

Original article

Risk factors association with Foot and Mouth Disease outbreak in cattle in Vientiane, the Capital City of Lao People's Democratic Republic

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Abstract The objective of this study was to determine risk factors associated with villages having Foot and Mouth Disease (FMD) in cattle in Vientiane, The Capital city of Lao People's Democratic Republic (Lao PDR). All data were collected from July 2007 to August 2008. This study was an unmatched case-control study by using questionnaires interview with the chief of villages and stake-holders. The data were then analyzed through univariate analyses using chi-square test with 95% confidence interval. The results showed that 4 out of 27 tested variables were associated with an outbreak of FMD as follows: villages with public pasture where cattle commingled with goats, villages with free transboundary animal movement, villages where animals were raised in wild areas, and villages with low land areas. The odds ratios were of 9.9, 6.5, 5.54 and 2.88, respectively. In conclusion, the basic information of risk factors associated with an outbreak of FMD in cattle in Vientiane Capital was important and can be used for setting up strategic control programs toward FMD in Vientiane capital. Moreover, further studies on the outbreak of FMD and setting up effective control program is still important and will be carried on in other areas in Lao PDR. *Chiang Mai Veterinary Journal 2009;7(2):97-106.*

Keywords: Risk factors, foot and mouth disease, cattle, outbreak, Lao PDR

Introduction

Foot and mouth disease (FMD) is a highly contagious disease of cloven hoofed animals especially in domestic livestock such as cattle, buffaloes, sheep, goats and pigs.⁽¹⁻³⁾ Early indication of infection to the disease is a high fever with temperature up to 42°C, and followed by either a clinical or subclinical FMD infection.⁽⁴⁾

The disease spreads rapidly in a non-immunized animal, because this disease causes very high morbidity but low mortality, except for young animals that mortality rates are higher than the rates for older animals.⁽⁵⁾ FMD is classified in genus *Aphthovirus*, in the *Picornaviradae* family with seven serotypes: O, A, C, SAT1, SAT2, SAT3

and Asia1.^(3,6) The FMD outbreak in many countries within the South East Asia region including Lao PDR were O, A and Asia1, however, only type O was a major serotype causing an outbreak in the Lao PDR.⁽⁷⁻¹⁰⁾

In the Lao PDR, FMD has been endemic since 1946, but there was no formal report of the outbreak, until considerably recognized in 1994 and 1995. The number of outbreaks increased because of increasing movement of animals into the capital city.⁽¹¹⁾ However, FMD outbreak had been reported in Vientiane Capital for 9 months in 2007 - 2008, the infection affected approximately 4,175 (5.45%) cattle, 561 (3.39%) buffaloes and 344 (2.06%) goats. Currently, the government of Lao PDR had launched the FMD outbreak control by ring vaccination around outbreak area concomitant with strict animal movement control.⁽¹²⁾

The dynamics and impacts of FMD outbreak in smallholder farming systems in Khanthabouly district in Savannakhet Province have been studied. They found that trading of livestock animals inter-border (The Socialist Republic of Vietnam - Lao PDR) was a main cause of FMD infection and the diseases were spread rapidly within villages.⁽¹³⁾ In Northern Thailand, the risk factors of FMD outbreak in farms were due to sharing pasture with other villages, no disinfectant spraying in house, FMD outbreak in nearby farms, artificial insemination officer, no

disinfectant pool, total number of cattle in farms, number of visiting by the Department of Livestock Development officer, number of vehicles come in farm, proportion of vaccinated animal, distance to the nearest slaughter house, buying new stock⁽¹⁴⁾, and sharing of water source.⁽¹⁵⁾ Interestingly, the risk factors for FMD at province level were the purchase of cattle from markets, mixing of herds at watering points, and having buffalo near the herd in Cameroon.⁽¹⁶⁾ However, the information of the risk factors related to an outbreak of FMD in Lao PDR has never been studied to date. Thus, the aim of this study was to determine risk factors associated with FMD in cattle at a village level in Vientiane, Lao PDR.

Materials and Methods

This study was unmatched case-control study with a ratio of case: control at 1:1. Villages that had FMD outbreak in cattle during July 2007 to August 2008 were a case group and villages without FMD outbreak in cattle were a control group. The outbreaks were reported by a chief of village or a district livestock official (Officer) including stakeholders, and had confirmed by LP-ELISA. The case and control samples were chosen by simple random sampling. The study was carried out in the Vientiane Capital, Central part of Lao PDR. (Figure 1), the area included 9 districts with 500 villages of which 372 villages raise livestock. The interview data were collected

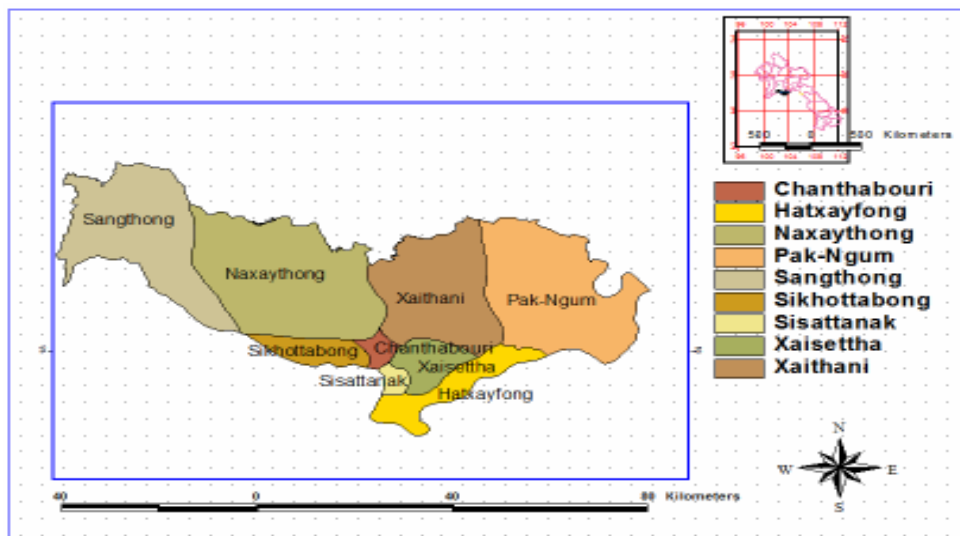


Figure 1. Map of Vientiane, the Capital City of Lao PDR

in 92 villages by well-trained interviewers. The form was tested and retested in the field priority and it was adjusted accordingly. It was composed of 7 parts as follows: demographic information, geographic information, people and vehicles moving in and out of the village, animal husbandry, FMD outbreak information, animal movement information, and recommendations from interviewees.

Data were managed and analyzed in Microsoft Excel[®] and EpiCalc 2000. Descriptive analysis was done for all continuous variables. The discrete variables were grouped and demonstrated as percentages. The continuous variables were categorized into 3 categories using the characteristic of data distribution, minimum to first quartile, first to third quartile and third quartile to maximum indicated as low, median and high. Associations between factors and FMD outbreaks were analyzed using odds

ratio and Chi-square test with 95% confidential interval.

Results

During July 2007 to August 2008, the heads of 92 villages (50 cases and 42 controls) in Vientiane Capital of Lao PDR were interviewed by using validated questionnaires. Most of the interviewees' educations were secondary school followed by primary school, higher diploma and bachelor or higher with the percentage of 70.7%, 22.8%, 5.4% and 1.1%, respectively. The occupations ranking from high to low were rice farmers, animal raisers, general traders and employees. The summary of continuous variable is shown in Table 1.

The univariate analysis indicated 4 significant risk factors (out of 27 variables) that were related to FMD outbreak in cattle at the village level in Vientiane Capital. The significant factor-relating to FMD outbreak were public pasture where

cattle have commingled with goats, The odds of FMD for villages with public pasture where cattle commingled with goats, villages with free transboundary animal movement, villages where animals were raised in wild areas, and villages with low land areas were of 9.9, 6.5, 5.54 and 2.88 times more likely than the odds of FMD for village without the factors, respectively, as shown in Table 2.

Table 1. Summary statistics for variables used in the analysis in cattle in Vientiane, The Capital city of Lao PDR.

Variables	Unit					Minimum–Maximum
	Mean	Q1	Median	Q2	SD	
Families in village	275.92	232	245.5	437	158.02	47 - 960
Area of village (hectare)	382.25	217.5	348	496	220.08	42 - 935
Average Income/month (US\$)	71.03	55.68	58.70	70.33	81.00	11.72 – 820.54
Number of cattle in village	324	109	223	529	283.61	11 – 1,292
Number of buffalo in village	34.04	6	14.5	39	47.25	0 - 217
Number of pig in village	58.16	6.5	30	78	77.49	0 - 387
Number of goat in village	61.52	16.5	38	85	85.12	0 - 715
Times of tractor get into village	0.20	0	0	0	1.05	0 - 9
Times of antique buyer's truck get into village	6.04	0	2	0	9.87	0 – 30
Times of manure buyer get into village	0.35	1	0	4	1.24	0 – 9
Times of goods buyers get into village	10.9	1	4	25	11.9	0 – 30
Times of dog traders get into village	1.11	0	0	1	3.36	0 – 30
Times of kitchenware Salesman get into village	2.80	0	1	2	5.75	0 – 30
Times of freelance slaughter get into village	1.96	0	0	0	7.44	0 – 30
Times of workers in slaughter houses get into village	3.59	0	0	0	9.78	0 – 30
Number of cattle bought per trader per village	1.09	0	1	2	1.63	0 - 12
Number of cattle sold per trader per village	3.15	1	2	5	3.24	0 – 10
Areas of pasture per village (hectare)	1.11	0	0	0	6.43	0 – 50

Note: Q1 = Lower quartile; Q3 = Upper quartile; SD = Standard Deviation; Currency = 1US\$/8531 Kips on 28 May 2009

Table 2. Univariate analysis of factors associated with FMD outbreak in cattle in Vientiane, The Capital city of Lao PDR.

Factors (exposed/ not exposed)	Case (n; %)		Control (n; %)		OR (95% CI)	P-value
	Exposed	Not exposed	Exposed	Not exposed		
Education						
Primary school / others	9 (18.0)	41 (82.0)	12 (28.6)	30 (71.4)	1.82 (0.68-4.88)	0.34
Secondary school / others	36 (72.0)	14 (28.0)	29 (69.0)	13 (31.0)	1.15 (0.47-2.88)	0.93
Number of cattle in village						
High / low	17 (34.0)	10 (20.0)	6 (14.0)	13 (31.0)	3.68 (1.06-12.77)	0.07
High / median	17 (34.0)	23 (46.0)	6 (14.0)	23 (55.0)	2.83 (0.95-8.47)	0.10
Median / low	23 (46.0)	10 (20.0)	23 (55.0)	13 (31.0)	1.30 (0.47-3.56)	0.79
Number of buffalo in village						
High / low	7 (14.0)	26 (52.0)	5 (33.0)	18 (12.0)	1.03 (0.28-3.77)	0.77
High / median	7 (14.0)	16 (32.0)	5 (33.0)	14 (43.0)	1.23 (0.32-4.74)	0.96
Median / low	16 (32)	26 (52)	14 (43)	18 (12)	0.79 (0.31-2.20)	0.80
Number of goat in village						
High / low	18 (37.5)	6 (12.5)	9 (24.3)	11 (29.7)	3.67 (1.02-13.14)	0.08
High / median	18 (36.0)	24 (50.0)	9 (33.0)	17 (46.0)	1.42 (0.51-3.90)	0.67
Median / low	24 (50.0)	6 (12.5)	17 (46.0)	11 (29.7)	2.59 (0.80-8.36)	0.18
Number of pig in village						
High / low	16 (32.0)	6 (13.0)	7 (17.0)	9 (25.0)	3.43 (0.88-13.39)	0.14
High / median	16 (35.0)	24 (52.0)	7 (19.5)	20(55.5)	1.90 (0.65-5.52)	0.35
Median / low	24 (52.0)	6 (13.0)	20(55.5)	9 (25.0)	1.80 (0.55-5.92)	0.51
Having goat per village: Yes/No	49 (98.0)	1 (2.0)	37 (88.0)	5 (12.0)	6.62 (0.74-59.11)	0.13

Factors (exposed/ not exposed)	Case (n; %)		Control (n; %)		OR (95% CI)	P-value
	Exposed	Not exposed	Exposed	Not exposed		
Flooding: Yes/No	6 (12.0)	44 (88.0)	5 (11.9)	37 (88.1)	1.01 (0.28-3.57)	0.75
Low land: Yes/No	22 (44.0)	28 (56.0)	9 (21.4)	33 (78.6)	2.88 (1.14-7.26)	0.03*
Animal grazing in wild area: wild/ other	24 (48.0)	26 (52.0)	6 (14.3)	36 (85.7)	5.54 (1.98-15.47)	0.01*
River in village: Yes/No	16 (32.0)	34 (68.0)	16 (38.1)	26 (61.9)	1.31 (0.55-3.09)	0.69
Road: main road /sub-road	30 (60.0)	20 (40.0)	16 (38.1)	26 (61.9)	2.44 (1.05-5.65)	0.06
Market: Yes/No	10 (20.0)	40 (80.0)	5 (11.9)	37 (88.1)	1.85 (0.58-5.92)	0.44
Tractor into village: Yes/No	5 (10.0)	45 (90.0)	1 (2.4)	41 (97.6)	4.56 (0.54-40.64)	0.29
Animal Freight car into village: Yes/No	49 (97.8)	1 (2.2)	41 (97.6)	1 (2.4)	1.20 (0.07-19.71)	0.55
Animal manure buyer into village: Yes/No	10 (20.0)	40 (80.0)	2 (4.8)	40 (95.2)	5.00 (1.03-24.28)	0.06
Antiques buyers' car into village: Yes/No	0 (0)	50 (100)	1 (2.4)	41 (97.6)	ND	
Dog traders into village: Yes/No	26 (52.0)	24 (48.0)	13 (31.0)	29 (69.0)	2.42 (1.02-5.70)	0.06
Kitchenware salesman into village: Yes/No	37 (74.0)	13 (26.0)	31 (73.8)	11 (26.2)	1.10 (0.44-2.76)	0.97
Method of husbandry: rotation/free	27 (54.0)	23 (46.0)	21 (50.0)	21 (50.0)	1.17 (0.52-2.67)	0.86
Villages with animals moving into village: Yes/No	16 (32.0)	34 (68.0)	0 (0)	42 (100)	ND	
Villages with public pasture where cattle commingled with goats: Yes/No	45 (90.0)	5 (10.0)	20 (47.6)	22 (52.4)	9.90 (3.28-29.8)	0.01*
Villages with public pasture where cattle nurture with pig: Yes/No	7 (14.0)	43 (86.0)	1 (2.4)	41 (97.6)	6.67 (0.79-56.6)	0.10

* = Statistical significant difference at $p < 0.05$; OR = odds ratio; 95% CI = 95% confidence interval; ND = Not determined.

Discussion

This study mainly demonstrated the risk factors associated with the FMD outbreak at village level of Vientiane Capital. The Villages where the cattle were commingled with goats and animal could move to the wild areas were the most important factors to outbreak of FMD. This finding was similar to the studies of Cleland et al., (1996) and Bronsvoort et al., (2004). Goats were highly susceptible to the FMD virus through the aerosol route,⁽¹⁷⁾ these might be the cause of infection to other animals raised together in the same area. Once an animal was infected, the virus can be disseminated into environment including field pasture, water resources and soil.⁽¹⁷⁻¹⁸⁾ Therefore, raising cattle and goat at the same pasture areas and sharing the same water source could be the cause of an outbreak of FMD, which was similar to the finding of FMD outbreak in Thailand.⁽¹⁴⁾ The sharing of pasture and water source is common in Lao PDR because the majority of smallholders in Lao PDR feed their animals by freely allowing the animals to roam in public pasture, thus promoting the spread of FMD.

Our study found that approximately 80% of villages in Lao PDR let animals move freely to other villages attributed to the insufficiency of pasture. In case that infection occurs, the FMD virus can be viable in the environment for a long

period of time.⁽⁴⁾ Transmission among cattle can occur by direct contact to other animals in the same areas by aerosol, because the respiratory system of cattle is very susceptible to aerosol virus.⁽²⁾ In this study, low land was one of a key risk factor of FMD outbreak in cattle in the Vientiane capital, of which it has never been reported elsewhere. In the rainy season, water flows from the high land area down to the pasture field in the low land area and this may cause a flow of FMD virus from infected area into the studied areas. Flooding was defined as water heavily flows into an area and the water was stagnant in that area for a few days. In case that the water contained FMD virus, the virus could contaminate the environment and survive for a long time. However, flooding was not a significant risk factor for an outbreak of FMD in Vientiane, because in our study only 6 out of 50 infected villages were experienced flooding. Geeing and Lubroth (2002) reported that the virus could survive in dry fecal material for 2 weeks, in slurry for 6 months, in urine for 39 days and soil surface for 4 weeks. However, the duration can be expected much shorter in hot climate countries.⁽⁴⁾ Besides, these can be windborne and spread many kilometers up on appropriate conditions as reported.⁽¹⁹⁾ Because flooding was not a significant risk factor, the probably virus present in the water may be diluted or killed prior to contaminating the area.

Conclusion

This study identified the risk factors of FMD outbreak which occurred in Vientiane Capital, during July 2007 to August 2008. They were villages having public pasture where cattle commingled with goats, villages with free transboundary animal movement, villages where animals were raised in wild areas, and villages with low land areas. This was the first study of risk factor associated with FMD in cattle in Vientiane Capital of Lao PDR. Moreover, this study gave fundamental information of related risk factors to the FMD. Therefore, it was valuable for implementing the effective prevention strategic activities toward an outbreak of FMD in other areas for example: Vientiane, Bolikhamxai, Xayabouri, and Xiangkhoang provinces of Lao PDR. The Department of Livestock and Fisheries (DLF), who are responsible of promoting animal health and controlling animal diseases, must take much effort to the surveillance program especially for suspected animals of FMD infection. The working team (Veterinary Village Worker or VVW) must shorten the timing of report and collection of sample to the National Animal Health Center at Vientiane capital, and pay more attention on animal movement control in outbreak area and ring vaccination around an outbreak area.

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