Section 2

Classical swine fever and foot-and-mouth disease country reports
Classical swine fever and foot-and-mouth disease in Lao PDR

Syseng Khounsy¹ and James Conlan²,³

Introduction

Approximately 75% of the population of Lao PDR is engaged in agriculture and the vast majority (approximately 90%) of these producers are in the smallholder sector. Livestock are an important contributor to national, agricultural and village economies and are relied on for food security. The pig population has increased over the past 5 years at an annual average increase of 4.7% at the national herd level and up to 20% in some provinces. Cattle and buffalo populations have grown at more modest rates of 1–2% (Figure 1).

Disease, including foot-and-mouth disease (FMD) and classical swine fever (CSF), is a major constraint to efficient and sustainable livestock production. Up to 80–90% of pigs and 99% of cattle and buffalo are produced in the smallholder sector using low input practices; as such, there is limited private sector input. Disease reporting, diagnosis, control and prevention are addressed by the Lao Government through the National Department of Livestock and Fisheries (DLF) and local agriculture and forestry offices at provincial and district government levels. These activities are supported by international partners such as the Australian Centre for International Agricultural Research (ACIAR), Commonwealth Scientific and Investigation Research Organisation (CSIRO), Japanese International Cooperation Association (JICA), Food and Agriculture Organization (FAO), European Union (EU) and Office International des Epizooties (OIE).

Disease reporting and communication are passive and reports are made from villages through government administrations at district and provincial levels and then to the national level—the DLF and the National Animal Health Centre (NAHC). Communication of FMD-related information at regional and international levels is coordinated by the OIE South-East Asian FMD regional coordination unit (SEAFMD RCU), where reports are submitted monthly. Disease reporting for CSF is less well coordinated and information is provided to the OIE.

Disease diagnosis

Classical swine fever

Initial suspicion of CSF is based on clinical signs. Routinely, the laboratory test used to confirm an outbreak of CSF is the antigen capture (AC)-ELISA (Shannon et al. 1993) for the detection of viral antigen in tissue or the white cell fraction of whole blood. The immunoblotting (IMB)-ELISA (Conlan et al., in press) for antigen detection is used at the NAHC and will be used in provincial laboratories in the future. These tests are supported by ACIAR and reagents are supplied by the CSIRO Australian Animal Health Laboratory (AAHL), Geelong, Australia. Capacity at the NAHC for virus isolation and the fluorescent antibody test (FAT) has been developed in cooperation with JICA; however, these tests are not routinely used.

Antibodies to CSF are detected in serum using the complex trapping blocking (CTB)-ELISA (Blacksell 2001) with the support of ACIAR and CSIRO.
The capacity to use the ‘gold-standard’ neutralising peroxidase linked assay (NPLA) has been developed but is not routinely used.

**Foot-and-mouth disease**

As with CSF, initial suspicion of FMD is based on clinical signs. Diagnosis of FMD is confirmed in the laboratory using the indirect sandwich ELISA and subtypes A, O and Asia 1 can be identified. Virus isolation in tissue culture can be done but is not routinely used.

Antibodies to FMD virus are detected in the serum of cattle, buffalo and pigs using the liquid phase blocking (LPB)-ELISA. During surveys to specifically look for naturally infected animals, the non-structural protein (NSP)-ELISA (CEDI Diagnostics, the Netherlands) is used.

**Epidemiology of CSF and FMD**

**Classical swine fever**

As the identification of CSF outbreaks is based on a system of passive surveillance, the incidence of CSF is probably under-reported. In 2003 five outbreaks in three provinces were laboratory confirmed: Bolikhamsay (3), Luang Namtha (1) and Xieng Khouang (1). In 2004, 11 outbreaks in six provinces were identified: Bolikhamsay (6), Khammuan (1), Vientiane Capital (1), Luang Prabang (1), Houaphan (1) and Bokeo (1). In 2005 five outbreaks in two provinces were confirmed in the laboratory: Bolikhamsay (2) and Vientiane Capital (3). In 2006 up to October, 10 outbreaks in three provinces were identified: Bolikhamsay (2), Vientiane Capital (7) and Luang Namtha (1). Refer to Figure 2 for location of outbreaks and the season in which they occurred.

In 2006 a serological survey for CSF and FMD was conducted in five northern provinces, Oudomxay, Luang Prabang, Phongsaly, Xayabouly and Houaphan. The survey was conducted with the support of the FAO ‘Transboundary Animal Disease in the Greater Mekong Sub-region’ project, OIE SEAFMD RCU and the ‘Lao–Australian Animal Health Research’ project (ACIAR Project Number AH/2003/001). The CTB-ELISA was used to detect antibodies to CSF virus (Table 1).

**Foot-and-mouth disease**

The predominant strain of FMD virus causing outbreaks in Lao PDR is type O. A small outbreak caused by type A occurred in Bokeo province in 2003, and no outbreaks of type Asia 1 were detected.

Table 1. Sero-prevalence of classical swine fever in five northern provinces of Lao PDR, 2006

<table>
<thead>
<tr>
<th>Province</th>
<th>Number of districts</th>
<th>Number of villages</th>
<th>Number of pig samples</th>
<th>Per cent sero-positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oudomxay</td>
<td>5</td>
<td>8</td>
<td>55</td>
<td>11</td>
</tr>
<tr>
<td>Luang</td>
<td>7</td>
<td>13</td>
<td>91</td>
<td>13</td>
</tr>
<tr>
<td>Prabang</td>
<td>7</td>
<td>13</td>
<td>88</td>
<td>15</td>
</tr>
<tr>
<td>Phongsaly</td>
<td>7</td>
<td>12</td>
<td>84</td>
<td>15</td>
</tr>
<tr>
<td>Xayabouly</td>
<td>8</td>
<td>23</td>
<td>161</td>
<td>6</td>
</tr>
<tr>
<td>Houaphan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Livestock population trends from 1980 to 2005

40
in the Lao PDR in the period 2003–06. In 2006 no outbreaks of FMD had been reported up to October (Figure 3). As described above, a sero-prevalence survey for CSF and FMD was conducted in 2006 (Table 2). In 2005 a survey in four provinces, Savannakhet, Vientiane Capital, Huaphan and Xieng Khouang, was conducted to measure the serological prevalence of naturally infected animals (Table 3). In both sero-surveys the NSP-ELISA (CEDI Diagnostics, the Netherlands) was used to detect antibodies to FMD virus.

Table 2. Sero-prevalence of foot-and-mouth disease in five northern provinces of Lao PDR, 2006

<table>
<thead>
<tr>
<th>Province</th>
<th>Number of districts</th>
<th>Number of villages</th>
<th>Number sampled</th>
<th>Per cent sero-positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oudomxay</td>
<td>5</td>
<td>8</td>
<td>112</td>
<td>0</td>
</tr>
<tr>
<td>Phongsaly</td>
<td>7</td>
<td>13</td>
<td>163</td>
<td>0</td>
</tr>
<tr>
<td>Huaphan</td>
<td>8</td>
<td>23</td>
<td>323</td>
<td>1</td>
</tr>
<tr>
<td>Luang</td>
<td>7</td>
<td>13</td>
<td>181</td>
<td>13</td>
</tr>
<tr>
<td>Xayabouly</td>
<td>7</td>
<td>12</td>
<td>168</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 3. Sero-prevalence of foot-and-mouth disease in four provinces of Lao PDR, 2005

<table>
<thead>
<tr>
<th>Province</th>
<th>Number sampled</th>
<th>Per cent sero-positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savannakhet</td>
<td>280</td>
<td>2</td>
</tr>
<tr>
<td>Xieng Khouang</td>
<td>765</td>
<td>0</td>
</tr>
<tr>
<td>Huaphan</td>
<td>458</td>
<td>0</td>
</tr>
<tr>
<td>Vientiane Capital</td>
<td>60</td>
<td>30</td>
</tr>
</tbody>
</table>

Disease control

Classical swine fever

There is no official policy for the control of CSF; however, vaccination is strongly encouraged and animal movement during an outbreak is discouraged. Prevention of CSF is also quite difficult to achieve in the smallholder farming sector. Vaccination is not routinely used (approximately 8% of the national herd is vaccinated) and regular trading of sick pigs facilitates disease spread.

Foot-and-mouth disease

Control of FMD is better coordinated than CSF control. It is highly reliant on a high level of awareness at village, district and provincial levels to rapidly report suspected cases of FMD and submission of samples for laboratory testing. National veterinary staff are responsible for implementing animal movement control once an outbreak occurs, and this may involve personnel from other ministries, including police notification to prevent animal movement. Livestock traders are also engaged, and trading of livestock and animal products during an outbreak is prohibited.

Lao PDR does not produce vaccine for FMD and does not have a routine vaccination program to prevent or control outbreaks of the disease. Bilateral agreements between the governments of Thailand and Lao PDR result in the supply of vaccine for emergency ring vaccination during an outbreak.
As mentioned above, control is reliant on a high level of disease awareness. During outbreaks, public awareness initiatives are undertaken to educate farmers and traders about the risks of disease spread.

**Future activities**

The control and prevention of these trans-boundary animal diseases require an ongoing commitment from all stakeholders involved in livestock production. In the future, activities will be undertaken in collaboration with international partners to strengthen the capacity of provincial and district livestock officers to recognise and control disease outbreaks. This will involve specialist training in disease recognition, disease reporting, sample collection and submission, and public awareness.

Other activities will include:

- introducing improved diagnostics and control methods for CSF, with a particular focus on implementation of the newly developed IMB-ELISA for rapid diagnosis in provincial laboratories
- scaling up vaccination programs for, and public awareness of, CSF
- engaging and working with livestock traders and providing education materials to minimise the risk of disease spread
- continuing to work with international partners to prevent the movement of illegal animals and animal products in the Greater Mekong subregion.

**References**


Classical swine fever and foot-and-mouth disease in Yunnan province, People’s Republic of China

Li Le¹ and Gao Huafeng²

Introduction

China has an integrated veterinary administration system for animal health inspection and service that is divided into four levels—the national general veterinary station, provincial general veterinary stations, the region/prefecture level, and the county and township level. The county and township level is responsible for providing vaccination and collecting disease information, which is then sent to the region/prefecture level and the provincial general veterinary stations. Contagious diseases must be reported to the central government, which then issues the disease information through the government website <http://www.agri.gov.cn> in a monthly journal of agricultural information published openly by the government in the Chinese language. There is also international collaboration and communication between Yunnan province and other countries in South-East Asia. During 1998–2001 ACIAR, Lao PDR and Yunnan province participated in ACIAR project AS1/1994/038, which aimed to improve diagnostic methods and culminated in the research staff of Yunnan province participating in workshops and meetings held in this area. Training courses and meetings were also hosted in Yunnan province.

Many non-government organisations are also involved in disease diagnosis and control in Yunnan province. These are ‘for profit’ organisations, whose involvement in and capacity for disease diagnosis and control are quite varied.

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² Yunnan Tropical and Subtropical Animal Viral Disease Laboratory, Kunming, Yunnan Province, PR China

Disease diagnosis

Classical swine fever (CSF)

Clinical diagnosis: this is still an important method of diagnosis for veterinarians at the county level and in non-government organisations.

Laboratory diagnosis: a variety of methods are used in different circumstances:
• a direct immunofluorescence test on cryostat sections of organs from affected pigs; however, due to non-specific reactions, it is not very popular
• virus isolation in cell culture, with virus detection by immunofluorescence
• RT-PCR, which is widely used at the provincial level due to its rapidity and convenience, with primers mainly targeting E0, E2 and NS5B genes
• indirect ELISA kits produced by IDEXX (USA) in some laboratories.

Serological tests: serum samples from recovering animals, from sows with suspected congenitally infected litters, or from pigs under surveillance are tested by indirect haemagglutination and indirect ELISA methods to detect serum antibodies. Only the attenuated vaccine of C strain is used nationwide; therefore, it is the only strain used for analysis of immune antibody titres.

Foot-and-mouth disease (FMD)

Clinical diagnosis: this is still an important method of diagnosis for veterinarians at the county level.

Laboratory diagnosis: a variety of methods are used in different circumstances:
• antigen capture (AC)-ELISA
• virus isolation—inoculation of primary bovine thyroid cells, BHK-21 and IB-RS-2 cell lines; inoculation of mice
• RT-PCR, which is widely used at the provincial level; if the suspicious sample is positive, sequence analysis is needed to make a final diagnosis.

Serological tests include:
• liquid phase blocking (LPB)-ELISA
• virus neutralisation test.

Epidemiology of CSF and FMD in Yunnan province, PR China

Foot-and-mouth disease
There have been no reports of FMD in Yunnan province since November 2005, but CSF outbreaks occur every month.

From May 2005 to June 2006 (Tables 1 and 2), there were 12 FMD Asia 1 outbreaks in nine provinces in northern, north-western and eastern China. Among 4,608 susceptible animals, 634 were infected and showed clinical symptoms and one died. A total of 5,233 animals were slaughtered (Table 1).

Classical swine fever
According to statistical data, CSF occurred in 18 provinces / autonomic regions from January to November 2005. There were 1,221 disease cases and 85,010 pigs showed disease; 47,020 pigs died and 9,048 were slaughtered. There was no CSF reported in Liaoning, Jiling, Shandong, Hainan, Sichuan, Chongqing, Beijing, Shanghai, Tianjin, Shanxi, Inner Mongolia and Tibet. During 2005–06, 144 cases were reported in Yunnan province and 2,515 pigs died because of the disease (Table 3).

<table>
<thead>
<tr>
<th>Date of announcement</th>
<th>Date of report</th>
<th>Place</th>
<th>Animal</th>
<th>Number of susceptible animals</th>
<th>Number of animals with disease</th>
<th>Number of deaths</th>
<th>Number of animals slaughtered</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.5.2005</td>
<td>24.4.2005</td>
<td>Shandong</td>
<td>Dairy cow</td>
<td>40</td>
<td>17</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>13.5.2005</td>
<td>24.4.2005</td>
<td>Jiangsu</td>
<td>Dairy cow</td>
<td>183</td>
<td>15</td>
<td>0</td>
<td>183</td>
</tr>
<tr>
<td>26.5.2005</td>
<td>18.5.2005</td>
<td>Xinjiang</td>
<td>Cattle</td>
<td>308</td>
<td>75</td>
<td>0</td>
<td>308</td>
</tr>
<tr>
<td>26.5.2005</td>
<td>5.5.2005</td>
<td>Beijing</td>
<td>Dairy cow</td>
<td>2,464</td>
<td>252</td>
<td>0</td>
<td>2,464</td>
</tr>
<tr>
<td>26.5.2005</td>
<td></td>
<td>Hebei</td>
<td>Beef cattle</td>
<td>512</td>
<td>0</td>
<td>0</td>
<td>512</td>
</tr>
<tr>
<td>20.6.2005</td>
<td></td>
<td>Xinjiang</td>
<td>Beef cattle</td>
<td>261</td>
<td>40</td>
<td>0</td>
<td>261</td>
</tr>
<tr>
<td>24.6.2005</td>
<td></td>
<td>Hebei</td>
<td>Dairy cow</td>
<td>263</td>
<td>4</td>
<td>0</td>
<td>263</td>
</tr>
<tr>
<td>20.7.2005</td>
<td></td>
<td>Qinghai</td>
<td>Beef cattle</td>
<td>168</td>
<td>95</td>
<td>0</td>
<td>168</td>
</tr>
<tr>
<td>20.7.2005</td>
<td></td>
<td>Gansu</td>
<td>Beef cattle</td>
<td>290</td>
<td>66</td>
<td>0</td>
<td>454</td>
</tr>
<tr>
<td>30.12.2005</td>
<td></td>
<td>Shandong</td>
<td>Bull</td>
<td>91</td>
<td>48</td>
<td>0</td>
<td>91</td>
</tr>
<tr>
<td>16.1.2006</td>
<td></td>
<td>Ningxia</td>
<td>Cattle</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>298</td>
</tr>
<tr>
<td>16.1.2006</td>
<td></td>
<td>Jiangsu</td>
<td>Dairy cow</td>
<td>20</td>
<td>20</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

Note: Diagnostic laboratory—National FMD Reference Laboratory, Lanzhou Veterinary Institute, Chinese Academy
Diagnostic methods used—AC-ELISA, LPB-ELISA, RT-PCR, virus isolation

Table 2. Foot-and-mouth disease Asia 1 outbreaks in China in 2006*

<table>
<thead>
<tr>
<th>Province</th>
<th>Serotype</th>
<th>Date of report</th>
<th>Number of animals with disease</th>
<th>Number of animals slaughtered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jiangsu</td>
<td>Asia 1</td>
<td>16.1.2006</td>
<td>20 cows</td>
<td>100 cattle and cows</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 householder, 2 cattle</td>
<td>89 cattle, 110 sheep/goats</td>
</tr>
<tr>
<td>Gansu</td>
<td>Asia 1</td>
<td>16.1.2006</td>
<td>1 householder, 11 cattle</td>
<td>18 cattle</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19 cattle, 2 pigs</td>
</tr>
<tr>
<td>Qinghai</td>
<td>Asia 1</td>
<td>12.3.2006</td>
<td>1 householder</td>
<td>34 (cattle, cows, pigs and sheep/goats)</td>
</tr>
<tr>
<td>Gansu</td>
<td>Asia 1</td>
<td>30.5.2006</td>
<td>3 cattle</td>
<td>35 cattle</td>
</tr>
<tr>
<td>Huabei</td>
<td>Asia 1</td>
<td>30.5.2006</td>
<td>7 cattle</td>
<td>13 cattle, 32 pigs, 7 sheep</td>
</tr>
<tr>
<td>Gansu</td>
<td>Asia 1</td>
<td>23.6.2006</td>
<td>213 cattle</td>
<td>380 cattle</td>
</tr>
</tbody>
</table>

*Data from the information network <http://www.agri.gov.cn>, Ministry of Agriculture, PR China
Risk factors for virus spread

There are three main risk factors for virus spread. High animal density, including diverse management styles, is the most significant factor for the disease. There are more pigs in Yunnan province than any country in the EU, but the level of management varies according to different farming practices. The second factor is that animal movement within the province and to and from neighbouring countries is difficult to control. The third factor is the lack of widespread use of improved diagnostic and serological methods for classical swine fever virus (CSFV) in Yunnan province.

Disease control

Vaccination

Vaccination against major animal diseases is a main strategy in Yunnan province. Vaccines against FMD and CSF are provided free of charge by the government, and vaccination campaigns are carried out twice a year in spring and autumn.

Disease monitoring

Regulated disease monitoring is carried out at the county level by disease monitoring stations. Specimens are collected from suspected diseased animals and sent to Yunnan Provincial General Veterinary Station or Yunnan Tropical and Subtropical Animal Disease Laboratory to do the preliminary diagnosis.

Serological survey

Sera are collected from vaccinated animals to test antibodies. LPB-ELISA and micro-neutralisation tests are used to assay antibody levels against FMD. Study results have indicated that when the antibody titre of a vaccine is higher than $2 \times 10^5$ to $2 \times 10^6$, the animal is fully protected against virulent virus challenge.

Control measures

When there is a disease outbreak, farms or villages are quarantined for a time period during the outbreak, and vehicles which pass through the area are inspected and sterilised.

Future directions

Strengthening of veterinary facilities and services

A sum of 144.7 million yuan has been provided by both the central government and the Yunnan provincial government to upgrade veterinary facilities and services. The upgrade process is underway and includes the setting up of disease monitoring stations, the establishment of cold chains for vaccination campaigns, the upgrading of veterinary facilities at county and town levels, the establishment of a county- and town-level inspection and supervision system, and the building of a provincial residual chemical test laboratory.

Education and training

More training courses and meetings will be held in Yunnan province. Township-level veterinarians will thus be able to learn the basic methods of sample collection and make diagnoses in both the field and the laboratory.

Virus research

Studies about the molecular epidemiology of the CSFV should be strengthened. Some strains of field virus have been sequenced but more work still needs to be done. The current vaccination program needs to be reviewed, and should be based on information collected from virus activities and serological studies. It is necessary to assure vaccine quality and efficacy before carrying out large-scale vaccinations. New methods that are able to test potential virus-carrying animals are necessary.

Table 3. Classical swine fever in Yunnan province in 2005–06

<table>
<thead>
<tr>
<th>Province</th>
<th>Number of pigs with CSF</th>
<th>Number of deaths</th>
<th>Number of animals slaughtered</th>
<th>Total cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yunnan</td>
<td>3,693</td>
<td>2,515</td>
<td>83</td>
<td>144</td>
</tr>
</tbody>
</table>

Data from the information network <http://www.agri.gov.cn>, Ministry of Agriculture, PR China
International cooperation

ACIAR project AS1/1994/038 between China, Laos and the Australian Animal Health Laboratory improved the diagnostic ability for FMD and CSFV during 1998–2001. Cooperation between Yunnan province and neighbouring countries is enabling mutual information exchange. This cooperation is important for disease control and it should be strengthened.
Classical swine fever and foot-and-mouth disease, Myanmar

Cho Cho Htun¹ and Mya Mya Oo²

Introduction

The Livestock Breeding and Veterinary Department (LBVD) is mainly responsible for the livestock sector and for animal health in Myanmar. It has assigned 14 state and divisional officers, 63 district officers, 281 township officers and 683 assistant veterinarians for village tracts. They all have responsibility for taking care of animal health and improvement of livestock productivity. A network of disease information and reporting systems has been established among the LBVD headquarters, field veterinarians, local authorities and livestock farmers. According to the Animal Health Development Law proclaimed in 1993, and related orders and directives issued in 1999, the owner of a diseased or dead animal, or a person who has in his possession such an animal, should report promptly to the LBVD employee-in-charge of either a village tract or township, or a person designated for this purpose by the Ministry of Livestock and Fisheries. A veterinarian should report promptly to the nearest LBVD employee if he finds that an animal he is treating is suffering from a contagious disease. Based on this information, the Deputy Township Veterinary Officer takes responsibility for relaying the message through his superiors to LBVD headquarters or to the local authorities according to regulations (Figure 1). In the case of foot-and-mouth disease (FMD), the specimens are sent directly to the FMD laboratory for virus identification.

Disease diagnosis

Foot-and-mouth disease

The National FMD laboratory has capabilities for diagnosis and serological tests.

Antigen detection methods include:
- indirect sandwich ELISA prepared and standardised by WRL, Pirbright, UK
- ELISA for detection of FMDV antigen prepared and standardised by RRL, Pak Chong, Thailand
- BHK 21 monolayer cells to isolate the virus and confirm the diagnosis.

Antibody detection methods include:
- liquid phase blocking (LPB)-ELISA prepared and standardised by WRL, Pirbright, UK
- LPB-ELISA prepared and standardised by RRL, Pak Chong, Thailand
- FMDV NSP 3 ABC-ELISA manufactured by Bommeli Diagnostics
- FMDV NSP 3 B-ELISA manufactured by UBI, New York, USA
- FMDV NSP ELISA manufactured by CEDI Diagnostics B.V., Lelystad, the Netherlands
- virus neutralisation test.

Classical swine fever

Classical swine fever (CSF) is diagnosed by post-mortem examination and histopathological examination. The fluorescent antibody test (FAT) is used for the confirmation of CSF. The following methods are performed for virus isolation:
- egg inoculation
- animal inoculation
- tissue culture inoculation.

The Mandalay Regional Diagnostic Laboratory has one diagnostic facility for CSF by neutralising

¹ National FMD Laboratory, Livestock Breeding and Veterinary Department, Myanmar
² Research and Biology Section, Livestock Breeding and Veterinary Department, Myanmar
peroxidase-linked assay (NPLA) with the support of the JICA–ADC project in 2005. The Yangon Central Veterinary Diagnostic Laboratory has also planned to establish CSF diagnostic facilities using the NPLA method from the JICA–ADC project.

Statistical data from outbreaks of FMD and CSF are summarised in Tables 1 and 2.

**Risk factors for virus spread in the livestock population of Myanmar**

Disease outbreaks are caused by animal movement from endemic areas. Some outbreaks are associated with livestock owners who bring their animals to the market for sale, and with livestock traders moving from one market to another. In some areas there is limited grazing ground, so that farmers share common pasture and the animals can easily come into contact with the disease.

**Disease control**

When outbreaks occur, the owner has to report to the Deputy Township Veterinary Officer (DyTVO) and the village headman. The DyTVO checks the outbreak and reports to the Township Veterinary Officer (TVO) and directly to LBVD Headquarters (HQ). The village headman reports to the Township Administration Authorities (Figure 1). The DyTVO collects diagnostic specimens and sends them to the diagnostic laboratory, destroys the carcasses, cleans the premises using disinfectants and notifies other offices of the outbreak (Figure 1). The DyTVO segregates the diseased and susceptible animals, bans animal movements and undertakes emergency vaccination.

**Figure 1. Disease reporting system in Myanmar**
To minimise risk and prevent outbreaks, public awareness and communication programs are important. LBVD issues timely notification of FMD through public media such as daily newspapers, radio and TV programs, especially at the onset of the monsoon season, and conducts workshops and seminars on animal health and disease control for in-service personnel, farmers and livestock owners.

The national FMD laboratory produces 100,000–150,000 doses of monovalent type FMD vaccine every year with existing facilities. The vaccines are used for ring vaccination in case of outbreaks. CSF is controlled by local and imported CSF vaccines. Approximately 200,000 doses of CSF vaccine are produced by the Research and Biologic Section of LBVD.

**Table 1.** Outbreaks of foot-and-mouth disease in Myanmar 2001–06

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of animals infected</th>
<th>Virus types</th>
<th>Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>2,303</td>
<td>O, Asia 1</td>
<td>Kachin, Sagaing, Magway, Mandalay, Rakhine, Yangon, Shan, Ayeyarwaddy</td>
</tr>
<tr>
<td>2002</td>
<td>11,712</td>
<td>O</td>
<td>Bago, Magway, Rakhine, Yangon, Ayeyarwaddy</td>
</tr>
<tr>
<td>2003</td>
<td>946</td>
<td>O</td>
<td>Sagaing, Bago, Yangon</td>
</tr>
<tr>
<td>2004</td>
<td>2,972</td>
<td>O</td>
<td>Sagaing, Bago</td>
</tr>
<tr>
<td>2005</td>
<td>1,103</td>
<td>O, Asia 1</td>
<td>Chin, Bago, Magway, Rakhine, Yangon, Kayah</td>
</tr>
<tr>
<td>2006 (to Sept)</td>
<td>1,671</td>
<td>O</td>
<td>Ayeyarwaddy, Bago, Yangon, Sagaing, Rakhine, Chin</td>
</tr>
</tbody>
</table>

**Table 2.** Outbreaks of classical swine fever in Myanmar 2001–05

<table>
<thead>
<tr>
<th>Year</th>
<th>State/Division</th>
<th>Number of outbreaks</th>
<th>Pig population</th>
<th>Number of animals infected</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>Yangon</td>
<td>8</td>
<td>19,325</td>
<td>11</td>
</tr>
<tr>
<td>2001</td>
<td>Ayeyarwaddy</td>
<td>2</td>
<td>44,669</td>
<td>81</td>
</tr>
<tr>
<td>2002</td>
<td>Yangon</td>
<td>n.a.</td>
<td>n.a.</td>
<td>n.a.</td>
</tr>
<tr>
<td>2003</td>
<td>Shan (South)</td>
<td>1</td>
<td>19,325</td>
<td>2</td>
</tr>
<tr>
<td>2004</td>
<td>Shan (South)</td>
<td>2</td>
<td>13,777</td>
<td>3</td>
</tr>
<tr>
<td>2005</td>
<td>Shan (South)</td>
<td>4</td>
<td>13,777</td>
<td>4</td>
</tr>
<tr>
<td>2005</td>
<td>Shan (East)</td>
<td>1</td>
<td>42,388</td>
<td>1</td>
</tr>
</tbody>
</table>

n.a. = not available

To minimise risk and prevent outbreaks, public awareness and communication programs are important. LBVD issues timely notification of FMD through public media such as daily newspapers, radio and TV programs, especially at the onset of the monsoon season, and conducts workshops and seminars on animal health and disease control for in-service personnel, farmers and livestock owners.

The national FMD laboratory produces 100,000–150,000 doses of monovalent type FMD vaccine every year with existing facilities. The vaccines are used for ring vaccination in case of outbreaks. CSF is controlled by local and imported CSF vaccines. Approximately 200,000 doses of CSF vaccine are produced by the Research and Biologic Section of LBVD.

**Future directions**

A draft national FMD control plan with a zoning approach has been prepared and initiated in Myanmar. The logical framework of the Office International des Epizooties (OIE) Regional Coordination Unit (RCU) will be a performance indicator for FMD control in the South-East Asian region. Monthly, quarterly and emergency reports for FMD incidence in the country will be sent to OIE RCU. Country reports will be submitted to meetings of the OIE Sub-Commission for FMD in South-East Asia and to OIE RCU workshop meetings. FMD status in defined regions under the zoning approach will be monitored by sero-surveillance activities using improved serological tests including FMDV non-structural protein ELISA to differentiate vaccinated from infected animals.

The Research and Disease Control Division of LBVD continuously monitors the current status of contagious diseases in Myanmar and the preparedness for new or emerging diseases. FMD task forces at different levels and the national FMD laboratory will carry out control procedures and LBVD will hold evaluation meetings every 4 months at headquarters with the heads of state/division veterinary officers. Under the JICA project, an epidemiological survey on CSF was done in the Mandalay region in 2005 and a preliminary epidemiological survey on FMD was done in Sagaing division in 2006.
Classical swine fever and foot-and-mouth disease in Cambodia

Bun Chan

Introduction
In Cambodia the livestock sector comprises 12.8% of the gross domestic product (GDP) (World Bank 1995). It is considered the second priority after rice production and plays a crucial role in the national economy. Cattle and buffalo are widely used for draft power and means of transportation, being used on 85–95% of all cultivated lands. Pigs and poultry are normally raised for cash income and occasional home consumption. Most Cambodian farmers raise animals in the traditional manner without the use of modern technology. The animals are usually unpenned and fed by grazing the available natural feeds in the village, which leads to poor nutrition and susceptibility to disease. Classical swine fever (CSF) and foot-and-mouth disease (FMD) are endemic in Cambodia. FMD is considered an important disease because of high morbidity in affected cattle, buffalo and pigs, whereas CSF causes high mortality in affected pigs (DAHP 2001–04). Yearly animal population statistics are presented in Table 1 (DAHP 2005) and data from CSF and FMD outbreaks during 2001–06 are provided in Tables 2 and 3.

Disease diagnosis
The most common diagnostic method used for confirmation of CSF and FMD in Cambodia is assessment of clinical signs. However, enzyme-linked immunosorbent assays (ELISAs) are used for antibody detection of FMD and the neutralising peroxidase-linked assay (NPLA) is used for antibody detection of CSF at the National Animal Health and Production Investigation Centre (NAHPIC). NAHPIC, the national laboratory, is capable of CSF and FMD diagnosis, but the facilities and human resources have limited capacity for the handling of specimens for field diagnosis.

Epidemiology of CSF and FMD
Cambodia uses passive epidemiological surveillance to investigate reported diseases. The animal disease reporting system was introduced in 2001 in the four target provinces of the APIP project by using monthly reports from veterinary field services. In 2002 the epidemiology unit extended this system to all provinces. The reports are sent from all provinces on the 25th day of the month to the epidemiology section of NAHPIC. Epidemiology staff collect the animal morbidity and mortality reports for the different diseases and enter the data into a computer. Serological surveillance has also been conducted to estimate the prevalence of CSF and FMD in Cambodia.

In 2006 we conducted KAP and serological surveillance to study the prevalence of FMD and CSF by randomly selecting 69 villages in eight provinces (Kompong Speu, Kampot, Kandal, Koh Kong, Phnom Penh, Prey Veng, Krong Preah Sihanouk and Takeo). These provinces represent FMD and CSF control as identified by the Lower Mekong Working Group. A total of 974 serum samples from cattle and buffalo, and 483 from pigs, were collected. The serum surveillance results were as follows:

- Fifty-four (11%) pig serum samples were positive for FMD antibodies.
- Of the cattle and buffalo serum collected, 76 (8%) were positive for type O, 49 (5%) for type A and 25 (3%) for type Asia 1.

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Disease control

There is no definite policy being implemented at present for CSF and FMD disease control. However, we have regulatory measures that prohibit animal movement into and out of infected farms, and control of importation and exportation of animals and animal products at borders. Every year before the rainy season, the Department of Animal Health and Production (DAHP) provides vaccine to all provinces, and in 2006 DAHP provided vaccine to prevent FMD and haemorrhagic septicaemia (HS) throughout the country. Ring vaccination is implemented in case of outbreak in any locality to control the spread of disease.

Future directions

The objectives of the government of Cambodia in the control and eradication of CSF and FMD are:

- strengthening veterinary services from the central level to the village level
- strengthening the NAHPIC’s capacity and capability for the diagnosis of FMD and CSF virus
- improving national surveillance disease investigation of, and monitoring and reporting systems for, FMD and CSF
- studying the impact of FMD and CSF, and using the obtained results to indicate the direct and indirect impacts of FMD and CSF to farmers and the national economy
- implementing vaccination campaigns against FMD and CSF
- controlling movement of animals and animal products
- introducing training courses for district veterinarians and village animal health workers
- conducting serological surveillance in provinces that border neighbouring countries
- improving public awareness.

Table 1. Animal population statistics in Cambodia during 2001–05

<table>
<thead>
<tr>
<th>Livestock</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>2,868,727</td>
<td>2,924,457</td>
<td>2,989,416</td>
<td>3,039,945</td>
<td>3,184,146</td>
</tr>
<tr>
<td>Buffalo</td>
<td>625,907</td>
<td>625,912</td>
<td>660,493</td>
<td>650,572</td>
<td>676,646</td>
</tr>
<tr>
<td>Pigs</td>
<td>2,118,273</td>
<td>2,704,435</td>
<td>2,297,439</td>
<td>2,428,582</td>
<td>2,688,612</td>
</tr>
</tbody>
</table>

Table 2. Classical swine fever outbreaks during 2001–06

<table>
<thead>
<tr>
<th>Year</th>
<th>Outbreaks</th>
<th>Number of sick animals</th>
<th>Number of dead animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>8</td>
<td>1,862</td>
<td>233</td>
</tr>
<tr>
<td>2002</td>
<td>8</td>
<td>3,003</td>
<td>340</td>
</tr>
<tr>
<td>2003</td>
<td>9</td>
<td>2,972</td>
<td>333</td>
</tr>
<tr>
<td>2004</td>
<td>2</td>
<td>147</td>
<td>8</td>
</tr>
<tr>
<td>2005</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2006</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3. Foot-and-mouth disease outbreaks during 2001–06

<table>
<thead>
<tr>
<th>Year</th>
<th>Outbreaks</th>
<th>Number of sick animals</th>
<th>Number of dead animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2002</td>
<td>53</td>
<td>12,970</td>
<td>115</td>
</tr>
<tr>
<td>2003</td>
<td>21</td>
<td>3,983</td>
<td>38</td>
</tr>
<tr>
<td>2004</td>
<td>7</td>
<td>1,181</td>
<td>107</td>
</tr>
<tr>
<td>2005</td>
<td>53</td>
<td>55,785</td>
<td>706</td>
</tr>
<tr>
<td>2006</td>
<td>30</td>
<td>12,806</td>
<td>243</td>
</tr>
</tbody>
</table>
The classical swine fever and foot-and-mouth disease situation in Vietnam

Nguyen Thu Ha¹

Introduction

Vietnam, located in eastern Indochina, has an area of 332,000 km² and shares a 3,730-km border with China, Lao PDR and Cambodia. In 2005 Vietnam’s population increased to 82 million, with 70% practising farming. Livestock production has played an important role in agriculture, with the livestock sector comprising 31% of total agricultural production in Vietnam in 2005. Livestock production based on economic output is increasing steadily in the following order: pigs, cattle, buffalo and goats (Table 1).

The foot-and-mouth disease situation in recent years

From 2001 to 2005, foot-and-mouth disease (FMD) has occurred sporadically (Table 2). The number of provinces affected has increased slightly from five to nine, with the number of outbreaks being around 20 each year. In those 5 years FMD often occurred in cattle and buffalo. In 2001 and 2003 there were no FMD outbreaks in pigs. During 2001–03, all outbreaks were type O only, but in 2004 and 2005 type A also occurred and there was a type Asia 1 outbreak in 2005. FMD outbreaks were numerous in early 2006. From January to June, 46 out of 64 provinces were affected by FMD, with 19,381 cattle and buffalo and 2,579 pigs infected. The disease is now under control and only six provinces are affected. There were three types of FMD detected: O, A and Asia 1 (O is the most common type). Type A was detected only in cattle and buffalo. According to the World Reference Laboratory (WRL) in Pirbright, UK, the type A strain which caused outbreaks in Ninh Thuan province showed a close genetic relationship to the type A strain from the Thai outbreak of 2003, and the type Asia 1 strain isolated in 2005 showed a genetic similarity to type Asia 1 from Myanmar.

The classical swine fever situation in recent years

The number of classical swine fever (CSF) outbreaks in Vietnam during 2001–05 is presented in Table 3. In Vietnam there are two forms of CSF: a chronic form, and a congenital form where only the foetus is affected and the sows are infected without showing any clinical signs. Occasionally there were outbreaks in fattening pigs. Many pigs, especially sows, become virus carriers even following extensive vaccination. There are many CSF vaccines available in the market but their effectiveness is variable. In all cases of CSF the clinical signs are not clear, so clinical diagnosis is very difficult and results must be confirmed by laboratory testing.

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¹ Hanoi Regional Animal Health Centre Laboratory, Department of Animal Health, Hanoi, Vietnam
Weaknesses in disease control

Foot-and-mouth disease

- late disease detection resulting in the spread of outbreaks
- existence of various types: O, A and Asia 1
- late reports, not enough information or no report, so that the real situation of the epidemic is not known well enough to issue appropriate control plans
- farmers having to pay for vaccines, high vaccine prices, insufficient government subsidies, and an unclear vaccine subsidy policy, all of which affect vaccination effectiveness
- cattle and buffalo being freely pastured in outbreak areas, which makes vaccination very difficult and may result in disease spread
- ineffective animal movement control because of the very long border and varied natural conditions; animal owners and traders not following veterinary ordinances and trying to sell infected animals illegally.

Classical swine fever

- inability to detect and eliminate the CSF virus carrier
- late vaccination for weaned piglets
- animal movement without being quarantined.

FMD and CSF diagnosis

A laboratory for FMD diagnosis was established in 1996 and sponsored by an IAEA project; 1 year later another FMD laboratory was established by the FAO TCP project. Since then, these two laboratories (National Centre for Veterinary Diagnosis (NCVD) and Ho Chi Minh (HCM) Regional Animal Health Centre) have performed FMD diagnosis for the whole country. Currently, both laboratories use the antigen capture (AC)-ELISA to serotype FMD outbreaks, and other methods, such as RT-PCR and virus isolation, to detect the virus. The non-structural protein (NSP)-ELISA is also used in both laboratories to detect and differentiate infected and vaccinated animals. Every year, some FMD specimens are sent to reference laboratories (WRL, Pirbright, UK, and the Regional Reference Laboratory, Pakchong, Thailand) to research the genetic characteristics of the local strains.

Under the Department of Animal Health (DAH) of Vietnam there are a national diagnostic laboratory and six other diagnostic laboratories that belong to six regional animal health centres. In all laboratories CSF diagnosis is currently performed using AC-ELISA. Before ELISA was introduced, CSF had been diagnosed by the fluorescent antibody test. Since 2003, when highly pathogenic avian influenza (HPAI) occurred in Vietnam, and with great assistance from international donors, many real-time PCR machines have been provided to all the DAH laboratories, and these are also used for CSF diagnosis.

Foot-and-mouth disease surveillance in Vietnam

In Vietnam an FMD surveillance system has been established with assistance from FAO and OIE. In cooperation with OIE, Vietnam has drafted its own

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of affected provinces</th>
<th>Number of outbreaks</th>
<th>Number of infected cattle/buffalo</th>
<th>Number of infected pigs</th>
<th>Serotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>5</td>
<td>n.a.</td>
<td>644</td>
<td>0</td>
<td>O</td>
</tr>
<tr>
<td>2002</td>
<td>7</td>
<td>22</td>
<td>1,499</td>
<td>136</td>
<td>O</td>
</tr>
<tr>
<td>2003</td>
<td>5</td>
<td>13</td>
<td>397</td>
<td>0</td>
<td>O</td>
</tr>
<tr>
<td>2004</td>
<td>9</td>
<td>20</td>
<td>986</td>
<td>117</td>
<td>O, A</td>
</tr>
<tr>
<td>2005</td>
<td>8</td>
<td>20</td>
<td>1,031</td>
<td>565</td>
<td>O, A, Asia 1</td>
</tr>
</tbody>
</table>

n.a. = not available

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of cases</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>15,483</td>
<td>Sporadic</td>
</tr>
<tr>
<td>2002</td>
<td>19,891</td>
<td>Sporadic</td>
</tr>
<tr>
<td>2003</td>
<td>13,947</td>
<td>Sporadic</td>
</tr>
<tr>
<td>2004</td>
<td>12,105</td>
<td>Sporadic</td>
</tr>
<tr>
<td>2005</td>
<td>9,773</td>
<td>Sporadic</td>
</tr>
</tbody>
</table>

Table 2. The foot-and-mouth disease situation in Vietnam in recent years

Table 3. Classical swine fever outbreaks in Vietnam in recent years
National FMD Control Plan for the period 2005–10, which has been approved by the government. In Vietnam FMD is considered one of the most important diseases and its occurrence is reported on an emergency basis. Under the guidance of veterinary organisations, an animal disease information and disease reporting system has been established to report on outbreaks from the communal level up to the national level (Figure 1). Whenever an outbreak occurs, the Head of the Communal Veterinary Team reports to the relevant District Veterinary Station (DVS) immediately by telephone, which then reports to the Provincial Sub-DAH (SDAH) and, in turn, to the DAH by telephone or email with later confirmation by written letter. The SDAH reports and receives feedback reports on a monthly basis. Respective Regional Animal Health Centres (Figure 2) send their staff members immediately to the field for further investigations and take samples for laboratory confirmation. Measures to control outbreaks will be decided upon according to the prevailing Veterinary Ordinance. The Animal Health Information System has been developed to some extent with the FAO TADinfo database program and has been adapted for use under Vietnam circumstances. It was planned that the protocol for reporting CSF and FMD outbreaks be expanded to all 64 provinces throughout the country by the end of 2005. FMD vaccination campaigns were carried out regularly in provinces at higher risk, such as those that share international borders, have intensive livestock production and have had previous outbreaks. Together with sponsors of some international projects such as CARD (Australia), SEA FMD and some surveillance programs on FMD and CSF have been carried out in some provinces along the borders with China and Lao PDR.

FMD and CSF prevention and control plan

Establishing the zones and the objectives of zoning

The plan includes establishment of the following zones:
- control zone: to control the disease and reduce disease incidence; reduce the number of outbreaks in border provinces; prevent transmission of the disease across borders; and minimise the control zone through a step-by-step process
- buffer zone: to control the disease in the zone; prevent transmission of the disease to the free zone; and successfully control disease, through a step-by-step process, to enable 80% of the provinces in the buffer zone to become disease free
- free zone (intended objective): to eradicate the disease in the delta areas of Red River and Mekong River, where animal populations are high, and to potentially become an exporting zone.

FMD plan

The plan includes the following objectives:
- carrying out the national program on FMD control and eradication 2006–10
- conducting epidemiological surveys to establish disease maps from year to year
- epidemiological surveillance to observe and record disease information, control animal movement and slaughterhouse activity, ensure isolated quarantine of imported animals and destroy affected animals
• sero-surveillance in order to detect outbreaks early, and type and subtype viruses to apply appropriate vaccination
• a vaccination plan to determine appropriate vaccines for each area, including monovalent (type O), bivalent (O and Asia 1 or O and A) and trivalent (O, A and Asia 1) vaccines
• public awareness to propagate knowledge of FMD prevention control measures directly to farmers
• training of staff of the Sub-department of Animal Health on procedures of disease control
• international cooperation with neighbouring countries through disease information exchange, carrying out of commitments on animal quarantine at borders, and participation in animal disease prevention and control programs in order to prevent transmission of trans-boundary diseases.

**CSF plan**

The plan includes the following objectives:
• establishing CSF-free areas in two provinces in the Red River delta: Nam Dinh and Thai Binh
• a vaccination program twice each year and supplementary vaccination
• control of animal movement
• disinfection of the environment
• applying biosecurity to livestock
• strengthening the knowledge of farmers on CSF.
Introduction

The pig-raising system in Thailand is divided into two categories: the agri-business level and the village-agricultural level. The agri-business level is handled by the private commercial sector. Because of good management practices such as standard farming, vaccination programs and biosecurity systems, foot-and-mouth disease (FMD) and classical swine fever (CSF) are not problems at this level. At the village-agricultural level, small-scale farmers learn how to adjust their production to fit within their crop production levels and socioeconomic constraints for the sake of survival of their families. Although there are occurrences of FMD and CSF at this level, the number of outbreaks is decreasing.

There are many organisations responsible for disease reporting, diagnosis and control of FMD and CSF in Thailand.

The Ministry of Agriculture and Cooperatives through the Department of Livestock Development (DLD) is the principal government agency responsible for controlling FMD and CSF. A reporting system and control strategies have been formulated by this organisation, which can also diagnose these diseases and provide FMD and CSF vaccines to support farmers, especially at the village level.

Faculties of veterinary medicine within universities have established laboratories for CSF or FMD diagnosis.

Private agencies maintain large intensive production and also provide health services for farm customers, including the supply of drugs, vaccines and veterinary supervision.

Farmers must report disease outbreaks within 24 hours after finding sick pigs according to the Animal Epidemic Act B.E. 1956.

Village keymen provide voluntary help to government officers in clinical surveillance and vaccination.

In the case of FMD or CSF outbreaks, a report from farmers or village keymen or private veterinary farm advisers is sent through the district provincial and regional livestock office to the central office of DLD within 24 hours. Samples for identification of the causative agent are collected and submitted to the nearest laboratory. As soon as the disease is confirmed, the district officers, together with the provincial livestock officers of DLD are assigned to run the control program. In each outbreak the source and possible extent of infection is determined to give a better knowledge of the epidemiological picture of disease. This information is distributed to each organisation by the central office of DLD. Statistical information on the occurrence of the disease forms the basis of reports that are sent to the Office International des Epizooties (OIE) Regional Coordination Unit (RCU). Improved technology using facsimile and online computers has helped to minimise communication time among field personnel, the central office of DLD and the disease diagnostic laboratories.

Diagnosis

Classical swine fever

The diagnostic methods used for CSF are the fluorescent antibody technique (FAT) and cell culture. PCR is used for confirmation in some cases.
Foot-and-mouth disease

After field officers detect FMD-suspected cases by clinical surveillance, tissue culture and competitive ELISA methods are used for viral detection in tissue samples. For serum samples, non-structural protein ELISAs are used to detect FMD-infected animals. The liquid phase blocking (LPB)-ELISA is also used for detection to determine serum antibody titre and for evaluating herd immunity.

Epidemiology of CSF and FMD

Classical swine fever

In Thailand 40, 53, 50 and 25 CSF outbreaks were reported in 2003, 2004, 2005 and 2006, respectively. These occurred in small-scale farms in all parts of Thailand except the eastern region. From disease investigations, the main cause of CSF outbreaks is animal movement.

Foot-and-mouth disease

FMD outbreaks have decreased from 2003 to the present, with 205, 119, 117 and 46 outbreaks in 2003, 2004, 2005 and 2006 reported, respectively. These occurred in all parts of Thailand except the eastern region. The outbreaks mainly occurred in cattle. The strain of FMD virus diagnosed has appeared to change from O to A since 2003. No FMD virus type Asia 1 was found in these years. The last outbreak caused by FMD virus type Asia 1 was reported in Khon Khaen in 1998. However, the potential recurrence of type Asia 1 needs to be closely monitored. From disease investigations, animal movement was still a major factor associated with the occurrence of FMD. Animal movements were reported to be associated in 55, 51 and 43 outbreaks in 2003, 2004 and 2005, respectively. FMD sero-surveillance of 4,203 samples detected viral infection by the NSP method and immunisation from vaccine by the LPB-ELISA method. The results of this project, which is ongoing, indicate a prevalence of FMD outbreaks of 10.2% in 2005 and 7.2% in 2006.

Disease control

Vaccination

Vaccination is conducted at 6-monthly intervals with trivalent vaccines for types O, A and Asia 1, with the main objective being maintenance of herd immunity. The first vaccination round of the year is conducted in May and June and the second in November and December. The above-mentioned trivalent vaccines are produced by the Division of Veterinary Biologics under standardised quality control which complies with the OIE standard.

Animal movement control

According to the FMD information system, about 40–50% of FMD outbreaks in Thailand were associated with movement of animals, which included movement via animal markets, livestock vendors and directly by the owner. In general, the regulation of animal movement requires a formal approval form veterinary authorities when moving animals from one province to another or across the border. However, movement of animals within the province prior to the detection of FMD outbreaks is possible and difficult to control.

Public education

The main objective of this activity is to have farmers, livestock vendors and staff of related governmental organisations gain knowledge about the nature of FMD and the impact of the disease on them and the country. Mass media, such as radio and television broadcasting, newspapers, several forms of printed material and exhibitions, are used continuously to achieve this purpose.

Cooperation with neighboring countries

With assistance from international organisations such as FAO and OIE in coordinating plans and projects, cooperation between Thailand and its neighbouring countries can strengthen the national FMD control and eradication plan, not only in any individual country but also in the South-East Asian region.
Outbreak response

The following steps comprise the response to an outbreak:
- gathering information on animal populations, population distribution, the numbers of villages and farmers in the infected area, and specific routes of animal movement from the infected area
- formulating a program for vaccination, required staff, and materials needed including transport vehicles; and establishing the need for deployment of staff and facilities from another district or province
- strictly controlling animal movement in the infected area
- slaughtering all diseased and in-contact animals according to the regulated policies
- conducting ring vaccination around the infected area as soon as possible
- setting up a surveillance team to investigate the extent of FMD infection
- conducting an outbreak investigation in order to locate the origin of infection as soon as possible
- disseminating information on disease outbreak, vaccination and control measures to farmers and animal traders through various possible means and reporting to the authorities concerned.