



Analyzing the Foot and Mouth Disease outbreak as from 2008 to 2014 in cattle and buffaloes in Sri Lanka



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ABSTRACT

Foot and Mouth Disease (FMD) is a highly contagious disease that affects all cloven hoofed animals and causes considerable economic losses to cattle and buffalo farmers worldwide. FMD is endemic to Sri Lanka. The objective of this study was to analyze the past situation of FMD from 2008 to 2014 in the country and to identify relevant risk factors associated with the 2014 outbreak. Outbreak data from the Department of Animal Production and Health, Sri Lanka from 2008 to 2014 were used to describe the spatial distribution and to determine associations between the frequency of outbreaks across the country (nine provinces) and factors including vaccination coverage and outbreak year. A questionnaire was used to collect the information on potential risk factors for FMD for the 2014 outbreak from case farms (n = 83) and control farms (n = 161). Seven focus group (FG) discussions with farmers and five in-depth interviews with veterinarians and livestock officers were conducted. A negative binomial regression model was constructed to determine the relationship between frequencies of outbreaks by province, year, vaccine coverage and bovine numbers per province. A logistic regression model was used to determine the association between potential risk factors and disease status of the farm. There was no association between vaccination coverage and outbreak frequencies at province level (Risk Ratio = 1.02; 95% CI = 0.09, 1.05). Based on our cases-control study there were five variables significantly associated with the FMD spread: cattle/buffalo contact with nearby villages (Odds Ratio = 2.88; 95% CI: 1.23–6.72), cattle/buffalo grazing near water tank areas (OR = 3.11; 95% CI: 1.21–7.97), animals bought or sold during the outbreak (OR = 3.3; 95% CI: 1.39–7.83), being near to a road where animal traders travel (OR = 3.44 95% CI: 1.10–10.79), and being fed on the floor instead of feed troughs (OR = 2.61, 1.08–6.31). The major risk factor identified here was cattle/buffalo movement by means of grazing/trading. Both focus group discussions and the questionnaire ascertained that the vaccination had no effect in the most recent outbreak. Results from this study are expected to support veterinary services in developing effective control measures during future outbreaks.

1. Introduction

Foot and Mouth Disease (FMD) is a highly contagious disease that can cause considerable economic losses to cattle and buffalo farmers worldwide (Perry and Randolph, 2003). In Sri Lanka the FMD type O is endemic (Gunasekera and Fernando, 1980). In the 2014 Annual Report of the Department of Animal Production and Health (DAPH) of Sri Lanka the number of reported cases exceeded 68,000 cattle causing a

considerable economic loss to the farmers.

Sri Lanka is an island located in the Indian Ocean near South India. The administrative division of the country is hierarchical, from province, district, and divisional secretariat (DS) level to the village level. There are nine provinces, 25 districts and 331 DS in Sri Lanka covering a land area of 65,610 sq km. The commonly reared livestock species in Sri Lanka are cattle, buffalo, pigs and goats; at the Central province a low numbers of sheep is raised. All these species are susceptible to FMD

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(Alexandersen et al., 2001). Intensive farming is mostly practiced in the Central and Western border provinces of the country while in the other areas semi-intensive and extensive farming systems are largely practiced.

Epidemiological knowledge regarding the FMD history in cattle and buffalo in Sri Lanka is scarce and as a consequence control efforts have had limited success. As an OIE member country Sri Lanka has been identified to be in stage 1 of the FMD Progressive Control Pathway (3rd SAARC FMD Regional Roadmap Meeting Workshop, Colombo, 2016). Stage 1 of PCP includes the identification of risk factors and the self-assessment questionnaire to understand the socioeconomic impact of FMD which enable the country to formulate a strategic control plan at stage 2.

Annual vaccination is practiced in FMD “susceptible areas” of the country while biannual vaccination is carried out in the endemic areas. “Susceptible areas” selected for vaccination are those areas where the major slaughterhouses are located. Live animals and animal products from FMD endemic and non-endemic areas of the country are transported to and from these slaughterhouses. The vaccine is provided by the government free of charge to the farmers. Both locally produced and imported vaccines were used to control the disease. The field isolates were used for the local vaccine production. The final vaccine strain for Sri Lanka matching the field strain was identified in 2009 by the FAO World Reference Laboratory for Foot-and-Mouth Disease (WRL-FMD) based on samples isolated in the same year (O/SRL/1/2009).

The movement control during an outbreak was legally enabled by the Animal Disease Act no 59 of 1992. According to this act the government has the authority to declare and seal infected premises up to a three month period provisionally and published by a gazette notification. The notification specifies the species of animal and the nature of the disease. Once such an area is declared animals or animal related material cannot be removed from the area without prior veterinary approval.

Questionnaire based case-control studies have been widely used to obtain information with regard to the risk factors associated with FMD spread in countries such as Bhutan (Dukpa et al., 2011), Japan (Muroga et al., 2013), Thailand (Phouangsouvanh, 2009; Cleland et al., 1996), Ecuador (Ann et al., 2007), Bangladesh (Sarker et al., 2011) and Cameroon (Bronsvort et al., 2004). Animal transactions (buying and selling, exchange of animals between the farmers), animal contact between nearby villages, free ranging of cattle herd and farm management related practices were among such identified risk factors. Farm management related practices include sharing of farm utensils and services, sharing of animals for breeding purpose and the interaction among the farm workers. No scientific documents are available regarding the risk factor identification for FMD in Sri Lanka. For an individual country to proceed with its FMD control strategy it is important to have an established knowledge of these risk factors.

Participatory epidemiology (PE) methods are derived from the participatory appraisal methodology where diverse techniques that build up a relationship between the interviewer and the participants in the process. These methods are useful to obtain scientifically valuable information from the local population about their (indigenous) knowledge of livestock diseases and disease surveillance (CAHO, 2011).

PE studies have been widely used to determine the impact of FMD in many African and Asian countries (Catley et al., 2002; Rufael et al., 2008; Barasa et al., 2008; Molla et al., 2013; Bellet et al., 2012). These studies had been able to identify also the chronic effects of FMD, support active surveillance and the impact of the disease. This information from the PE methods is combined with regular veterinary investigations and epidemiological tools to improve the validity of the data (Bellet et al., 2012). We have utilized the PE approach in this study to improve the comprehensiveness of the risk factor study under Sri Lankan conditions.

The 2014 outbreak has been the most recent massive FMD outbreak in Sri Lanka after the year 2008 outbreak which reported less than 2000

cases. During the period 2009–2013 the number of reported cases remained less than 1000 (2009, 2010, 2011, 2012 and 2013 Epidemiological Bulletin, DAPH).

Thus, the objective of this study was to analyze the past history of FMD as from 2008 to 2014 in the country and to identify relevant risk factors associated with the recent outbreak (2014) by means of a case-control study and the participatory epidemiology approach.

2. Materials and methods

2.1. Study strategy

The study consists of two main parts. First, the FMD outbreak data from 2008 to 2014 were analyzed to describe the situation at the country level. Secondly, one specific geographic area was selected for conducting a case-control study to determine risk factors for the most recent outbreak.

A spatio-temporal analysis was carried out using data from the years 2008 to 2014 to describe trends in space and time of these outbreaks. For the years 2011–2014 a negative binomial model was used to determine the relevant risk factors associated with national FMD outbreak propagation.

The case-control study was carried out in one selected area of the country using the questionnaire and PE approach by applying focus group discussions (FGD) and in-depth interviews in the same area. Proportional piling, simple ranking, seasonal calendar and participatory mapping techniques were employed in FGD while in-depth interviews were conducted using a check list.

2.2. FMD outbreak analysis

2.2.1. Data sources for outbreaks

To describe the past FMD outbreaks, data for the years 2008–2013 were obtained from the Epidemiological Bulletin, DAPH, Sri Lanka. The national vaccination data of the years 2011–2014 (number of vaccinations conducted in each year at each DS level) and the 2014 reported outbreak data from the Department of Animal Production and Health.

The vaccine coverage was calculated for each province as the number of vaccine doses used in each province divided by the number of cattle and buffalo in the area. Vaccination coverage was taken as an annual value but in some of the regions vaccinations were carried out two times per year due to an impending FMD outbreak. The total cattle and buffalo population size and the total number of cattle and buffaloes slaughtered in each province from 2011 to 2014 were obtained from the Department of Census and Statistics, Sri Lanka (<http://www.statistics.gov.lk/>). Cattle, buffaloes and small ruminants are moved within the country across provinces for the purpose of slaughter.

An outbreak was considered as the reporting of several farms with clinically FMD infected cattle/buffalo from the nearby areas during the same time period.

2.2.2. Spatial analysis of the past FMD history

The outbreak locations were spatially identified via Google Earth[®] based on the location records available in the Epidemiological Bulletin.

A map for FMD outbreaks for each province and year from 2008 to 2013 was created using R with ggmap package (Wickham, 2009). Geographical coordinates including latitude and longitude centroid of the respective village for each outbreak were plotted on a map and broken down by year (2008–2014) at the district level.

For the year 2014 the number of outbreaks by month was summarized at province level. From the year 2008 to 2013 the number of outbreaks was listed for each year and month.

Eventually for further analysis, three data sets were used (i) the 2008–2013 national data (data 1), (ii) 2011–2014 national data (data 2) and (iii) the 2014 provincial outbreak data (data 3). The 2008–2013 data and 2011–2014 data were secondary data at national level

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