Pestforecast
Surveillance and early warning systems for climate sensitive diseases in Vietnam

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Pestforecast

Key research issues
• Develop and disseminate maps of hotspots of climate-sensitive diseases (CSDs)
• Develop a real-time prediction system for CSDs
• Develop weather-based forecasting for aflatoxin mitigation in Vietnam

Partners
• MARD (DAH and PPD) & MOH (GDPM)
• NIVR (veterinary institute): animal diseases
• PPRI (plant institute): plant diseases
• Hanoi School of Public health and NIHE: human diseases
• IMHEN (MONRE): climate data
• Provincial DARDs and DOHs

Japanese encephalitis
- A vector-borne virus disease
- 3 billion people live in endemic areas
- Fatality rate reached 60% in humans
- Pigs are the main amplifying hosts

Leptospirosis
- A bacterial disease, outbreak is associated with heavy rainfall
- Fatality rate from 5% to 30% in humans
- Rodents, pigs, horses, dogs and sheep/goats are the common reservoirs.

Aflatoxin-associated diseases
- Toxin produced by Aspergillus spp.
- Fungi infect crops and animals via feed
- Responsible for around 1 in 4 human cases of live cancer
Early Warning and Forecasting System concept

Met-Data

Model development: Forecast, mapping

Decision support tools

Notification to farmers

Public and Farmers

Climate sensitive diseases data - Surveillance system - Field survey

Responses - Vaccination - Harvesting - Selling - …

Adapted from ICRAF (2014)
Sampling areas (NIVR and PPRI)

- Swine urine/sera samples from 5 provinces (excluding Dong Nai)
  - NIVR (target samples: 1,925)
  - 385 samples / province
  - Slaughterhouses
  - JE, Lepto(sera)&AFM$_1$(urine)
  - sampling information & Questionnaires (252 people)

- Maize samples from 6 provinces
  - PPRI (target samples: 2,310)
  - 385 samples / province
  - Aflatoxin B$_1$
  - sampling information & Questionnaires (551 people)

*Sample size (each province): 50% prevalence, 95% CI and precision 5%
Climate and livestock disease: assessing the vulnerability of agricultural systems to livestock pests under climate change scenarios

Working Paper No. 116
CIGAR Research Program on Climate Change, Agriculture and Food Security (CCAFS)

Della Grace
Bernard Bett
Johanna Lindahl
Timothy Robinson

Seasonality of Viral Encephalitis and Associated Environmental Risk Factors in Son La and Thai Binh Provinces in Vietnam from 2004 to 2013

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Abstract

In Vietnam, Japanese encephalitis virus accounts for 12–71% of viral encephalitis (VE) cases followed by enteroviruses and dengue virus among identified pathogens. This study is the first attempt to evaluate the seasonality of VE and associated environmental risk factors in two provinces from 2004 to
Annual incidence rates for lepto and VE in humans

*Previous study showed that 17~71% of VE were caused by JE in Vietnam
Seasonality of VE in humans between 2004 and 2013 (Dien Bien, Hoa Binh, Lai Chau and Son La)

*Previous study showed that 17~71% of VE were caused by JE in Vietnam 4-5 times higher than Feb
## JE results in pigs - NIVR

<table>
<thead>
<tr>
<th>Province</th>
<th>District</th>
<th>Tested samples</th>
<th>ELISA results (no. of pos.)</th>
<th>ELISA results (% of pos.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pos</td>
<td>Sus</td>
</tr>
<tr>
<td>All total</td>
<td></td>
<td></td>
<td>1538</td>
<td>76</td>
</tr>
<tr>
<td><strong>Daklak</strong></td>
<td></td>
<td></td>
<td>385</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Buôn Đôn</td>
<td>81</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Cu' Mgar</td>
<td>77</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Krông Bôr</td>
<td>67</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>M'Dräk</td>
<td>79</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>TP. Buôn I</td>
<td>81</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td><strong>Hà Nội</strong></td>
<td></td>
<td></td>
<td>389</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>Chưong M</td>
<td>57</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Văn Chương</td>
<td>57</td>
<td>10</td>
<td>7</td>
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<tr>
<td></td>
<td>Dan Phuoc</td>
<td>80</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Hoài Đức</td>
<td>56</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Thanh Oai</td>
<td>106</td>
<td>20</td>
<td>14</td>
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<tr>
<td></td>
<td>Van Phuc</td>
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<td>7</td>
<td>7</td>
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<tr>
<td><strong>Nghệ An</strong></td>
<td></td>
<td></td>
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<td>12</td>
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<tr>
<td></td>
<td>Điện Chậu</td>
<td>73</td>
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<td>0</td>
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<tr>
<td></td>
<td>Đồ Lương</td>
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<td>3</td>
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<tr>
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<td>Nam Đàn</td>
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<td>5</td>
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<tr>
<td></td>
<td>TP. Vinh</td>
<td>95</td>
<td>6</td>
<td>5</td>
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<tr>
<td></td>
<td>Yên Thành</td>
<td>67</td>
<td>1</td>
<td>1</td>
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<tr>
<td><strong>Son La</strong></td>
<td></td>
<td></td>
<td>384</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Mai Sơn</td>
<td>77</td>
<td>7</td>
<td>1</td>
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<tr>
<td></td>
<td>Mộc Châu</td>
<td>77</td>
<td>0</td>
<td>0</td>
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<tr>
<td></td>
<td>Thuận Châu</td>
<td>76</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>TP Sơn La</td>
<td>77</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Yên Châu</td>
<td>77</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**JE OD**

- **< 0.2** --> Negative
- **0.2-0.4** --> Suspected
- **> 0.4** --> Positive
### Leptospirosis results in pigs - NIVR

<table>
<thead>
<tr>
<th>Province</th>
<th>Samples</th>
<th>Positive</th>
<th>% Pos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hanoi</td>
<td>390</td>
<td>37</td>
<td>9.49</td>
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<tr>
<td>Daklak</td>
<td>385</td>
<td>27</td>
<td>7.01</td>
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<tr>
<td>Nghe An</td>
<td>380</td>
<td>30</td>
<td>7.89</td>
</tr>
<tr>
<td>Son La</td>
<td>384</td>
<td>27</td>
<td>7.03</td>
</tr>
<tr>
<td>An Giang</td>
<td>420</td>
<td>36</td>
<td>8.57</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,959</strong></td>
<td><strong>157</strong></td>
<td><strong>8.01</strong></td>
</tr>
</tbody>
</table>
Percentage of Leptospira in Nghe An

- Yên Thành
- TP. Vinh
- Đô Lương
- Diễn Châu
- Nam Đàn

Percentage of Leptospira in Hanoi

- Thanh Trì
- Thanh Oai
- Chương Mỹ
- Hoài Đức
- Đan Phượng

Percentage of Leptospira in An Giang

- Châu Đốc
- Châu Thành
- Châu Phú
- TP. Long Xuyên
- Tân Châu

Percentage of Leptospira in Daklak

- M'Đrăk
- TP. Buôn Mê Thuột
- Cu Mgar
- Buôn Đôn
- Krông Bông

Percentage of Leptospira in Son La

- Mộc Châu
- Mai Sơn
- Yên Châu
- TP. Sơn La
- Thuận Châu
# Aflatoxin B₁ in Maize - PPRI

## Max. acceptable level for aflatoxins in each country
- **5 ppb** - Vietnam (human), (animal feed X)
- **20 ppb** - USA
- **4 ppb** - EU
- **10 ppb** - Kenya

<table>
<thead>
<tr>
<th>Province (Hu:An)</th>
<th>Tested samples</th>
<th>Positive samples (&gt;5 ppb)</th>
<th>Positive % With 95% CI</th>
<th>Positive samples (&gt;20 ppb)</th>
<th>Positive % With 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hanoi (13:384)</td>
<td>397 (327)</td>
<td>163</td>
<td>41.06 (36.18-46.07)</td>
<td>15</td>
<td>3.78 (2.13-6.16)</td>
</tr>
<tr>
<td>An Giang (131:268)</td>
<td>400 (197)</td>
<td>64</td>
<td>16 (12.5-20.0)</td>
<td>3</td>
<td>0.75 (0.15-2.18)</td>
</tr>
<tr>
<td>Dak Lak (184:195)</td>
<td>389 (336)</td>
<td>13</td>
<td>3.34 (1.79-5.65)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dong Nai (194:201)</td>
<td>395 (356)</td>
<td>157</td>
<td>39.75 (34.89-44.76)</td>
<td>7</td>
<td>1.77 (0.72-3.62)</td>
</tr>
<tr>
<td>Nghe An (3:391)</td>
<td>394 (229)</td>
<td>87</td>
<td>62.69 (57.70-67.48)</td>
<td>12</td>
<td>3.05 (1.58-5.26)</td>
</tr>
<tr>
<td>Son La (0:395)</td>
<td>395 (334)</td>
<td>203</td>
<td>51.39 (46.34-56.42)</td>
<td>4</td>
<td>1.01 (0.28-2.57)</td>
</tr>
<tr>
<td>Total</td>
<td>2,370 (1,779)</td>
<td>687</td>
<td>28.99 (27.17-30.86)</td>
<td>41</td>
<td>1.73 (1.24-2.34)</td>
</tr>
</tbody>
</table>
Research contributions

• **New knowledge on CSDs pattern & climate changes**
  - Human diseases associated with climate variability from secondary data (JE, shigellosis, dengue and malaria)
  - New data on animal and plant diseases (JE, leptospirosis and aflatoxins) at national scale for the first time in Vietnam

• **Event-based surveillance and response to CSDs are established and functional**
  - To raise awareness of CSDs among farmers and farm-related workers based on our findings (such as risk maps and prediction models)

• **One Health research partnership is established**
  - Trans-disciplinary team working with other stakeholders at local level to work on animal and plant pests, ensuring the application of tools developed to reduce/prevent the CSDs in the future
Main knowledge-related challenges

- **Surveillance and early warning systems tools**
  - Reliability of risk maps/prediction models for application

- **Lack of national data & pushed back on the priority list**
  - Human, animal, plant disease data: lack of diagnostic methods and under-reporting
  - Climate sensitive diseases (mainly zoonotic diseases) vs. human diseases: lack of awareness among farmers and policy makers

- **Limited recourses and awareness to implement tools**
  - Most farmers are smallholders and poor, little investment for preventive measures (such JE vaccination) in humans/animals
Future plans for 2017

• Building a website: update on the progress of Pestforecast (wiki)

• Master student (VNUA): aflatoxin B₁ in Maize

• Conference of research workers in animal diseases (CRWAD) in Chicago: Dec 5 2016 -> presentation (lepto in pig)

• Developing more manuscripts using secondary datasets as well as Pestforecast data: prediction models and risk maps

• Sampling during the rainy season in Vietnam for 2017

• CCAFS dairy production project in Indonesia (~ April 2019)
  - Partner: Wageningen University (Funded by Dutch government)
  - Reduce greenhouse gas emission from dairy cattle
  - Development of prediction models/risk maps on climate sensitive diseases
THANK YOU!