

Foot and mouth disease in the Lao People's Democratic Republic: I. A review of recent outbreaks and lessons from control programmes

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Summary

Foot and mouth disease (FMD) causes sporadic disease outbreaks in the Lao People's Democratic Republic (Lao PDR). As the Lao PDR is a major thoroughfare for transboundary animal movements, regular FMD outbreaks occur, causing economic hardship for farmers and their families. In this review of the recent history of FMD in the Lao PDR between 1997 and 2006, the authors examine the virological and epidemiological aspects of the disease and appropriate control measures, including the distribution of outbreaks, causative serotypes and the molecular epidemiology of the viruses, as well as large-scale vaccination programmes. The dominant serotype, type O, was reported every year from 1998 to 2005. The majority of outbreaks occurred in Vientiane Capital (n = 42; 28%) and the highest number of outbreaks were reported in cattle (n = 94; 61%); followed by buffalo (n = 41; 27%) and pigs (n = 18; 12%). All type A outbreaks occurred in cattle. Type Asia 1 outbreaks were reported in the central provinces around Vientiane Capital between 1996 and 1998.

Keywords

Asia – Bovines – Buffalo – Cattle – Foot and mouth disease – Lao People's Democratic Republic – Pigs – Swine – Vaccination.

Introduction

Foot and mouth disease (FMD) causes sporadic disease outbreaks in the Lao People's Democratic Republic (Lao PDR) and appears to be endemic. However, there is little in the way of peer-reviewed published knowledge on the epidemiology of the disease in the Lao PDR. Since large-

scale vaccination is not routinely practised, the livestock population of the Lao PDR remains largely susceptible to infection, although residual immunity from previous infections is often present in older animals (1). The Lao PDR is a major thoroughfare for transboundary animal movements (5, 12) and regular FMD outbreaks occur, causing economic hardship for farmers and their families. In April 1997, a project (AS1/94/38) began, funded by the

Australian Centre for International Agricultural Research (ACIAR), with the primary objectives of:

- establishing appropriate diagnostic facilities and methodologies
- undertaking research on the local epidemiology of FMD and classical swine fever viruses, aspects of vaccinology and the characteristics of local virus strains.

This review details the recent history of FMD from the beginning of the project until the present day, raising issues and highlighting lessons from FMD control programmes in an FMD-endemic, developing country.

Lao People's Democratic Republic: the setting

The Lao PDR is a landlocked country, located in Southeast Asia and sharing common borders with Thailand, Myanmar, the People's Republic of China, Vietnam and Cambodia. The country is 236,800 km² in area, has a population of approximately six million people, with a density of 24 persons per km², and an annual gross national income of US\$440 per person (19). In administrative terms, the Lao PDR is divided into 17 provinces (Fig. 1), comprising 147 districts, 11,386 villages and 799,289 households (11). Approximately 79% of the Lao population is rurally based and 76% is engaged in farming (3, 19). The economy of the Lao PDR is largely based on agriculture, with the agricultural sector contributing 46% of the gross domestic product (GDP). Of this 46%, the livestock sector contributes 14.3% (i.e. 6.6% of total GDP) (3, 19). Livestock production includes:

- cattle (1.27 million)
- buffalo (1.10 million)
- pigs (1.83 million)
- goats (0.19 million)
- poultry (>15 million) (11).

At the village level, large livestock are primarily used for draught power and other subsistence purposes (including local slaughter and consumption), or as part of an 'animal bank', which may be sold to raise capital should the need arise.

Capacity and infrastructure

At the beginning of the ACIAR project in 1997, the Lao PDR had only limited veterinary infrastructure within the



SR: special region

Fig. 1
Map of the Lao People's Democratic Republic showing provinces and regions

Department of Livestock and Fisheries (DLF). The major limiting factors were a shortage of qualified veterinarians, limited technical capacity and limited budget. While human resources remain a constraint, bilateral and multilateral projects have generally improved the capacity of the Lao PDR to deal with veterinary disease. When the programme began, there was no local capacity for FMD diagnosis and all samples were sent to the Food and Agriculture Organization of the United Nations (FAO) World Reference Laboratory (WRL) for FMD (WRL FMD), Pirbright, United Kingdom. A high priority for the DLF and the project was to establish a local means of FMD diagnosis and serotyping at the National Veterinary Diagnostic Laboratory (NVDL), using the FMD virus (FMDV) antigen typing enzyme-linked immunosorbent assay (ELISA) (15).

To facilitate sample submissions to the NVDL, a rudimentary diagnostic sample submission network (DSSN) was established. The ACIAR project provided disease awareness training, funding for communications and a small revolving fund to meet local costs (travel and postal) for district and provincial livestock officers (DLO and PLO). The DSSN followed a stage-by-stage approach, beginning with Vientiane Capital in August 1997. This was gradually expanded to other provinces as the diagnostic specimen submission process was refined and DLO and

PLO completed their training in sample collection and submission. To enable safe transport of specimens to Vientiane for diagnosis, a sample transport container (STC) (2) was devised and constructed from locally available polyvinyl chloride plumbing pipe, to form an integral body with a cap. The STC proved to be inexpensive, strong, lightweight and, in addition to being locally produced, was acceptable to the local postal authorities.

Outbreaks of foot and mouth disease and distribution of serotypes

In the period before 1997, a small number of samples were sent to the WRL FMD for typing. The majority of these outbreaks were caused by type O (1978, 1981, 1982, 1984, 1987, 1988, 1989, 1990) and type Asia 1 (1984, 1991, 1992, 1993) (10). From 1998 to 2007, 142 FMD outbreaks were diagnosed, using the FMDV antigen-typing ELISA (AT-ELISA) (Table I). The dominant serotype was type O, reported every year from 1998 to 2005. Type A was reported in 2003, 2006 and 2007, whereas type Asia 1 was observed only in 1998. The majority of outbreaks occurred in Vientiane Capital ($n = 42/153$; 27.5%). The majority of vesicular samples submitted to confirm FMD diagnosis were from cattle ($n = 94$; 61.4%); followed by buffalo

($n = 41$; 26.8%) and pigs ($n = 18$; 11.7%). All type A outbreaks occurred in cattle. Table II presents an antigenic analysis of recent Lao FMDV serotypes against vaccine strains, performed by the WRL FMD, using liquid-phase blocking ELISA.

Causes of foot and mouth disease outbreaks in the Lao People's Democratic Republic

It is generally believed that a significant cause of FMD outbreaks in the Lao PDR is the introduction of infected animals into susceptible populations. This may occur either through the transboundary movement of infected animals, since the Lao PDR is a natural trade route within Southeast Asia (5, 12), or the movement of infected animals through local trade.

There is also believed to be an association between livestock density and FMD incidence. The hypothesis is that low animal density equals low FMD incidence and a reduction in the spread of disease. Using livestock demographics for 2005 (4), and FMD incidence figures from 1998 to 2006, a multiple linear regression analysis was conducted to search for associations between livestock density and FMD incidence. Livestock demographics were

Table I

Distribution of outbreaks of foot and mouth disease, type O, in the Lao People's Democratic Republic by year and province

Outbreaks caused by types A and Asia 1 are denoted by (a) and (b), respectively. Figures in parentheses are a proportion of the column total

Province	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Total
Attapu	11	1	–	–	–	–	–	–	–	–	12 (7.8)
Bolikhamxai	–	–	1	–	–	5	2	–	–	–	8 (5.2)
Bokeo	–	–	2	2	–	6	–	–	–	–	11 (7.2)
						1 ^(a)					
Champasak	–	12	–	–	–	–	–	3	–	–	15 (9.8)
Houaphan	–	–	–	–	–	–	–	–	–	–	0
Khammouan	–	–	2	–	–	5	–	–	–	–	7 (4.6)
Louangnamtha	–	–	–	5	–	–	–	–	–	–	5 (3.3)
Louangphrabang	–	–	–	–	–	1	2	2	–	–	5 (3.3)
Phongsali	–	–	–	–	–	–	–	–	–	–	0
Salavan	–	1	–	–	–	–	–	–	–	–	1 (0.7)
Savannakhet	–	9	8	–	–	–	1	–	–	–	18 (11.8)
Xekong	–	–	–	–	–	–	–	–	–	–	0
Vientiane Province	2 ^(b)	–	–	–	–	–	–	–	–	–	2 (1.3)
Vientiane Capital	1 ^(b)	–	1	–	–	18	2	–	15 ^(a)	5 ^(a)	42 (27.5)
Xaignabouli	–	–	11	1	–	–	–	–	–	–	12 (7.8)
Xiangkhoang	–	–	–	12	3	–	–	–	–	–	15 (9.8)
Total	14	23	25	20	3	36	7	5	15	5	153

Table II**Antigenic analysis of selected foot and mouth disease viruses from the Lao People's Democratic Republic, conducted at the World Reference Laboratory for foot and mouth disease, Pirbright, United Kingdom**

The interpretation of 'r values' is as follows: 0 to 0.19 = highly significant variation; 0.20 to 0.39 = protection may be satisfactory if using a potent vaccine or repeated vaccination, and; 0.40 to 1.00 = should confer immunity

WRL FMD Ref. No.	Topotype ^(a)	r values						
		BFS	Manisa	4174	Type O			3039
					IND R2/75	IND 53/79	PHI95	
O/LAO/1/1999		0.3	> 1.0	0.5		0.6		
O/LAO/2/2001	SEA	< 0.2	NP	0.3	0.4	0.8	1.0	> 1
O/LAO/7/2003	SEA		0.41					
O/LAO/20/2003	ME-SA		0.19					
O/LAO/24/2003	ME-SA		0.41					
O/LAO/32/2003	ME-SA		0.50					
					Type A			
		A22 Iraq	A15	A24 Cruzeiro	A Iran 96	A May 97	A Iran 87	
A/LAO/36/2003	ASIA	0.13	0.26	0.06	0.20	0.36	0.25	
					Type Asia 1			
		IND 8/79	SHAMIR 3/98		WBN 117/85		TAI 85	
Asia1/LAO/1/96		> 1	0.4		0.4		0.5	
Asia1/LAO/3/98		0.5	0.8		0.3		1.0	

WRL FMD: World Reference Laboratory for foot and mouth disease

(a) Source: WRL FMD (20)

NP: not performed

SEA: Southeast Asian topotype

ME : Middle Eastern topotype

SA: South Asian topotype

grouped by region (south = 930,000 animals; north = 1,283,000 animals; central = 1,981,000 animals), and demonstrated a positive but non-significant linear correlation ($r^2 = 0.93$, $p = 0.169$) with the overall incidence of FMD outbreaks between 1998 and 2006 (south = 28; north = 33; central = 92). That is, more FMD outbreaks occurred in regions with a higher animal density.

Analysis by species demonstrated significant correlations between buffalo and cattle density and FMD incidence (buffalo $r^2 = 0.99$, $p = 0.012$; cattle $r^2 = 0.99$, $p = 0.051$). Using multiple linear regression analysis of cattle, buffalo and pig demographics by province with outbreak statistics from 1998 to 2006 demonstrated that cattle density was significantly correlated with FMD outbreaks ($p = 0.044$). These results lend weight to the hypothesis that, in general, increasing livestock density leads to increased numbers of FMD outbreaks. This observation is potentially confounded by disproportional numbers of samples submitted from the central region, due to greater access to laboratory services and improved FMD awareness in that area.

Moreover, whilst animal density is implicated as a factor in FMD outbreaks, the influence of the FMDV carrier status

of cattle (16, 17, 18) has not been examined and the role of Asiatic buffalo as a carrier of FMDV needs to be defined.

Details of major foot and mouth disease outbreaks in the Lao People's Democratic Republic during 1998 and 2000

The foot and mouth disease type O outbreak (Southeast Asian topotype) between 1998 and 1999

In September 1998, a significant outbreak of FMD in the southern Lao PDR was reported from the Xamakysai District (in Attapu Province), and subsequently spread to other districts, most probably through animal movements. The disease subsequently spread to the west, via transport routes, to Champasak Province. Seven districts of these two provinces were rapidly affected, with approximately 70 to 100 villages reporting the disease (56 villages were

confirmed to have the disease by mid-January 1999). Morbidity rates in susceptible animals of up to 100% were estimated in some villages. Cattle and buffalo appeared to be the only susceptible species, as no reports of FMD were recorded in pigs or goats. Up to March 1999, the outbreak continued to spread unchecked in both provinces, finally spreading north to Xekong and Salavan provinces. Laboratory testing in the Lao PDR identified the outbreaks as being caused by a type O virus, and genetic analysis by the WRL (O/LAO/4/98) indicated that the virus was a member of the Southeast Asian (SEA) toptotype Cam-94 strain (9) (Table II). From an epidemiological perspective, the high morbidity suggested the introduction of FMD into a naive population, and the rate of spread indicated a population with little prior exposure. Given the proximity of the Lao index cases in Attapu Province to neighbouring Vietnam and Cambodia, it seems plausible that this outbreak originated from a transboundary incursion. The antigenic characterisation of the virus by the WRL FMD (Table II) demonstrated an r value > 1 against the O₁ Manisa strain vaccine.

The foot and mouth disease type O outbreak (pan-Asia strain) between 1999 and 2000

In August 1999, an apparently new outbreak of FMD was reported in the Xepon District of western Savannakhet Province, which borders Vietnam (Fig. 1). An increased susceptibility in pigs (causing significant mortalities in young pigs), as well as cattle and buffalo, raised the possibility of a new FMDV strain. The outbreak spread rapidly eastwards, following highway route No. 9, and eventually reached the Savannakhet provincial capital, Khantibouly (12). Initial characterisation in the Lao PDR demonstrated that this virus was also type O. Samples sent to the WRL FMD indicated that it was a member of the Middle East-South Asia (ME-SA) toptotype pan-Asia strain and therefore had a different origin from the SEA toptotype virus which caused the 1998 to 1999 outbreak. Antigenic analysis at the WRL FMD confirmed that the O₁ Manisa vaccine strain would also be protective against this strain of virus.

Socio-economic impact of foot and mouth disease in the Lao People's Democratic Republic

Studies in a number of Asian countries have demonstrated the significant impact of FMD on the livelihood of farmers (12, 13, 14). In the Lao PDR, many villages in the central and southern regions rely on the production of a dry-season rice crop to provide sufficient rice for the coming year. The wet-season rice crop is also extremely important,

although this can be unpredictable, as annual flooding of these lowland areas can result in the loss of the crop. In FMD-affected villages, the supply of livestock to plough the paddy fields can be severely diminished or absent altogether, resulting in reduced or no planting of the dry-season rice crop (12). To overcome the lack of draught power, buffalo are often rented from neighbouring villages, exacerbating the spread of the disease. In cases where insufficient rice is produced in the villages, livestock (i.e. cattle, pigs or buffalo) may be sold to purchase rice. Affected animals may also become permanently lame, due to secondary bacterial infection, which severely reduces the value of the animal for draught or sale purposes.

Vaccination as a method of controlling foot and mouth disease

Vaccination is not routinely practised to control FMD in the Lao PDR. Some reports provide information on previous vaccination programmes supported by international agencies, but there are few details of these vaccination regimes or their outcomes. It has been reported that various combinations of vaccines have been used (O/A in 1988; O/Asia 1 in 1989 & 1991 to 1993; Asia 1 in 1990), of which 70% were of Indian origin (10); however, the vaccine strain information was not mentioned in the report. In 1992, 49,380 doses of vaccine were administered, primarily in the southern provinces of Champasak, Salavan and Xekong (10). The Royal Thai government has also donated Thai-produced vaccine to the Lao PDR for emergency control purposes. There is anecdotal evidence that some commercial farms import Thai-produced FMD vaccine.

The most recent large-scale FMD vaccination programme in the Lao PDR occurred during 1999 and was supported by the Australian government. The programme was implemented jointly by the Department of Livestock and Fisheries (DLF) and the ACIAR as project AS1/94/38, to:

- control the 1999 to 2000 outbreaks of the FMDV SEA toptotype and pan-Asian strain
- prevent the spread of the disease to other provinces
- reduce the impact on farmer livelihoods and food security.

Following antigenic characterisation of the circulating strains, 100,000 doses of bivalent vaccine (O₁ Manisa and Asia 1 Shamir) in double oil emulsion adjuvant were purchased, as well as vaccination guns and needles. The bivalent vaccine was purchased as this was the only

suitable vaccine available at short notice since no monovalent type O vaccine was obtainable. Two approaches were used to control the spread of FMD:

- a strategic vaccination programme in areas previously affected by FMD, and along recognised animal movement routes, to provide ‘immune buffer zones’. This was coupled with an education programme;
- emergency ‘ring vaccination’ in areas newly affected by FMD.

The strategic vaccination programme

The primary objective of the strategic vaccination programme was to control the spread of FMD from affected areas into unaffected areas. ‘Immune buffer zones’ were created by vaccinating susceptible animals in a 6 km radius around villages which had previously experienced an FMD outbreak in the Attapu, Champasak, Salavan and Xekong provinces. The maximum vaccination radius (6 km) for these buffer zones was calculated by considering the number of affected villages, and the estimated numbers of animals in both affected villages and non-affected surrounding villages. The logistics of co-ordinating human resources, vehicles, vaccine supply, education and finances were the responsibility of the ACIAR project and the DLF. Human resources, a recognised constraint on such a programme, required the participation of staff from the DLF, PLO, DLO and village veterinary workers (VFW). All participants received training in FMD vaccination and control strategies before starting the vaccination programme.

The programme used three vaccination teams, comprising the following members:

- the vaccination team leader (VTL): a DLF staff member with training in vaccination theory. The VTL was also a vaccinator;
- the recorder: a DLF staff member or PLO proficient in data recording. During the vaccination period, the recorder conducted a village interview to obtain livestock numbers and other relevant details. The recorder was also responsible for accounting for the number of vaccine bottles used during the visits to each village;
- vaccinators: a DLF staff member, PLO or DLO with training in vaccination techniques and animal restraint. There were up to two dedicated vaccinators per team;
- the advance team: the advance team worked in conjunction with the vaccination teams to provide advance notice to villages (of at least one to two days) that the vaccination team would visit on a certain date. The DLO, working in co-operation with provincial and DLF staff, performed this duty.

In logistic terms, the VTL reported to the main base sites at the provincial livestock offices of Champasak and Savannakhet. Both sites had good refrigeration facilities and enough accommodation for staff, although many of the vaccination teams also stayed overnight in the villages when necessary. At the end of the day, the data collected by the recorders were collated and checked, and the vaccination guns and associated equipment were disinfected and cleaned.

Implementation and mobilisation of the strategic vaccination programme

Delays in the commencement of the vaccination programme were caused by the early onset of the wet season (mid-April 1999), restricting access to most villages, and a decision was made to postpone the programme. Delays were also caused by the time it took to order, produce and deliver the vaccine (approximately nine weeks) and the antigenic assessment of the subsequent outbreak of the type O pan-Asia strain of the FMDV, which was initially recognised in August 1999. Nevertheless, the delays worked to the advantage of the programme as they allowed the inclusion of the pan-Asia topotype outbreaks, as well as the original SEA topotype outbreaks.

The strategic vaccination programme began in September 1999 and was completed in the second week of December 1999. As a result of the continuing outbreaks in Savannakhet Province, a district within the eastern part of that province, Xepon District, was chosen as the first area for vaccination. In subsequent weeks, the vaccination programme moved south to Salavan, Xekong, Champasak and Attapu provinces. The vaccination programme teams were careful not to ‘back-track’ into infected areas, where there was potential for the vaccination team to inadvertently spread the disease. During this vaccination programme, more than 55,000 doses of vaccine were administered in five provinces (Table III).

Table III
Strategic distribution of foot and mouth disease vaccine and doses administered in the Lao People’s Democratic Republic between September and December 1999

Province	Districts vaccinated	Villages vaccinated	Doses
Savannakhet	6	91	13,964
Salavan	1	38	6,292
Attapu	3	56	9,164
Xekong	2	31	4,644
Champasak	8	144	21,621
Total	20	360	55,685

Emergency vaccination programme

At the end of the strategic vaccination programme in the southern areas of the Lao PDR, approximately 45,000 doses of vaccine remained in storage. It was recognised that there was still potential for additional FMD outbreaks, despite the vaccination programme, due to uncontrolled animal movements. As a result, vaccine was stored at strategic points for rapid distribution should a new FMD outbreak occur; namely, provincial and district livestock offices in Vientiane Capital, Savannakhet and Champasak provinces. Sporadic FMD outbreaks occurred in Vientiane Capital, Vientiane Province and Savannakhet in mid-December 1999 and the early months of 2000, requiring ring vaccination to control the disease. Additional smaller outbreaks in Salavan and Khammouan provinces also required vaccine.

When an outbreak occurred, the provincial or district livestock authorities made a formal request to the DLF for vaccine and associated assistance. Vesicle samples from the outbreak were tested by the ACIAR project laboratory and virus typing results obtained. The vaccine was transported by road or air (where possible) to the requesting authority and administered by DLF, provincial and district officers.

Objective measures of the success of the 1999 to 2000 vaccination programme

Controlling the disease

Assessing such a programme requires a review of the initial objectives. The objective of this programme was to control – through vaccination – the spread of FMD from affected to unaffected areas. It was not the objective of the programme to totally eradicate FMD from the Lao PDR.

Therefore, the primary and best independent measure of the success of the programme was the absence of new major outbreaks of FMD in previously affected areas. This was largely the case (Table I), with the disease being confined to southern regions of the Lao PDR.

Pre-vaccination and post-vaccination serology

Pre-vaccination and post-vaccination serology was used to determine whether vaccination induced protective immunity in individual animals and herds. Some 359 serum samples were collected from four provinces before the vaccination programme took place (Table IV). Sera were screened at a dilution of 1:40 for the presence of FMDV antibodies against serotypes O, A and Asia 1, using the FMDV liquid-phase blocking ELISA (6, 7). Background immunity similar to that observed during strategic and abattoir FMDV serological surveys (1) was noted (type O: 12.5%; type A: 6.4%; type Asia 1: 13.1%). In addition, 182 sera were assessed, approximately six months after vaccination, from animals in the Khammouan and Savannakhet provinces. These areas were included in the emergency and strategic vaccination programmes, respectively (Table IV). Herd immunity levels of more than 80% are considered effective in preventing the spread of FMD within a herd. Nine out of the ten herds (90%) sampled demonstrated herd immunities greater than 80% for type O. Of the 182 post-vaccination samples collected, 155 (85.2%) tested positive serologically for the presence of antibodies against type O. These results indicate that vaccination against type O was effective in the majority of cases. In the case of type Asia 1, 104 samples (57.1%) were serologically positive and only two of the 10 herds (20%) indicated greater-than-80% immunity, although seven herds (70%) indicated greater-than-50% immunity. A possible reason for this lower-than-expected immunity against type Asia 1 may be interference with vaccine

Table IV
Serological results for foot and mouth disease virus in sera collected pre-vaccination and approximately six months post-vaccination, in the Lao People’s Democratic Republic

Figures in parentheses are a proportion of the total number of animals sampled in each row

Timing of sample collection	Province	Number of districts sampled	Number of villages sampled	Number of animals sampled	FMDV liquid-phase blocking ELISA ≥1:40 (%)		
					O	Type A	Asia 1
Pre-vaccination	Savannakhet	6	13	109	9 (8.2%)	0	6 (5.5%)
	Salavan	1	2	20	1 (5.0%)	1 (5.0%)	6 (30.0%)
	Attapu	3	8	80	23 (28.8%)	7 (8.8%)	10 (12.5%)
	Xekong	1	1	10	0	0	0
	Champasak	5	15	140	12 (8.6%)	15 (10.7%)	24 (17.1%)
	Total	16	39	359	45 (12.5%)	23 (6.4%)	46 (12.8%)
Post-vaccination	Khammouan	2	3	48	29 (61.%)	0	11 (22.9%)
	Savannakhet	2	7	134	126 (94.0%)	0	93 (69.4%)
	Total	4	10	182	155 (85.2%)	0	104 (57.1%)

FMDV: foot and mouth disease virus
 ELISA: enzyme-linked immunosorbent assay

uptake by residual type Asia 1 immunity, as demonstrated in the pre-vaccination serology. Other reasons for variability in post-vaccination immunity are:

- the quality (potency) of the vaccine
- the effectiveness of the vaccine cold chain
- whether the vaccine was correctly administered.

Type A antibodies were not detected in any of the animals. This may be expected, as a type A strain was not included in the vaccine. However, background immunity was demonstrated in some provinces during pre-vaccination (Table IV) and in previous structured and abattoir serological surveys (1).

Benefits and constraints of the vaccination programme against foot and mouth disease in the Lao People's Democratic Republic

The most obvious benefit of such a programme to the Lao PDR was the control of FMD. Nevertheless, less tangible benefits were also gained, such as:

- a) DLF, PLO and DLO staff gained training and experience in large-scale vaccination
- b) PLO and DLO staff and villagers were educated in FMD prevention
- c) the general awareness of FMD and other infectious diseases was raised at all levels
- d) local authorities were empowered in disease control management.

Constraints on the success of such programmes in the Lao PDR included:

- a) the unrestricted movement of infected animals to uninfected zones. These movements included transboundary (international) movements, inter-provincial (long-distance, domestic) movements and local foraging (village to village, district to district);
- b) the limited numbers of trained staff;
- c) the presence of unvaccinated susceptible animals in vaccinated villages, due to the difficulty of ensuring the collection of all animals for vaccination;
- d) difficulties in language and communication between various stakeholders in the vaccination programme (e.g. the level of general literacy is not high and, in some provinces, not all cattle owners are ethnic Lao).

Conclusions

Foot and mouth disease continues to constrain livestock production in the Lao PDR, threatening food security and the welfare of marginalised farming families. The disease remains endemic in neighbouring Thailand, Vietnam and Cambodia, which places the Lao PDR at constant risk of new FMD infections through transboundary movements of animals. The authors have also demonstrated that animal density appears to influence the incidence rate of FMD and the spread of disease. However, continued monitoring is required to confirm these observations, due to the presence of possible confounding factors. Whilst animal density is implicated as a factor in FMD outbreaks, the influence of the FMDV carrier status of cattle has not been examined and the role of Asiatic buffalo as a carrier of FMDV needs to be defined.

As demonstrated in the outbreaks of type-O SEA and the pan-Asia strains of FMDV in southern regions of the Lao PDR, during 1999 and 2000, vaccination can be an effective method for controlling smaller outbreaks in an FMD-endemic setting. A slaughter policy is not an option, due to the impacts on farmer livelihoods caused by no compensation, and animal movement restrictions can be difficult to enforce. Sustainable local interventions to prevent disease occurrence, such as quarantine and infection control methods, should also be considered.

For more than the past decade, many multilateral projects have been established to control the spread of FMD. These include the FMD World Organisation for Animal Welfare (OIE) Sub-Commission for FMD Control in Southeast Asia, through the Regional Co-ordination Unit in Bangkok; the FAO with the Global Framework for progressive control of Transboundary Animal Disease; and bilateral programmes, such as the FMD control activities assisted and co-ordinated by ACIAR and AusAid.

These programmes not only supported control measures but also provided a forum and support network for regional FMD-related communication. While these endeavours have provided a platform for engagement and the development of technical capacity, the challenge of FMD control in Southeast Asia remains.

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Fièvre aphteuse en République démocratique populaire lao : I. Un aperçu des derniers foyers et les enseignements des programmes de lutte

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Résumé

La fièvre aphteuse est à l'origine de foyers sporadiques en République démocratique populaire lao (Laos). Le Laos offrant une voie de passage pour les déplacements transfrontaliers d'animaux, des foyers de fièvre aphteuse y sont régulièrement notifiés, occasionnant à chaque fois de graves problèmes économiques pour les éleveurs et leurs familles. Dans cet aperçu de l'histoire récente de la fièvre aphteuse au Laos entre 1997 et 2006, les auteurs décrivent les aspects virologiques et épidémiologiques de la maladie, les mesures de lutte appliquées, la distribution des foyers, les sérotypes en cause, l'épidémiologie moléculaire des virus et les programmes de vaccination à grande échelle. La plus forte prévalence concerne le sérotype O, qui a été notifié chaque année de 1998 à 2005. La majorité des foyers sont survenus dans la capitale de Vientiane (n = 42 ; 28 %) ; les foyers ont surtout affecté les bovins (n = 94 ; 61 %), les buffles (n = 41 ; 27 %) et les porcs (n = 18 ; 12 %). Les foyers dus au sérotype A affectaient les bovins exclusivement. Des foyers dus au sérotype Asia 1 ont été notifiés dans les provinces du Centre, autour de Vientiane, entre 1996 et 1998.

Mots-clés

Asie – Bovidé – Bovin – Buffle – Fièvre aphteuse – Porc – République démocratique populaire lao – Suidé – Vaccination.



La fiebre aftosa en la República Democrática Popular Lao: I. Estudio de brotes recientes y enseñanzas extraídas de los programas de control

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Resumen

La fiebre aftosa causa brotes esporádicos en la República Democrática Popular Lao (RDP Lao). Dado que el país es un punto de paso importante en los movimientos transfronterizos de animales, periódicamente se producen brotes de fiebre aftosa que resultan perjudiciales para la economía de los productores. Los autores pasan revista a la historia reciente (entre 1997 y 2006) de la enfermedad en la RDP Lao, examinando sus distintos aspectos virológicos y epidemiológicos (entre otros la distribución de los brotes, los serotipos causantes y la epidemiología molecular de los virus) y las medidas de control adecuadas (como los programas de vacunación a gran escala). Cada año, entre 1998 y 2005, se ha notificado la presencia del serotipo dominante, que es el tipo

O. La mayoría de los brotes tuvieron lugar en la capital de Vientiane (n = 42; 28%) y afectaron básicamente a bovinos (n = 94; 61%), seguidos de búfalos (n = 41; 27%) y cerdos (n = 18; 12%). Todos los brotes de tipo A se dieron en ganado vacuno. Entre 1996 y 1998, en las provincias centrales aledañas al capital de Vientiane, se notificaron brotes del tipo Asia 1.

Palabras clave

Asia – Bovinos – Búfalo – Cerdo – Fiebre aftosa – Ganado vacuno – Porcino – República Democrática Popular Lao – Vacunación.



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