The Impact of Foot and Mouth Disease in Cambodia: A Case Study

Naomi Boyd
Faculty of Veterinary Science, University of Sydney

Introduction

Cattle play a pivotal role in the economic well being of rural Cambodia. They serve as a source of draught power for transport and the production of rice as well as a household reservoir of wealth. At a national level, livestock production contributes to 5% to Cambodia’s total GDP (DAHP 2010). Currently, Foot and Mouth Disease (FMD) is the most important global transboundary disease of cattle. FMD has major social impacts in developing countries, particularly in south-east Asia, with impacts on both small-holder farms and national production (Khounsey et al. 2008). FMD is detrimental at the village level, by reducing the value of large ruminants, their draught power and their use as a store of wealth along with increases in labour and management costs. At the national level, the impact of FMD is mainly through the loss of international trade or potential trade (Rast et al. 2009).

FMD is endemic in Cambodia (Gleeson 2002) and considered to have a high incidence of outbreaks throughout the year (Sumption et al. 2008). Moreover, Cambodia is vulnerable to incursions of FMD, sitting within the commercial networks of Thailand, Laos and Vietnam with no significant geographical or regulatory barriers limiting the transboundary passage of livestock. Effective control of FMD is impossible without considerable regional cooperation and a ‘slaughter out’ policy is impractical at both the local and national level. Consequently, vaccination and biosecurity measures become important tools in disease control for the smallholder farmer.

Improvement in the health and husbandry of cattle provides an opportunity to reduce rural poverty by improving draught power, sale value and trade opportunities. Additionally, increasing the value of large ruminants through enhanced productivity has been suggested as a means to inspire the interest of farmers in disease management (Khounsey et al., 2008). The research project ‘Best Practice Health and Husbandry in Cattle and Buffalo, Cambodia’ (Windsor, 2005) aims to identify those interventions that can best be utilized by farmers to improve productivity, including strategies to enhance animal health, nutrition, reproduction management and marketing. The project has implemented biannual FMD vaccination in six villages in three southern Cambodian provinces. As part of this project, data on morbidity and mortality, loss of weight, loss of draught power, days sick and total costs associated with FMD have been collected in four villages within the same provinces without FMD vaccinations. This paper documents the investigations of FMD and its impact in vaccinated and unvaccinated villages.

Material and Methods

National surveillance of foot and mouth disease
Data on the prevalence of FMD and rates of FMD vaccination is collected on a monthly basis by the provincial offices of the Department of Animal Health and Production (DAHP). Reports on outbreaks are also submitted to the DAHP as they occur. Cases of FMD are generally considered to be underreported and the prevalence and incidence of FMD is likely to be higher than discovered in this report.

**Study site and household selection**

Villages where FMD vaccination occurred were part of the research project ‘Best Practice Health and Husbandry in Cattle, Cambodia’ (Windsor, 2005). These villages were originally selected for this research project based on selection criteria including: similarity of size, type of livestock enterprises and livestock numbers (as the research involves a 4-year longitudinal study in these villages and comparisons between villages are to be made), large ruminant populations exceeding 250 animals (to allow for some losses because of trade or deaths during the 4-year study period, and still maintaining a large enough sample size), willingness by households, village officials and local officials to participate, all year road access (to ensure research staff can access sites at least quarterly for data collection), evidence of forage growing for large ruminant supplementary feeding, and villages being more than 10 km apart (to avoid ‘spill over’ of interventions to be researched in individual villages).

The other case-study villages, Preak Taprum, Kompong Os, Meemang and Tang Tpang, were non-research project sites located within the same provinces as the project villages. The local AHW selected 20 households within these villages (AHW) based on a willingness to participate, FMD vaccination rates of zero and a minimum number of 3 cattle.

**Data Collection**

Staff from the DAHP visited the unvaccinated villages of Preak Taprum, Kompong Os, Meemang and Tang Tpang between the 9th and the 17th September 2010 and collected information from small holder farmers on the large ruminant populations, disease management and the recent FMD outbreak, using a semi-structured questionnaire including open and closed questions developed by the team leader for the animal health program at the DAHP in Phnom Penh (see Appendix 1).

Within the vaccinated project villages, the local AHW was interviewed regarding vaccination rates and animals exhibiting clinical signs of FMD on a quarterly basis.

**Foot and mouth disease vaccination**

The research project vaccinated large ruminants older than 6 months in six project villages: Veal and Sen Son Tbong located in the Kampong Cham province, Preak Por and Koh Kor in the Kandal province, Nor Mo and Dem Pdet in the Takeo province against FMD as part of routine animal health interventions that are being researched. Vaccines used were trivalent-inactivated FMD vaccine containing type O, A and Asia1 antigens in a mineral oil adjuvant (Raksha-Ovac®; Indian Immunologicals Ltd, India) by intramuscular injection by trained animal health staff and in accordance with manufacturers recommendations.
Efficacy of Foot and mouth disease vaccination

In the villages of Preak Por, Veal and Nor Mo, serum samples were collected prior to vaccination and at 21 and 180 days post vaccination for evaluation of antibody titres by ELISA at the National Veterinary Research Institute, Phnom Penh. Immunity to FMD was supported through the absence of FMD during outbreaks by interviewing involved farmers and examining their cattle for clinical signs by extension staff of the Best Practice Health and Husbandry of Cattle project trained in the recognition of FMD.

Foot and mouth disease diagnosis

In the unvaccinated villages, the diagnosis of FMD was based on the answers consistent with a case of FMD from a questionnaire distributed by DAHP extension staff to all households involved in the study and confirmed by discussion with the local AHW.

In the vaccinated villages within the Best Practice Health and Husbandry of Cattle, Cambodia, the diagnosis of FMD was based on quarterly discussions with involved farmers and AHW regarding the absence of clinical signs of FMD.

Financial analysis

The cost of supportive care and treatment was the sum and mean of reports from farmers of their expenditure. Draught power was calculated based on the reported cost to the farmer of hiring draught animals per day and multiplied by the number of days the animals were unable to work.

Using local expertise, the costs of morbidity and mortality were calculated from estimates of the sale value of healthy animals of moderate body condition score versus the sale value of a sick animal or carcass respectively.

All information on costs were gathered in riel however, for simplicity, these values have been converted to US dollars with 1 USD being equal to 4100 riel.

Estimation of weight loss

Weight loss following infection with FMD was based on the difference between pre-illness and post-illness body weights as estimated by farmers.

Results

National foot and mouth disease status 2007 – 2010

In 2007, outbreaks of FMD were recorded in 13 of 25 Cambodian provinces. Vaccination rates for FMD nationally were 0.6%.
In 2008, 63 outbreaks of FMD were recorded in 14 provinces of Cambodia and FMD vaccination rates were 0.5%.

In 2009, 41 outbreaks of FMD were recorded in 10 provinces and FMD vaccination rates were 2.65%.

Between January and September, 2010, outbreaks of FMD were recorded in 10 provinces with clinical disease present in a total of 32 230 cattle and a further 888 deaths from FMD. Unfortunately, data on total livestock numbers in affected areas was unavailable due to resource constraints.

**Foot and mouth disease serotype**

Serotype O and, to a lesser extent, Asia 1, were suspected based on serotyping of samples taken during outbreaks in the same region during 2007, 2008 and 2010 and processed at the National Veterinary Research Institute, Cambodia (Wilai 2010). This is supported by samples taken from animals in the same provinces as the surveyed villages suggesting exposure serotype O (30% of cattle), serotype A (100%) and serotype Asia 1 (35%). No laboratory data is available on strains.

**Clinical features**

Disease signs observed by farmers, Animal Health Workers and government staff in the four villages in cattle and buffalo included: anorexia, lethargy, excessive salivation, vesicular lesions in the mouth and on the feet and lameness.

**Weight loss**

The mean weight of clinically healthy cattle across all survey villages was 247kg. Following FMD, cattle lost a mean weight of 46kg or 19% of their total body weight.

**Morbidity and mortality.**

Morbidity and mortality in large ruminants in the survey villages are tabulated (Table 1). The mean morbidity rate across all unvaccinated villages was 80.7% and mean mortality rate was 8.7%.
Vaccination for foot and mouth disease

The number of animals presented and vaccinated was 100% and 0% in the six research project villages and the 4 survey villages respectively.

In the villages of Preak Por, Veal and Nor Mo where antibody titres were measured, 100% of vaccinated animals had antibody titres to the FMD virus consistent with immunity at 21 and 180 days post-vaccination.

Treatment

Treatment of ill animals consisted of supplemental nutrition to promote survival, washing of sores with astringents and the use of empirically selected antibiotics at recommended dose rates on affected animals acquired from the local AHW. All farmers in the surveyed households applied treatment and provided supportive care to affected animals as described above.

Financial Analysis

Costs associated with treatment and hiring alternative draught power are calculated and tabulated in Table 2 along with estimated financial losses associated with the sale value of affected animals or carcasses compared with healthy animals. The costs due to loss of draught power could not be calculated per animal as alternative animals were hired on a per household, rather than per animal basis. The mean cost of hiring an animal for draught was USD 20.75.
The cost of vaccination is USD 2 per animal.

<table>
<thead>
<tr>
<th></th>
<th>Preak Taprum</th>
<th>Kompong Os</th>
<th>Meemang</th>
<th>Tang Tpang</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Per animal</td>
<td>Total</td>
<td>Per animal</td>
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<tr>
<td>Supportive care &amp;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>treatment</td>
<td>367.05</td>
<td>18.35</td>
<td>45.35</td>
<td>15.1</td>
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<tr>
<td>Loss of draught power</td>
<td>21.95</td>
<td>219.5</td>
<td>1170.75</td>
<td>1365.85</td>
</tr>
<tr>
<td>Illness</td>
<td>3475.6</td>
<td>231.7</td>
<td>609.75</td>
<td>304.9</td>
</tr>
<tr>
<td>Mortality</td>
<td>1304.85</td>
<td>260.95</td>
<td>390.25</td>
<td>487.8</td>
</tr>
<tr>
<td>Total</td>
<td>5169.45</td>
<td>1264.85</td>
<td>7843.65</td>
<td>6067.55</td>
</tr>
</tbody>
</table>

**Discussion**

Studies in Cambodia on the epidemiology and impact of FMD have not previously been reported, nor on the financial benefit of FMD vaccination. From the limited economic data available it was possible to conclude that the potential cost of not investing in FMD vaccination was very high in the unvaccinated villages, estimated at a mean total cost of USD 5086.35 per village. The total costs to the farmer are likely to be higher than these figures suggest as, in most households, one or more days of work was lost to sickness with FMD and this, along with costs associated with additional labour and time were not able to calculated. Potential financial losses associated with a loss of trade opportunities were also not calculated. Further research is required to enable more precise financial analyses as these are crude estimates are based on limited data and local expertise. Nevertheless, they indicate the potential large economic return that can be gained from investing in vaccination.

The mode of transmission between villages was uncertain. Livestock, people and fomite movements occurred in all villages but could not be investigated due to resource constraints. In all of the villages that had experienced an outbreak of FMD, a small percentage of farmers hired animals for draught work from neighbouring areas, providing a potential source of propagation for the spread of FMD. Prior to intervention by the Best Practice Health and Husbandry of Cattle project, farmer knowledge of disease transmission and biosecurity measures were identified as being very poor as determined through farmer knowledge surveys conducted as part of the project (Nampanya et al. 2010). This is assumed to still be the case in most of Cambodia.

Protocols of disease declaration and movement restrictions exist in Cambodia but implementation and enforcement of these restrictions is difficult because of resource and capacity constraints combined with the lack of compliance by many farmers. The practice of selling ill livestock is actively discouraged by local AHW’s, as is the sale of dead animals for meat, which is illegal in Cambodia.
Yet this practice may become a necessity among poor smallholder farmers increasing the risk of disease transmission amongst villages and districts.

Based on the measurement of antibody titres and inspection of cattle for signs of FMD post-vaccination. Although not recommended, due to the comparatively high cost of FMD vaccination, many farmers also report gaining adequate protection from FMD infection by vaccinating annually only. Strategically vaccinating when the risk of an outbreak is high due to outbreaks in the region or when livestock movement is at its highest, may contribute to the apparent success of an annual vaccination program. Naturally acquired immunity to FMD in these cases is considered unlikely as pre-vaccination antibody titres were at levels considered too low to provide immunity.

Besides vaccination, other strategies are crucial to the control of FMD in Cambodia. Important changes in biosecurity practices have occurred as a result of education of smallholder farmers regarding the quarantine of sick animals, cleaning and disinfection and movement controls in villages participating in the Best Practice Health and Husbandry of Cattle, Cambodia (unpublished data, Erng LV). These measures significantly decrease the rate of spread of FMD and at no appreciable cost to the farmer.

**Conclusion**

The estimated financial losses due to FMD in unvaccinated villages are considerable. Vaccination against FMD provides reliable protection against infection and presents a cost effective approach for farmers to avoid the associated costs, improve the productivity of their farms and alleviated their poverty.
Appendix 1

Foot and Mouth Disease Questionnaire

Date:
Village: Commune: Street Province:
Interviewer:

General information on the farmer
Name:
Age:
Sex:
How many people within the household?

Livestock inventory
How many — pigs?
- cattle?
- buffalo?

N.B. A livestock inventory of goats was not originally on the questionnaire but numbers of goats was recorded if they were present.

General information on livestock
• Species:
• Number of animals:
• Number of animals that became ill with FMD (not including those who died):
• Number of animals that died from FMD:
• Age:
• Sex:
• How many days had the animal been sick prior to the interview?

Information on treatment
• Were any livestock been vaccinated against FMD?
• Were animals treated?
• How much was spent on treatment (riel)?
• How many days were animals treated for?
• What medicines were used?

Information on management and care
• Were any other management practices implemented?
• How much was spent on these practices (riel)?
• What management practices did you employ (traditional medicines/supplementary feeding)?

Financial impact
• How much was the animal be worth when healthy (estimation)?
• How much the animal worth after becoming sick with FMD (estimation)?
• How much is the carcass worth after death from FMD (estimation)?
• How many days of draught power were lost?
N.B. a ‘-’ in this column does not indicate that no days of draught power were lost. It indicates that draught power may or may not have been lost but it was not necessary for the farmer to hire alternative draught power.

**Information on draught power**

- Did you rent other animals for draught?
- How much did you pay per day (riel)?
- How many days did you rent an animal for draught?

**Information on body condition**

- How many days has the animal been sick prior to the interview?
- What was the weight of the animal when healthy (estimation)?
- What is the weight of the animal after becoming ill (estimation)?

**Impact on reproductive performance**

- Has abortion occurred as a result of FMD?
References:


