IDENTIFICATION OF RISK FACTORS FOR THE RECENT FOOT AND MOUTH DISEASE OUTBREAK IN SRI LANKA

Hanoi, Vietnam
September 20, 2015

Umanga C. Gunasekera 1*, Veerasak Punyaporndithaya 2, Nihal Wedasingha 3, Warangkhana Chaisowwong 4, Maximilian Baumann P.O. 5, Marcus G. Doherr 6
1 Joint Master Course in Veterinary Public Health (Joint MVPH), Freie Universität Berlin, Chiang Mai University, Thailand
2 Department of Food Animal Clinic, Faculty of Veterinary Medicine, Chiang Mai University
3 Department of Animal Production and Health, Sri Lanka
4 Department of Veterinary Biosciences and Veterinary Public Health, Faculty of Veterinary Medicine, Chiang Mai University, Thailand.
5 Postgraduate Studies in International Animal Health, Department of Veterinary Medicine, Freie Universität Berlin, Germany
6 Institute for Veterinary Epidemiology and Biostatistics, Department of Veterinary Medicine, Freie Universität, Berlin, Germany
Introduction
Foot and Mouth Disease

• FMD Type O is endemic in Sri Lanka. This serotype has a great genetic diversity.

• As an OIE member country Sri Lanka strategies to eradicate the disease by 2020 following the Progressive Control Pathway (PCP).
History of the disease situation

Legend
prevalence by the density of cases
- 0
- 0.000143
- 0.000298
- 0.000551
- 0.0013

Legend
prevalence by the density of cases
- 0
- 0.0059
- 0.0184
- 0.0708
- 0.0749
- 0.346
History of the disease situation

Legend
The prevalence of cases by density
0
2.21e-05
2.43e-05
4.32e-05
0.000351
0.000537
0.00798

2011

2012

Legend
prevalence of data by density
0
0.00481
0.0121
0.0196
0.21
History of the disease situation

2013
2014 outbreak

Location of cases with the cattle density 2014

Legend
Cattle density 2014
- 10020 - 41740
- 41740 - 73460
- 73460 - 105180
- 105180 - 136900

75 km

75 0
Major drawbacks for the disease control in Sri Lanka

- There are no strategic documents that outline the nationwide control of FMD in all susceptible production animals.

- Currently annual vaccination, ring vaccination, passive surveillance and movement control is practiced during an outbreak but are not efficient enough to control outbreak.
Objectives
Objectives of this study

- To identify the potential risk factors in the recent FMD outbreak (2014) in the North Central Province, Sri Lanka
Materials and methods
Study Scope

Case Control study

1. Questionnaire
   - Cases
   - Controls

2. Participatory Epidemiology approach
   - Focus Group Discussions
   - In-depth Interview
Questionnaire
• **Case definition**
  Infected farms showing the clinical signs of FMD within the recent 12 months period based on the veterinary records.

• **Control definition**
  Non infected farms with FMD in the same area as the cases during the same time duration.
• Questionnaire ➔ Farmer Interview
• 20 case farmers and 40 control farmers from each range
• Number of farmers interviewed (n= 240)
Contents of the questionnaire

• General information
• Livestock information
• Risk factors
<table>
<thead>
<tr>
<th>Risk Factor considered</th>
<th>Year and author</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buying and selling of cattle during the outbreak</td>
<td>C. Cleland, 1996</td>
<td>Thailand</td>
</tr>
<tr>
<td></td>
<td>Wieland et al., 2015</td>
<td>Mongolia</td>
</tr>
<tr>
<td></td>
<td>Bronsvoort 2004</td>
<td>Cameroon</td>
</tr>
<tr>
<td>Farm management and the farm location</td>
<td>Muroga et al., 2013</td>
<td>Japan</td>
</tr>
<tr>
<td>The distance from the slaughter house and movement of vaccinated cattle</td>
<td>Ann et al., 2007</td>
<td>Ecuador</td>
</tr>
<tr>
<td>Human activity and movement</td>
<td>Picado et al., 2011</td>
<td>Tanzania</td>
</tr>
<tr>
<td>Human activity along the main road</td>
<td>Chandana 2008</td>
<td>Sri Lanka</td>
</tr>
<tr>
<td>Cattle herd roaming for free grazing, wetland areas, and weather conditions</td>
<td>Phouangsouvah 2009</td>
<td>Laos</td>
</tr>
<tr>
<td></td>
<td>Dukpa 2011</td>
<td>Bhutan</td>
</tr>
<tr>
<td></td>
<td>C. Cleland, 1996</td>
<td>Thailand</td>
</tr>
<tr>
<td></td>
<td>Bronsvoort 2004</td>
<td>Cameroon</td>
</tr>
<tr>
<td></td>
<td>Yano T (2009)</td>
<td>Thailand</td>
</tr>
<tr>
<td>Animal contact among nearby villages</td>
<td>Phouangsouvah 2009</td>
<td>Laos</td>
</tr>
<tr>
<td></td>
<td>Picado et al, 2011</td>
<td>Tanzania</td>
</tr>
<tr>
<td>Aggregation of animals near communal drinking pools</td>
<td>Hamoongaa R., et al 2014</td>
<td>Zambia</td>
</tr>
<tr>
<td></td>
<td>C. Cleland, 1996</td>
<td>Thailand</td>
</tr>
<tr>
<td></td>
<td>Bronsvoort 2004</td>
<td>Cameroon</td>
</tr>
<tr>
<td>Feeding commercial feed</td>
<td>Bronsvoort 2004</td>
<td>Cameroon</td>
</tr>
<tr>
<td>Farming system and seasonal influence</td>
<td>Sarker, S 2011</td>
<td>Bangladesh</td>
</tr>
</tbody>
</table>
Focus group and in-depth interview
Check List for the Interviews

- To obtain general information with regard to livestock husbandry system
- Initiation of the outbreak
- Further information regarding the risk factors
- Impact of the disease
- Control measures
Techniques used

• Focus group discussions
  • 7 focus group discussions (7-8 farmers) from each study area

• Methods used
  • Ranking method
  • Proportional piling
  • Participatory mapping
  • Seasonal calendar

• In-depth interview
  • 5 Semi structured interviews with the veterinarian and the livestock officers in the areas
Statistical analysis

• Univariable analysis
  OR calculation with Chi-square and Fishers exact test
Results
Quantitative results
Results from the questionnaire

General information

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Management practice</strong></td>
<td></td>
</tr>
<tr>
<td>Open air tethering (housed in night paddock)</td>
<td>36% (85/243)</td>
</tr>
<tr>
<td>Free ranging at day time (housed at night)</td>
<td>23% (56/243)</td>
</tr>
<tr>
<td>Sick animals sent for grazing</td>
<td>16% (13/83)</td>
</tr>
<tr>
<td>Sick animals separated from the other animals in herd</td>
<td>25% (21/83)</td>
</tr>
<tr>
<td><strong>Additional source of feed provided other than cut and fed grazing</strong></td>
<td></td>
</tr>
<tr>
<td>Cut and fed grass</td>
<td>68% (163/240)</td>
</tr>
<tr>
<td>Commercial feed</td>
<td>47% (114/240)</td>
</tr>
<tr>
<td>Crop byproducts</td>
<td>13% (33/240)</td>
</tr>
<tr>
<td><strong>Vaccination</strong></td>
<td></td>
</tr>
<tr>
<td>Case farms</td>
<td>49% (40/83)</td>
</tr>
<tr>
<td>Control farms</td>
<td>52% (84/160)</td>
</tr>
<tr>
<td>Belief of the vaccine can protect animals</td>
<td>93% (99/107)</td>
</tr>
</tbody>
</table>
The housing systems in the area
Identified risk factors from the uni variable analysis

- Common cattle/buffalo grazing areas

<table>
<thead>
<tr>
<th></th>
<th>Cases</th>
<th>Controls</th>
<th>OR</th>
<th>Confidence Interval</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest</td>
<td>30%</td>
<td>30%</td>
<td>1</td>
<td>0.53 to 1.84</td>
<td>1</td>
</tr>
<tr>
<td>Near lake</td>
<td>79%</td>
<td>62%</td>
<td>2.35</td>
<td>1.22 to 4.68</td>
<td>0.009</td>
</tr>
<tr>
<td>Common grassland</td>
<td>83%</td>
<td>79%</td>
<td>1.95</td>
<td>0.96 to 4.12</td>
<td>0.059</td>
</tr>
<tr>
<td>Near the road side</td>
<td>34%</td>
<td>24%</td>
<td>1.57</td>
<td>0.84 to 2.91</td>
<td>0.134</td>
</tr>
<tr>
<td>Individual grass land</td>
<td>23%</td>
<td>30%</td>
<td>0.71</td>
<td>0.36 to 1.36</td>
<td>0.291</td>
</tr>
</tbody>
</table>
Where does the animal go for grazing?
• Additional feed sources provided by the farmers

<table>
<thead>
<tr>
<th></th>
<th>Case farms</th>
<th>Control farms</th>
<th>OR</th>
<th>Confidence Interval</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial feed</td>
<td>60%</td>
<td>41%</td>
<td>2.14</td>
<td>1.19 to 3.84</td>
<td>0.009</td>
</tr>
<tr>
<td>Crop by products</td>
<td>14%</td>
<td>14%</td>
<td>1</td>
<td>0.41 to 2.3</td>
<td>1</td>
</tr>
<tr>
<td>Grass cut and fed</td>
<td>82%</td>
<td>61%</td>
<td>3.06</td>
<td>1.53 to 6.39</td>
<td>0.001</td>
</tr>
</tbody>
</table>
Cut and fed grass
Stored crop byproduct
- Animal movement

<table>
<thead>
<tr>
<th></th>
<th>Cases</th>
<th>Controls</th>
<th>OR</th>
<th>Confidence Interval</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle bought /sold from other districts</td>
<td>15%</td>
<td>14%</td>
<td>1.02</td>
<td>0.42 to 2.29</td>
<td>1</td>
</tr>
<tr>
<td>Bought/sold animals during last year</td>
<td>44%</td>
<td>27%</td>
<td>2.13</td>
<td>1.17 to 3.36</td>
<td>0.009</td>
</tr>
</tbody>
</table>

- Animal contact

<table>
<thead>
<tr>
<th></th>
<th>Cases</th>
<th>Controls</th>
<th>OR</th>
<th>Confidence Interval</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal contact among villages</td>
<td>65%</td>
<td>50%</td>
<td>1.82</td>
<td>1.02 to 3.3</td>
<td>0.045</td>
</tr>
<tr>
<td>Animal contact with in the village</td>
<td>85%</td>
<td>67%</td>
<td>2.92</td>
<td>1.41 to 6.41</td>
<td>0.002</td>
</tr>
</tbody>
</table>
Qualitative results
Focus group discussions

• Most of the livestock farmers participated were rearing animals for 10-15 years. Among them majority were doing the crop cultivation along with keeping the animals.
• Most of them are cattle farmers and limited buffalo, goat and swine farmers.
Results from the Focus Group Discussions
The Difficulties Faced by the Farmers in Livestock Rearing

- Lack of attention from government: 36%
- Lack of grass land: 43%
- Lack of good quality animals: 21%
The Importance of the Disease

- Gastrointestinal worm disease: 31%
- Mastitis: 17%
- FMD: 26%
- Tick fever: 9%
- Calf Diarrhea: 4%
- Black quarter: 13%
Identified Risk Factors

- Vaccination: 24%
- Animal and human movement: 19%
- Cattle buying and selling: 14%
- Buyers from slaughter house: 10%
- Going to the milk collecting center: 33%
Disease Entering Routes into the Village

- 25% Salvaged animals
- 50% Cattle coming from other village
- 12% Animal sent for grazing
- 13% Animal movement for slaughter

Spreading of the Disease Inside the Village

- 75% Grazing near the lake area
- 25% Grazing in the common grass land
Mapping of the Area

Paddy field area

Dwellings of the villagers

Tank beds where the cattle graze
Results from the In-depth Interview
The Key Points of the In-Depth Interview

• The source of FMD to the village
  • “The free ranging cattle and buffalos coming from other villages with the disease”
  • “The salvaged animals released for the religious purpose are released without consent”

• Control measures
  • In-depth interview 2; “The farmers should be made aware using the new communication technology so they tend to remember information better”
  • “Vaccination program should be made biannual”
Discussion
Quantitative analysis
Animal contact among nearby villages  
(OR 2.88 (1.23,6.72) , p =0.015)  

Animal sent for grazing near tank areas  
(OR 3.11 (1.21,7.97) p=0.018)  

Animal brought/ sold during the outbreak  
(OR 3.3 (1.39,7.83) p=0.007)  

Located near a road where animal traders travel  
(OR 3.44 (1.1,10.79) p=0.034)
Mapping of the Area

- Paddy field area
- Dwellings of the villagers
- Tank beds where the cattle graze
Qualitative conclusion
• The farmers in the area believe having large herd that they do not have an alternative to send animals for grazing

• Both focus group and in-depth interview emphasized the need of knowledge and infrastructure improvement for good biosecurity measures and disease control

• Located near a road where animal traders travel is a risk factor that can’t be changed by the farmers or authority.
Acknowledgements

• International Joint Masters program in Veterinary Public Health, of Freie University of Berlin and Chiangmai University, Thailand

• All the farmers, livestock officers and the veterinarians participated in the study

• Financial Support
  DAAD
  VPHCAP

• GFRA
• Vaccination
• 5 months of age
• After 3 months booster dose
• Annual vaccination
Major drawbacks for the disease control in Sri Lanka

• no strategic documents
• No planned vaccination
• Under reported cases
• illegal animal transport
Sri Lanka in 2014
Batch: WRLFMD/2014/00030

◆ indicates viruses in this batch

Software: MEGA 6.06
Analysis
Analysis ------------------- Phylogeny Reconstruction
Scope ---------------------- All Selected Taxa
Statistical Method -------- Neighbor-joining
Phylogeny Test
Test of Phylogeny ------------ Bootstrap method
No. of Bootstrap Replications ------- 1000
Substitution Model
Substitutions Type ------------ Nucleotide
Model/Method -------------- Kimura 2-parameter model
Substitutions to Include ------- d: Transitions + Transversions
Rates and Patterns
Rates among Sites ----------- Uniform rates
Pattern among Lineages -------- Same (Homogeneous)
Data Subset to Use
Gaps/Missing Data Treatment ------- Pairwise deletion
Codons Included -------------- 1st+2nd+3rd+Non-Coding
No. of Sites : 642
No Of Bootstrap Reps = 1000
Only bootstrap values of 70% and above are shown

*, not a WRLFMD Ref. No.

N.J. Knowles, J. Wadsworth & K. Bachanek-Bankowska,
• 70000 cases
• 2000 deaths