World Organisation for Animal Health

# Findings of LSD impact assessment study in Asia

Veerasak Punyapornwithaya (DVM, Msc, PhD)
Faculty of Veterinary Medicine
Chiang Mai University

# Team members

- Veerasak Punyapornwithaya : PI, data analysis, spatial modelling
- Waraphon Phimpraphai (Kasetsart University) : stakeholder and value chain analysis
- Noppawan Buamithup (Department of Livestock Development: DLD) : stakeholder and value chain analysis, LSD prevention and control policy
- Orapun Arjkumpa (DLD) : Risk factors and economic-impact of LSD

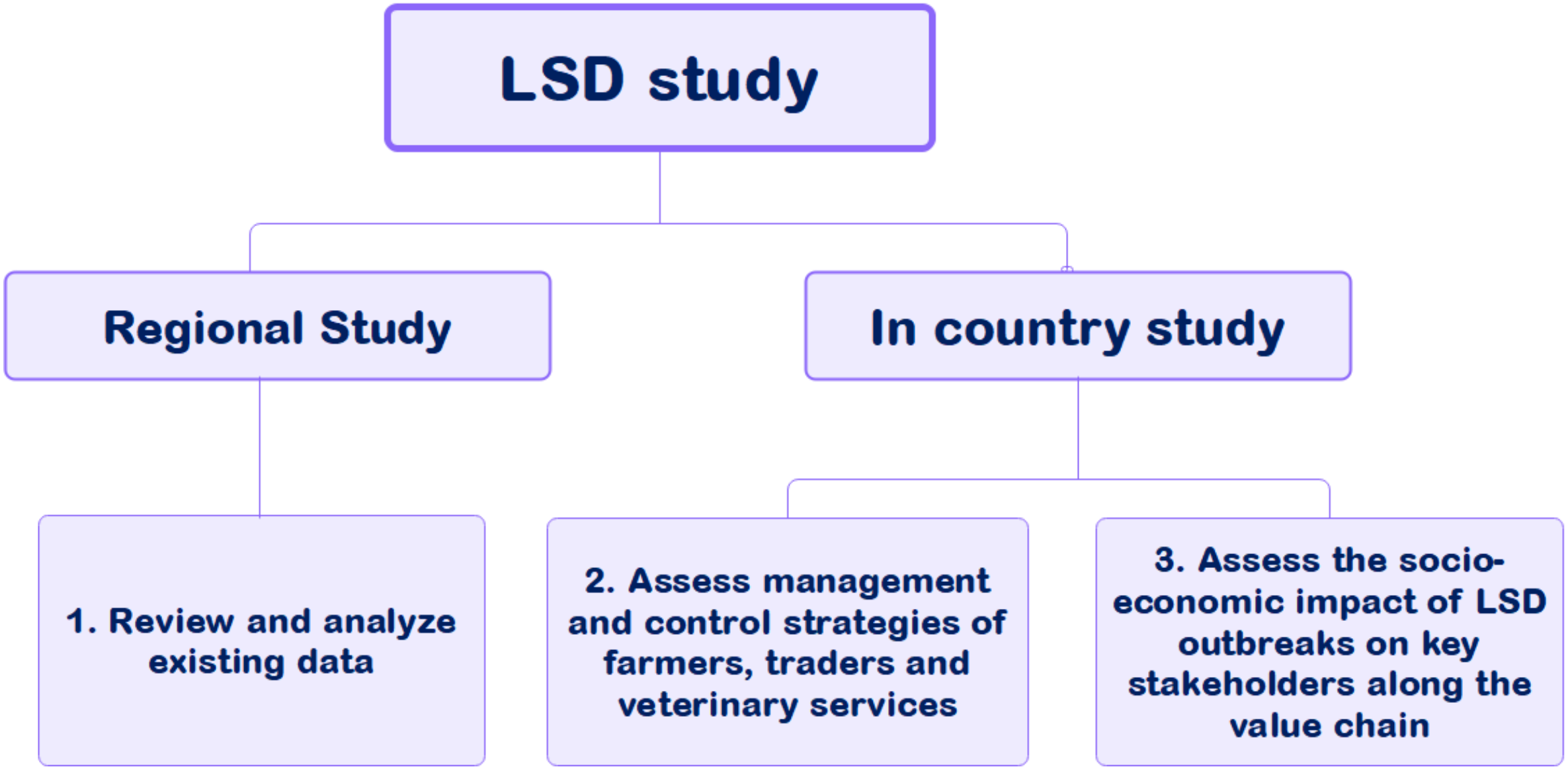
- Md. Taohidul Islam (Faculty of Veterinary Science Bangladesh Agricultural University) : PI for the study in Bangladesh


## Download link for full report

https://rr-asia.woah.org/app/uploads/2024/06/Final-Report_Study-to-assess-the-impact-of-LSD_June-2024.pdf

# Outline

- Introduction and objectives
- Regional study
- In country study: Thailand and Bangladesh
- Summary


LSD study
Regional Study
In country study
1. Review and analyze existing data
2. Assess management and control strategies of farmers, traders and veterinary services
3. Assess the socio-economic impact of LSD outbreaks on key stakeholders along the value chain

# Literature review

Some key findings related to : the impact of LSD outbreaks
LSD Prevention and control strategy

# Resources and references

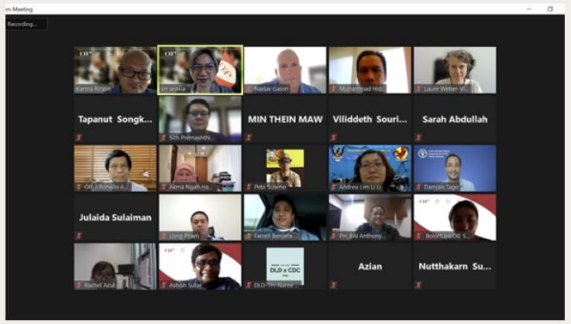
- WAHIS data
- WOAH regional meeting on LSD
- WOAH-CMU project (data analysis, field study)
- Country reports
- Research Publications

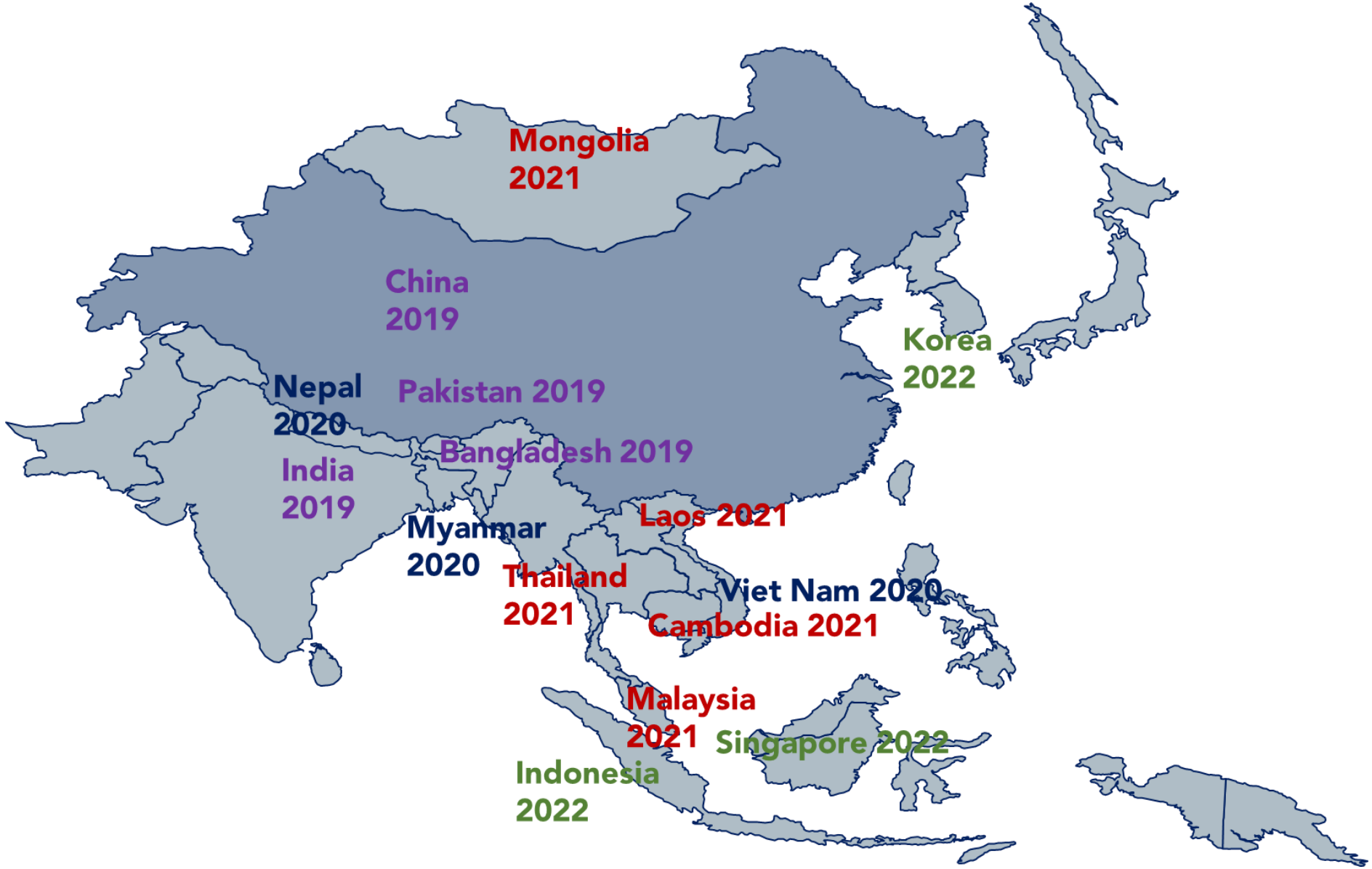
World Organisation for Animal Health
Founded as OIE

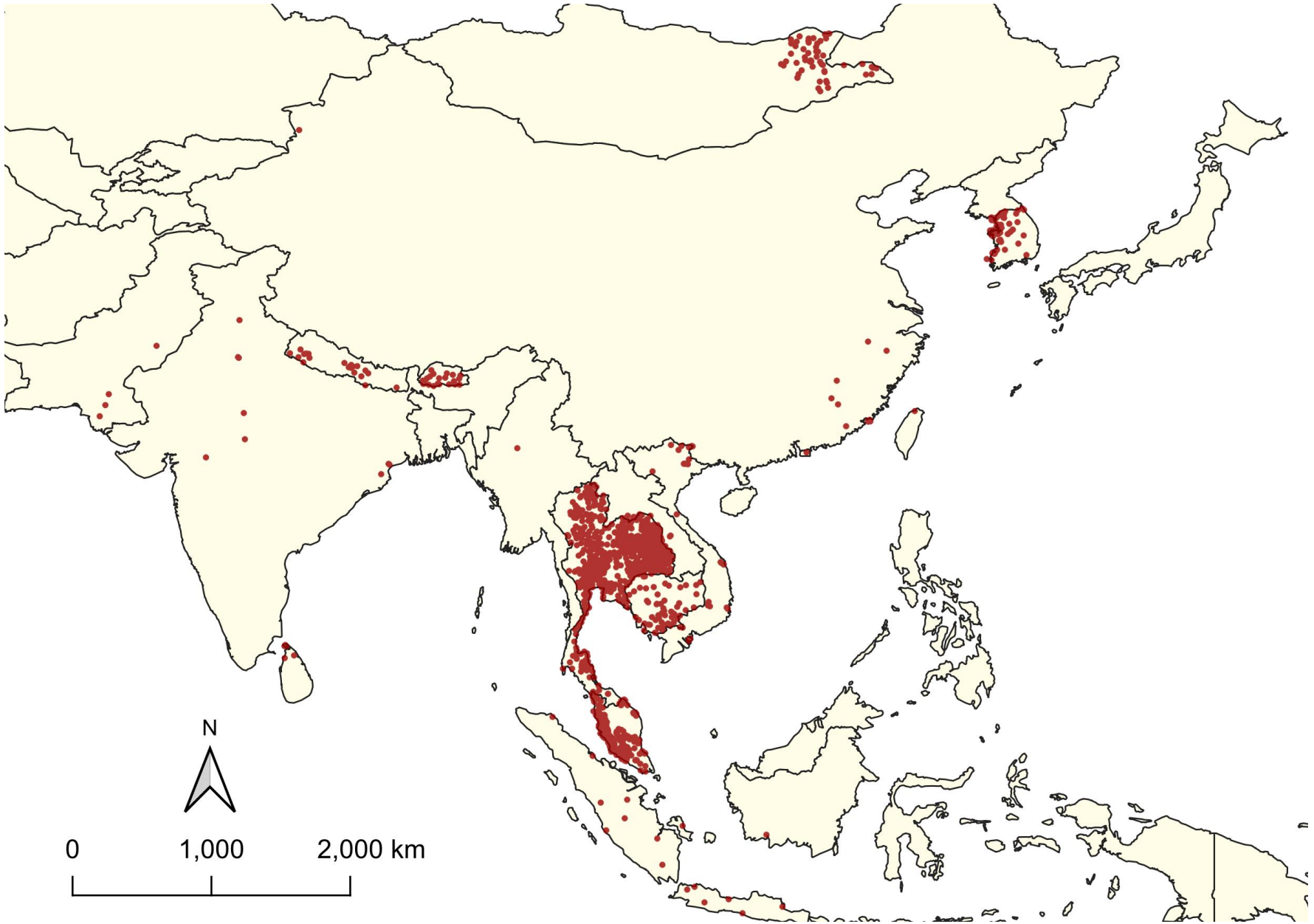
WAHIS

LSD

Lumpy skin disease (LSD) coordination meeting for South East Asia




Mongolia
2021
China
2019
Korea
2022
Nepal
2020
Pakistan 2019
Bangladesh 2019
India
2019
Laos 2021
Myanmar
2020
Thailand
2021
Viet Nam 2020
Cambodia 2021
Malaysia
2021
Singapore 2022
Indonesia
2022




Distribution of LSD outbreaks in Asia

# Some key findings from the literatures

- Risk factors for LSD outbreaks in Asia include animal movement, insect vectors, and low farm biosecurity.
- Financial losses per LSD case were USD 110 in Bangladesh and USD 119–413 per farm in Thailand due to reduced milk sales (consider only milk losses).
- Thailand is reported a nationwide vaccination campaign, highlighting its effectiveness.

# Some key findings from the literatures-2

- Clusters of LSD outbreaks were identified in several areas across the region.
- Phylogenetic analysis showed LSDV strains in Vietnam closely resemble those from China, Cambodia, Thailand and Indonesia.
- LSDV strains in Myanmar were similar to those identified in Bangladesh and India.

Mazloum A, Van Schalkwyk A, Babiuk S, Venter E, Wallace DB, Sprygin A. Lumpy skin disease: history, current understanding and research gaps in the context of recent geographic expansion. Frontiers in Microbiology. 2023;14:1266759

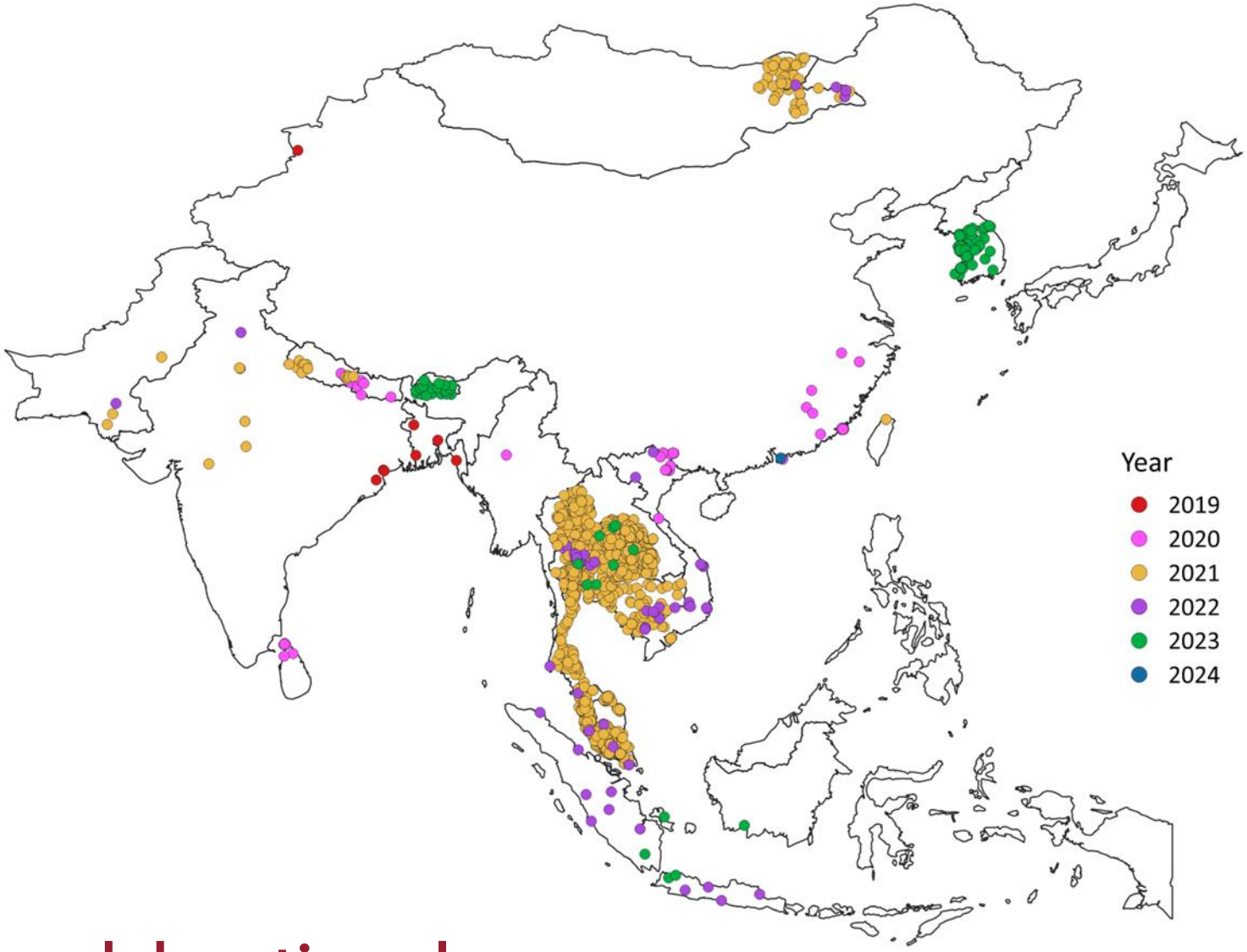
# Vaccination is the most common control measure

## Type of vaccine

| Country | Vaccine | Trade Brand |
|---|---|---|
| Vietnam | Homologues<br>Heterologous | LumpyShield-N® / LumpyShield-G®<br>JovivacStrong® |
| Thailand | Homologous | LUMPYVAX®, MEVAC® |
| Malaysia | Homologous | Bovivax LSD-N®, LUMPYVAX®, MEVAC® |
| Cambodia | Homologous | LUMPYVAX®, |
| Indonesia | Homologous | LUMPYVAX®, MEVAC® |
| India | Homologous | Lumpi-ProVacInd® |

# Spatial Epidemiology of LSD outbreaks

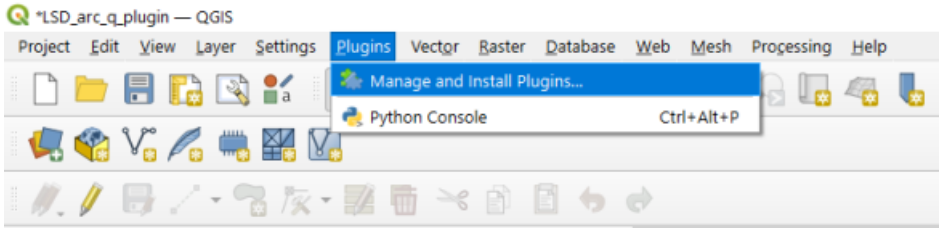
- to ascertain the existence of spatio-temporal clusters of LSD outbreaks in the Asian countries

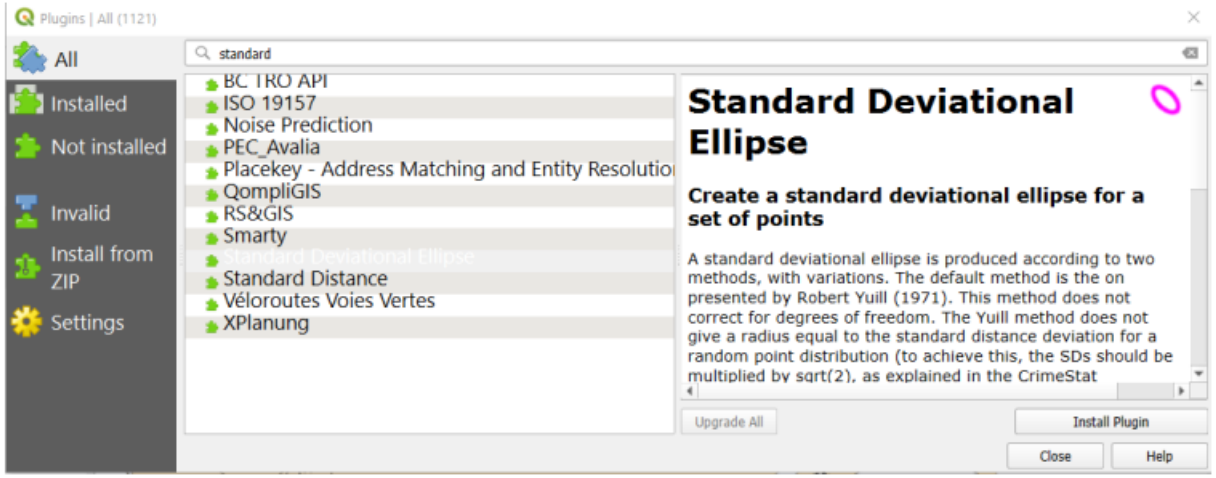


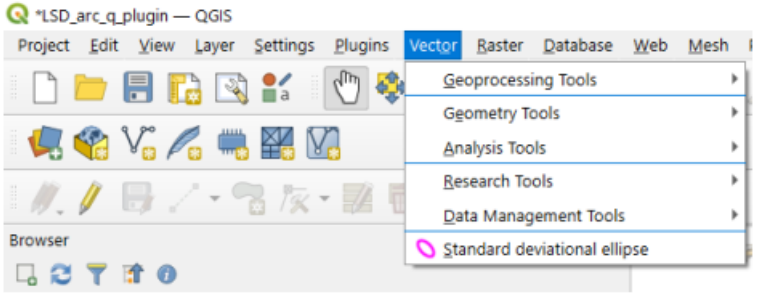

# LSD outbreak locations by year

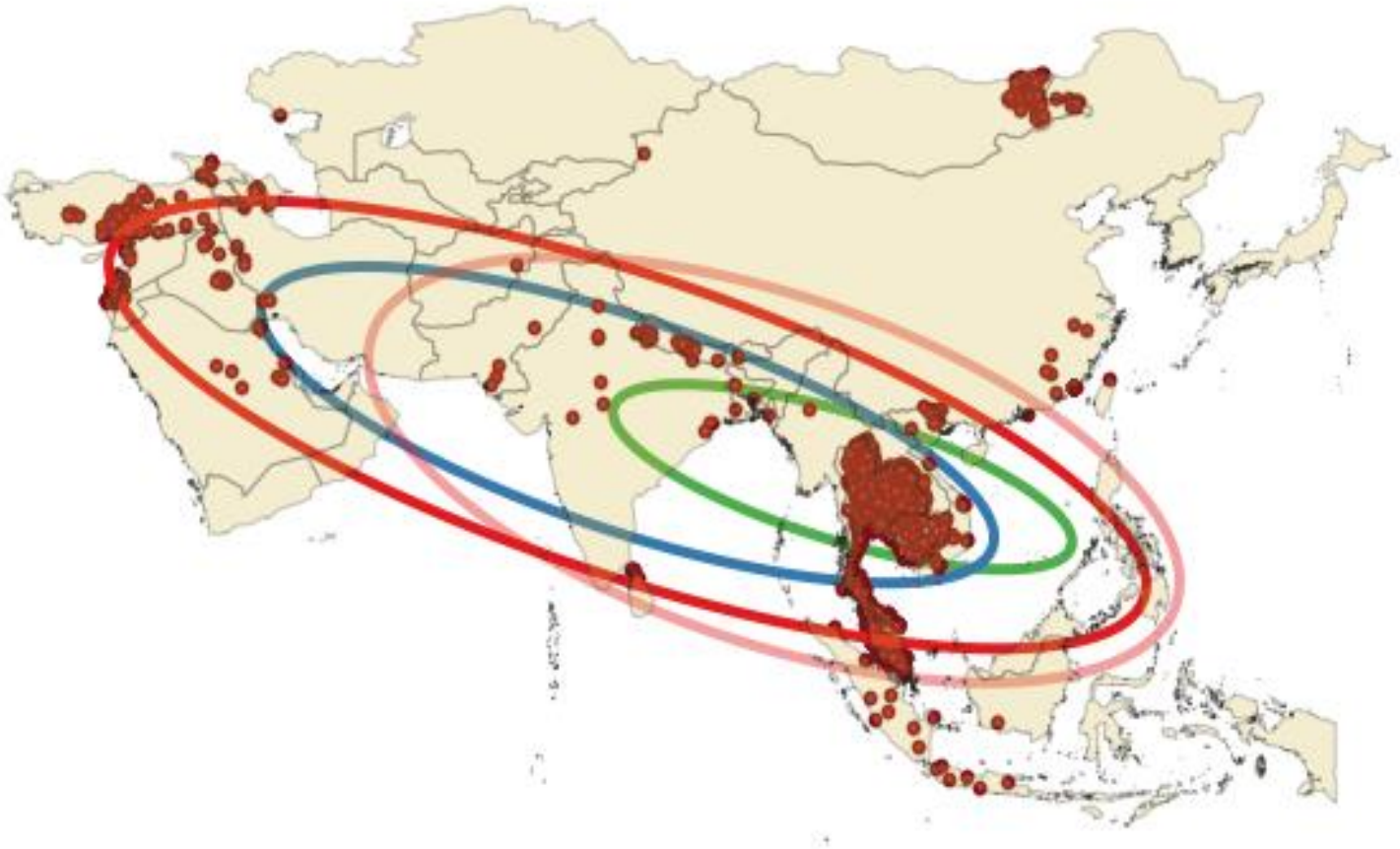
# Directional analysis

- Determine spatial distribution trend of LSD outbreaks considering date or date and number of cases

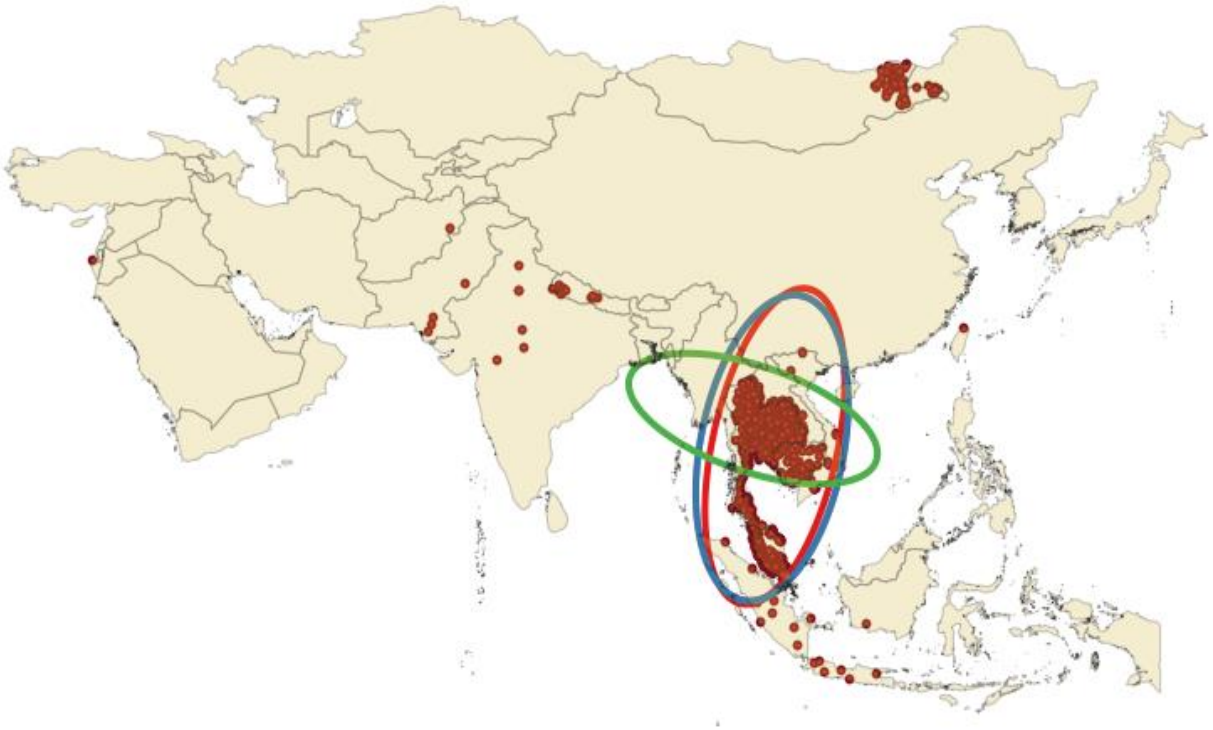


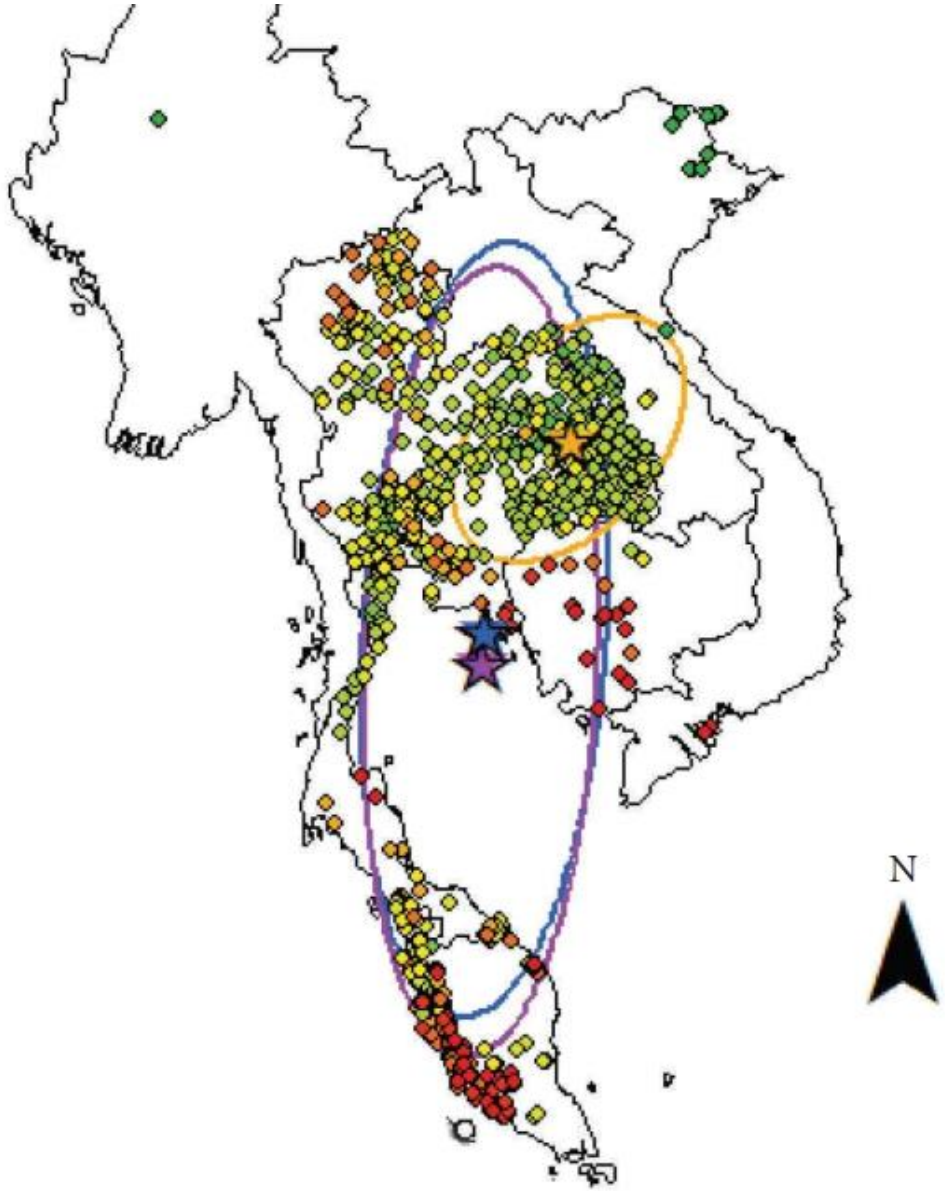





Standard deviation ellipses were obtained from the Yuill method, with (green line) and without weighting (blue line) and CrimeStat with (pink line) and without weighting (red line) based on lumpy skin disease outbreak data from **2006 to 2023 (May).**



Standard deviation ellipses were obtained from the Yuill method, with (green line) and without weighting (blue line) and CrimeStat, with (pink line) and without weighting (red line) based on lumpy skin disease outbreak data from **2021 to 2023 (May)**.




Epidemic Day

- 1 - 74
- 75 - 199
- 200 - 218
- 219 - 235
- 236 - 254
- 255 - 270
- 271 - 289
- 290 - 318
- 319 - 345
- 346 - 361

Wilhelm and Ward, 2023

# Spatio-temporal model

- Determine clusters of LSD outbreaks considering spatial and temporal dimensions
- Cluster of high LSD cases

- 16 spatio-temporal models were investigated
- Space-time permutation
- Space-time Poisson
- Asia data
- South East Asia data

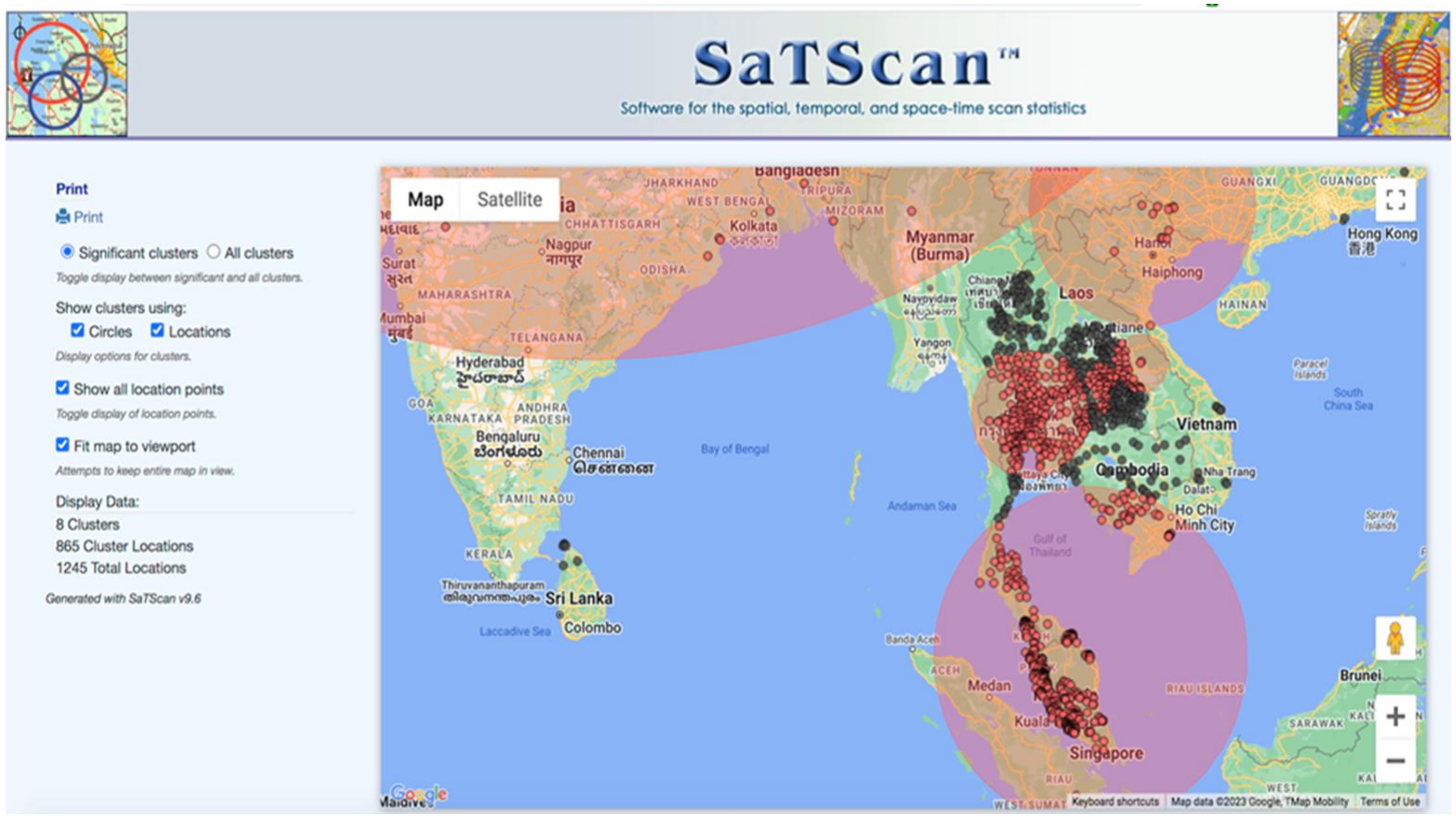
| No | Type of analysis | Model | Area | Time aggregation | Maximum temporal cluster size |
|---|---|---|---|---|---|
| 1 | Space-time | Poisson | Asia | Year | 50% of the study period |
| 2 | Space-time | Poisson | Asia | Year | 1 year |
| 3 | Space-time | Poisson | Asia | Month | 50% of the study period |
| 4 | Space-time | Poisson | Asia | Month | 1 month |
| 5 | Space-time | STP | Asia | Year | 50% of the study period |
| 6 | Space-time | STP | Asia | Year | 1 year |
| 7 | Space-time | STP | Asia | Month | 50% of the study period |
| 8 | Space-time | STP | Asia | Month | 1 month |
| 9 | Space time | Poisson | SEA | Year | 50% of the study period |
| 10 | Space time | Poisson | SEA | Year | 1 year |
| 11 | Space-time | Poisson | SEA | Month | 50% of the study period |
| 12 | Space-time | Poisson | SEA | Month | 1 month |
| 13 | Space-time | STP | SEA | Year | 50% of the study period |
| 14 | Space-time | STP | SEA | Year | 1 year |
| 15 | Space-time | STP | SEA | Month | 50% of the study period |
| 16 | Space-time | STP | SEA | Month | 1 month |

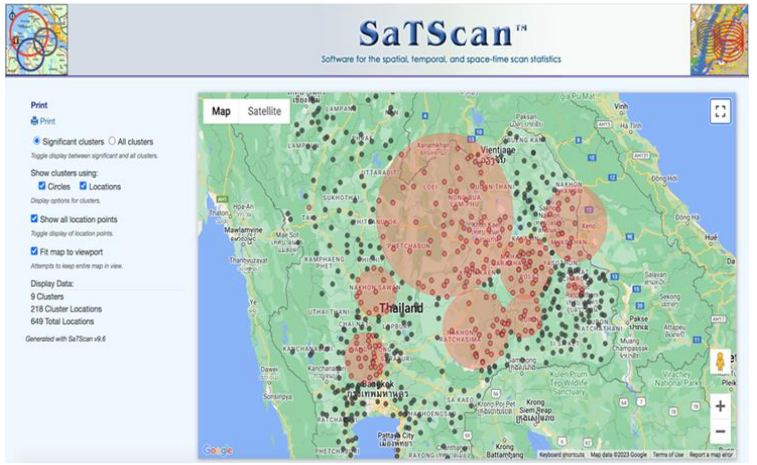
# Number of LSD outbreak clusters

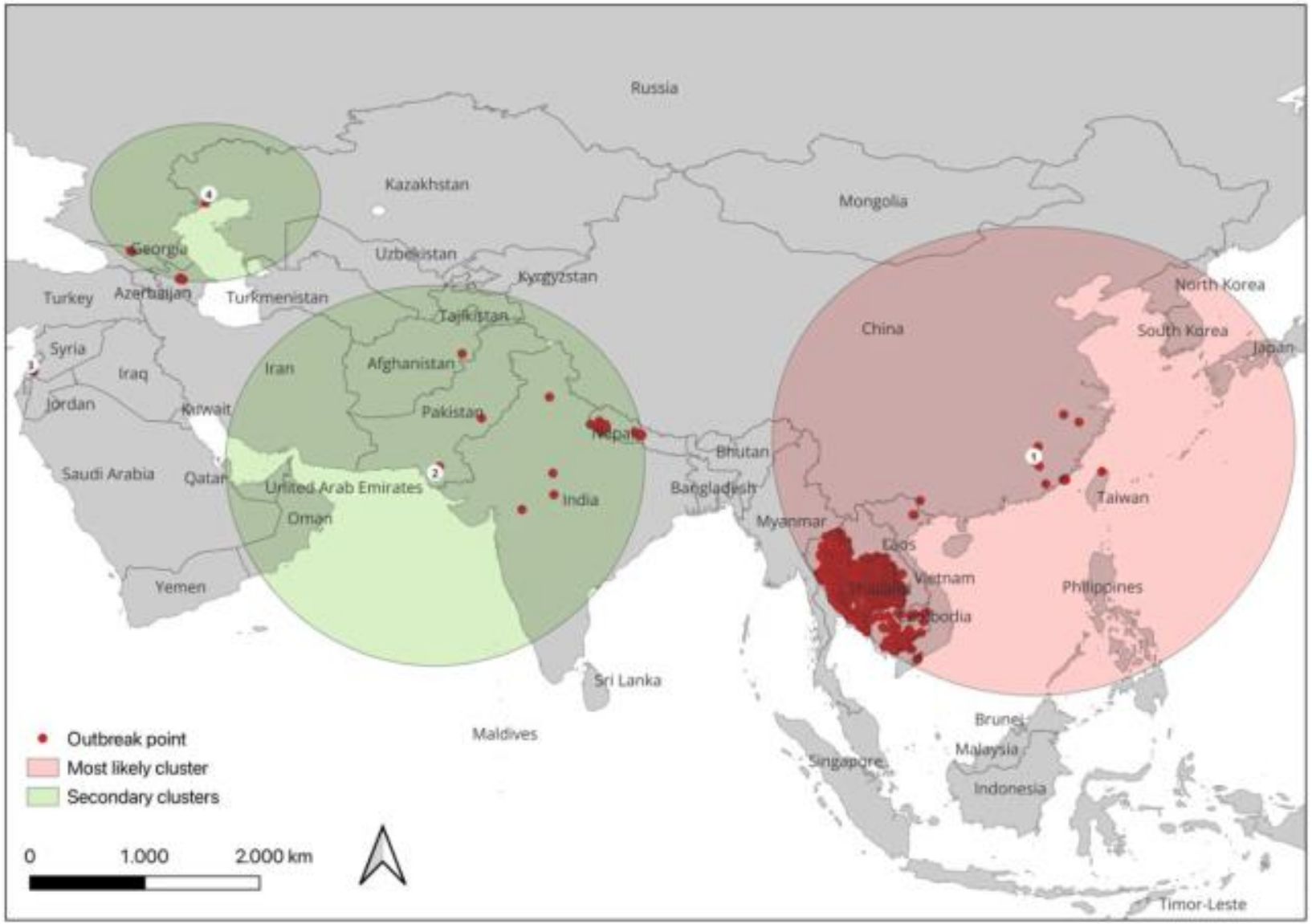
| Model | Description | Area | Number of clusters |
|---|---|---|---|
| 1 | Space time - Poisson model | ASIA | 8 |
| 2 | Space time - Poisson model | ASIA | 8 |
| 3 | Space time - Poisson model | ASIA | 2 |
| 4 | Space time - Poisson model | ASIA | 4 |
| 5 | Space time - STP model | ASIA | 6 |
| 6 | Space time - STP model | ASIA | 7 |
| 7 | Space time - STP model | ASIA | 9 |
| 8 | Space time - STP model | ASIA | 9 |

| Model | Description | Number of clusters | Table number |
|---|---|---|---|
| 9 | Space time - Poisson model | 1 | 3.9 |
| 10 | Space time - Poisson model | 1 | 3.10 |
| 11 | Space time - Poisson model | 2 | 3.11 |
| 12 | Space time - Poisson model | 2 | 3.12 |
| 13 | Space time – STP model | 6 | 3.13 |
| 14 | Space time – STP model | 6 | 3.14 |
| 15 | Space time – STP model | 7 | 3.15 |
| 16 | Space time – STP model | 8 | 3.16 |

# Example of the spatio-temporal results

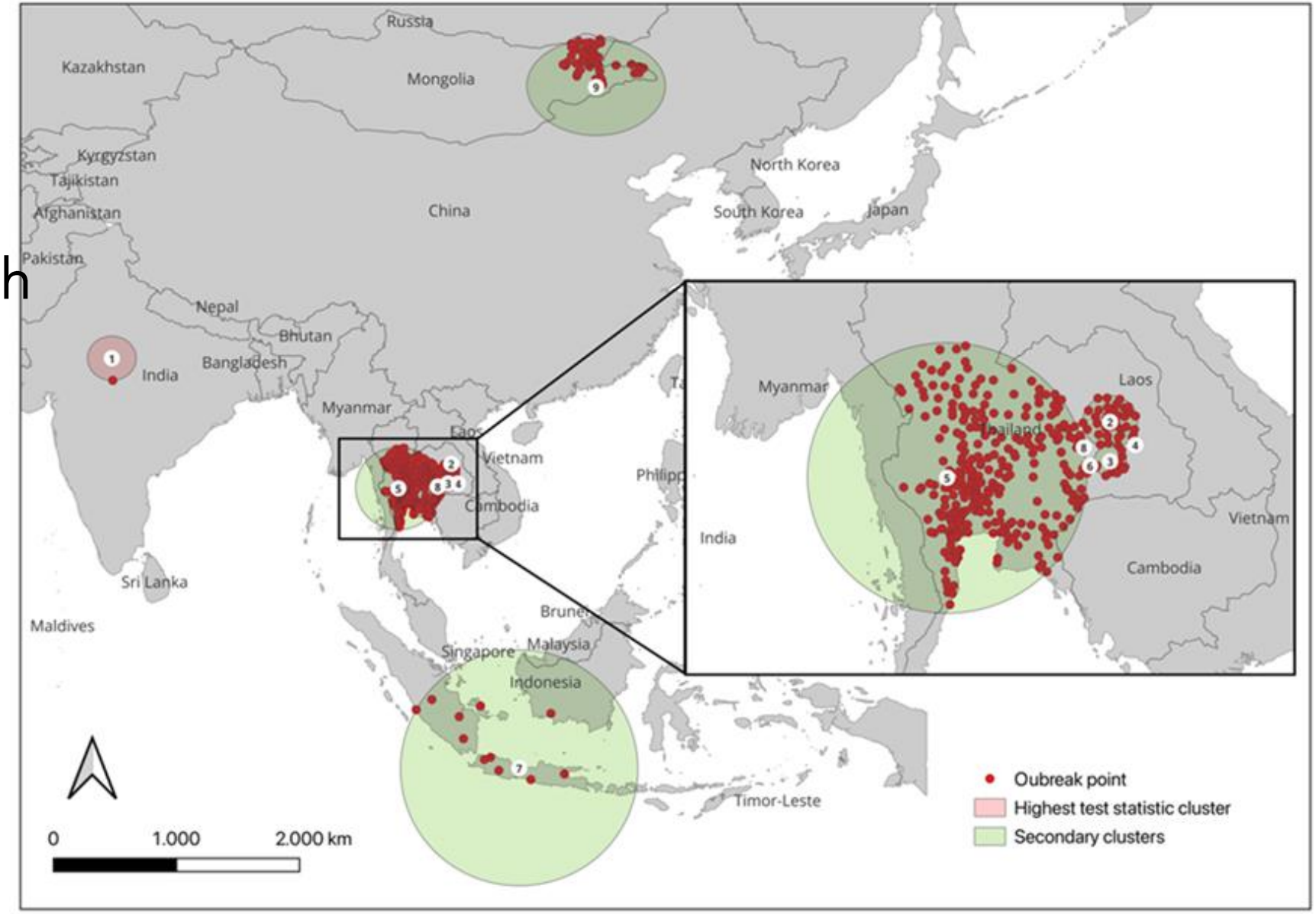



Russia
Kazakhstan
Mongolia
Georgia
Uzbekistan
Kyrgyzstan
Turkey
Azerbaijan
Turkmenistan
Tajikistan
China
North Korea
South Korea
Japan
Syria
Iraq
Iran
Afghanistan
Jordan
Kuwait
Pakistan
Nepal
Bhutan
Saudi Arabia
Qatar
United Arab Emirates
Bangladesh
India
Taiwan
Oman
Myanmar
Laos
Vietnam
Philippines
Cambodia
Yemen
Sri Lanka
Maldives
Brunei
Malaysia
Singapore
Indonesia
Timor-Leste
Outbreak point
Most likely cluster
Secondary clusters
0
1.000
2.000 km

- SEA region
- SPT model
- MSCS = 50%
- MTCS = 1 month

**Type of models and parameter settings affect on the results (e.g., cluster size, number of cases, time period).**



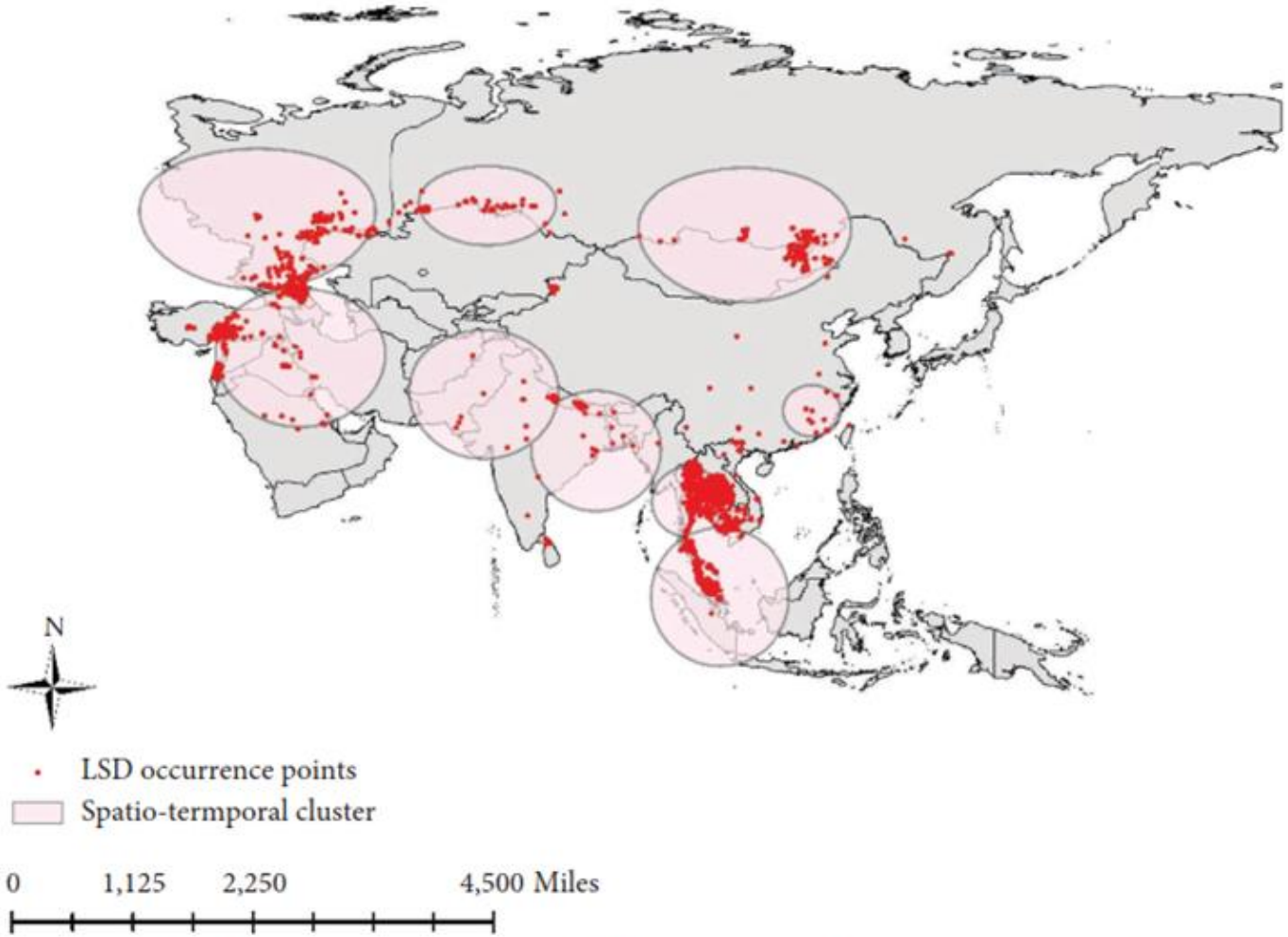


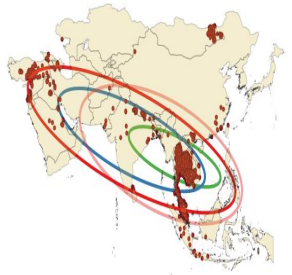

FIGURE 1: The LSD epidemic outbreak point and spatiotemporal clusters areas in the Asian continent (January 2012 to September 2022).

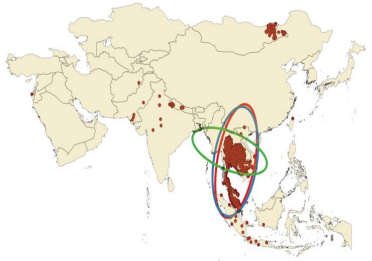
Li et al., 2023


25

# Summary

- **LSD outbreak clusters were identified in Western, Southern, and Southeastern Asia.**
- **Primary clusters in Southeast Asia were detected in Thailand and Indonesia.**
- **Parameter settings influenced the results, emphasizing the need to align settings with defined objectives.**
- **LSD outbreaks across Asia generally spread west to east.**
- **In Southeast Asia, outbreaks followed a northeast-to-southwest trajectory.**





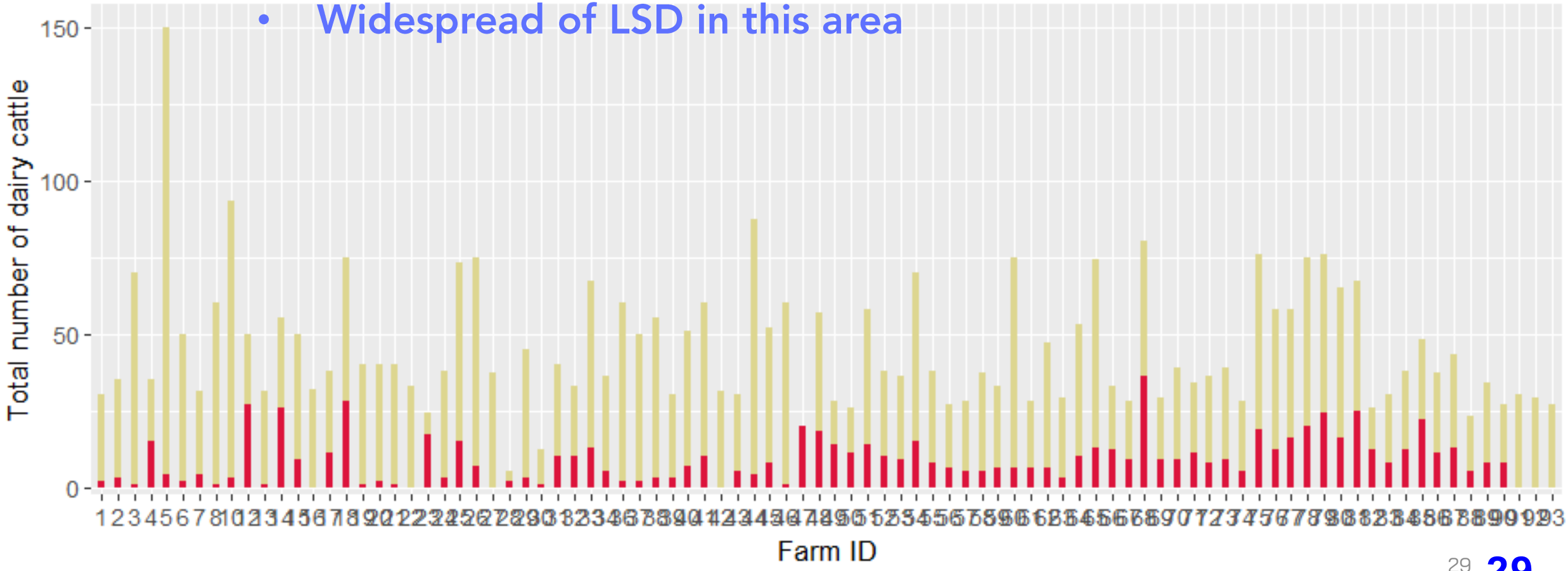
# 2. Strategies and practices for preventing and controlling LSD outbreak

To assess management and control strategies of farmers, traders, and veterinary services during and post LSD outbreaks in selected countries to identify best practices

Khokkho dairy cooperative
Mahasarakham province
Thailand

Bangladesh Milk Producer's Cooperative Union
Ltd. (known as 'Milk Vita') at Shahjadpur upazila of Sirajganj district and Bhaluka upazila of Mymensingh district

- 90 dairy farms (outbreak = 83 farms)
- Herd size: average = 45.6 and median = 38
- LSD cases: average = 8.8, and median = 8
- Vaccine: 2 weeks before and during the outbreak period
- Restriction of animal movements
- Widespread of LSD in this area



# Thailand

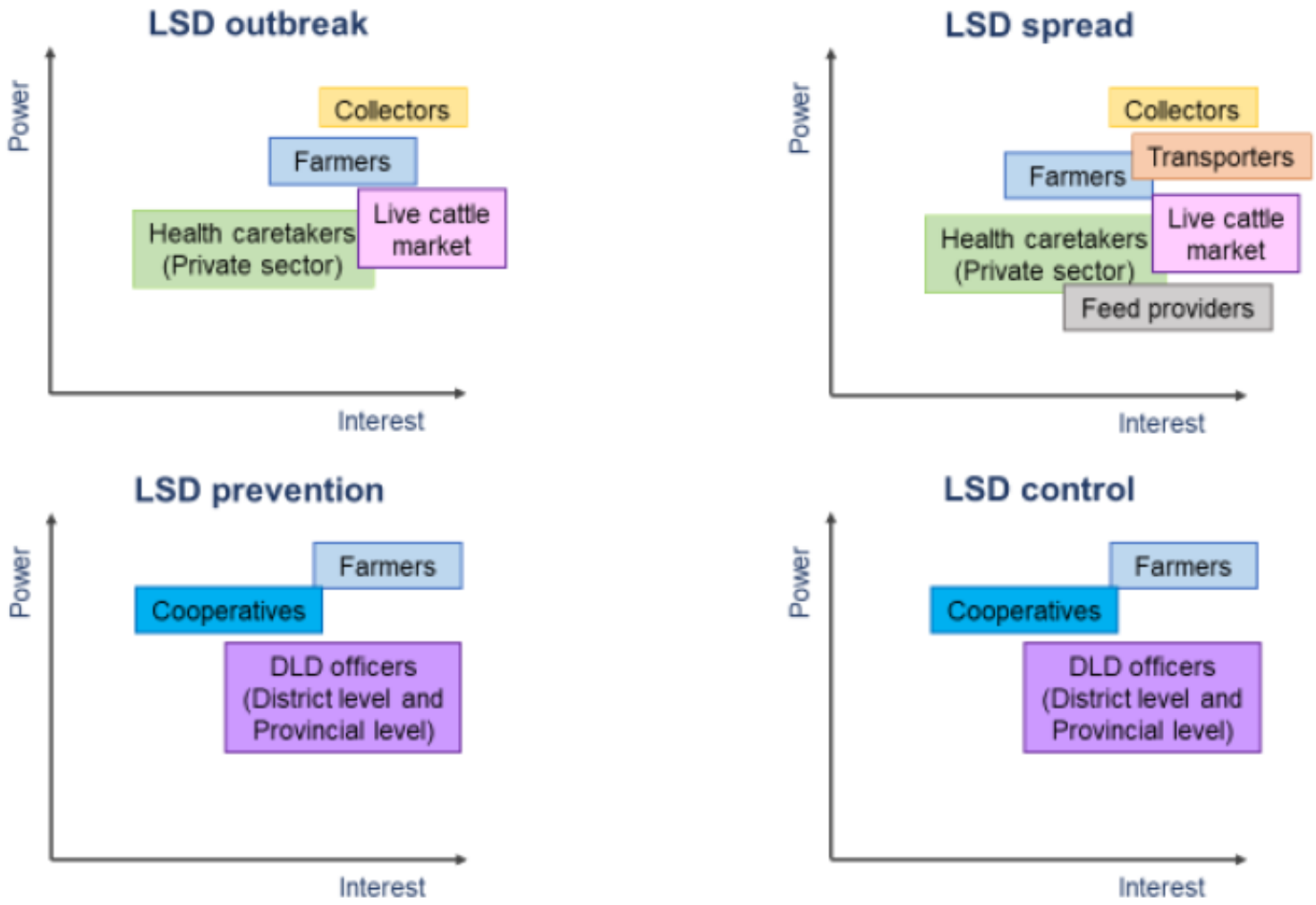
- **Management practices**

| Managements | Yes | No |
|---|---|---|
| Farm has a fence | 90 | 0 |
| Farm shares a water source with other farms | 0 | 90 |
| Having other animals (e.g., poultry) on the farm | 74 | 16 |
| Using disinfectant | 87 | 3 |
| Cattle on the farm have a chance to come into contact with cattle from other farms | 2 | 88 |
| Keeping a log-book record for visitors | 86 | 4 |
| Farm has a deworming program for cattle | 89 | 1 |
| Insects are present on the farm | 90 | 0 |
| History of purchasing cattle before the LSD outbreak | 8 | 82 |


ป้องกัน
โรคลัมปี สกิน
(Lumpy Skin Disease : LSD)
สค. โคกก่อ
043-784104


KUBOTA

# • Stakeholder analysis



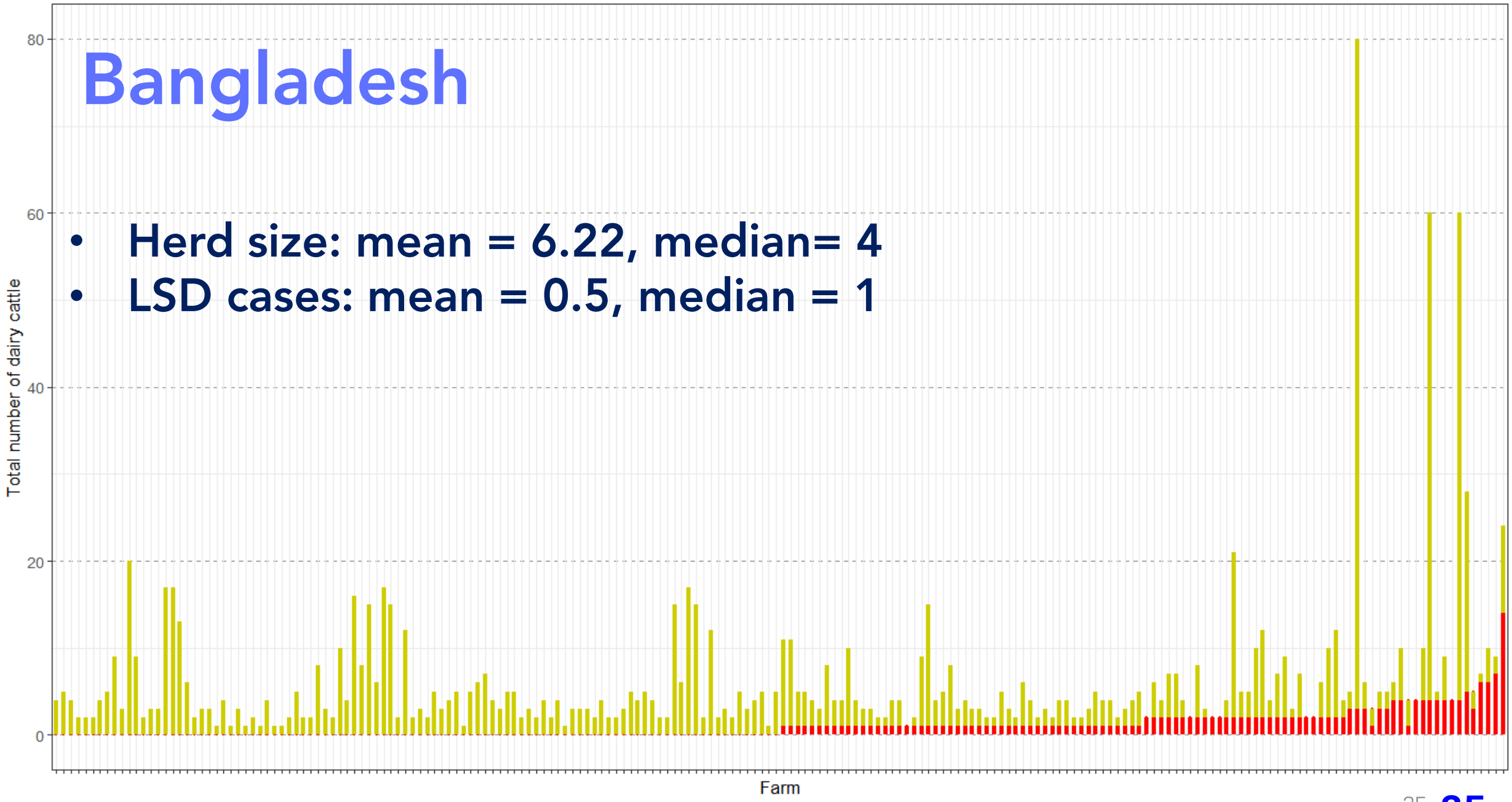

**Animal traders play important role for LSD outbreak and spread**

**Farmers and the cooperation among stakeholders play important role for LSD prevention and control**

# Bangladesh

# Bangladesh

- Herd size: mean = 6.22, median= 4
- LSD cases: mean = 0.5, median = 1





35

# Results

| Risk factors | Odds ratios | 95% Confidence Interval | P-value |
|---|---|---|---|
| Raise cattle by public grass grazing | 2.95 | 1.03 – 9.51 | 0.053 |
| Lacking vector management practice | 3.15 | 1.39 – 7.47 | **0.007** |
| Previous history of LSD outbreak | 52.49 | 20.20 – 165.82 | **<0.001** |

- In the Thailand study, all farms in the study area were naïve herds, with LSD vaccination administered only two weeks before or during the outbreaks.
- In the study from Bangladesh, 39% of farms (n=78/200) reported a previous history of LSD in the herd, while only 24% (n=49/200) had administered LSD vaccination.

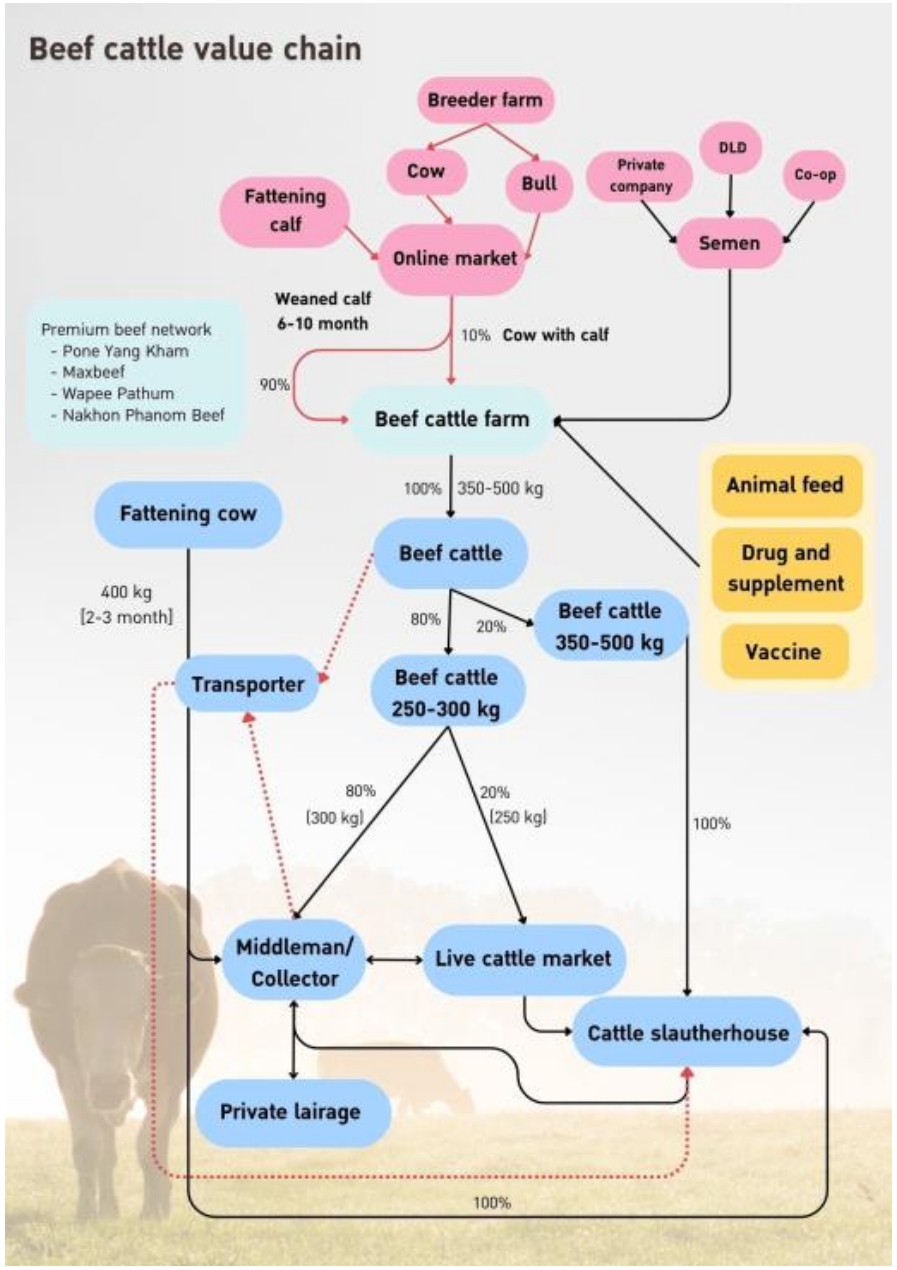
# Value chain analysis and socio-economic impact of lumpy skin disease outbreaks on key stakeholders within the value chain

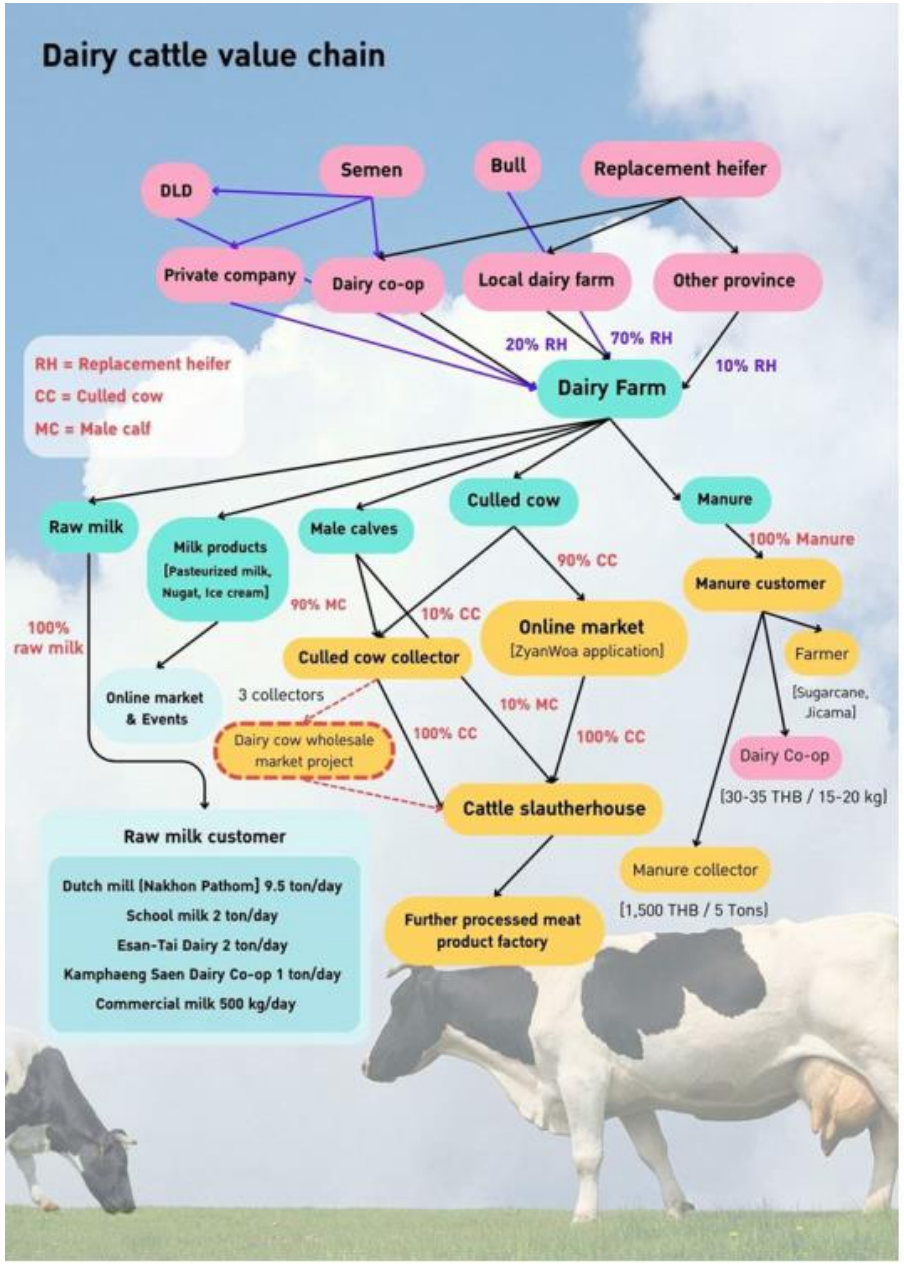
**To assess the socio-economic impact of LSD outbreaks on key stakeholders along the value chain**

# Value chain analysis

## Thailand

Khokkho Dairy Cooperative



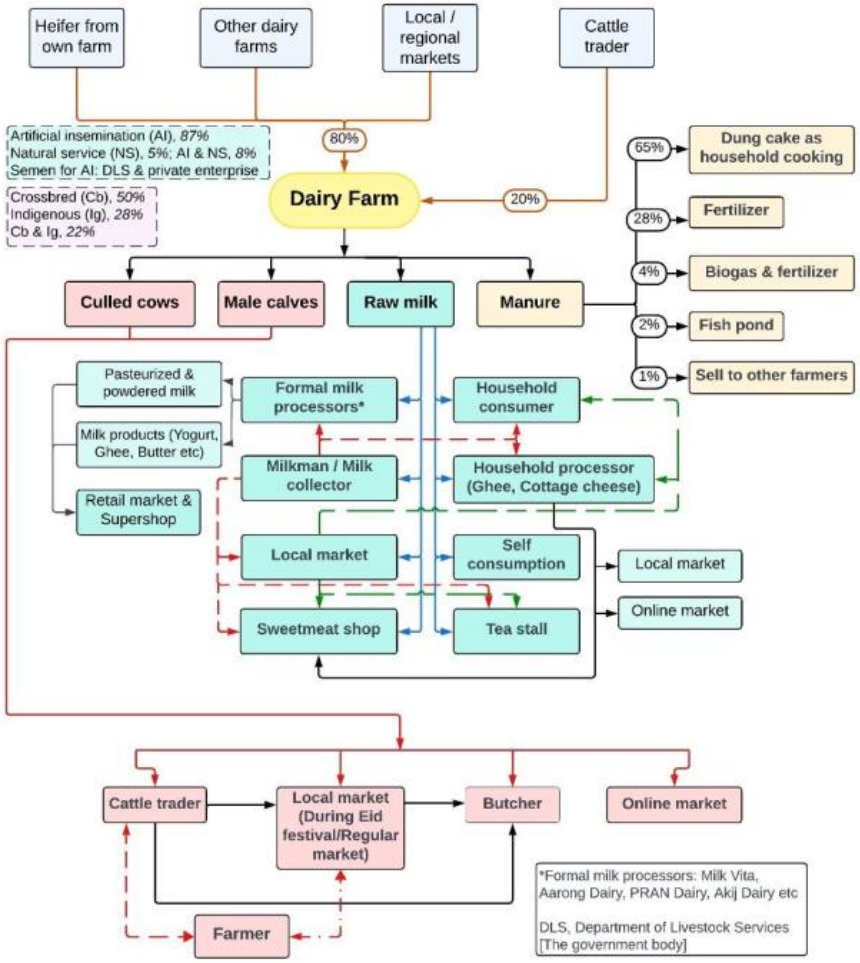



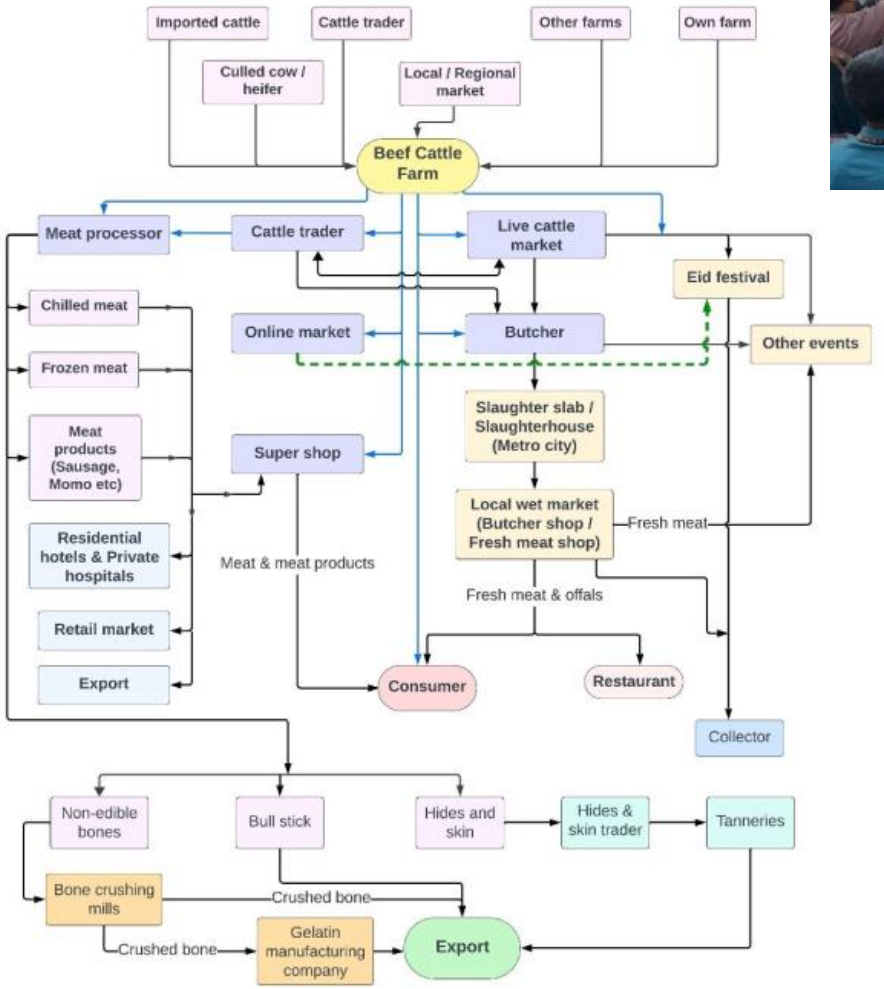

the connection of stakeholders in the value chain

Preliminary knowledge is valuable for disease prevention and control

stakeholders engage with each other during the outbreak

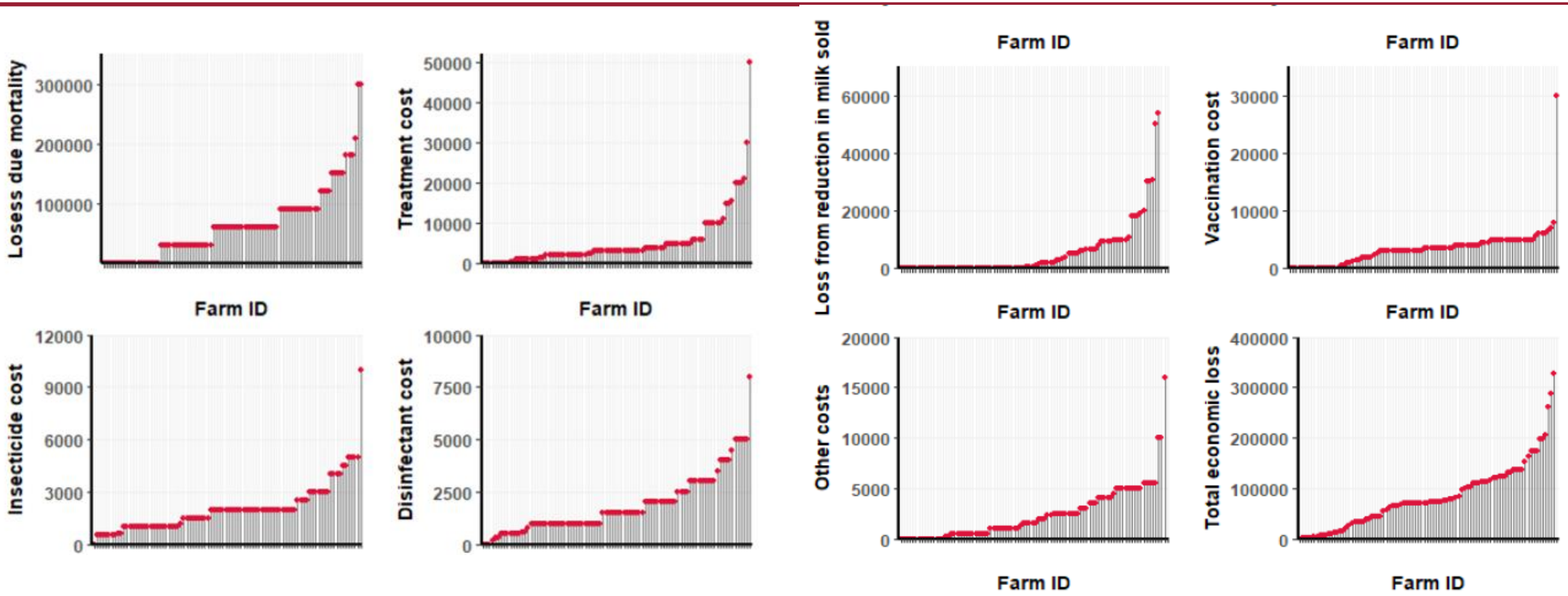
# Bangladesh



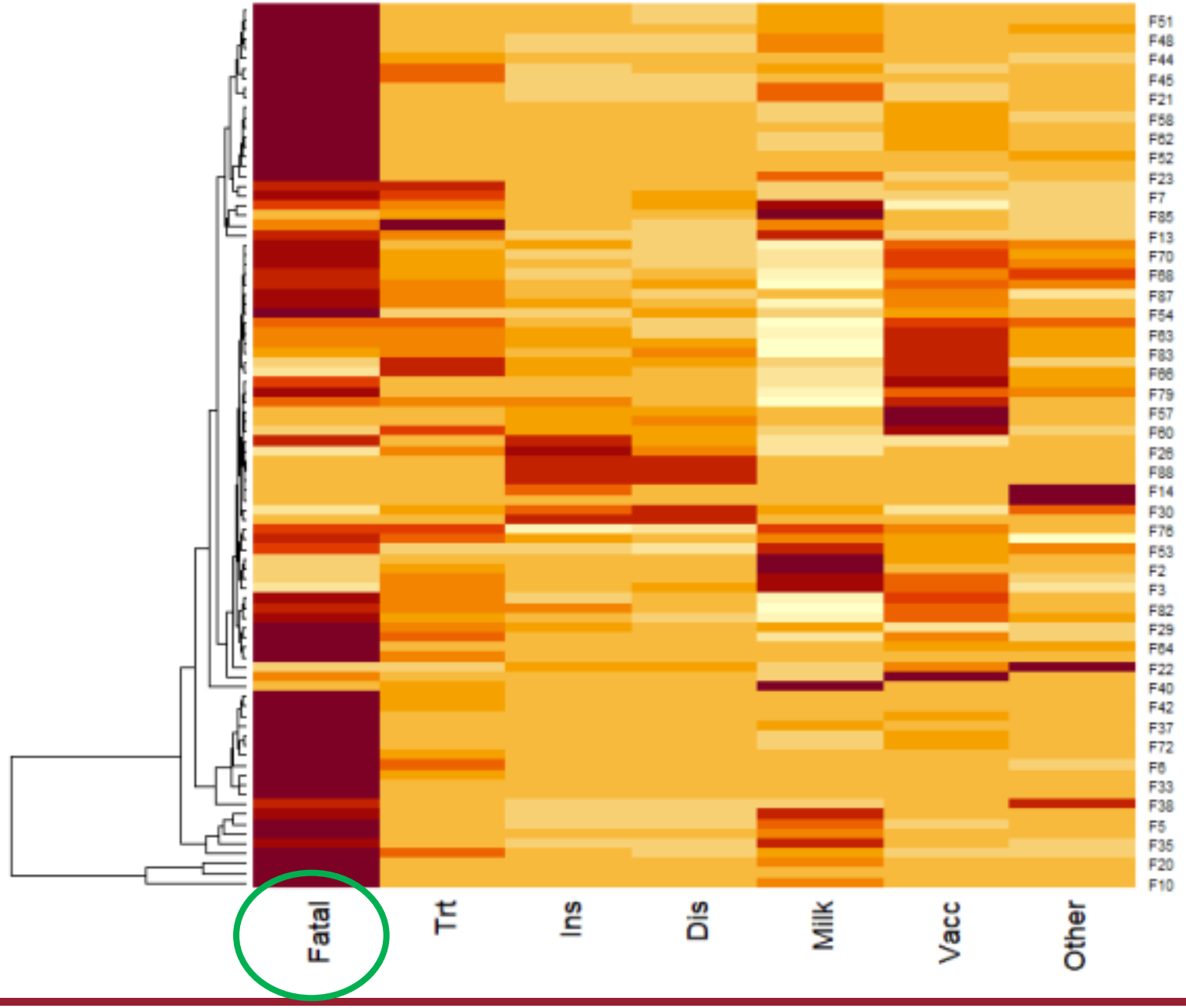

## Dairy and beef cattle value chain

- **Thailand's dairy industry operates on a larger scale with more extensive herd sizes, while beef herd sizes are similar in both countries.**




# Thailand

- Primary loss: mortality of LSD-affected cattle.
- Vaccination cost was lower than treatment cost


F51
F48
F44
F45
F21
F58
F62
F52
F23
F7
F85
F13
F70
F68
F87
F54
F63
F83
F66
F79
F57
F60
F26
F88
F14
F30
F76
F53
F2
F3
F82
F29
F64
F22
F40
F42
F37
F72
F6
F33
F38
F5
F35
F20
F10
Fatal
Trt
Ins
Dis
Milk
Vacc
Other

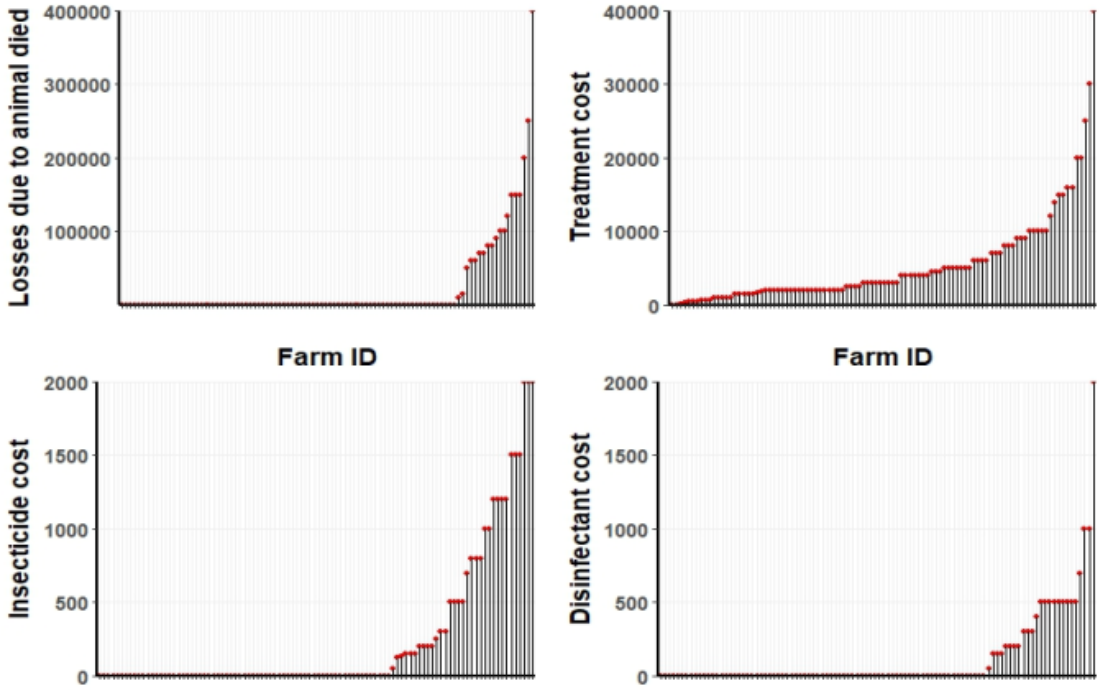

44

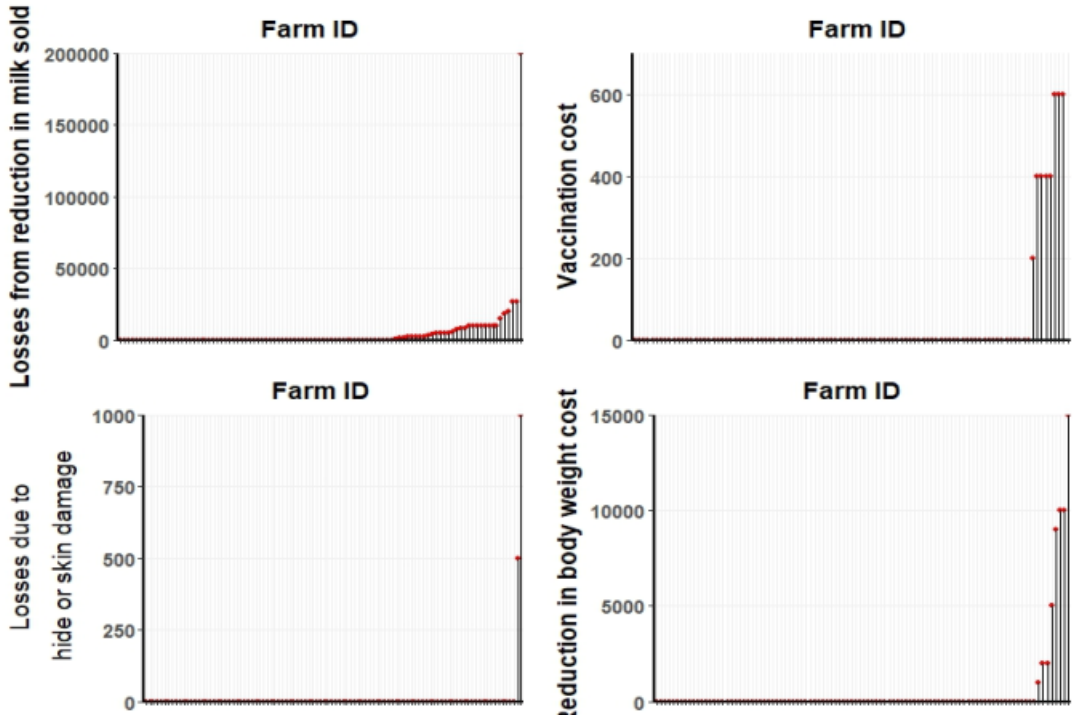
| Items | Mean±Standard deviation (Thai Bath) | USD * |
|---|---|---|
| Loss due to mortality of cattle | 64,000±61,366.46 | 1,801± 1,727 |
| Treatment cost | 5,227 ±7,273.22 | 147± 204 |
| Insecticide cost | 2,026 ±1,430.01 | 57± 40 |
| Disinfectant cost | 1,858±1,435.26 | 52± 40 |
| Loss due to reduction in milk sold | 8,084±1,722.71 | 227± 48 |
| Vaccination cost | 3,327±34,66.17 | 93± 97 |
| Other costs | 2,903 ±5,651.59 | 81± 150 |
| Total economic loss | 87,429 ± 74,903.06 | 2,461 ±2,108 |

*Approximate 35.5 Thai Bath equal 1 USD

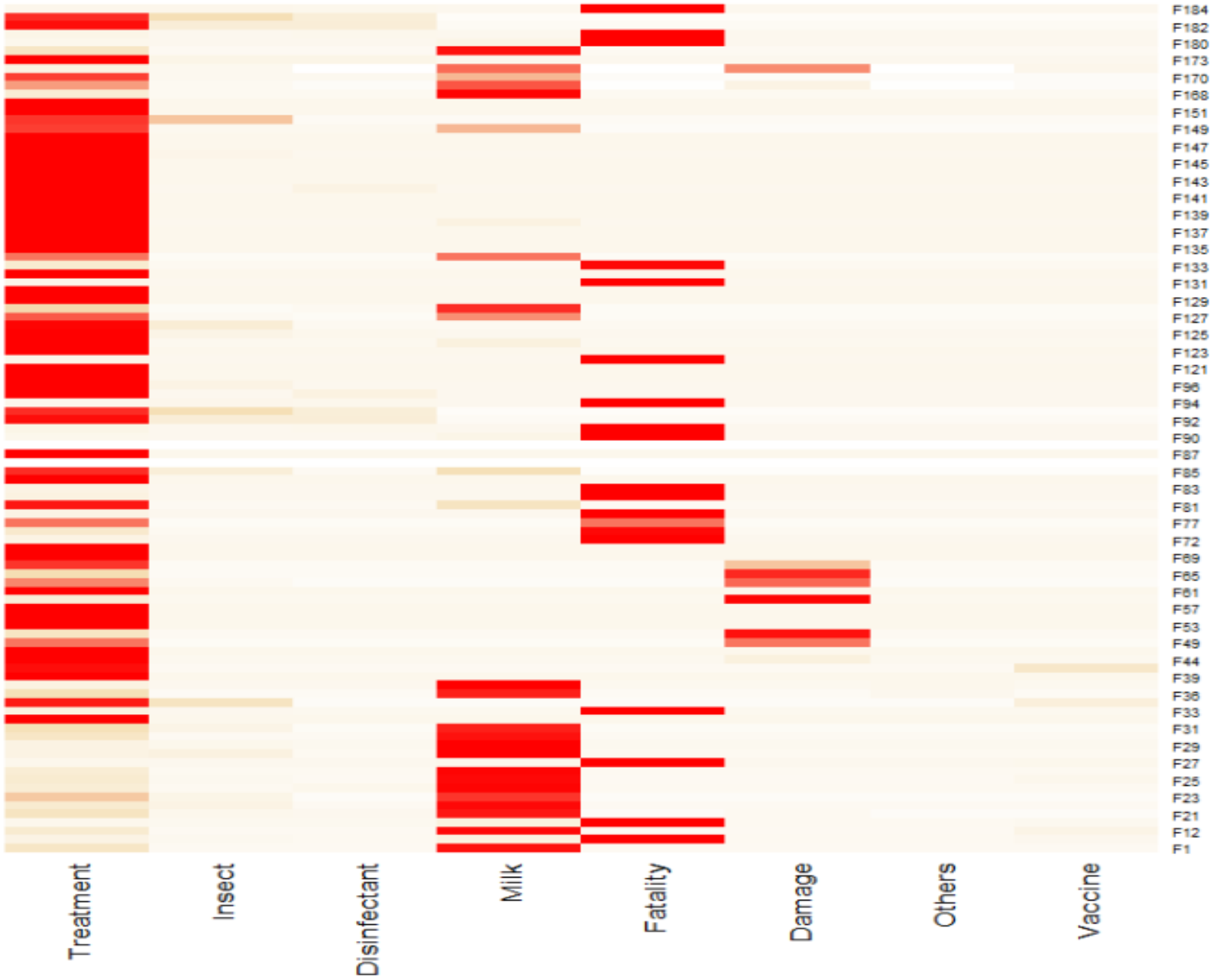
Average losses = 2,461 USD per farm

# Bangladesh




- All 100 farms incurred treatment costs.
- Cattle mortality resulted in losses for 19 farms.
- Vaccination costs were reported by 9 farms.


F184
F182
F180
F173
F170
F168
F151
F149
F147
F145
F143
F141
F139
F137
F135
F133
F131
F129
F127
F125
F123
F121
F96
F94
F92
F90
F87
F85
F83
F81
F77
F72
F69
F65
F61
F57
F53
F49
F44
F39
F36
F33
F31
F29
F27
F25
F23
F21
F12
F1
Treatment
Insect
Disinfectant
Milk
Fatality
Damage
Others
Vaccine


47

| Item | Frequency* | BDT (Mean ± SD) | USD |
|---|---|---|---|
| Treatment cost | 100 | 5618.80 ± 6553.71 | 51.25±59.78 |
| Insecticide cost | 33 | 751.51 ± 606.89 | 65.17±55.28 |
| Disinfectant cost | 25 | 472.00 ± 399.50 | 4.30±3.64 |
| Vaccination Cost | 9 | 644.44 ± 598.15 | 5.87±5.45 |
| Milk yield loss | 34 | 14168.38 ± 33648.95 | 129.13±306.67 |
| Loss due to animal died | 19 | 116842.11 ± 90142.03 | 1064.90±821.56 |
| Losses due to hide or skin damage | 2 | 750 ± 353.55 | 6.84±3.22 |

*Frequency values indicate the number of respondents reporting the cost or losses for each category. The mean and standard deviation (SD) are calculated based on the frequency, not the total number of respondents for each group.

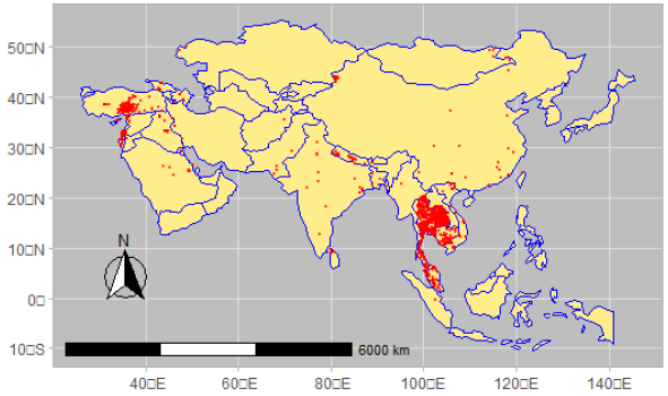
**Average losses = 283 USD/household**

- In both countries, the major losses were attributed to cattle mortality and reduced milk production.

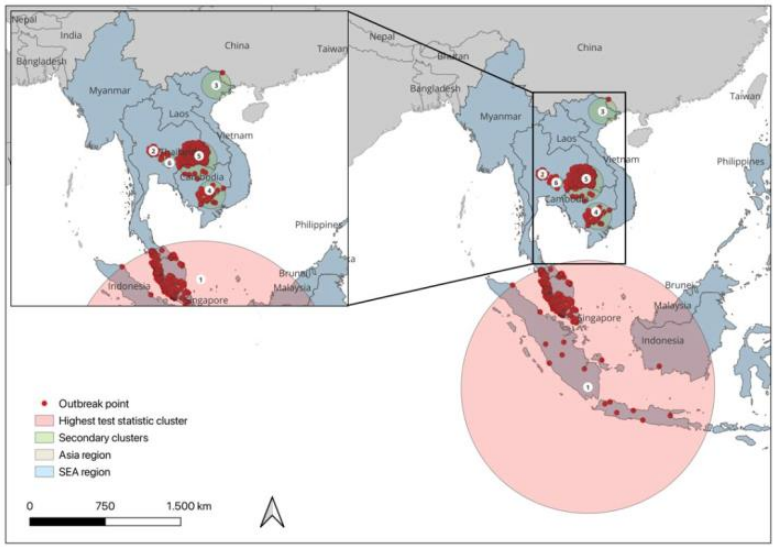
- Differences in economic impact between the two countries can be attributed to Thailand's larger herd sizes, which amplify production losses.

- In smallholder farms, where cattle are valuable assets, the loss or sickness of cattle has significant social and economic impacts, affecting family livelihoods and stability.


49


50□N
40□N
30□N
20□N
10□N
0□
10□S
N
6000 km
40□E
60□E
80□E
100□E
120□E
140□E


เกิดโรค
ป้องกันโรค
แผนรับโรค
ควบคุมโรค


Nepal
India
Bangladesh
China
Taiwan
Myanmar
Laos
Vietnam
Cambodia
Philippines
Brunei
Malaysia
Singapore
Indonesia
Outbreak point
Highest test statistic cluster
Secondary clusters
Asia region
SEA region
0
750
1.500 km

# Summary-1

- LSD leads to significant financial losses.
- Spatio-temporal analysis revealed clusters of LSD outbreaks across multiple regions.
- Genetically similar LSD strains were detected in several countries.
- Vaccination remains a key strategy for LSD prevention and control.

# Summary-2

- **Low biosecurity and poor insect vector control are major risk factors for naïve herds.**
- **Collaboration among stakeholders is essential for effective control.**
- The ASEAN LSD Prevention and Control Strategy [2024-2030] has been developed.

# Acknowledgement


- Working Group Members
- WOAH SRR SEA
- WOAH RRAP
- WOAH HQ
- Thanks for funding support from Australia, DAFF Capacity Building Project


World Organisation for Animal Health

Australian Government
Department of Agriculture, Fisheries and Forestry