.
- Bandage
- Analgesic

Procedure

- The staff involved in treating affected animals with FMD should take only the supplies required for the treatment and all the equipment used for treatment should disinfected.
- Staff entering the affected premises should wear gumboot/shoe cover, apron and gloves.
- Select a clean area for the display of the treatment items and accordingly tether the sick animals for treatment.
- Only the items required for the treatment should be opened or taken out of the treatment box
- Washing and dressing of the wounds
  - Restrain the animal and open the mouth
  - Gradually wash the mouth with Alum (2%) and Boric acid (2-3%) or Copper sulphate (0.5%) or Potassium permanganate solution (1:2000) and Sulphanilamide (1%) solution.
  - After washing the mouth, smear buccal mucosa with the ointment composed of Tannic acid and Glycerine @ 30g and 150ml respectively after mixing.

Foot dip

- The hooves of the FMD animals should be washed with the above antiseptics and then foot dipped with any of the disinfectants like 5% formalin or antiseptics (1:1000 to 1:5000 Potassium Permanganate). The foot dip with formalin has the

advantage as it makes the hooves hard and avoid injuries during walk.

Teat ulcers

- Washing of the teat with ulcers can also be done similar way to that of the mouth and applied 2-3% Boric acid ointment.

Treatment to control secondary bacterial infection

The most important reason for treatment of FMD affected animal is to control the secondary bacterial infection using antibiotics and antiseptics.

- The choice of antibiotics to control secondary bacterial infection are
  - Strepto-penicillin @2ml/50kg body weight i/m after mixing 2000000 IU procaine penicillin and 2.5g Streptomycin sulphate vial with 7.5ml of distil water.
  - Long acting Oxytetracycline @ 1ml/10kg or 20mg/kg body weight.
- In case of pyrexia, the animals can be given parental injection with antipyretics/analgesics.
- Supportive treatment such as fluid therapy and vitamins can be given to severely infected animals.
- If the hooves have sloughed, bandage the hoof after dressing with antiseptics such as sulphanilamide and potassium permanganate or other wound ointments on daily basis with the application of fly repellents in fly dominated areas.

Once the treatment is completed, all the used materials shall be burnt or buried while the reusable instruments and materials should be thoroughly disinfected with appropriate disinfectant. The disposal gloves and used materials should also be buried. The concerned staff involved in treatment should follow zoo-sanitary measures like proper washing of hands and gumboot with antiseptic solutions before leaving the premises.

4. SOP for disposal of FMD carcasses by burial

Purpose: The purpose of the SOP is to have standard procedure for safe disposal of FMD infected carcasses and related materials.

Scope: This SOP describes procedures for site selection and safe burial of FMD carcasses to avoid spread of the virus through contamination

Users: Veterinary Officers and Veterinary Paraprofessionals.

Manpower:

1. Veterinarians
2. Veterinary paraprofessionals
3. Village Tshogpa
4. Animal owners

Materials/ Equipment required:

- Gloves
- Face masks
- Apron (disposable)
- Gum boot
- Disinfectant-Lime/Virkon-S/chlorhexidine
- Spades, crowbars, pickaxe

Procedure:

- Select an appropriate site for carcass burial. Preferably away from water source, residential areas, livestock facilities, pastures and motor roads and footpaths.
- Dig a pit with sufficient width to accommodate the carcass with a minimum depth of 2 meters considering the size of the carcasses.
- Wear apron, face masks, gumboot and hand gloves before handling the carcasses.
- Drop the carcass into the pit and dispose of the used gloves, face mask and apron into the pit
- Cover the carcasses with soil, 400 mm is suggested, and add an unbroken layer of lime (calcium carbonate). Do not spray lime directly on to the carcasses as it will slow decomposition process.
- Close the pit with sufficient soil and make a heap over the site.
- Then put a layer of lime over the soil
- Disposal site should be secured by putting stones, thorns, logs, etc.
- All tools, utensils and equipment used for burial should be thoroughly cleaned and disinfected. The animal handlers should thoroughly clean and disinfect themselves before leaving the burial site.

5. SOP for disinfection and decontamination

Purpose: To have standard procedure for effective disinfection and decontamination of contaminated premises and materials

Scope: The document describes procedures for disinfection and decontamination of contaminated materials and premises.

Users: VOs and VPPs

Manpower:

1. Veterinarians
2. Para-veterinarians
3. Animal owners/Helpers

Materials/ Equipment required:

- Hand gloves
- Apron (disposable)
- Gum boots
- Buckets
- Mugs/jugs
- Water
- Virkon-S (disinfectant)
- Sprayer (if available)

Procedure:

- Prepare 2% Virkon solution in a bucket.
- Collect the bedding materials and bury them with carcasses if it is in small quantities; or collect and burn it in a pit if in larger quantities.
- Contaminated premises should be disinfected thoroughly with 2% Virkon-S. Allow contact time of 2-3 hrs.
- Disposable items, including used PPEs must be buried in a pit.
- While leaving the infected premises the personals and vehicles should be thoroughly disinfected.
- All tools, utensils, equipment used for burial should be thoroughly cleaned and disinfected with disinfectant solution using 2% Virkon-S.

6. SOP for quarantine and movement control

Purpose: To have standard procedure for effective quarantine and movement control during FMD outbreak

Scope: The document describes procedures for quarantine and movement control to contain the disease

Users:

- Regulatory Officers (BAFRA officials)
- Police personnel
- Veterinarians/ Para-veterinarians

Manpower:

1. Regulatory Officers (BAFRA officials)
2. Police personnel
3. Veterinarians/ Para-veterinarians

Materials/Equipment required:

- Barrier tape
- Sign board
- Basic PPEs (Mask, Gloves)

Procedure:

- Ban and movement restriction of all cloven-hoofed animals and their products from the FMD outbreak areas and or routing through an affected area.
- Ban on importation of all cloven-hoofed livestock and livestock products into/routing through an area affected with FMD.
- BAFRA should mobilize their staff to attend check posts and entry points, and to strictly control movement of livestock and livestock products in and out of the outbreak area in the event of outbreak.
- The slaughter and sale of all cloven-footed animals for meat should be banned in the outbreak area.
- The animals in the affected herd should be confined within their shed or grazing area and avoid mixing with other healthy animals in the neighbouring village.
- The affected animals within the herd should be segregated from other apparently healthy animals and given appropriate treatment.
- The team shall seek local government support for enforcement

7. SOP for sample collection to diagnose FMD in animals

Purpose: To have standard procedure for collecting appropriate samples from host for laboratory diagnosis

Scope: This standard Operating Procedure (SOP) describes the steps and precautions required while collecting samples that includes appropriate time of collection and type of samples to be collected for each type of indicated test.

User: Veterinarians/ Laboratory Officer/ Laboratory Technicians /VPPs

Manpower:

1. Veterinarians
2. Veterinary paraprofessionals
3. Laboratory technician
4. Animal attendants
5. Animal owners

Materials/equipment required:

- Sample submission form
- Vacutainers (red cap)
- PBS tablet/pre-prepared PBS
- Glycerine
- Needle and syringe (18 and 22 gauze, 2.5 ml)
- Needle holder
- Serum tube
- Screw capped bottle
- Gum shoes
- Disinfectant (Calcium carbonate, Virkon-S)
- Apron
- Hand gloves
- Cool box
- Marker pen (permanent)
- Cotton/tissue paper
- Sample label
- Self-sealing plastic bags/snap lock bag
- Scissor
- Blades
- Packing tape
- Ethanol 70%
- PBS 50% glycerine (PBSG) (7.5 pH)
- Waste disposal bag/bio-hazard bag
- Sharp container
- Viral transport media

8. Sample collection procedure

Follow the sampling guide chart (Figure 20) to collect appropriate sample at appropriate time

Blood collection

- Restrain animal properly
- Put on gumboots, apron and hand gloves
- Swap jugular area with 70% ethanol
- Collect the blood in the disposable plastic syringe or Vacutainer
- Allow the blood to clot within the syringe. The syringe should be placed at 45º angle for better serum separation at room temperature or at 37ºC for 20-30 minutes.
- Separate the serum in Eppendorf tubes/cryo vials for sending to the laboratory
- Complete sample submission form with the details of each sample
- Label each tube with code number corresponding to that in the sample submission form
- Pack properly in the plastic bags and keep in cool box

Epithelium and vesicle/vesicle fluid collection

- Restrain animal properly
- Put on gum shoes, apron and hand gloves
- Collect epithelium from affected buccal area
- If vesicles are present, aspirate fluid using needle and syringe and transfer into 50% glycerine PBS saline pre-aliquoted in a screw cap vial
- Epithelium and vesicular fluid can also be collected in VTM
- Complete sample submission form with the details of each sample
- Label each tube with code number corresponding to that in the sample submission form
- Pack properly in the plastic bags and keep in cool box

Oropharyngeal fluid collection

- Restrain the animals properly
- Put on gum shoes, apron and hand gloves
- Insert probang cup into the oropharyngeal cavity and scoop fluid by taking utmost care not to release probang into oesophagus or trachea
- Transfer fluid into 50% glycerine PBS saline pre-aliquoted in a screw cap vial
- Oropharyngeal fluid can also be collected in VTM
- Complete sample submission form with the details of each sample
- Label each tube with code number corresponding to that in the sample submission form
- Pack properly in the plastic bag sand keep in cool box

Waste disposal

- Used glove, syringe and disposable apron should be collected in a waste disposable bag and sealed with tape. The sealed bag should be put into another bag and again

sealed with tape (double bag procedure).

- Sharps such as used needle and blades should be collected into a sharp container.
- All the waste bags and sharp container should be sprayed with 2% Virkon-S or bleaching powder before putting back into the car.
- Once reaching back to laboratory or office, the waste should be disposed appropriately either by incinerating or autoclaving

Disinfection and decontamination during sampling

- Reusable instrument, apron and gum shoes should be sprayed with 2% Virkon-S.
- Apron and gum shoes should be changed while leaving sampling site
- If the cars have entered sampling site, the tyres should also be sprayed with 1-2% Virkon-S.
- Sampling site should be surface sprayed with 1-2% Virkon-S after sample collection

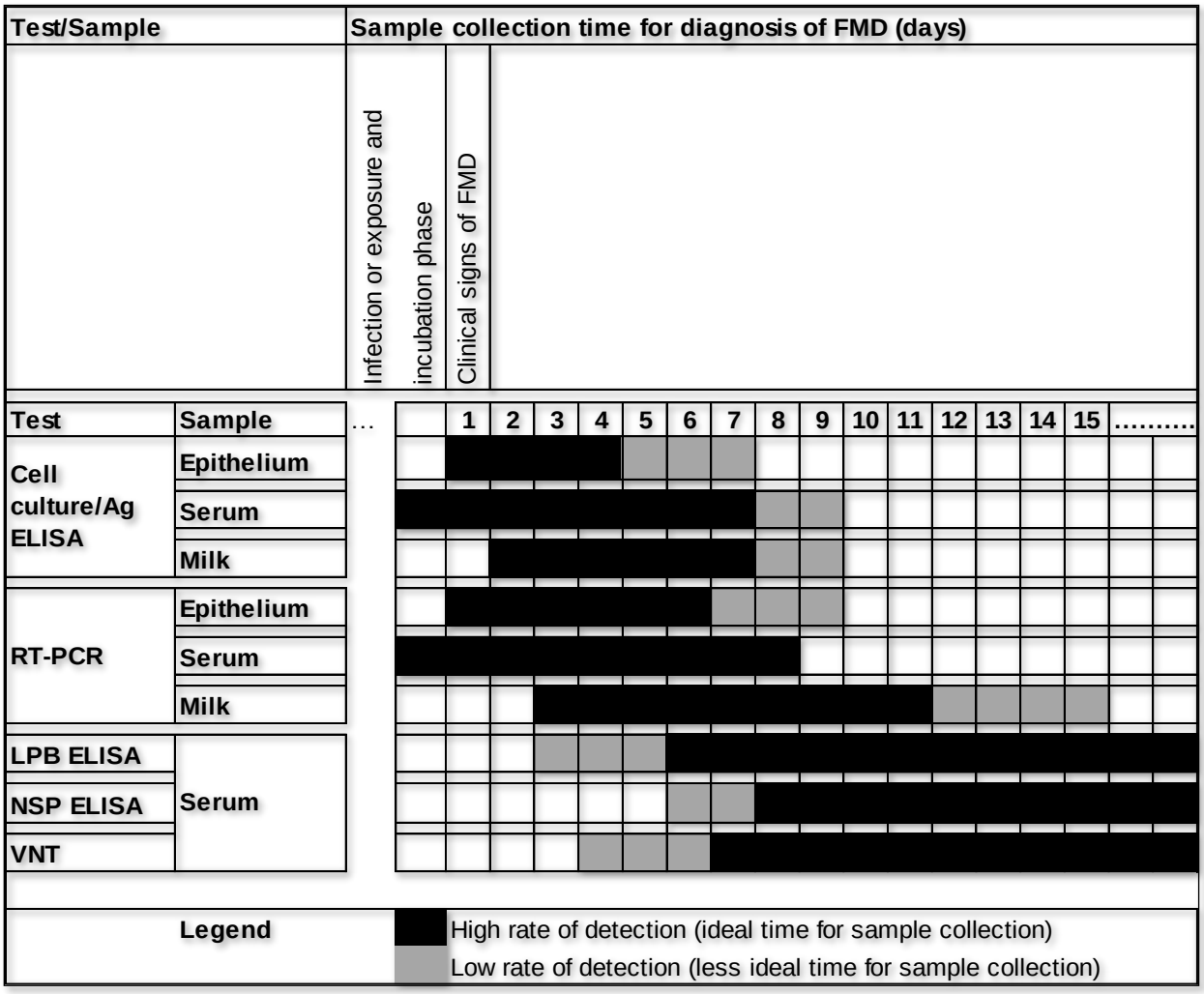


Figure 20: Sample collection guide chart

Note: Epithelial/ vesicular fluid should be collected within four days from the onset of clinical symptoms. Serum for antibody detection should be collected six-day post onset of clinical signs.

Tests:

- Ag ELISA — Antigen Enzyme linked immunosorbent assay
- RT-PCR — Reverse transcriptase-polymerase chain reaction
- LPB ELISA — Liquid phase blocking ELISA
- NSP ELISA — Non-structural protein ELISA
- VNT — Virus neutralization test

9. SOP for NSP antibody Rapid Test

Purpose: Foot and Mouth Disease NSP antibody is a sandwich lateral flow immuno-chromatographic assay for qualitative detection of FMD virus non-structural protein antibody in serum from infected animal

Scope: This SOP outlines the general principles and steps to detect FMD NSP antibody in serum samples

Assay time: 5-10 min
Sample: Serum

Principle: FMD NSP antibody rapid test (Quicking, China) is a test based on sandwich lateral flow immune-chromatographic assay. The test device has a testing window with invisible T (test) zone and C (control) zone. When the sample aliquot is pipetted into the sample well, the liquid will laterally flow into the surface of the test strip. If there is enough FMD NSP antibodies in the sample, a visible T band will appear. The C band should always appear upon feeding the sample indicating valid test result.

Users: Veterinarians and laboratory staff of RLDCs/VH/NCAH

Manpower:

1. Veterinarians
2. Laboratory Officer
3. Laboratory Technicians
4. Veterinary paraprofessional

Materials/equipment required:

- Sample submission form
- Vacutainer blood tubes (red cap)
- PBS tablet
- Needle and syringe (18 gauze, 10 ml)
- Needle holder
- Serum tube
- Gum shoes
- Disinfectant (Virkon-S)
- Apron
- Hand gloves
- Cool box
- Marker pen (permanent)
- Cotton/tissue paper
- Sample label
- Self-sealing plastic bags/snap lock bag
- Scissor
- Blades
- Packing tape
- Ethanol 70%
- Waste disposal bag/bio-hazard bag
- Sharp container
- NSP Ab test kit (cassette in foil pouch, product insert, dropper)

Sample collection procedure
Follow SOP for sample collection (blood)

Laboratory Procedure

- Do centrifugation to animal's whole blood sample to collect serum or plasma for use.
- If serum is too sticky to move, please do a dilution of 1:1 with PBS or distilled water.
- Take out the cassette from the foil pouch and place it horizontally on a flat surface.
- Gradually drip 3 drops of serum/plasma into the sample hole "S".
- Interpret the result in 5-10 minutes. Result after 10 minutes is considered as invalid.

Result Interpretation

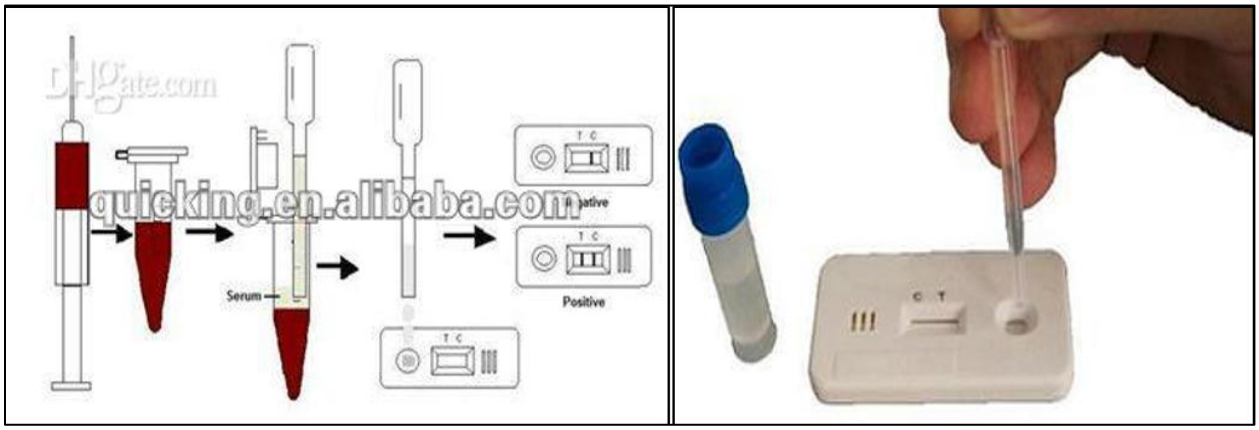


Figure 21: Serum separation and dilution process, and sample loading on cassette

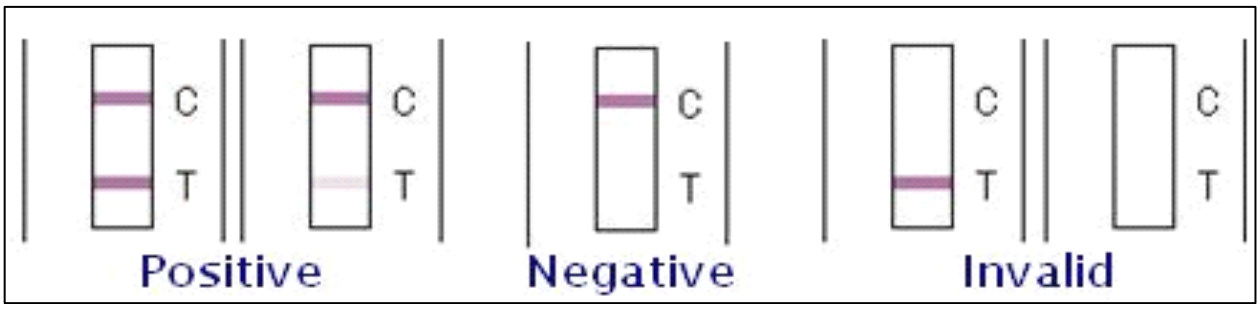


Figure 22: Test reaction

Interpretation of results

Positive: The presence of both C band and T band, no matter T band is clear or vague.
Negative: Only clear C band appears.
Invalid: No coloured band appears in C zone, no matter whether T band appears.

Waste disposal

- Used glove, blood tubes, serum tubes, test cassette and syringe should be collected in a waste disposable bag/bin and sealed with tape.
- Sharps such as used needle and blades should be collected into a sharp

container.

- All the waste bags and sharp container should be sprayed with 2% Virkon-S/disinfectant
- Waste generated should be appropriately disposed either by incinerating or autoclaving

Annexure 6: Standard forms

Form 1: Temperature recording form (to be used to record temperature of vaccine storage refrigerator)

Name of Centre: Gewog: Dzongkhag:
Month:

Temperature (vaccine storage refrigerator)	Date																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Morning																															
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Remarks

Form 2: FMD syndromic surveillance and reporting form

Dzongkhag:
Gewog/ Centre:
Reported by:
Reporting period:

Month	Presence/absence of FMD in animals	
	Yes	No
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		
Submitted by:		

Form 3: Flash Report format for disease outbreak reporting

Sl. No.	Parameters	Data/Information
1	Name of farmer	
1	Village	
2	Location	Latitude: Longitude:
3	Gewog	
4	Dzongkhag	
5	Date of outbreak	
6	Date of report by owner to LEC/RNREC/DVH	
7	Date of report by LEC/RNR/DVH to RLDC/NCAH	
8	Disease suspected	
9	Species affected	
10	Sex/ Age	
11	Number of cases	
12	Number died	
13	Number of households affected	
14	Number of susceptible animals in the village	
15	Probable source of outbreak	
16	Contact person in village (Name and phone number)	
17	Control measures taken	
18	Reported by (Name and phone number)	

Form 4: FMD Vaccination form

Name of Centre: .....Gewog: .....Dzongkhag: .....

Vaccination campaign period: …….

Sl. No	Owner name	House No.	Mobile No.	Village	Cattle		Sheep/ Goat		Pig		Yak		ID of animal(s) not vaccinated	Reasons for not vaccinating cattle, Write the code: 1: Pregnant 2: Young/calves 3: Milk reduction 4: Animal not available 5. Others	Remarks
					Total Population	No. vaccinated	Total Population	No. vaccinated	Total Population	No. vaccinated	Total population	No. vaccinated			

Form 5: FMD Sample submission form

Sample collection form for sero-prevalence study of FMD
District: ……. Gewog: …… Date: ……

Sl. No	Village	Farmer's name	Animal name / Ear tag No.	Species	Breed	Age (years or month)	Sex	Vaccinated against FMD last year? (Tick one)		Date of last vaccination (If vaccinated)	Was there any FMD outbreak in this farmer's herd in last 3 years? (Write Yes/No)	Did this animal suffer from FMD within last 3 years? (Yes/No)
								Yes	No			

Please use the following abbreviations
Species: Bov – Bovine; Cap – Caprine; Por – Porcine; Ovi – Ovine
Breed: L – local; JX – Jersey cross; BSX – Brown Swiss cross; MX – Mithun cross (For Sheep, goats, and pigs, use Local and Cross)

Form 6: Disease Outbreak Investigation Form

Reference No.:		Date:	
Name of the farm/ farm owner:			
Contact number (mobile):			
Address: Village:		Gewog:	Dzongkhag:
Geo coordinates	Longitude (N)		Latitude (E)
Information about the farm			
Type of farm: Cattle: Commercial [ ]; Semi-commercial [ ]; Backyard [ ]; Others [ ] Pigs: Commercial [ ]; Semi-commercial [ ]; Backyard [ ]; Others [ ] Goat: Semi-commercial [ ]; Backyard [ ]; Others [ ] Sheep: Semi-commercial [ ]; Backyard [ ]; Others [ ] Yak: Free-range [ ]; Backyard [ ]; Others [ ]			
Number of Animals in the affected household Cattle: Cross: ……. Local: ……Bull/ Bullock: ……...Calves: …… Pigs: Improved: ……. Local: …… Goat: Improved: ……. Local: …… Sheep: Improved: ……. Local: …… Yaks: Cross:……..Local:……			
Information about the affected village/ Total number of animals in the affected village Total no. of household: ……Total human population: …… Cattle: …… …… Pigs: …… Goat…… Sheep: …….. Yaks: …… Others (specify)……..			
Type of housing (tick or describe briefly) Cattle: Permanent shed with concrete floor [ ]; Permanent shed with local beddings [ ]; Temporary shed [ ]; Others (specify) [ ]…… Pigs:			

Goat: Sheep:
Grazing system Stall fed [ ]; Private pasture [ ]; Common grazing land/ pasture [ ]; Mixing with other susceptible animals [ ]; Mixing with other herds [ ] Others (specify) Pig: Sheep: Goat:
Feed: Whether concentrate is fed to animals? Cattle - [Yes | No] Source…….. Pig - [Yes | No] Source……..…… Goat - [Yes | No] Source……..… Whether animals are fed with kitchen waste/ swills? Cattle - [Yes | No] …….. Pig - [Yes | No] ……..……
Herd migration practice Cattle – Yes [ ] No [ ]; If yes, route and season …… Yak – Yes [ ] No [ ]; If yes, route and season …….
Other animal present in the farm, give details
Presence of wild animals in area, give details
Bio-security arrangements in the affected farm Disinfectant foot-bath [ ]; Perimeter wall/fence [ ]; Mixing of different species of animals [ ]; Contact between different herds [ ]; Others (specify)
Topography of the outbreak areas: Road network [ ]; market [ ]; school [ ]; BHU [ ]; RNR/LEC [ ]; Monastery [ ]; Towns [ ] Others (specify)

Movement of animals and products
Recent introduction of animals from other establishment/ places, [Yes / No];
if yes, from where?
Species…… Source……Pieces……. Date.....

Recent purchase of livestock products
Beef - [Yes | No] ……kg, Date……..
Pork - [Yes | No] ……kg, Date……
Mutton- [Yes | No] ……kg, Date……
Chevon - [Yes | No] ……kg, Date……
Fresh milk - [Yes | No] …lit, Date……..
Others (specify)…….

Supply/ sale of animals/ milk/ meat to other farms/ places, [Yes / No]; if yes to where?
Village.....Gewog.....Dzongkhag.....Date.....

Movement of people/vehicle
Any recent movement of people or vehicle from other farms/ places [Yes / No];
if yes from where? When?

Any recent movement of people or vehicle out of farm to other farm/ places [Yes / No];
if yes to where?..... When?

Any recent festival or gathering in the village/household/nearby villages [Yes / No];
if yes to where?.....when?

Vaccination history of affected household

Type of vaccine	Date of vaccination	Vaccine details	Remarks
FMD			
BQ/ HS			
Anthrax			

Whether the affected animals vaccinated in the last vaccination?
Yes | No: If no, when was the last vaccination?

What was the reason for not vaccinating during the last vaccination programme?

Information about the disease outbreak

Date and time of report of outbreak from farmer to LEC/ RNEC/DVH:

Date and time of report from LEC/ DVH to RLDC/ NCAH:

Date and time of onset of clinical signs:

Date and time of onset of mortality:

Details of animals affected:

Date	Species	Breed	Age	No. affected	No. died	Remarks

Clinical signs observed

Necropsy findings (if any)

If any treatment already given in the present outbreak, give details							
Probable source of infection							
Action taken or recommendations							
Samples collected							
Sample Id.	Species	Specimen type	No. of specimens	Laboratory referred to	Date of shipment	Test requested for	
Name & Designation of Investigation Team:					Signature		

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