
15th Jan 2018
Joint activity of pest and disease management and seed systems in Southeast Asia
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CIAT
International Center for Tropical Agriculture
Since 1967: Science to cultivate change

ACIAR-SRA 1st Phase (2016-2017)

ACIAR Short Research Activity (SRA): Cassava mosaic disease

Activities:

- cassava leaf & whitefly sampling and short seed systems interview
- In-depth seed systems survey & traders interview

Geographical distribution of SLCMV

Field-level incidence

Whitefly populations of nymphs & adults

Whitefly biotypes

Network analysis of seed movement

Combined with virus detection & seed systems survey

Individual survey	In-depth survey
virus infection rate x types of seed trading in each area	virus infection rate x dynamics of network in growth/ established area

➡ Better understanding of virus spread factor

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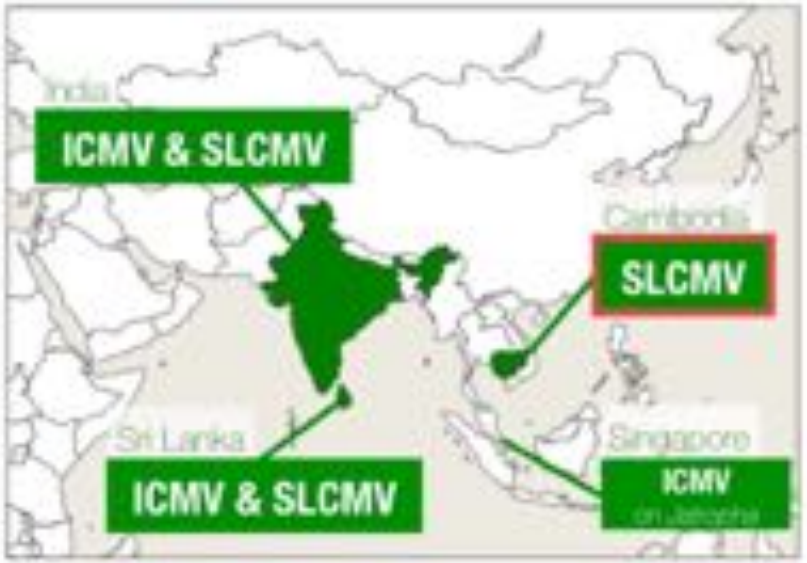
Cassava mosaic disease in Asia: Spatial and temporal distribution

Indian cassava mosaic virus (ICMV)

Sri Lankan cassava mosaic virus (SLCMV)

In December 2015,
SLCMV was reported in Cambodia



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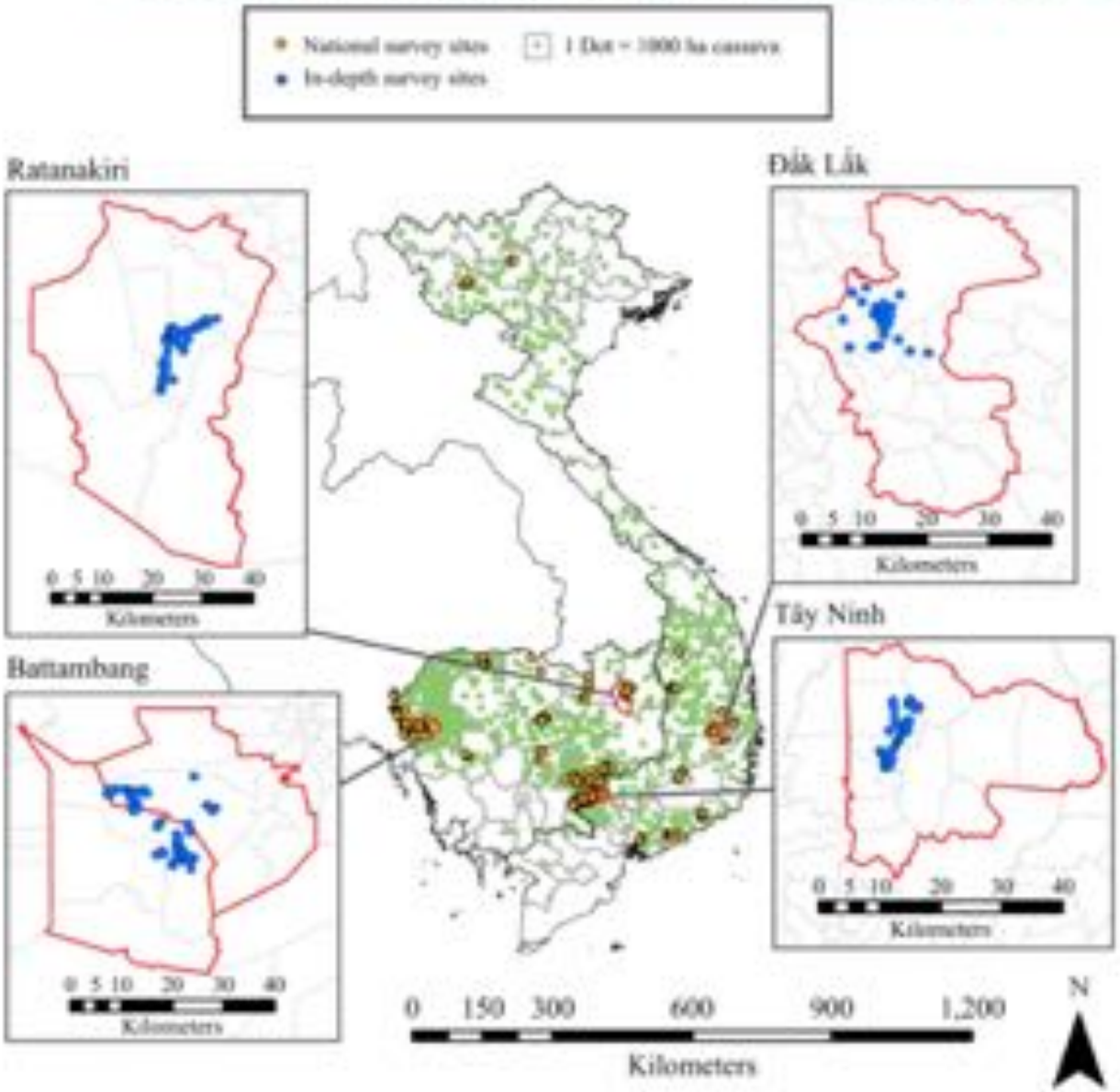
Cassava production area and our study sites of bi-national surveillance



- **15 districts with the largest cassava production** per country
- **+ Koun Mom, Ratanakiri** as the first reported infection site
- For virus diagnosis randomly selected **15 fields/district**, and **16 plants/field** were surveyed
- Photographs, leaf tissues, GPS coordinates, and seed trading data were collected **in a total of 419 fields/households for a total of 6,480 plants**

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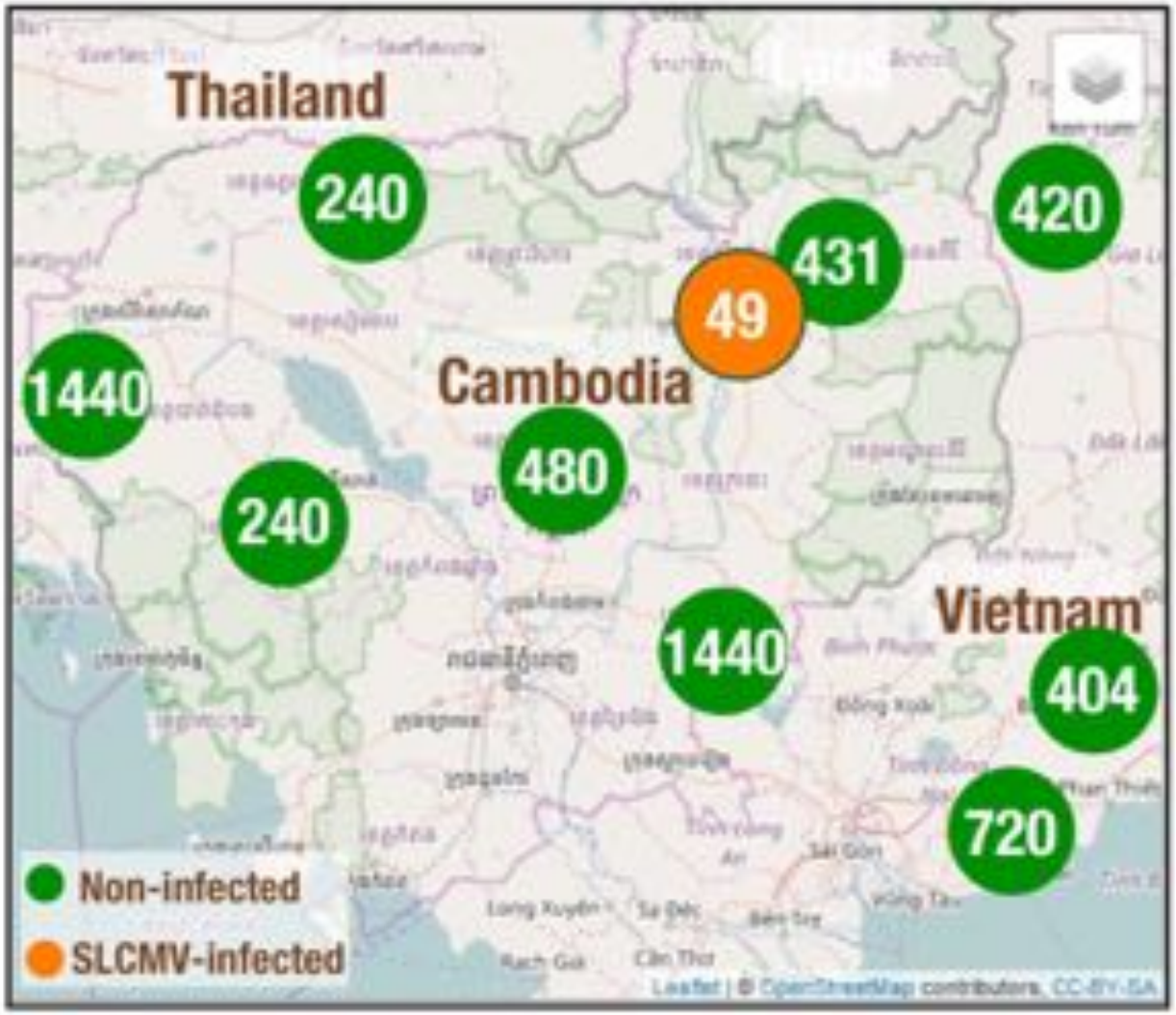
KEY FINDING 1: Geographical distribution of SLCMV in 2016



- From the 419 fields surveyed in Vietnam and Cambodia, **9 SLCMV-infected fields (49 total infected plants)** were found. Infections were **restricted in Ratanakiri and Stung Treng provinces of Eastern Cambodia**, with 13.3% and 46.6% of the occurrence, respectively.

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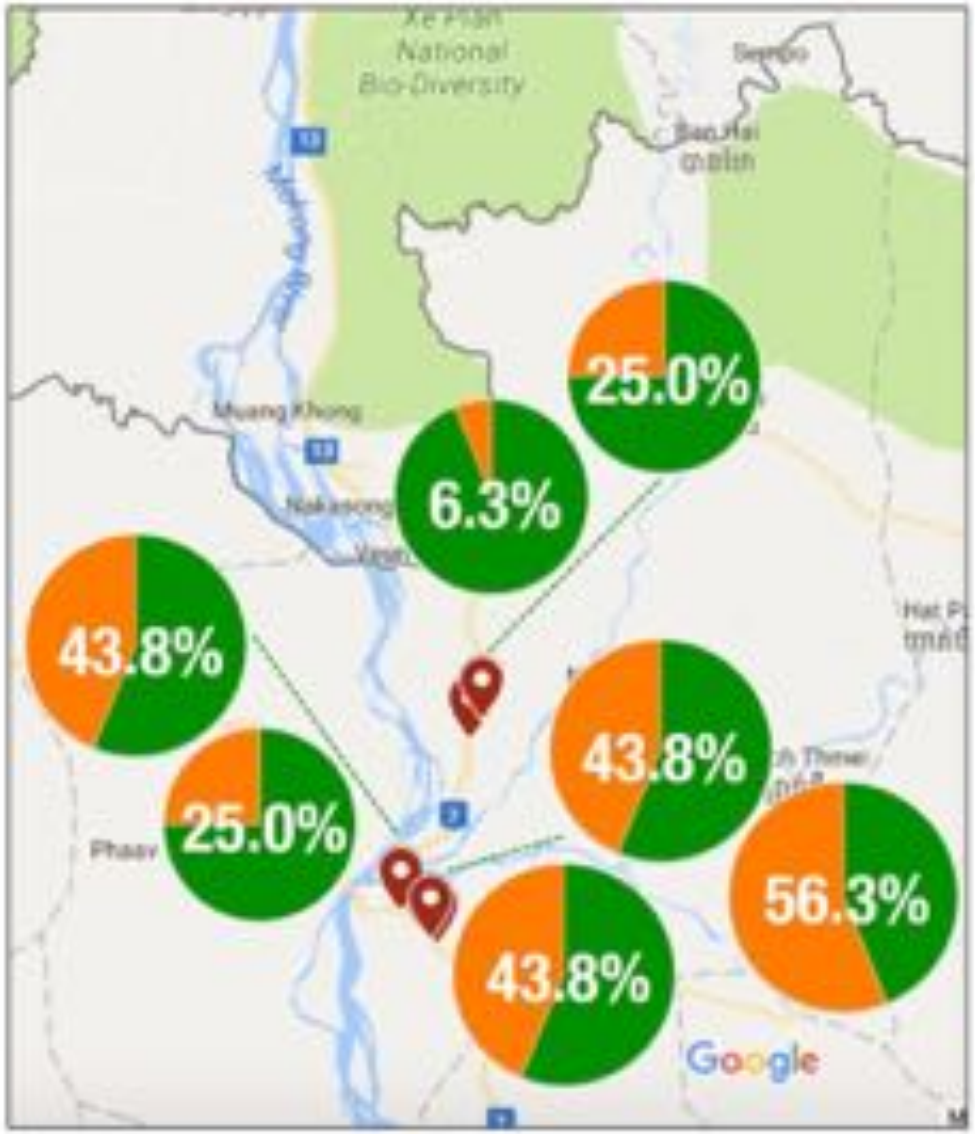
KEY FINDING 1: Geographical distribution of SLCMV in 2016



- In Stung Treng province, **4 of 7 infected fields showed within-field SLCMV incidences higher than 40%**. The most remote virus-infected field was **approx. 70 km away** from the initial reporting site of 2015.

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KEY FINDING 2: Symptom variation of SLCMV in Cambodia

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KEY FINDING 2: Symptom variation of SLCMV in Cambodia

Systemic

Through infected seeds

Non-systemic

Insect Vectoring

- From 6/8 infected fields we found **both systemic and non-systemic infected plants**, indicating that **most of infected fields acquired virus through infected planting materials** as well as insect vector transmission by whiteflies.

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KEY FINDING 2: Symptom variation of SLCMV in Cambodia

Asymptomatic

w/ witches' broom

- **SLCMV-infected plants exhibiting typical cassava witches' broom disease symptoms** like shoot proliferation

- SLCMV infection does not bother appearance of witches' broom symptom, thus that plant response against SLCMV may not disturb/inhibit/conflict the mechanism inducing proliferation symptom.

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KEY FINDING 3: Seed acquisition of virus-infected fields

Field Code	Infection Rate (%)	Source of stakes	Stakes from	Surveyed field size (ha)	Variety originally acquired from	Month planted	Pest/Deease recognition	pesticide use
Koun Mom District, Ratanak Kiri Province								
K9F2	37.5%	Own seed stock from 2015	the own village	2	Vietnam	2016 May	1	0
K9F3	25.0%	Own seed stock from 2015	the field	1	the village	2016 May	0	0
Stueng Traeng District, Stung Treng Province								
K10F1	25.0%	Own seed stock from 2015	the village	0.1	the field	2016 May	1	0
K10F2	43.8%	Own seed stock from 2015 & Trader	the village & KampongCham province	0.4	Tboung Khmum	2015 Sept	1	0
K10F5	6.3%	Own seed stock from 2015	the field	1	the village	2015 Oct	0	0
K10F6	25.0%	Own seed stock from 2015	the field	0.5	the village	2016 July	0	0
K10F13	43.8%	Own seed stock from 2015	PrahVihea province	0.5	PrahVihea province	2016 April	1	1
K10F14	43.8%	Friend / neighbour / relative within the community	the village	0.5	OuPongMean district	2016 March	1	0
K10F15	56.3%	Own seed stock from 2015	the village	0.1	the village	2016 June	1	0

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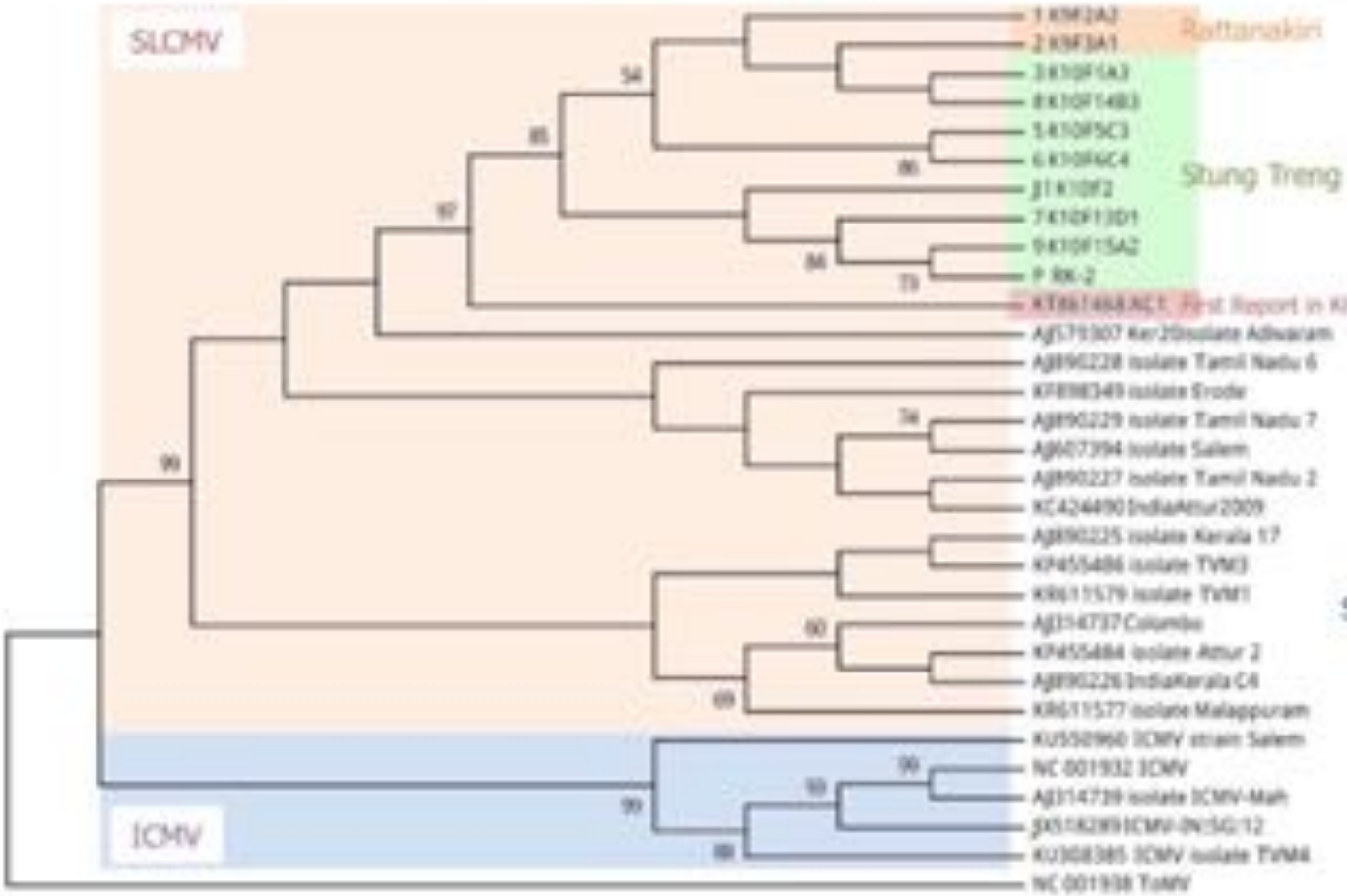
KEY FINDING 4: Phylogeny of SLCMV appeared in Southeast Asia



(1) SLCMV and ICMV were clearly differentiated into two different groups.

(2) all SLCMV isolates from our study (10 top seq) were likely derived from the first isolate of Cambodia.

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Conclusion from bi-national surveys

Virus detection by district

Vietnam

Cambodia

Field-level occurrence

Ratanakiri

Stung Treng

- SLCMV was first detected in Cambodia in the 2015 cropping season.
- Our project conducted binational virus surveillance throughout cassava fields in Cambodia and Vietnam in 2016.
- We found 2 districts with SLCMV occurrence in Cambodia, while no virus infection was found in Vietnam.
- In addition to the initial historic virus detection site in Ratanakiri province, 46.6% of fields in the neighboring province Stung Treng also contained virus infection, indicating that the virus has spread in 2016.

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ACIAR Short Research Activity (SRA): Cassava mosaic disease

PROJECT EXTENSION:

- ☐ 1-year project -> + 1-year extension till July 2018

ADDED ACTIVITIES:

Activity 1.8 Develop georeferenced global database (utilised by multiple stakeholders) of spatial and temporal dynamics of invading pathogen populations

Objective 3. Enhance diagnostic capacity of national partners utilising existing technology, evaluate improved diagnostic technologies utilising NGS technology and the feasibity of different short-term control measures

Activity 3.1 Provide hands-on capacity building on PCR-based, virus sequence analysis and field

Activity 3.2 Evaluate Next Generation Sequencing (NGS) applied to diagnostics to track the occurrence of other cassava-infecting viruses in symptomatic and asymptomatic plants

Activity 3.3 Conduct a feasibility study of different practical and more advanced options (isolation, QDS, etc.) to support ongoing surveillance, diagnostics, and multiplication of clean materials through private-public partnerships

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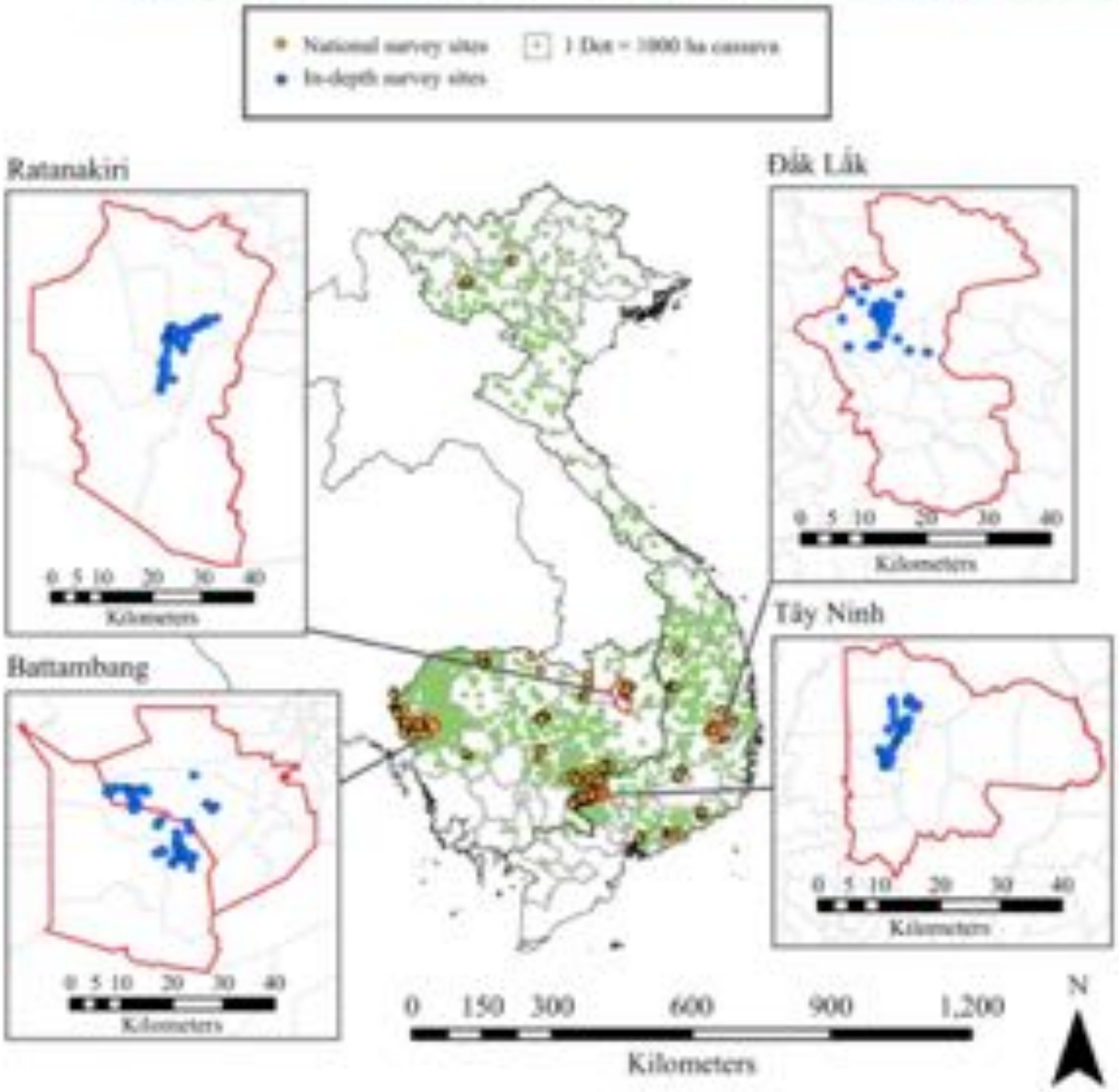
Cassava production area and our study sites of bi-national surveillance



Zoom-in seed systems survey

- ☐ **Established sites**
  (Battambang; Tay Ninh)
- ☐ **Expansion sites**
  (Ratanakiri; Dak Lak)
- ☐ 100 household interviews
  + trader survey

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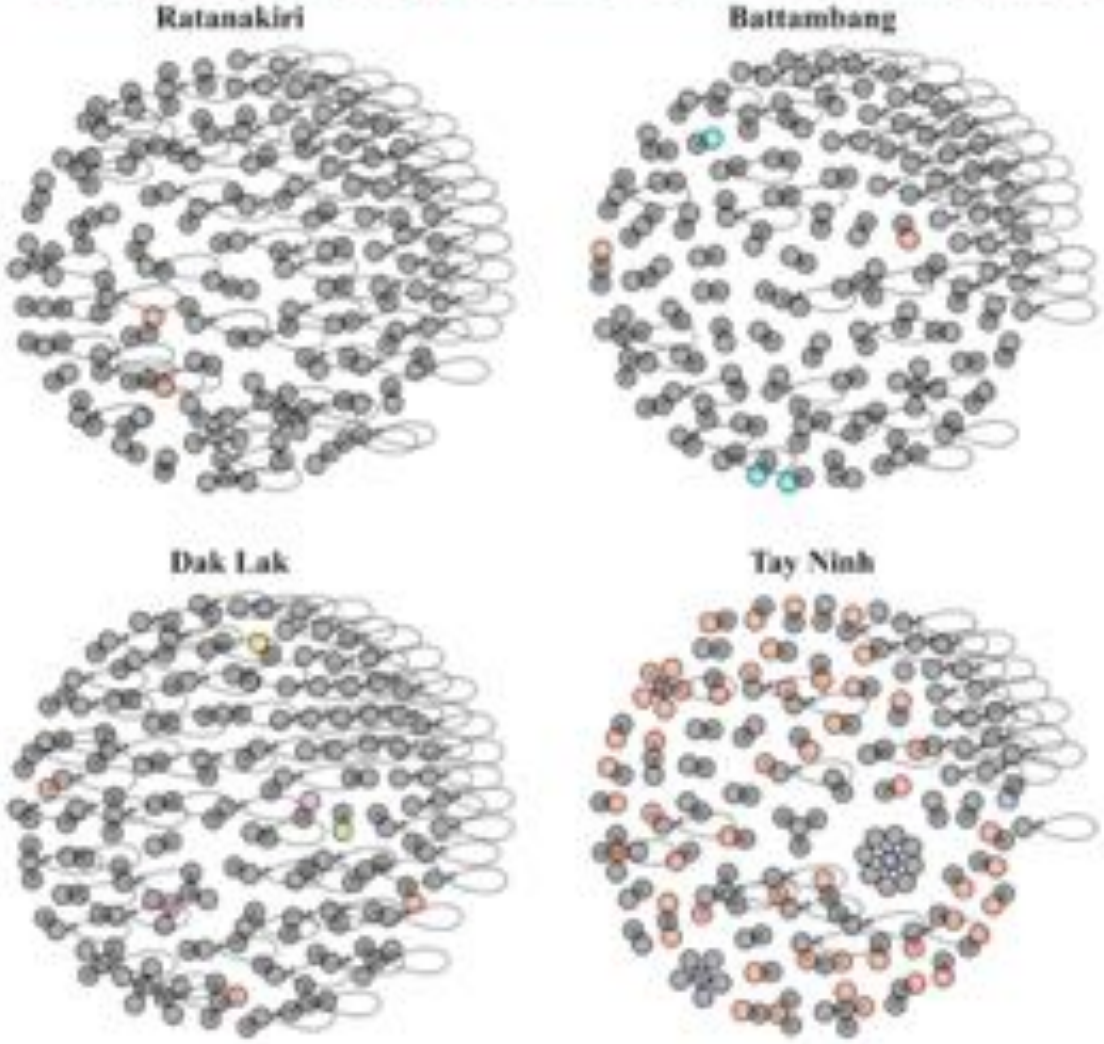
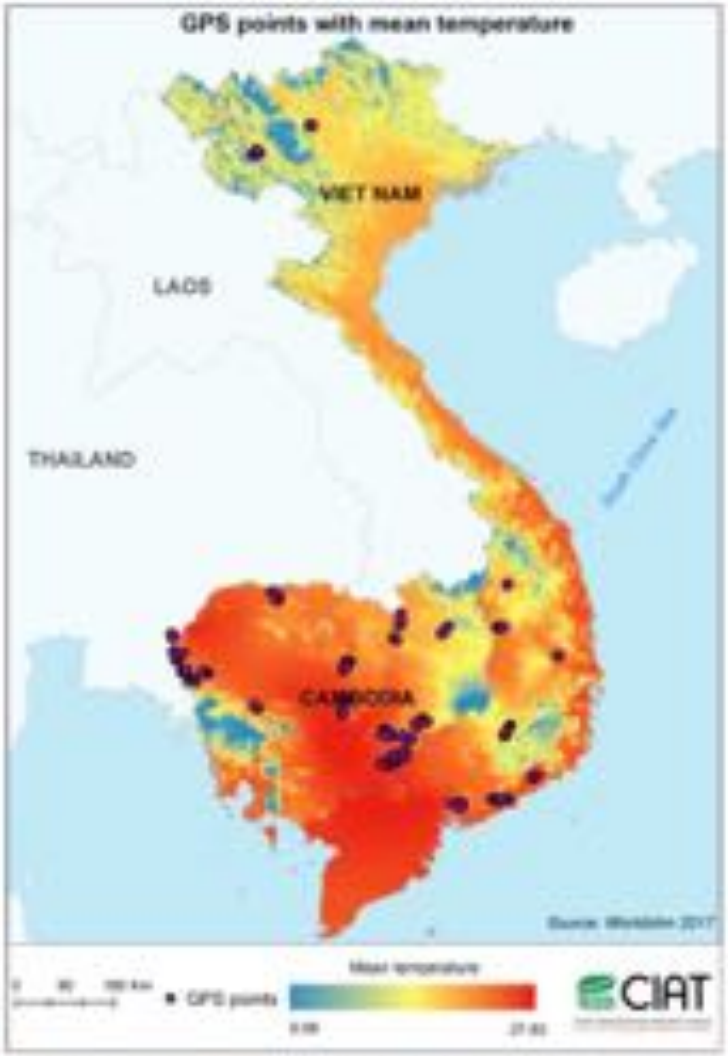
National survey to see SLCMV distribution



- **Established site** (Tay Ninh) has over 30 traders
  => beyond borders
- **Expansion site** (Ratanakiri) has a few traders
  => network is inwards centered
- **The risk of intensive spread of CMD from Ratanakiri is relatively low**

Supplementary data

Surveyed districts



Location of 419 field sampling sites in Cambodia & Vietnam.

- Covering big production areas
  - 15 districts in each country

Country	District
Vietnam	1 Thuan Chau
	2 Van Yen
	3 Chu Prong
	4 Mad Lak
	5 Eaker
	6 Dak Glong
	7 Sa Thay
	8 Krong Pa
	9 Song Hinh
	10 Bac Binh
	11 Ham Tan
	12 Tan Bien
	13 Tan Chau
	14 Ham Thuan Nam
	15 Long Thanh

Country	District
Cambodia	1 Anlong Veaeng
	2 Malai
	3 Sala Krau
	4 Pailin
	5 Kamnieng
	6 Phnum Proek
	7 Rattanak mondul
	8 Kravanh
	9 Koun Mom
	10 Steung Treng
	11 Snoul
	12 Dambae
	13 Memot
	14 Romeas Haek
	15 Sandan
	16 Baray