Risk-based FMD control

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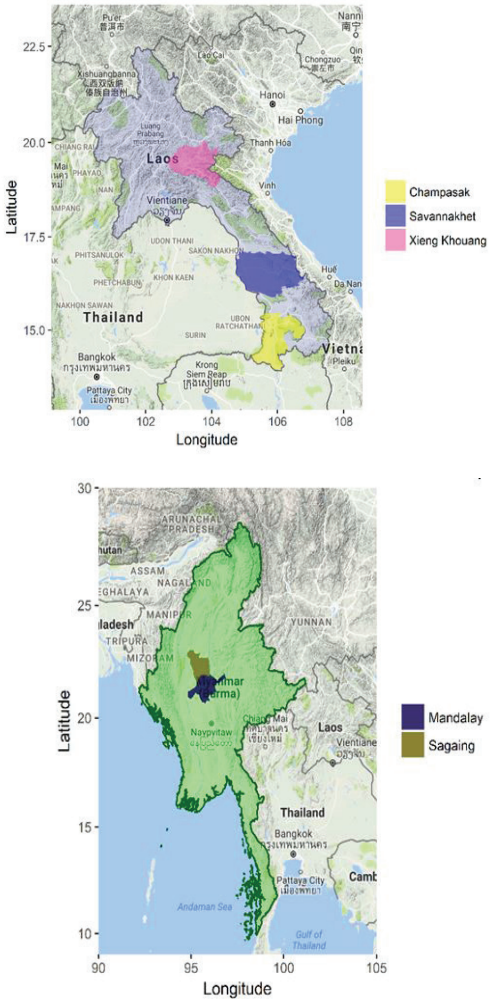
Background

Foot-and-Mouth Disease (FMD) is an insidious, highly infectious disease that affects livestock holders in Asia. The International Organisation for Animal Health (OIE) is heading a multi-country initiative to control and eventually eliminate FMD virus from South-East Asia and China (SEAC-FMD). The region is characterised by small household economies, limited public resources and poor infra-structure. Illegal across-border movements of livestock have increased in the past 5-10 years due to steep value chain incentives from Myanmar, Lao People's Democratic Republic (PDR) and Cambodia to Vietnam and China. Transboundary movements of cattle to markets are an added threat to endemic FMD that in this region is mainly associated with virus serotypes A and O. Hence, across border movements likely introduce new viruses (e.g. Asia 1) that can cause large outbreaks in endemic areas.

The aim of major grants from Australia (2010-2015) and New Zealand (2016-2020) is to "control FMD through a risk-based partial vaccination strategy" along with biosecurity, surveillance and awareness campaigns. The New Zealand funded programme continues the former six-year Australian investment. The Ministry of Foreign Affairs and Trade (MFAT) contracted the sub-regional OIE-Office in Bangkok to implement the programme in 2016 for an initial duration of five years (2016-2020). Here we report the results of initial baseline surveys and post-vaccination monitoring to inform the development of control strategies in Myanmar and Lao PDR. The point is to discuss the currently available evidence that the two countries intend to use for strategy development.

Figure 1. Location of target areas for FMD control: Lao People's Democratic Republic (top) and Myanmar (below).



Surveys

Baseline surveys were conducted in households (hh) of three provinces of Lao PDR in 2016/17 (Champasak CH, Savannakhet SV, Xiengkhouang XK) and two central regions of Myanmar in 2017 (Mandalay MA, Sagaing SA; Figure 1). Cattle and buffaloes in XK had been vaccinated under the Australian funded programme annually during 2012-2016. In the other areas, vaccination campaigns were implemented in 2016 (Lao PDR) and Myanmar (2017).

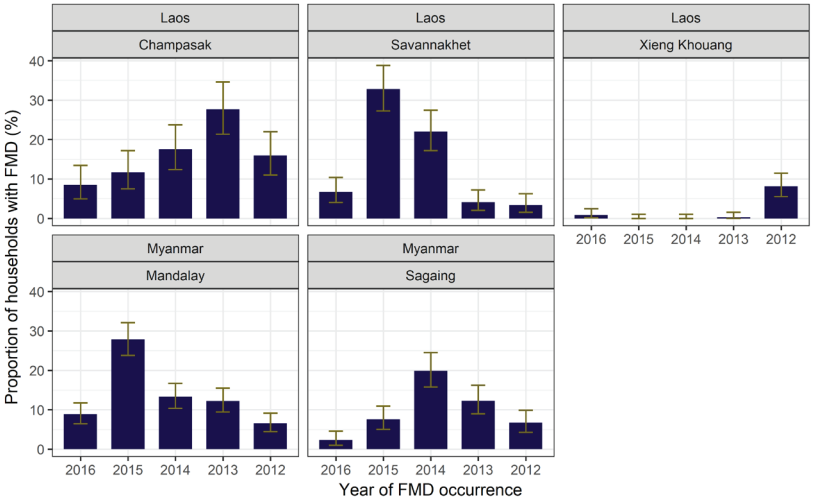
The first aim was to describe the endemic level and spatial distribution of reported FMD outbreaks and unreported occurrences. Comparing FMD occurrences in villages regarded to be of high FMD risk with low risk villages, based on passively available information of outbreaks and census data, was a primary objective. The question was whether passive information used for the FMD risk definition correlated with actual FMD occurrences measured by serology and farmer-observation.

The second aim was to report about the efficiency of vaccination campaigns through sero-surveillance of vaccinated and unvaccinated cattle and buffaloes of different ages in vaccination target areas. Serum was tested by the Non-Structural Protein (NSP) ELISA responds to field virus exposure while being negative for non-exposed, vaccinated animals.

Findings

FMD is endemic in both countries. Figure 2 demonstrates that farmers of 4-35% hh had observed clinical signs of FMD in every year 2012-2016, except for the XK province in Central Lao PDR where farmers could almost not recall any clinical FMD after 2012. Annual vaccination campaigns had been carried out in XK since 2012.

Figure 2. Proportion of house-holds (hh) reporting foot-and-mouth disease (FMD) from the most recent year 2016 to 2012, in Lao PDR (Champasak 188 hh, Savannakhet 268 hh, Xieng-khouang 356 hh) and Myanmar (Mandalay 474 hh, Sagaing 342 hh), with error bars showing 95% confidence intervals.



Despite this apparent vaccination success of preventing clinical FMD in XK, serological evidence suggested that FMD virus types A and O continued to circulate in all provinces and regions. This was demonstrated by a 13-33% NSP prevalence range in 6-18 months old calves. Continued susceptibility to virus infection after vaccination was demonstrated by Stenfeldt *et al.* (2016), but the excretion sites and the length of shedding were both reduced. Thus, observing a somewhat reduced continued NSP prevalence in XK was not surprising and does not compromise the understanding of a protective effect of vaccination against shedding, except shedding is reduced instead of being prevented totally.

Because calves are born naïve and maternal antibodies last 2-6 months, the NSP prevalence of 6-18 months old calves represents the annual incidence of contacts with circulating field FMD virus (Figure 3). Sera collected for post-vaccination monitoring were tested by Liquid Phase ELISA for virus types A and O. About three quarters

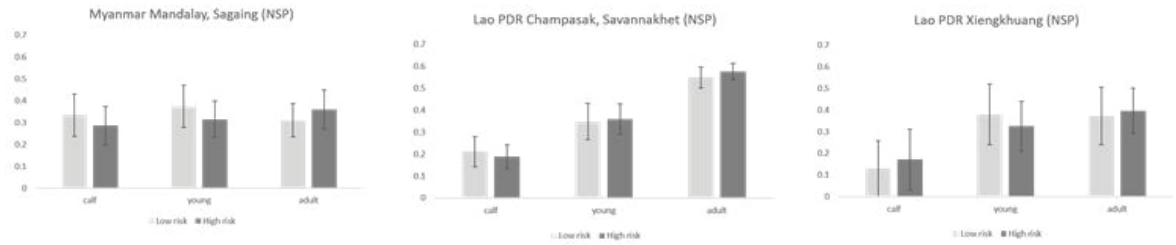
(73%) of non-vaccinated animals that had been exposed to circulating field virus (NSP=positive) were positive for either type A or type O, which demonstrated the dominance of these two endemic serotypes.

However, among non-vaccinated cattle and buffaloes without natural exposure to the virus (NSP=negative), 32% were also positive to either type A or type O. This finding can't easily be interpreted other than by an incorrect vaccination status, a lack of sensitivity of the NSP ELISA or a sub-optimal cutoff of the LP-ELISA. Misclassifying vaccinated animals as 'not vaccinated' could have been caused by the loss of their ear tags or recording errors. Nevertheless, clarification is required about the validity of the different ELISAs and their cutoff values as well as misclassification errors in the field.

A positive correlation between sero-positivity in hh where farmers had recently observed FMD suggests that farmer-recall of FMD was a credible indicator of FMD occurrence.

In both countries, passively available information was insufficient to describe the true FMD risk status. Both sero-prevalence and farmer observed signs of clinical FMD were equally endemic in all regions (except XK), independent of the risk status (Figure 3). In XK, no risk status had been allocated to villages as vaccination had been carried out at a standard schedule since 2012.

Figure 3. Serological prevalence of field virus exposure of cattle/buffaloes by age group (calf <18 months, young 18 – 36 months, adult >36 months) to FMD virus measured by the Non-Structural-Protein ELISA (NSP) in two regions of Myanmar and three provinces of Lao PDR (error bars are 95% confidence intervals).



An analysis of serological data of the post-vaccination monitoring survey showed that young and growing animals below two years of age benefitted from vaccination through development of antibody titres over the level of non-vaccinated animals. In adult animals older than two years however, there was similar prevalence of protecting titres in vaccinated and non-vaccinated animals. These findings propose that vaccination may be restricted to young animals, thus making more efficient use of the limited availability of vaccines while maintaining the same level of protective titre coverage.

There was a huge variation between villages in the proportion of animals with protective titres. In Myanmar, 20/30 (67%) villages reached the target of 80% protective immunity in vaccinated animals while vaccination coverage, based on the sampling design, was 87% (range 67-100%). This excluded one village with 0% coverage. In the two Southern Lao PDR provinces, 12/28 (43%) villages reached the protection target immunity of 80% with 47% (range 13-80%) of animals being vaccinated.

Vaccination monitoring data also indicated that the village level protection (i.e. above or below 80% animals with protective immunity) depended to a greater extent on the level of natural virus circulation than on vaccination coverage. Thus, the set goal of 80% herd immunity may not be a valid indicator of area level protection as FMD virus continues to circulate despite high coverage. This scenario needs to be monitored in future years of annual vaccination.

Conclusions

Because FMD occurred equally in high and low risk areas, a risk based partial vaccination strategy cannot rely on currently available passive information in these two countries. This finding informs decision makers to improve the quality of passive data by strengthening outbreak reporting and investigation activities. Vaccination against the endemic virus serotypes A and O was partially successful by achieving protective levels of immunity of 60-80% in vaccinated animals. However, vaccination coverage was highly variable. If

67% vaccinated animals developed protective titres and 87% animals in the population were vaccinated, the overall level of protection in the target population in high-risk areas would only be 58% which is 22% short of the anticipated target. Hence, vaccination activities will have to be better resourced or restructured (e.g. by vaccinating only young stock). The target level for 80% herd immunity requires a critical review when more post vaccination monitoring data become available.

Acknowledgements

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Reference

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