Preventive Veterinary Medicine 159 (2018) 115–122

Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Risk factors for emergence of exotic foot-and-mouth disease O/ME-SA/Ind-2001d on smallholder farms in the Greater Mekong Subregion

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ARTICLE INFO

Keywords:
Biosecurity
Epidemiology
Outbreak
Cattle
Buffalo
Transboundary

ABSTRACT

Foot-and-mouth disease (FMD) is a significant endemic transboundary animal disease in Lao People's Democratic Republic (Lao PDR) and throughout the Greater Mekong Subregion (GMS). The disease has been shown to perpetuate the cycle of smallholder poverty through reduced animal production, plus limitations on market access for trading in livestock and their products. Despite significant national and multilateral efforts to control FMD over the past two decades, endemic FMD viruses (FMDVs) continue to circulate in Lao PDR. Further, the threat from new and emerging FMDVs is increasing as transboundary movements in the region intensify in response to increasing regional demand for meat. Although the economic impacts of FMD on smallholder farmers in Lao PDR are significant, studies investigating household-level risk factors for FMD are lacking. Following an outbreak of a novel FMDV (O/ME-SA/Ind2001d) in Lao PDR in 2015, a questionnaire and serological study were conducted in Naxaythong District to identify household-level risk factors associated with this outbreak, as well as endemic circulating viruses in the outbreak area. Data were analysed using a multivariable generalised estimating equation (GEE) model with a logit link function and associations were calculated as odds ratios (OR) with 95% confidence intervals ($CI_{95\%}$). After adjusting for other variables, the practice of quarantining new livestock for a minimum of two weeks prior to introduction to a herd was found to be a significant protective factor during the 2015 outbreak (OR 0.225, $CI_{95\%}$ [0.06, 0.88], p-value 0.003). In addition, households owning one or more animals with titres to the non-structural proteins of FMDV, indicating prior infection, had 5.5 times the odds ($CI_{95\%}$ [6.16, 49.11], p-value < 0.001) of sharing communal grazing land with neighbouring villages. These findings indicate that implementing basic on-farm biosecurity and improved husbandry measures to minimise FMDV circulation at the household level are important and reinforce the need to enhance the education of smallholder farmers in infectious disease control.

1. Introduction

Foot-and-mouth disease (FMD) is the most significant economic transboundary animal disease globally. The disease impacts negatively on smallholder farmers in the Greater Mekong Subregion (GMS), particularly the developing agrarian economies including the Lao People's Democratic Republic (Lao PDR) (Young et al., 2014a; Nampanya et al., 2014b). Dependency on livestock for subsistence is a common feature of the lower income sectors in such countries and controlling FMD is considered a key focus for poverty reduction initiatives (Knight-Jones and Rushton, 2013). Although FMD-related mortality is generally low, the economic impact of FMD on smallholders can be significant due to production losses and indirect costs involving treatment, loss of draught power and trade limitations (James and Rushton, 2002; Nampanya et al., 2014a, b).

In Lao PDR, smallholders produce more than 94% of all livestock products (Khounsy et al., 2008; Nampanya et al., 2014a). FMD presents a significant barrier for efficient livestock production in the country, with losses from FMD in 2011 estimated at almost 12% of the predicted farm gate value of the national large ruminant herd (Nampanya et al.,

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https://doi.org/10.1016/j.prevetmed.2018.09.007
Received 2 July 2018; Received in revised form 3 September 2018; Accepted 5 September 2018

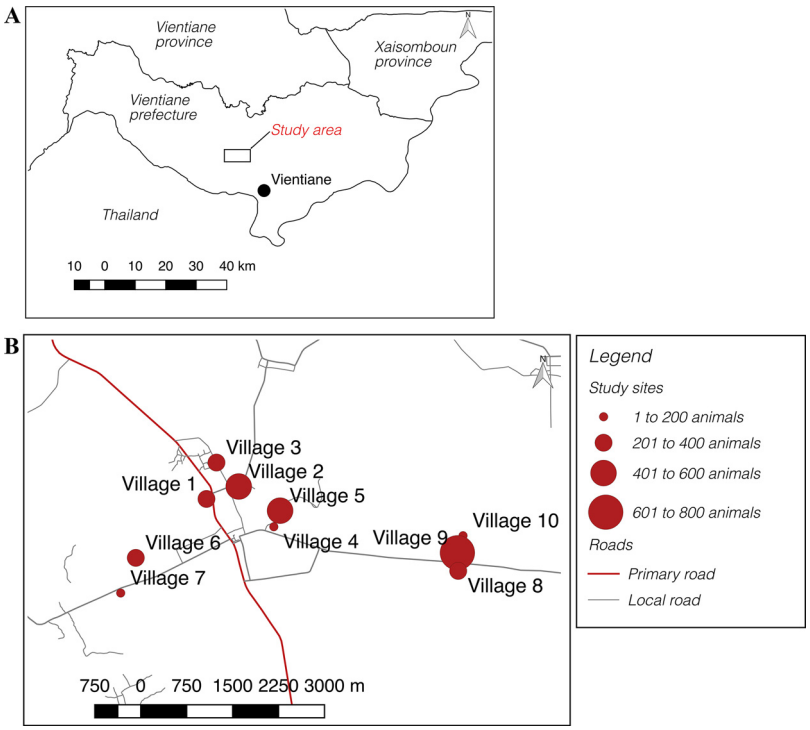

Fig. 1. a & b: Maps illustrating the (a) study area and (b) location of villages and size of large ruminant population.

2014b). At the smallholder level, direct and indirect losses may amount to as much as 60% of the annual household income (Nampanya et al., 2013a). However, as underreporting of outbreaks in Lao PDR and other GMS countries is likely, the incidence and impact of FMD on smallholder farmers is also likely to have been underestimated (Nampanya et al., 2013b; Young et al., 2016).

Knowledge of FMD epidemiology in the GMS has expanded over the past two decades through national and multilateral donor project collaborations, and coordination activities led by the World Organisation for Animal Health (OIE) through the South-East Asia and China Foot and Mouth Disease (SEACFMD) campaign (OIE, 2016b) and the framework of the Progressive Control Pathway (PCP) (OIE and FAO, 2012). The SEACFMD campaign, initially established in 1997 by the OIE and its collaborative partners, is now in its fifth phase, with a regularly updated roadmap aimed at long-term sustainable FMD prevention and control (OIE, 2016b). However, despite such control efforts, endemic FMD viruses (FMDVs) continue to circulate in Lao PDR and threats from emerging viruses are increasing as transboundary movements in the region intensify (Madin, 2011; Smith et al., 2015). Successful FMD control will require considerable and sustained financial and political investment in GMS countries, and recent research has highlighted the importance of engaging with smallholder farmers to increase farmer husbandry and on-farm biosecurity knowledge and improve understanding of household-level risk factors (Nampanya et al., 2014a, b; Young et al., 2015, 2017). Several recent studies in the GMS have identified the need for village biosecurity training and implementation of change management practices to reduce the risk of infectious diseases occurring at the household level (Nampanya et al., 2010; Young et al., 2015, 2017).

In Lao PDR, transboundary trade in livestock occurs across national borders shared with multiple countries with endemic FMD infection (OIE SRR-SEA, 2016a), with the distribution and movement of FMD viruses reflecting this trade (Gleeson, 2002; Cocks et al., 2009; Smith et al., 2015). FMD control presents a particular challenge as the country is situated on a thoroughfare for animal movements between Myanmar and Thailand to China and Vietnam (Khounsy et al., 2008; Windsor, 2011; Smith et al., 2015). In recent years, rising market demand for animal products in advancing regional economies has resulted in an increasing volume of unofficial livestock movements (Madin, 2011; Smith et al., 2015), resulting in trade routes from India and Bangladesh transiting through Lao PDR (Smith et al., 2015). Managing the risks of emerging FMDVs associated with increasing livestock and animal product movements is a critical issue if national and regional FMD control initiatives are to be sustainable.

In April 2015, the Lao Department of Livestock and Fisheries (DLF) detected the first outbreak of the South Asian strain of FMD type O/ME-SA/Ind2001d (the Ind2001d sub-lineage within the Middle East-South Asia topotype of serotype O, or O/Ind2001d) in the GMS (FAO, 2015; Qiu et al., 2017). The outbreak occurred in Naxaythong District in Vientiane Capital and was the first reported outbreak of FMD in this district since 2007 (OIE SRR-SEA, 2016a). The O/Ind2001d virus has since been detected regionally in Vietnam, Myanmar, Thailand, China and the Republic of Korea (FAO, 2017; Qiu et al., 2017). The continued spread of FMD O/Ind2001d reinforces the need for an understanding of the risk factors associated with disease transmission in order to develop the most appropriate evidence-based control strategies.

Although the economic impacts of FMD on smallholder farmers in Lao PDR are significant, studies investigating risk factors for FMD transmission at the smallholder level are limited (Cleland et al., 1996). This paper reports on a study that investigated the household-level risk factors associated with emerging and endemic FMD viruses in Naxaythong District, driven by the 2015 emergence of O/Ind2001d. The objective was to provide improvements in evidence-based management interventions for FMD control on smallholder farms in Lao PDR and the wider GMS.

2. Materials and methods

This research was conducted within the research project ‘Enhancing transboundary livestock disease risk management in Lao PDR’ administered by the University of Sydney and the DLF of Lao PDR, with approval of the University of Sydney Animal Ethics (2015/765) and Human Ethics (2014/783).