A lot at stake: Establishing sustainable solutions to cassava diseases in mainland Southeast Asia

UQ Seminar – 29th October 2019

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Outline

1. The Cassava Program at CIAT
2. UQ-CIAT current ‘Cassava Value Chain and Livelihood Program’
3. Emerging pest and disease situation
4. New project ‘ Establishing sustainable solutions to cassava disease in Mainland southeast Asia
5. Potential to expand the UQ-CIAT research partnership

Cassava Program for Asia

CGIAR RESEARCH PROGRAM ON Roots, Tubers and Bananas

Australian Government
Australian Centre for International Agricultural Research

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Building a sustainable future

Why Cassava?

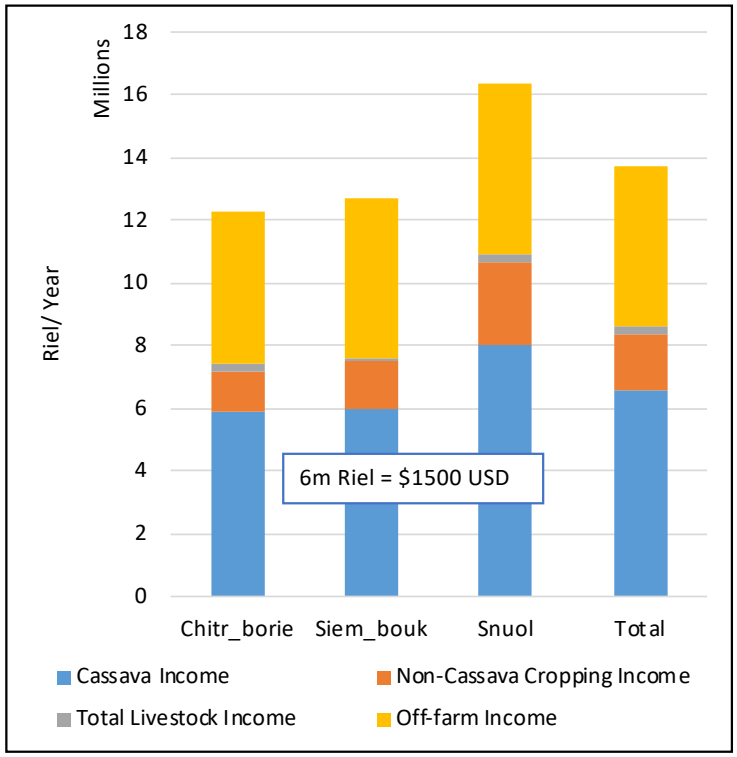

1 NO POVERTY
Improved crops
A better deal for farmers and consumers
SUSTAINABLE DEVELOPMENT GOALS

What's a stake? Livelihoods of millions of smallholder families

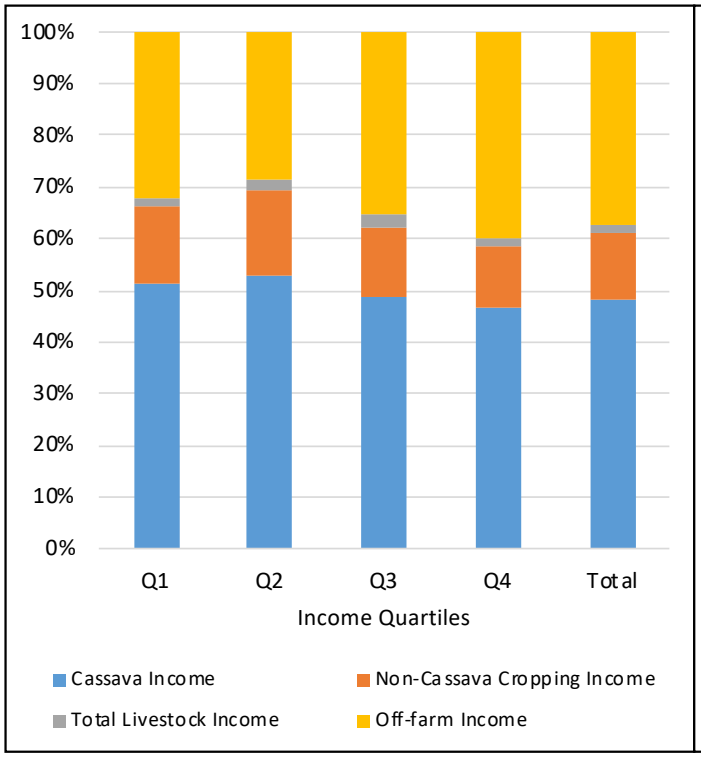
Country	Area of cassava production (2016)	Estimated number of households
Vietnam	579,898 ha	1,117,625 (2016 Ag Census)
Cambodia	387,636 ha *613,900 ha	306,950 households (based on average area of 2ha)
Lao PDR	94,726 ha	43,057 households (based on average area of 2.2ha)
Myanmar	36,609 ha	NA
Thailand	1,461,827 ha	544,774 (Official statistics)
TOTAL	~ 2.8 million ha	> 2 million households

Grown by upland farmers to support livelihood security (Eastern Cambodia)

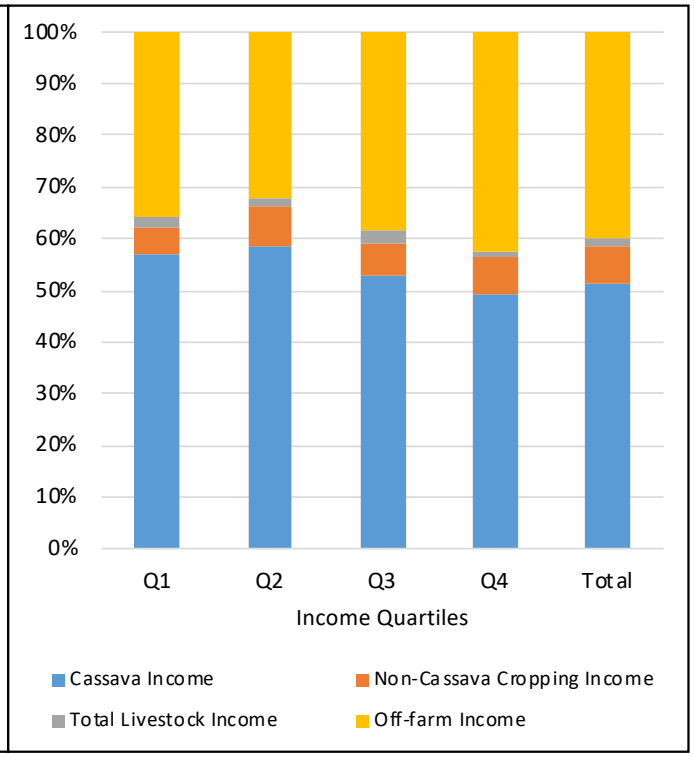
Gross total income



% share of total income

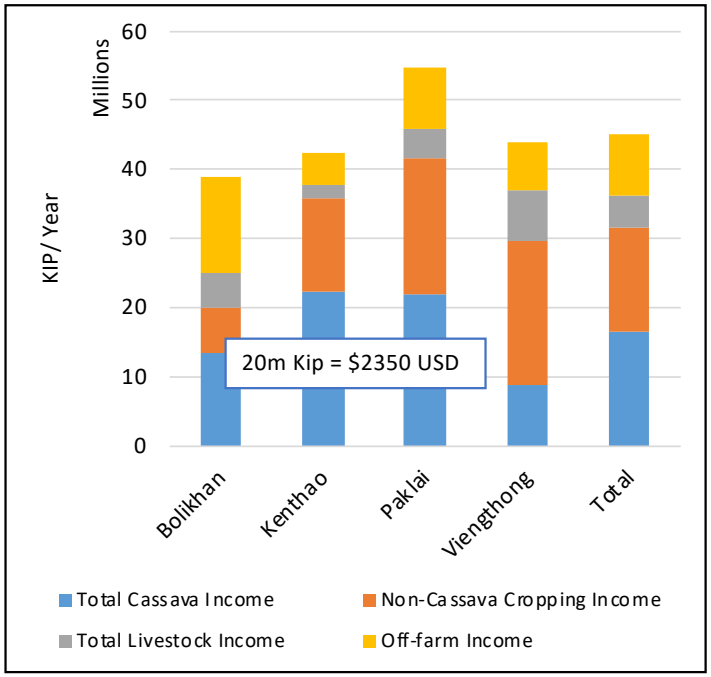


% share of cash income

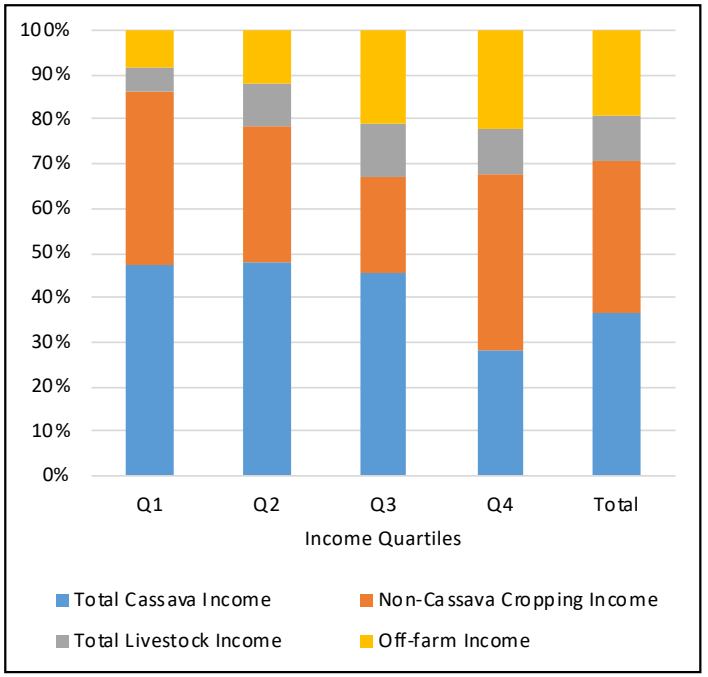


Grown by upland farmers to support livelihood security (Lao PDR)

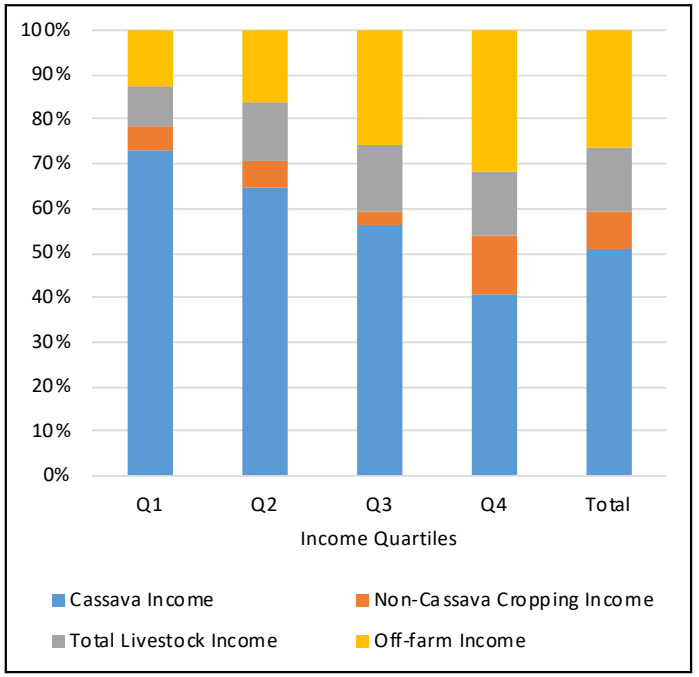
Gross total income



% share of total income



% share of cash income




SUSTAINABLE
DEVELOPMENT
GOALS
8 DECENT WORK AND ECONOMIC GROWTH
• Inclusive markets
• Seed availability and access

Rural economic activity, employment and a large processing sector

- In Vietnam there are **110 starch processor** with a capacity larger than 10 tons starch output per day, and an additional 400 small scale processors.
- In Vietnam there are **7 ethanol factories** that were established with cassava as the primary feedstock to meet the biofuel mandates now implemented nationwide..
- Processing capacity has expanded in **Lao PDR with over 11 starch factories** and a large number of dried chip traders, collectors and processors.
- In Cambodia the majority of roots and chips are traded and processed in Vietnam and Thailand. There are several new starch factories established in recent years and others under construction. The viability of these processing factories is under threat should root yields fall and prices rise.
- In **Thailand there are 97 wet starch millers** processing roots. On top of there are several modified starch factories that purchase native starch and several ethanol factories.
- Myanmar there are more than **200 small cassava starch processors**. 134 are registered processors that are part of the Cassava Growers, Millers and Traders Association (CGMTA)

Value of cassava (fresh or dried) exports between project countries and world (2016 $'000)

Importer / Exporter	Thailand	Viet Nam	Lao PDR.	Cambodia	China	World
Thailand		5	21	2	1,106,456 (1,139,302)	1,108,946
Viet Nam			6		219,786 (236,045)	256,205
Lao PDR	50,260 (56,418)	11,552 (14,547)			73	62,203
Cambodia	12,872 (260,976)	42 (212,807)			8,355 (15,484)	21,333
Myanmar	12				31	43

Figures in parenthesis is the import value reported by partner countries. In some cases there is significant differences between the recorded export value and import value by the partner country.

Value of cassava starch exports between project countries and world (2016 $'000)

Importer / Exporter	Thailand	Viet Nam	Lao PDR	Cambodia	Myanmar	China	Indonesia	World
Thailand		3,460	272	11	751	524,603 (535,697)	198,569	1,112,428
Viet Nam	11			59	146,295	649,604 (181,453)	25,410	738,588
Lao PDR		5,794				2,830 (1,337)		8,982
Cambodia						10,564 (10,428)		13,366
Myanmar								

Drivers of use of cassava starch in food processing sector

Factors influencing growing demand:

1. Desired functional properties in many food applications
2. Reduced cost in modification
3. **Consumer demand and clean label market**

Stronger Demand for Clean Label in Asia Pacific Reveals Ingredion Consumer Research

Email Print Share

22 Jun 2015 --- Ingredion has highlighted key results of its latest wave of global consumer research conducted in March 2015, showing that clean label is as much on the radars of consumers in Asia Pacific as in many other parts of the world. The online study was conducted across 17 countries; including China, Japan and Australia, in order to provide Ingredion and its customers with key insights into consumer perceptions of ingredients, labels and product positioning.

Since 2011, Ingredion has been conducting the global consumer research study with an independent research partner – MMR Research Worldwide. The survey is repeated annually to help benchmark and identify any shifts in attitudes or patterns, helping Ingredion and its customers to keep ahead of the changing shape of the clean label trend.

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There remains a lot of challenges

15 LIFE ON LAND

- Preserving ecosystem services
- Pest and disease management
- Soil health

Social inclusion

Building a sustainable future

CIAT

Limited focus in the past decades in Asia, focus on Africa

Indonesia
Pacific
Philippines

ACIAR Cassava Value Chain and Livelihood Program

Join the conversation at : https://www.facebook.com/groups/1462662477369426/

Project website : http://cassavavaluechains.net/

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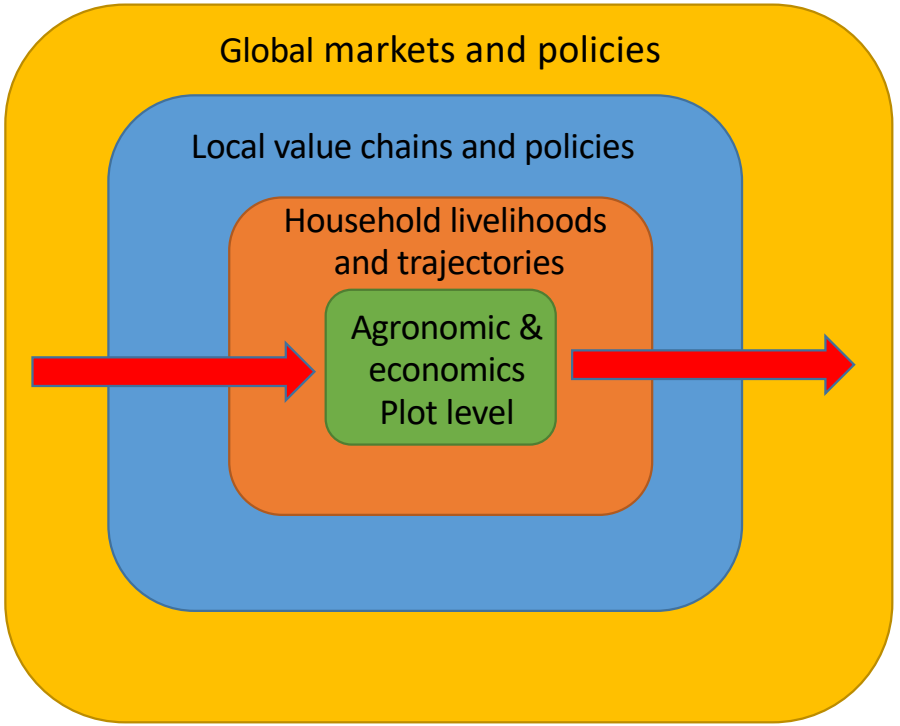
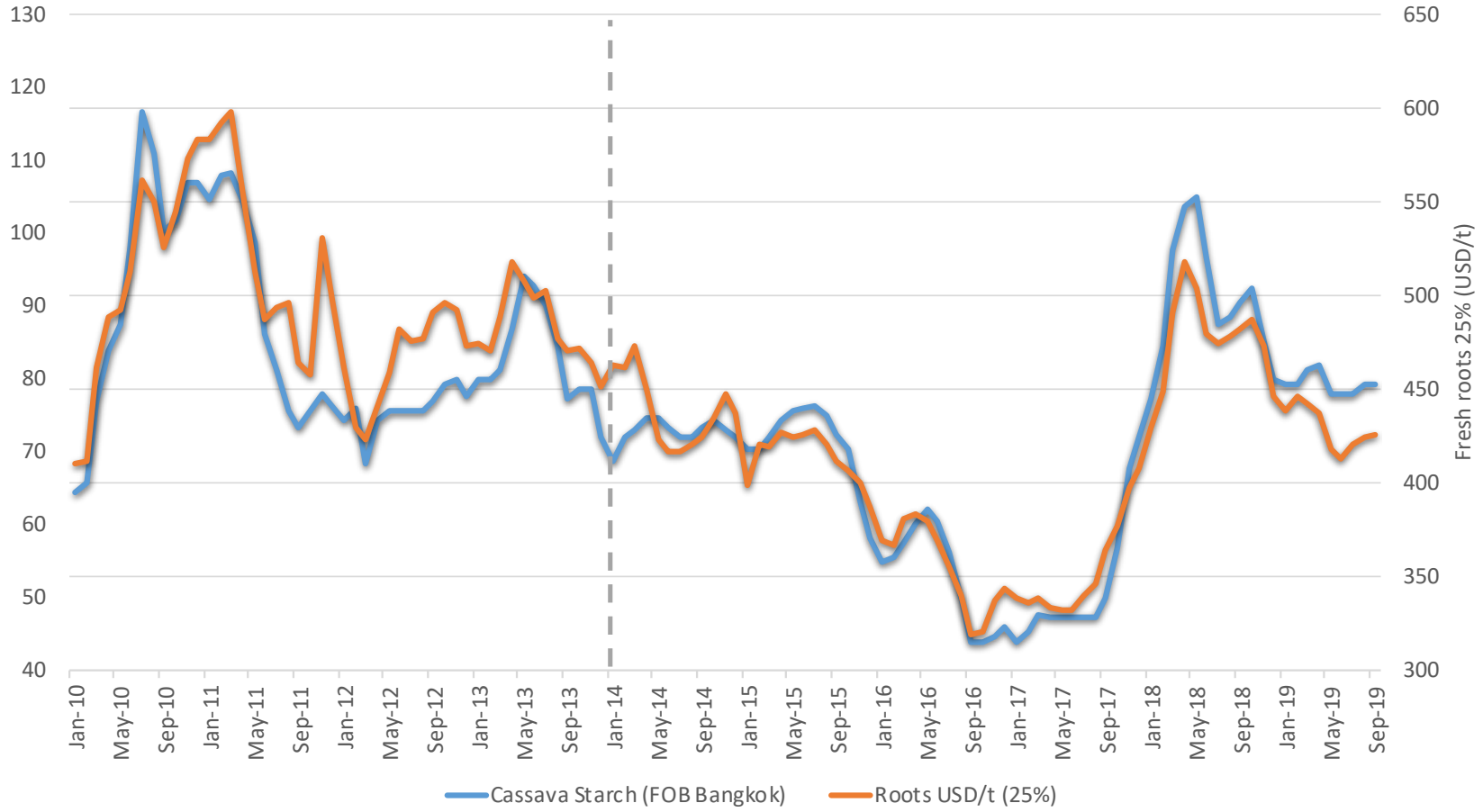
Framework on the project

1. Global markets and external polices
2. Local value chains and domestic policies
3. Household livelihoods and trajectories
4. Field level agronomic and economic results
5. Implications for household livelihoods
6. Implications for local value chain actors



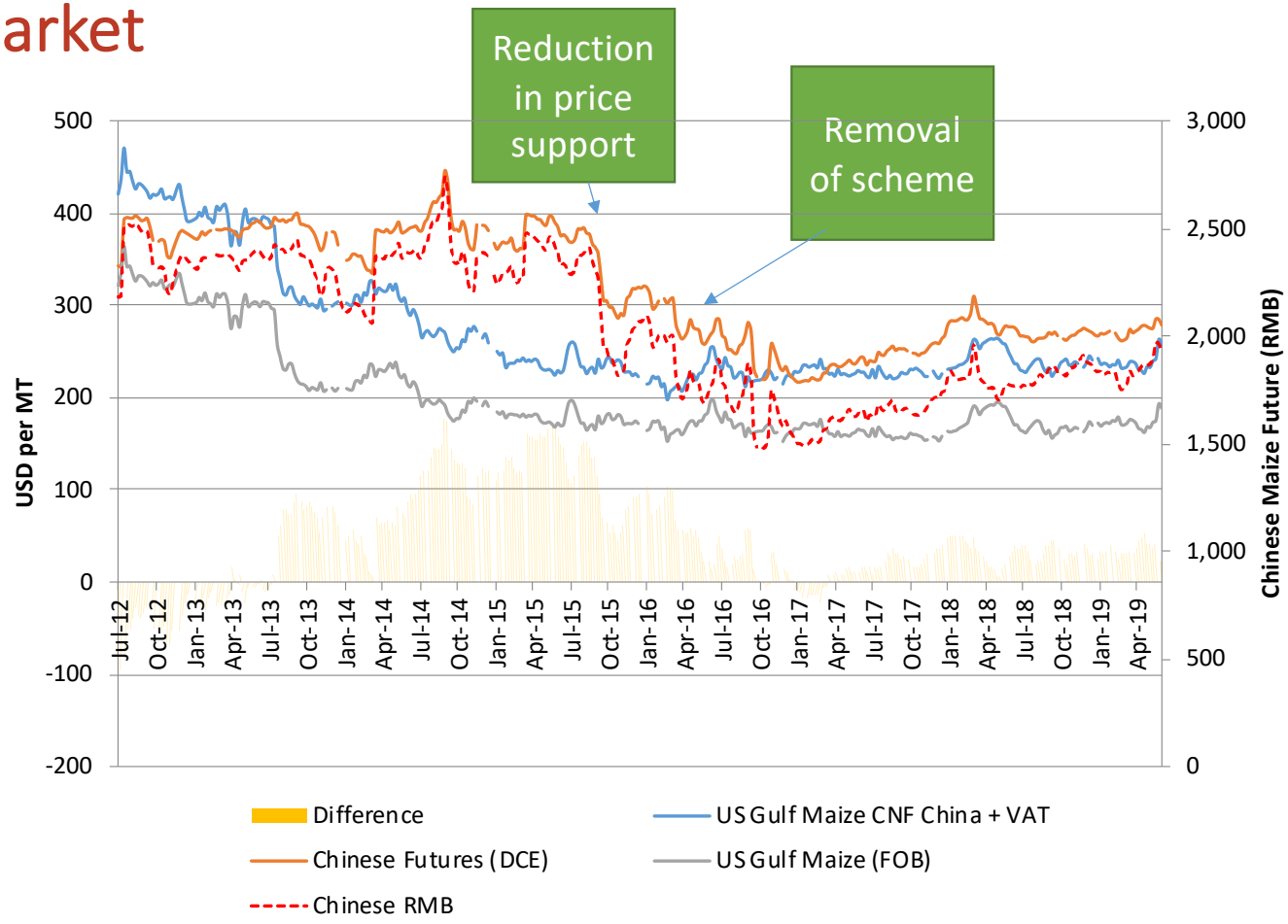
Major market fluctuations during the life of the project



On the demand side – the market outlook for cassava in Asia needs to be considered in the context of substitutes in different applications

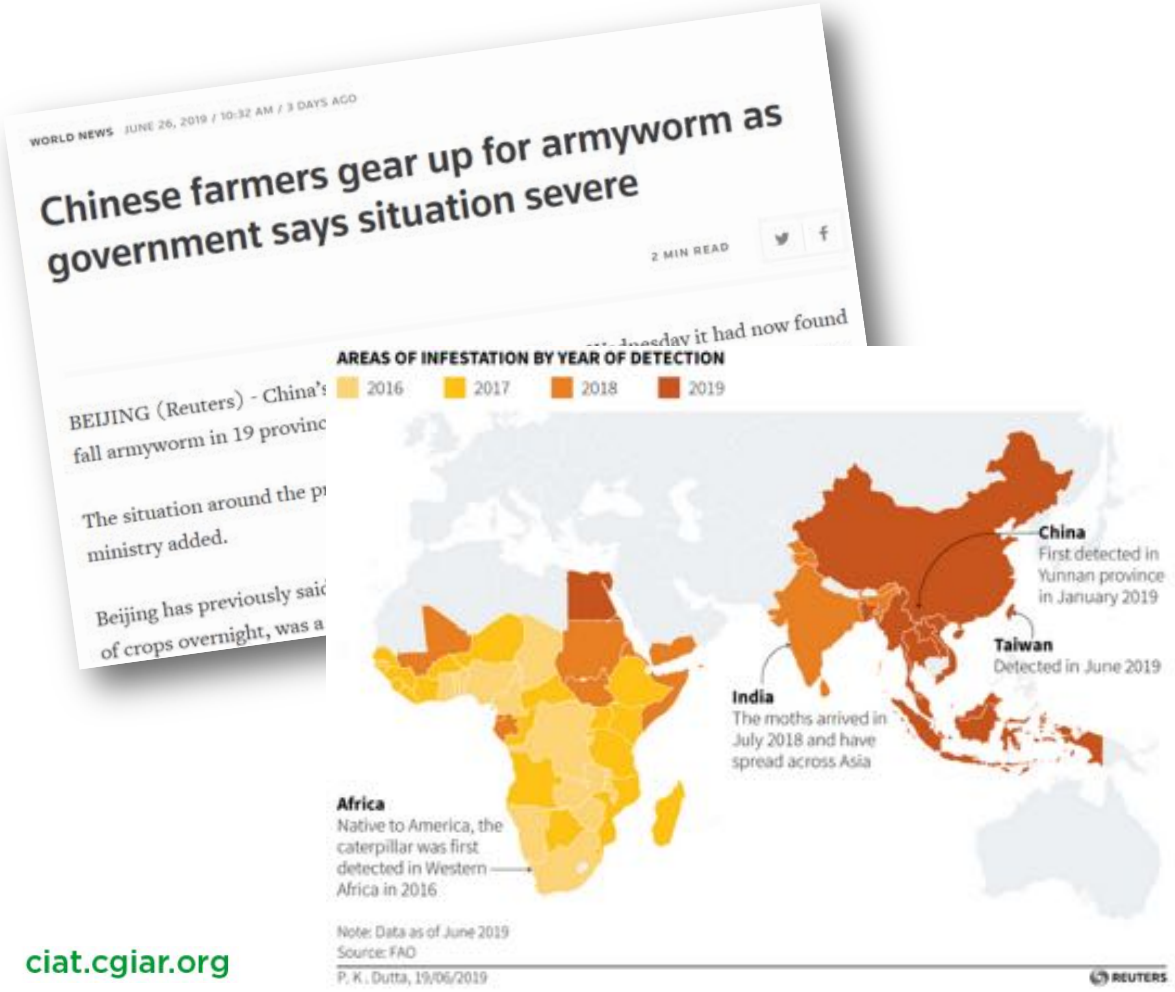
1. Global markets where cassava chips compete with other forms of carbohydrate for processing animal feed or ethanol such as **maize, sorghum, wheat, molasses – oil, gas.**
2. Markets where cassava starch competes largely on price with substitutes such as **maize** and **potato** starch, **sugarcane**.
3. Markets where the functional properties of the starch are desired. Consumer preferences, clean label segment, gluten free etc.

Smallholders cassava farmers part of a larger global carbohydrate market



Large stockpile remains:
Allowed to be used for biofuel

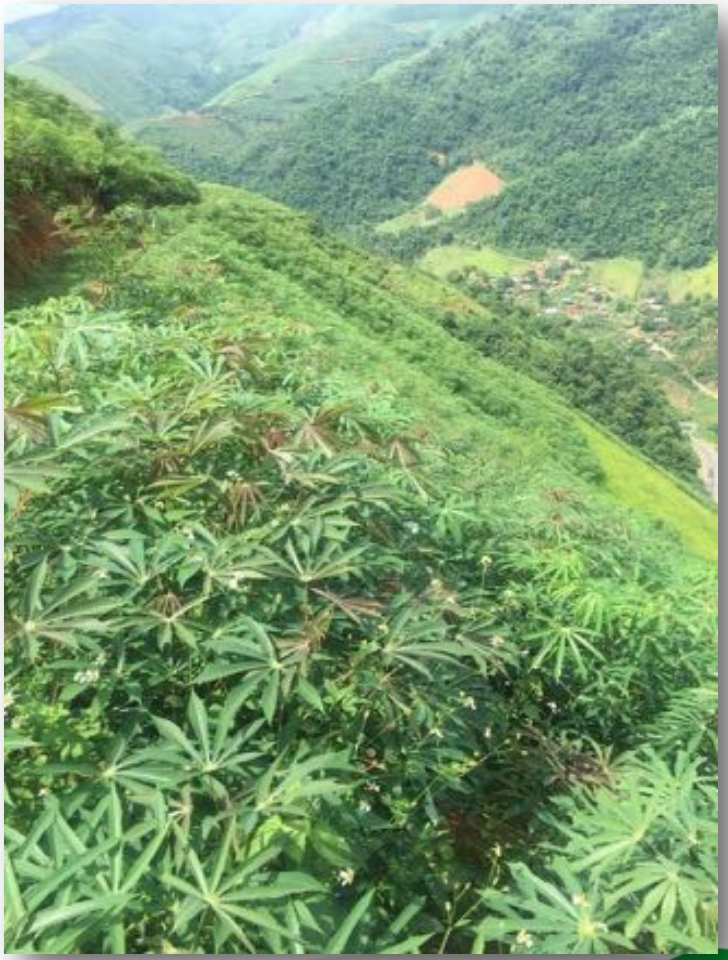
Fall armyworm to impact maize supply in the region



African Swine Fever to moderate demand in the short-term: substitution to other animal protein - poultry

And on the supply side – the relative competitiveness against other land use in the context of different trends and shocks

- Own price and relative prices to other commodities that can be produced in agro-ecological zones
- Changes in costs of production
  - Changing labour costs and ease of mechanization
  - **Ban on herbicides**
- Long term climate trends
- Floods and droughts
- Changes in land suitability and land degradation
- **IMPACT OF PEST AND DISEASE**



Agronomic results: what is the farm level economics?

Economic analysis of 2018-19 trial

			Xayabouli		Bolikhamxai	
	Treatment	**Cost**	**Net Benefits**	**MRR**	**Net Benefits**	**MRR**
P1	Control (No fertiliser)	0	10,156,944		3,662,500	0
P3	N:P2O5:K2O (40-20-40)	814,157	16,287,232	753%	**5,401,120**	**214%**
P2	**N:P2O5:K2O (15-5-30): 300 Kg/ha)**	**1,320,000**	**16,950,833**	**131%**	3,216,806	D
P4	N:P2O5:K2O (80-20-80)	1,401,172	14,709,939	D	3,761,328	D

Root rot cause low yields and a reduction in net benefits

Economic results of demonstrations

District	Paklai	Kenthao	Bolikan	Viengthong
Yield without fertiliser (t/ha)	27.8	24.8	12.3	26.4
Yield with fertiliser (t/ha)	37.2	36.8	21.1	29.7
Difference (t/ha)	9.5	12.0	8.8	3.3
Current price (kip/kg)	540	540	540	500
Cost fertiliser (kip/ha)	1,320,000	1,320,000	1,320,000	1,320,000
Current cassava root price				
Marginal Net Benefits (kip/ha)	3,785,333	5,140,667	3,428,240	313,796
MRR (%)	286.8%	389.4%	259.7%	23.8%
Low cassava root price: 300 kip per ton				
Marginal Net Benefits (kip/ha)	1,516,296	2,269,259	1,317,911	- 339,722
MRR (%)	114.9%	171.9%	99.8%	-25.7%

Impact of cassava returns

	Without fertiliser	With fertiliser
Material costs (A)	1,600,000	2,920,000
Labour costs (B)	6,420,000	6,660,000
Total costs (A+B = C)	8,020,000	9,580,000
Revenue (D)	16,114,691	21,598,198
Net returns (D-C)	8,094,691	12,018,198
Net returns to household resource (D-A = E)	14,514,691	18,678,198
Labour days (F)	152	158
Net returns per labour day (E/F)	95,491	118,216
Low price scenario		
Revenue	8,335,185	11,171,481
Net returns	315,185	1,591,481
Net returns to household resource	6,735,185	8,251,481
Labour days	152	158
Net returns per labour day	44,310	52,225

Livelihood and value chain analysis help understand the incentives for stakeholders to bring technology to farmers in different contexts

Cassava witches broom disease in fertiliser trials and variety evaluations in Paklai, Xayabouli Province

Without fertiliser

KU50

Rayong11

Net benefit analysis of fertiliser trials in Lao PDR

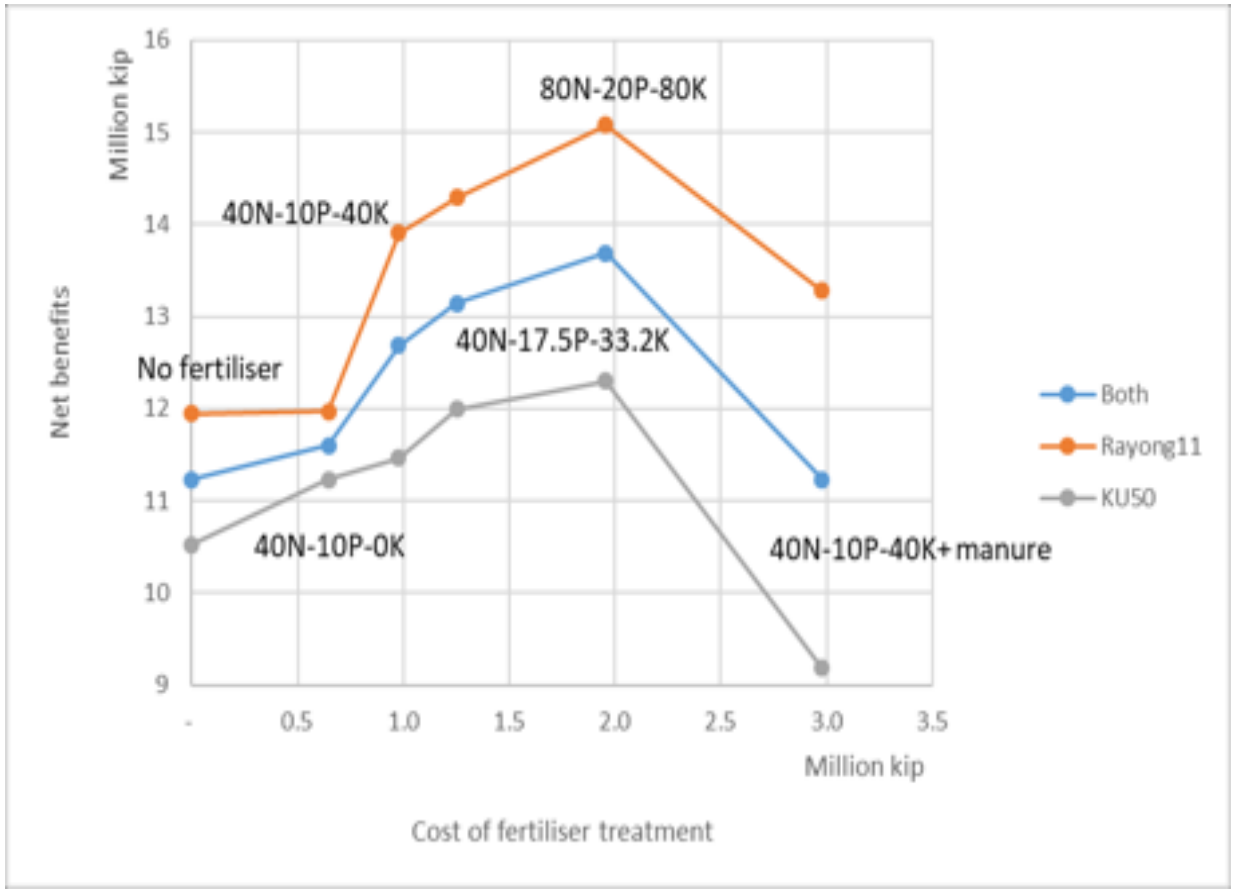
District/Treatment	Both	KU50	Rayong 11	Rayong 72
Kenthao				
Control	11,234,722	10,522,222	11,947,222	
40N-10P-0K	11,601,324	11,233,963	11,968,685	
40N-10P-40K	12,686,026	11,462,415	13,909,637	
N-P-K (15-15-15)	13,142,578	11,995,356	14,289,801	
80N-40P-80K	**13,686,220**	**12,296,637**	**15,075,803**	
40N-10P-40K+Manure (5t/ha)	11,229,081	9,181,859	13,276,304	
Paklai				
Control	7,432,639	6,668,056	8,197,222	
40N-10P-0K	8,963,824	6,261,740	11,665,907	
40N-10P-40K	8,124,915	5,197,137	11,052,692	
N-P-K (15-15-15)	6,632,856	5,234,245	8,031,467	
80N-40P-80K	**9,718,859**	**7,454,970**	**11,982,748**	
40N-10P-40K+Manure (5t/ha)	8,456,165	6,237,415	10,674,915	
Viengthong				
Control	3,732,500		4,215,000	3,250,000
40N-10P-0K	3,642,713		4,478,963	2,806,463
40N-10P-40K	**5,032,415**		**5,441,581**	**4,623,248**
N-P-K (15-15-15)	4,399,245		5,327,578	3,470,912
80N-40P-80K	4,208,720		4,800,803	3,616,637
40N-10P-40K+Manure (5t/ha)	3,334,915		4,169,915	2,499,915

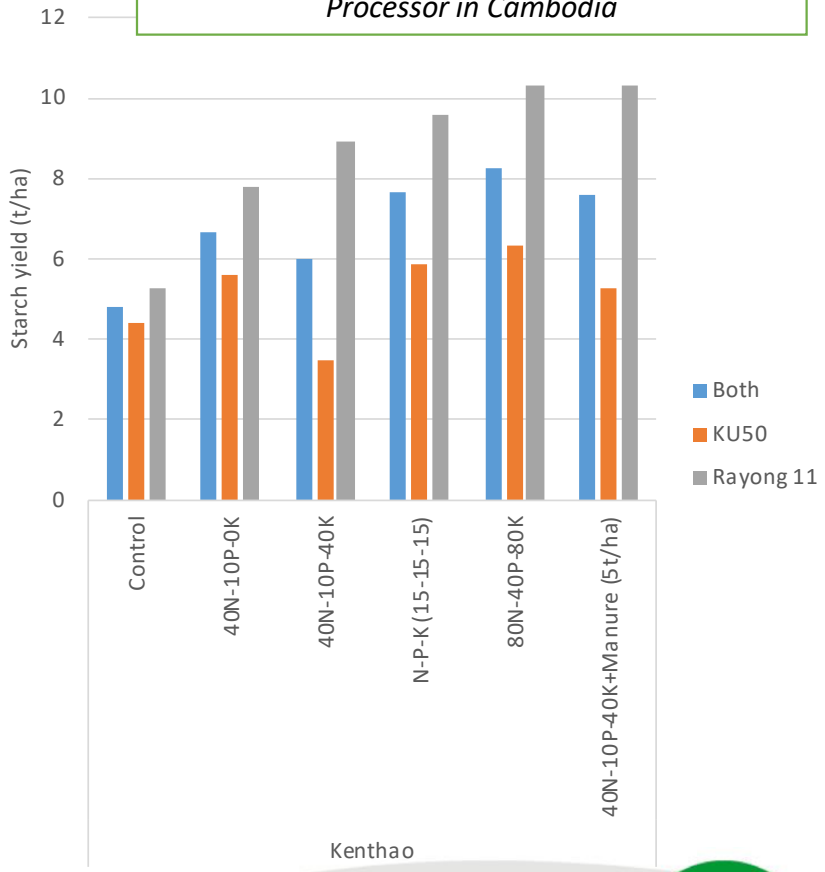
~50% MRR

Note: Net Benefits do not equal profit. Only costs that vary are considered (fertiliser)

Large impact of disease the farm and processing economics

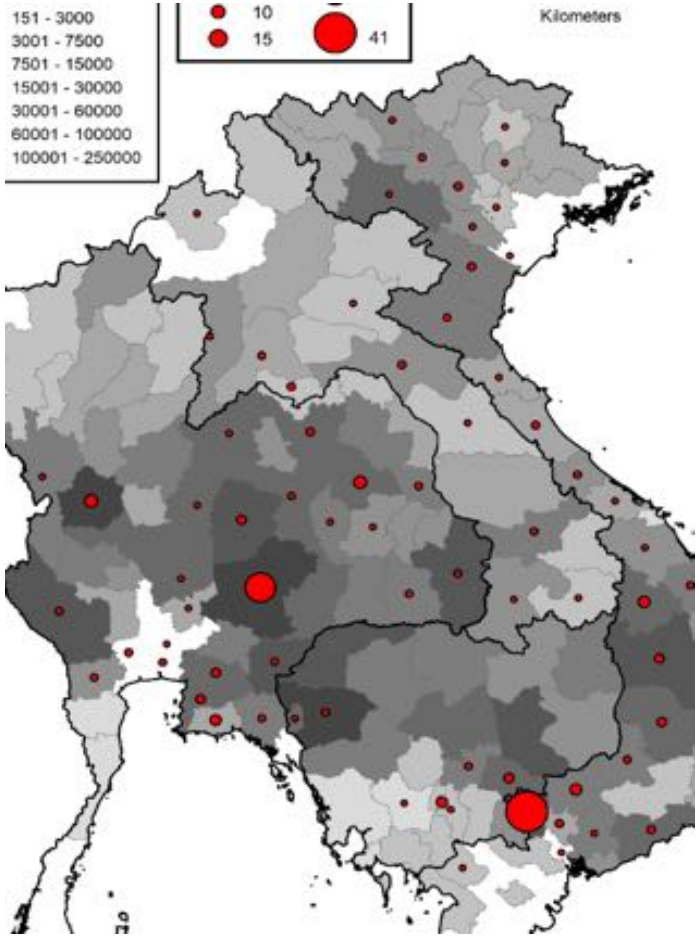
Typically 1000t roots = 250t starch;
With disease 1000t roots = 140t starch
Processor in Cambodia

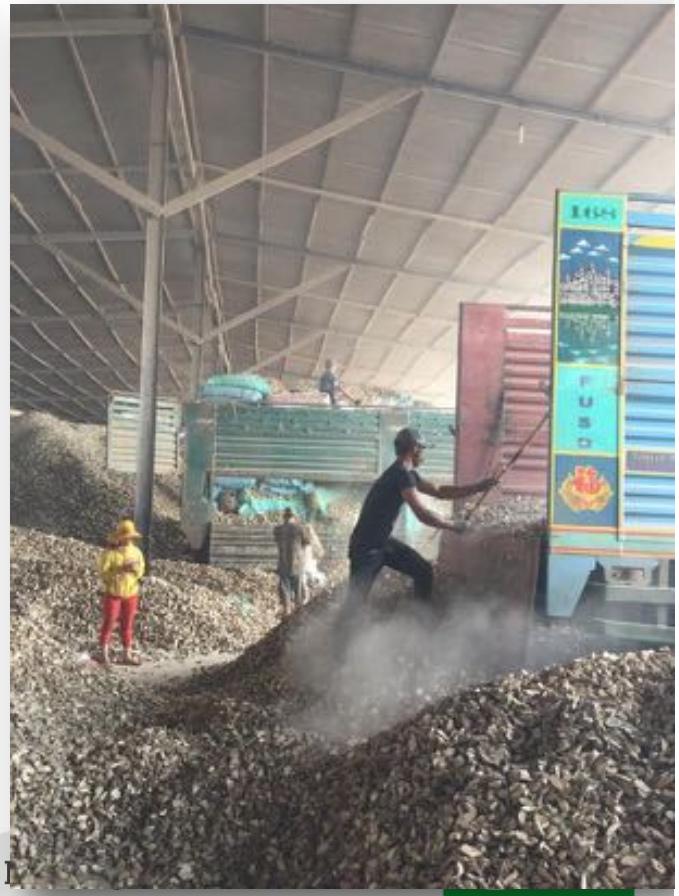




Large variation in degree of susceptibility of existing varieties in the regional

The regional value chain for cassava products involves large amounts of cross border trade

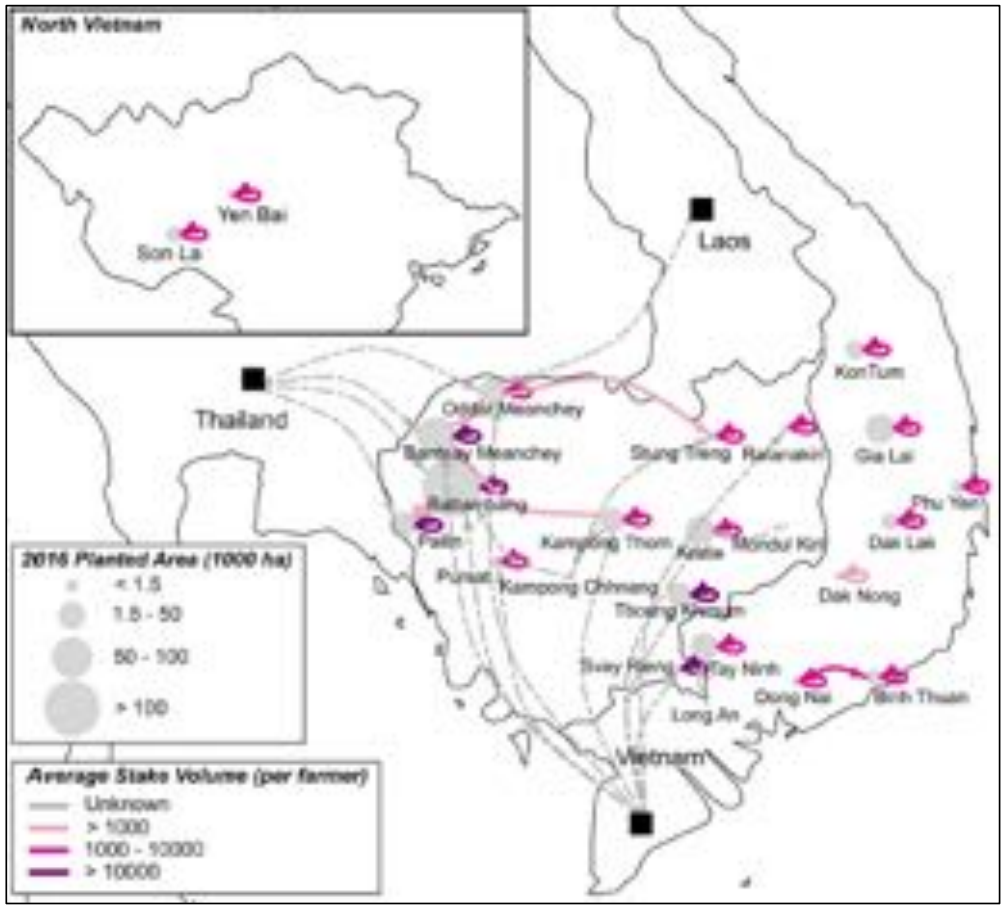


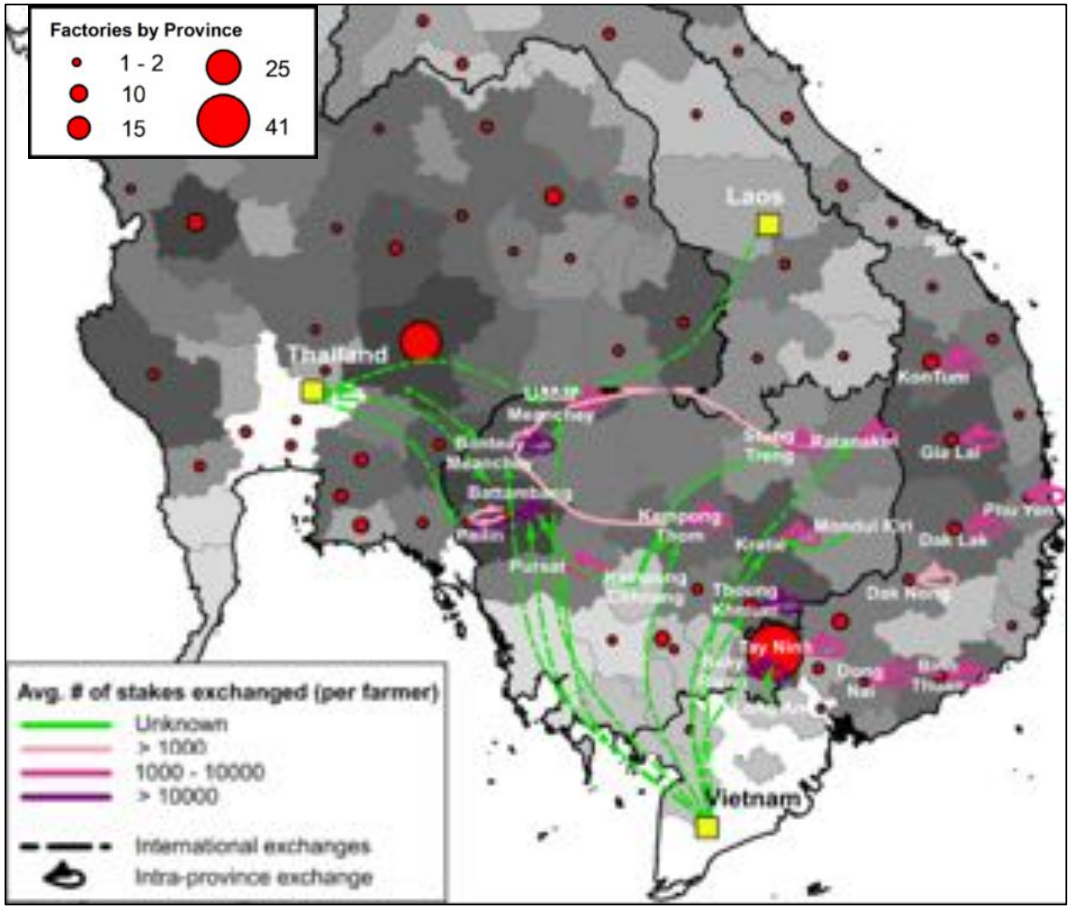


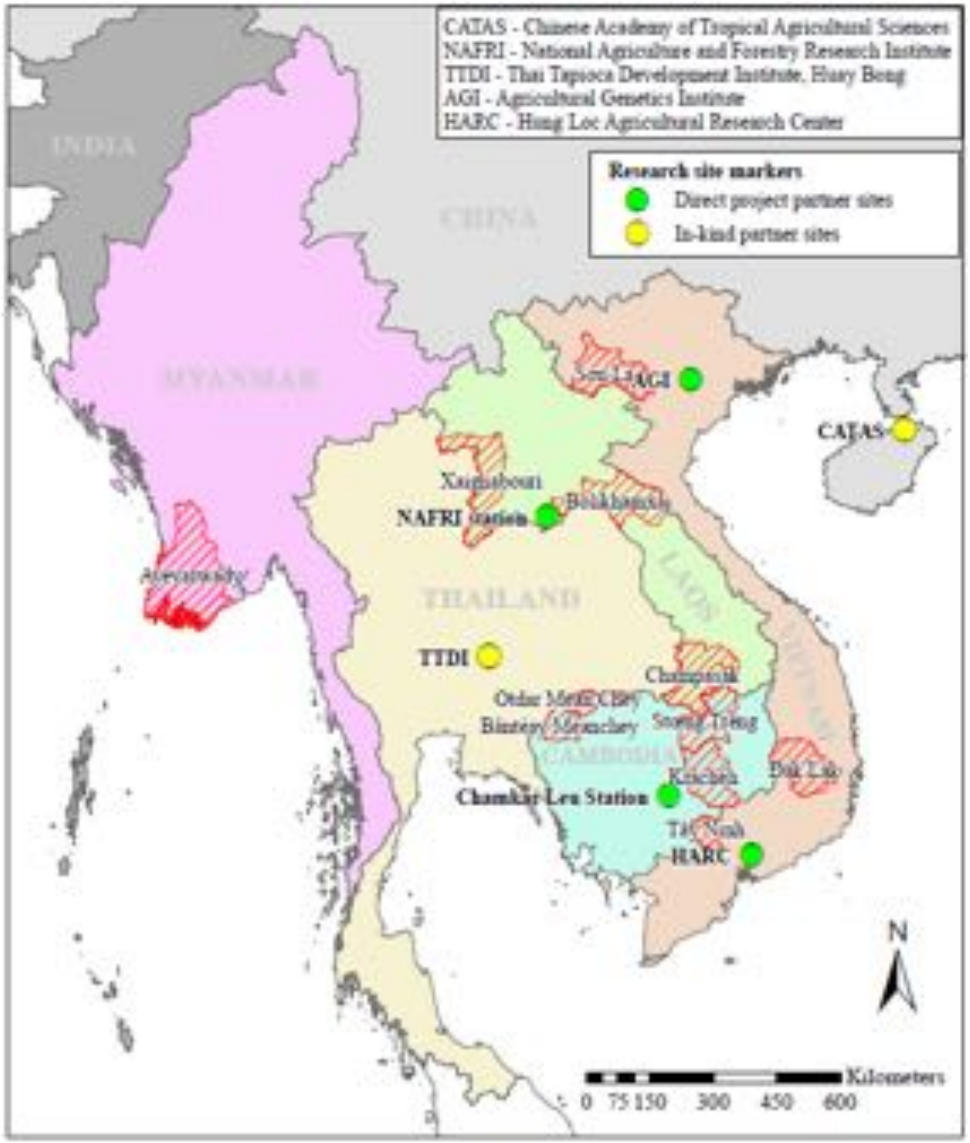
Including large volumes of planting material moving around the region

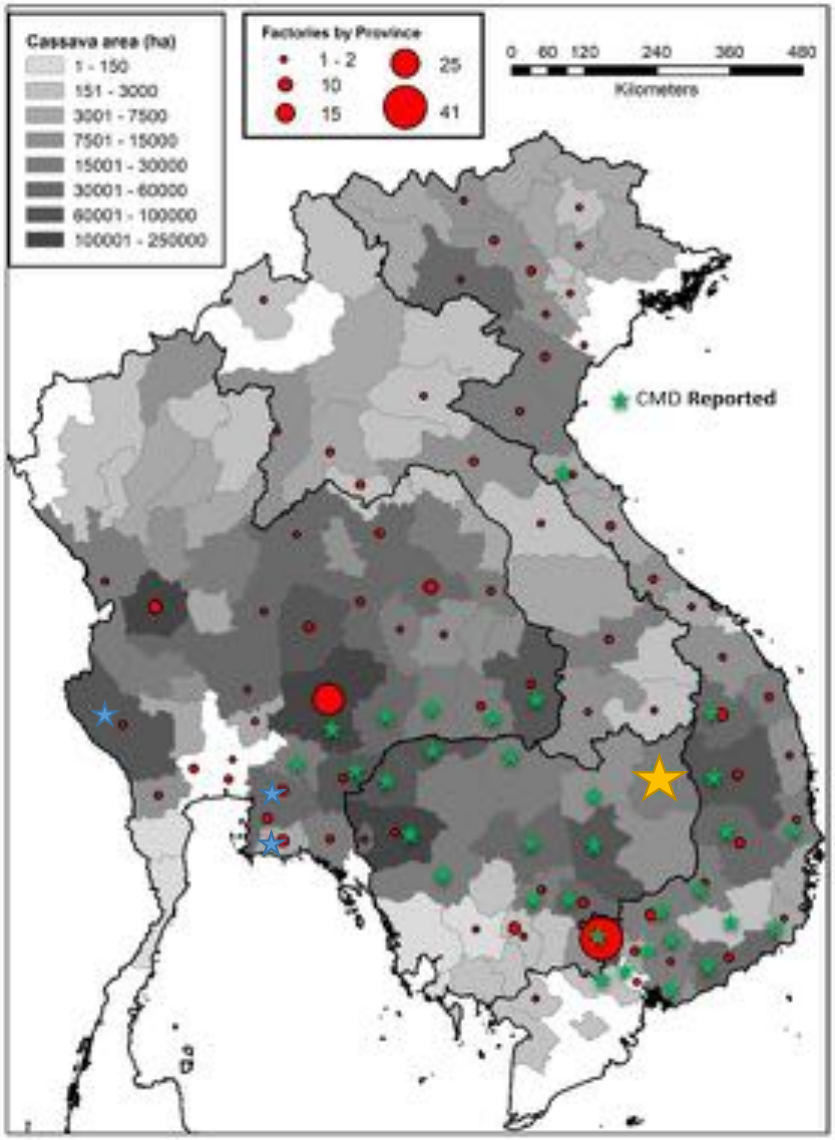
FANTASTIC IN THE ABSENCE OF PEST AND DISEASE

CIAT


North Vietnam
Yen Bai
Son La
Laos
Thailand
KonTum
Gia Lai
Dak Lak
Dak Nong
Tay Ninh
Dong Nai
Binh Thuan
Long An
Vietnam
2015 Planted Area (1000 ha)
< 1.5
1.5 - 50
50 - 100
> 100
Average Stake Volume (per farmer)
Unknown
> 1000
1000 - 10000
> 10000


Factories by Province
1 - 2
10
15
25
41
Laos
Thailand
KonTum
Gia Lai
Dak Lak
Dak Nong
Tay Ninh
Dong Nai
Vietnam
Avg. # of stakes exchanged (per farmer)
Unknown
> 1000
1000 - 10000
> 10000
International exchanges
Intra-province exchange


CATAS - Chinese Academy of Tropical Agricultural Sciences
NAFRI - National Agriculture and Forestry Research Institute
TTDI - Thai Tapioca Development Institute, Huay Bong
AGI - Agricultural Genetics Institute
HARC - Hung Loc Agricultural Research Center
Research site markers
Direct project partner sites
In-kind partner sites
INDIA
CHINA
MYANMAR
THAILAND
CATAS
NAFRI station
TTDI
Chamkar Leu Station
HARC
N
Kilometers
0 75 150 300 450 600


Cassava area (ha)
1 - 150
151 - 3000
3001 - 7500
7501 - 15000
15001 - 30000
30001 - 60000
60001 - 100000
100001 - 250000
Factories by Province
1 - 2
10
15
25
41
0 60 120 240 360 480
Kilometers
CMD Reported

ure

ACIAR Short Research Activity

Australian Government
Australian Centre for International Agricultural Research

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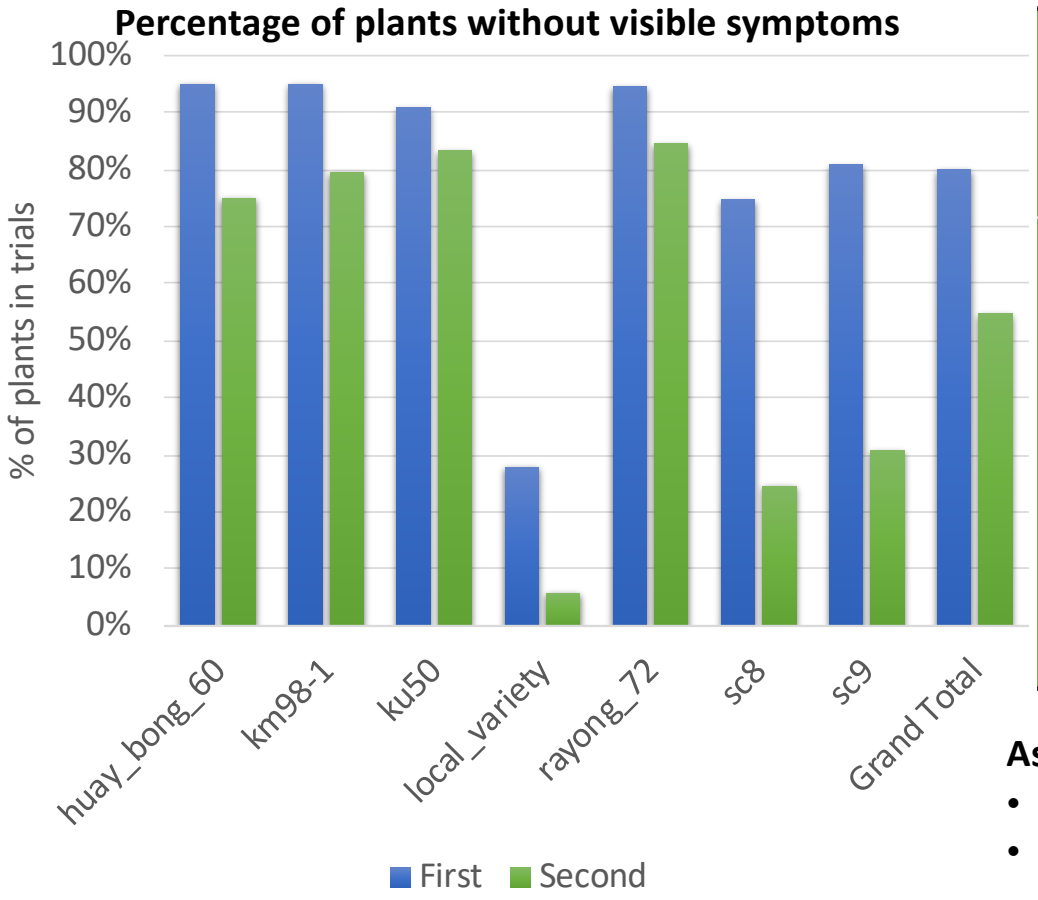


Variety	Infection rate (%) Location 1	Infection rate (%) Location 2	Asymptom rate (% of infected) Location 1	Asymptom rate (% of infected) Location 2
Huay Bong 60	6.7	0.0	100	0.0
KM98-1	6.7	5.6	100	100
KU50	0.0	0.0	0.0	0.0
Farmer's Local Variety	76.7	88.9	26.1	20.0
Rayong 72	43.3	61.1	84.6	81.8
SC8	16.7	27.8	80.0	60.0
SC9	16.7	66.7	40.0	58.3

Asymptomatic plants

- **SC8/SC9** showed high levels symptoms by November 2017
- **Rayong 72** was still not showing high levels of symptoms by the second inspection despite high levels indicated with PCR

* DNA fingerprinting suggest SC8 and SC9 in the trial were the same variety.

The project aim

The overall project aim is to enhance smallholder livelihoods and economic development in mainland SEA by improving the resilience of cassava production systems and value chains by addressing the rapidly evolving disease constraints.

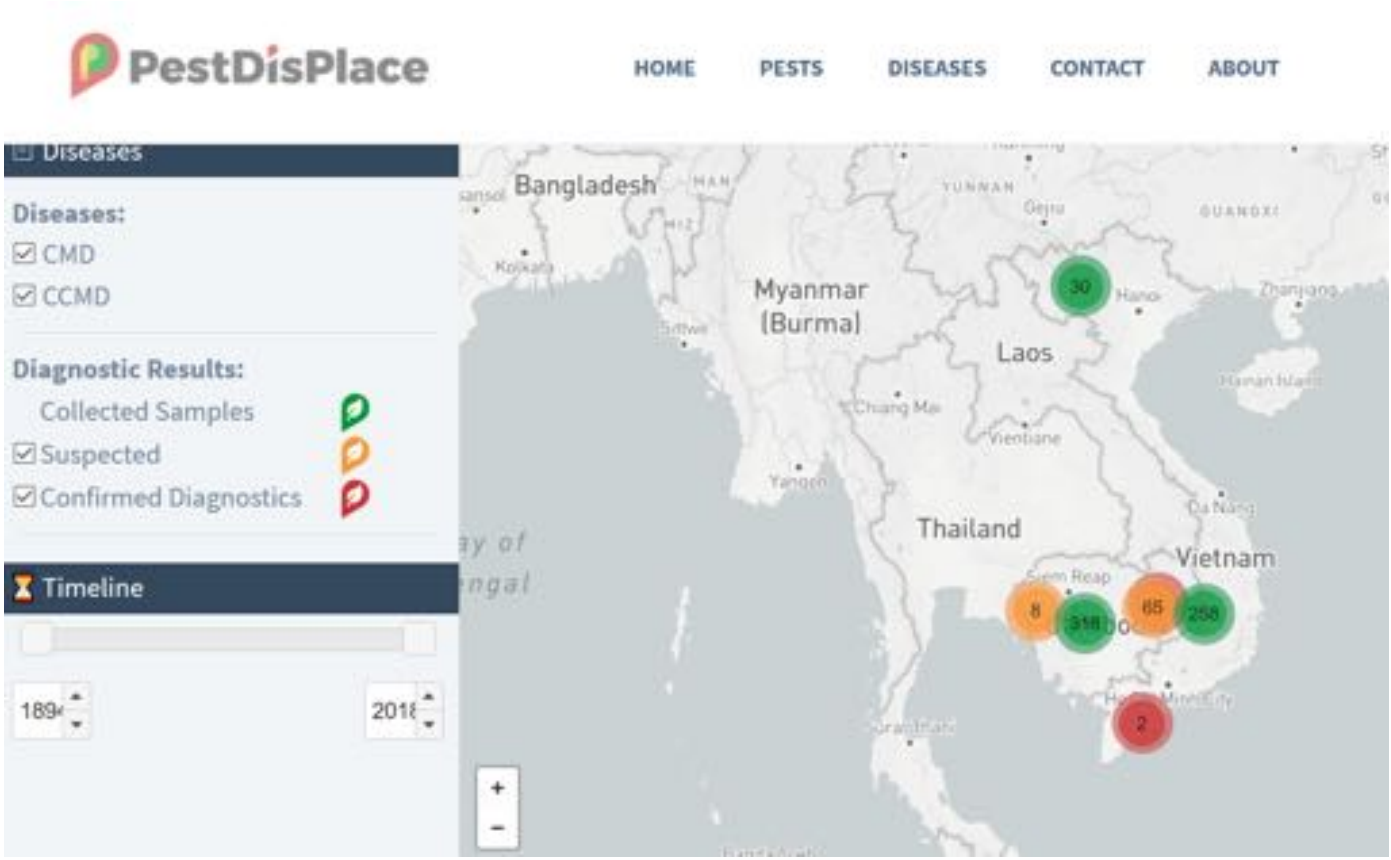
Short term

Evaluate which existing varieties are less susceptible

Speed of degeneration and yield loss

Develop clean ‘seed systems’ for production and distribution

Tracking and communicating the location of disease and clean zones



CAVAC Innovation In Agriculture

Australian Aid

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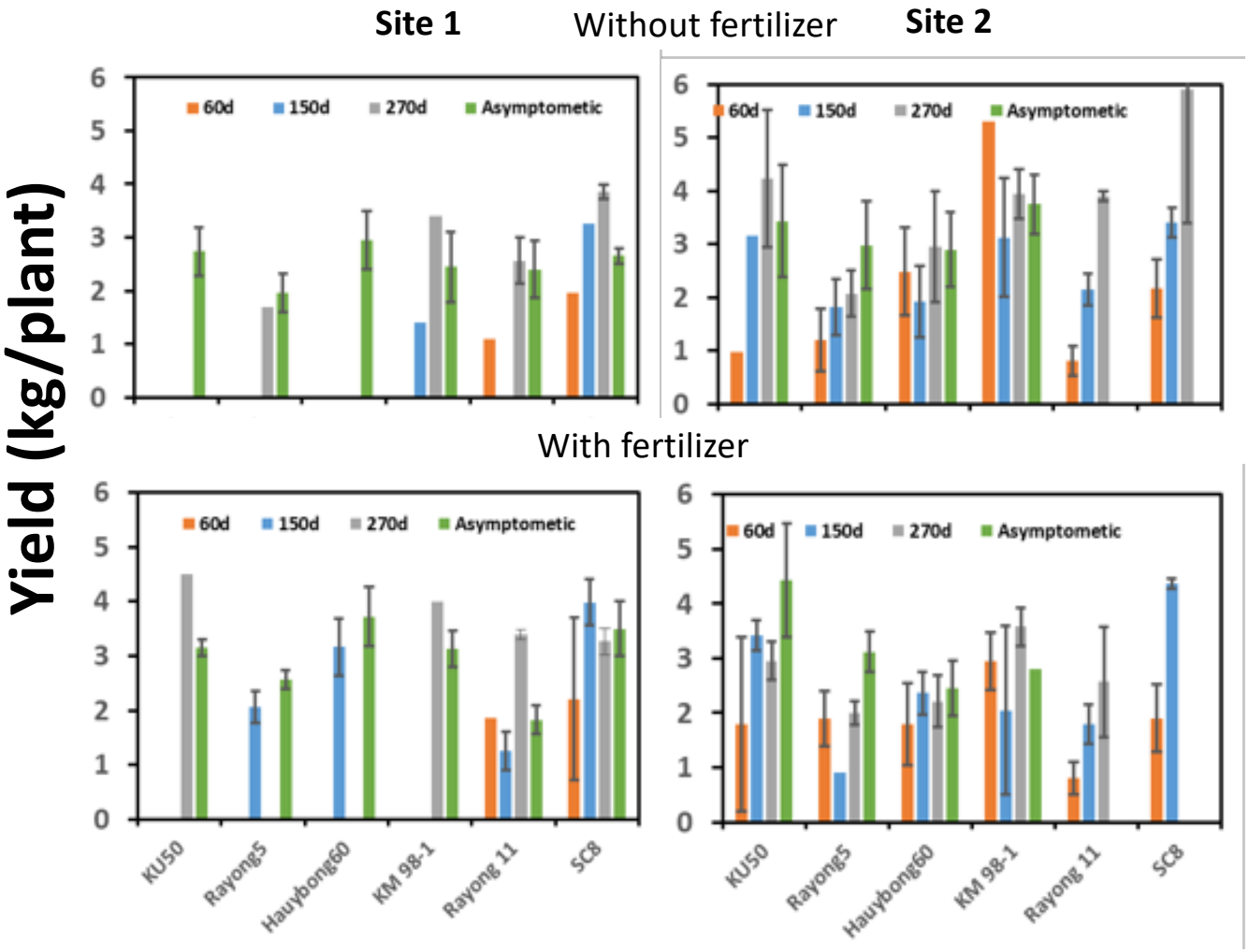
Since 1967 *Science to cultivate change*

TTDI


Field Day for Research
Varieties to Ca
Mosaic Disease

Early infection reduces yield



Infected at 60 DAP produced on an average 1.5 to 2.2 kg/plant

Infected at 270 DAP and/or asymptomatic plants produced 2.5 to 3.8 kg/plant

Poor management of planting material

"The corner of prosperity"

CIAT'S CASSAVA SEED SYSTEM APPROACH

1 **Implementation of relevant technologies for different scales**
- Industrial level
- Small farmer associations

2 **Simplified protocol to achieve low-cost design with adaptable equipment.**

3 **High throughput platform to integrate with multiple crops.**

1 Conventional in vitro culture 2 Bioreactores 3 Synthetic seeds 4 Rural TC laboratory 5 Rural schools initiatives

1 Hardening phase of in vitro culture 2 Tunnels system & sprouting rooting 3 Mature and immature cuttings 4 Pellets

1 Farmers associations 2 Industrial company 3 NGO's 4 NAR's 5 School projects

Tunnels system: For scaling up and speed up process

Lateral table 1
0.7 x 9 m
36 tray/50 holes
3600 plantlets

Central bed
1x 8 m
1000 mini-cuttings

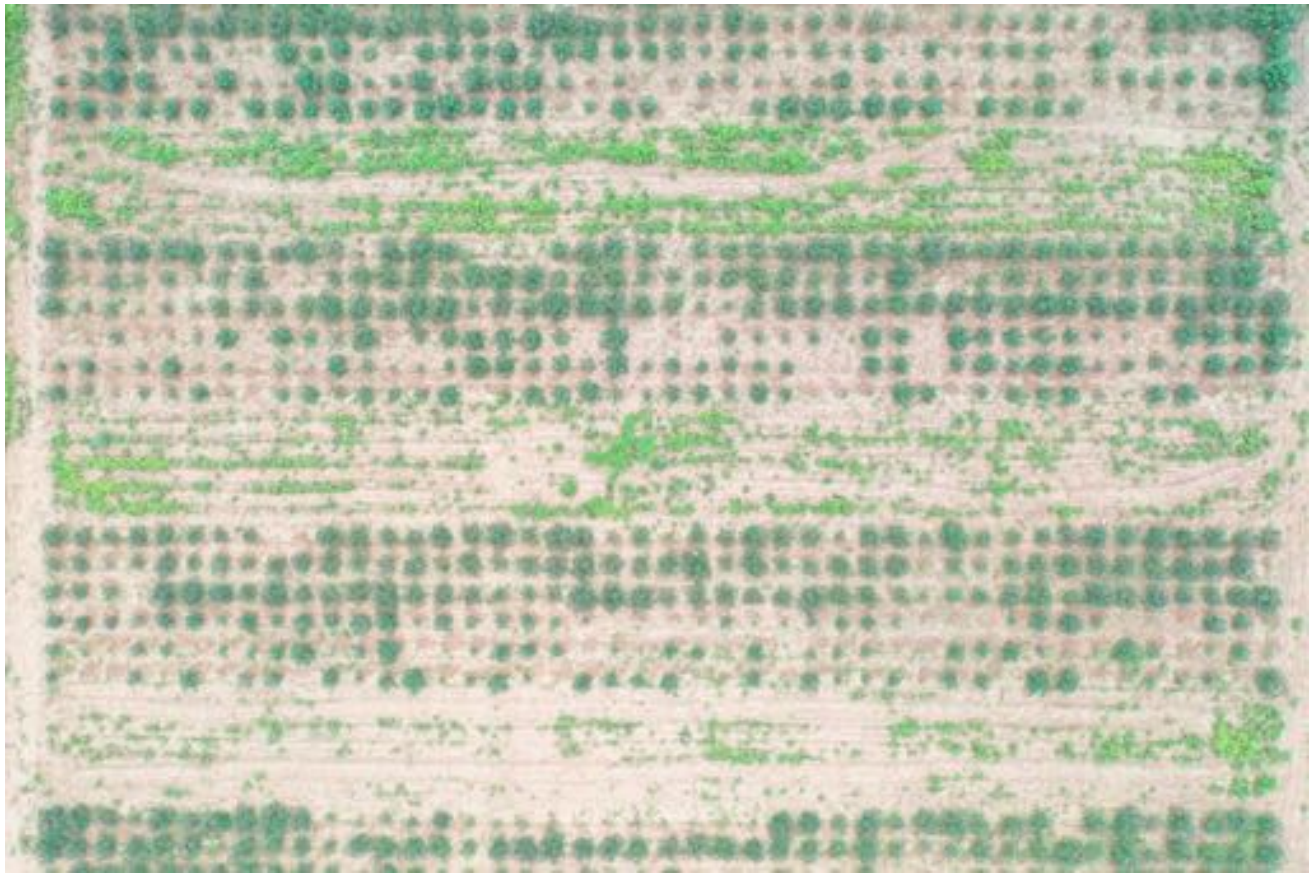
Lateral table 2
0.7 x 9 m
36 tray/50 holes
3600 plantlets

Benefits:

Allow to attend remote areas and offer planting materials at rural level

Easy construct of system & It could facilitated a entrepreneurships

On-station irrigation trials for multiplication of clean planting stems



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AUSTRALIA

CGIAR RESEARCH PROGRAM ON Roots, Tubers and Bananas

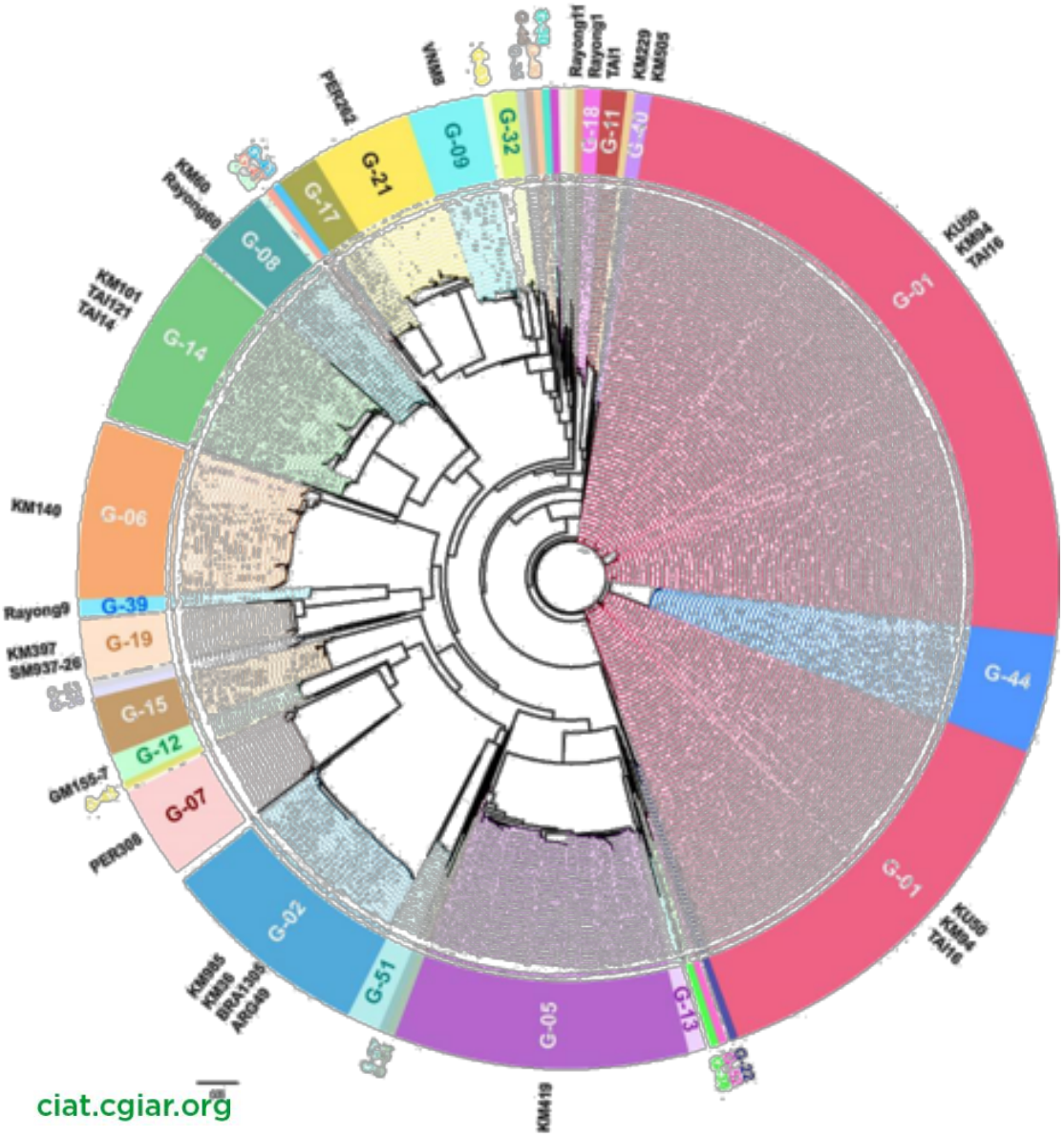
Medium term

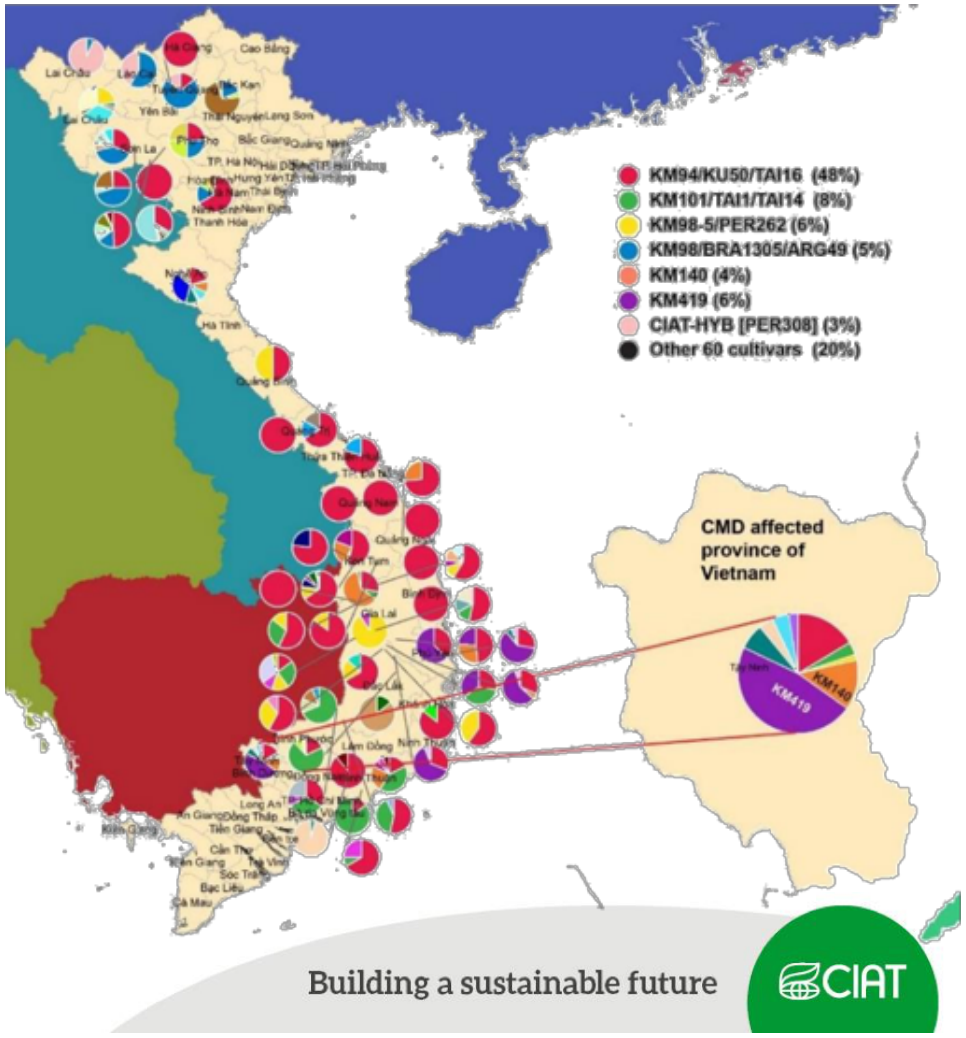
Evaluate varieties with resistance for performance in different agro-ecological regions

มหาวิทยาลัยเกษตรศาสตร์
KASETSART UNIVERSITY

TTDI

Variety identification





Evaluation of new clones with partners: over 200 clones in Tay Ninh

Longer term

Breeding for resistance for SLCMD and CWBD

Additional diversity and sources of resistance coming

CIAT transferring and additional clones for screening, breeding and distribution into the region

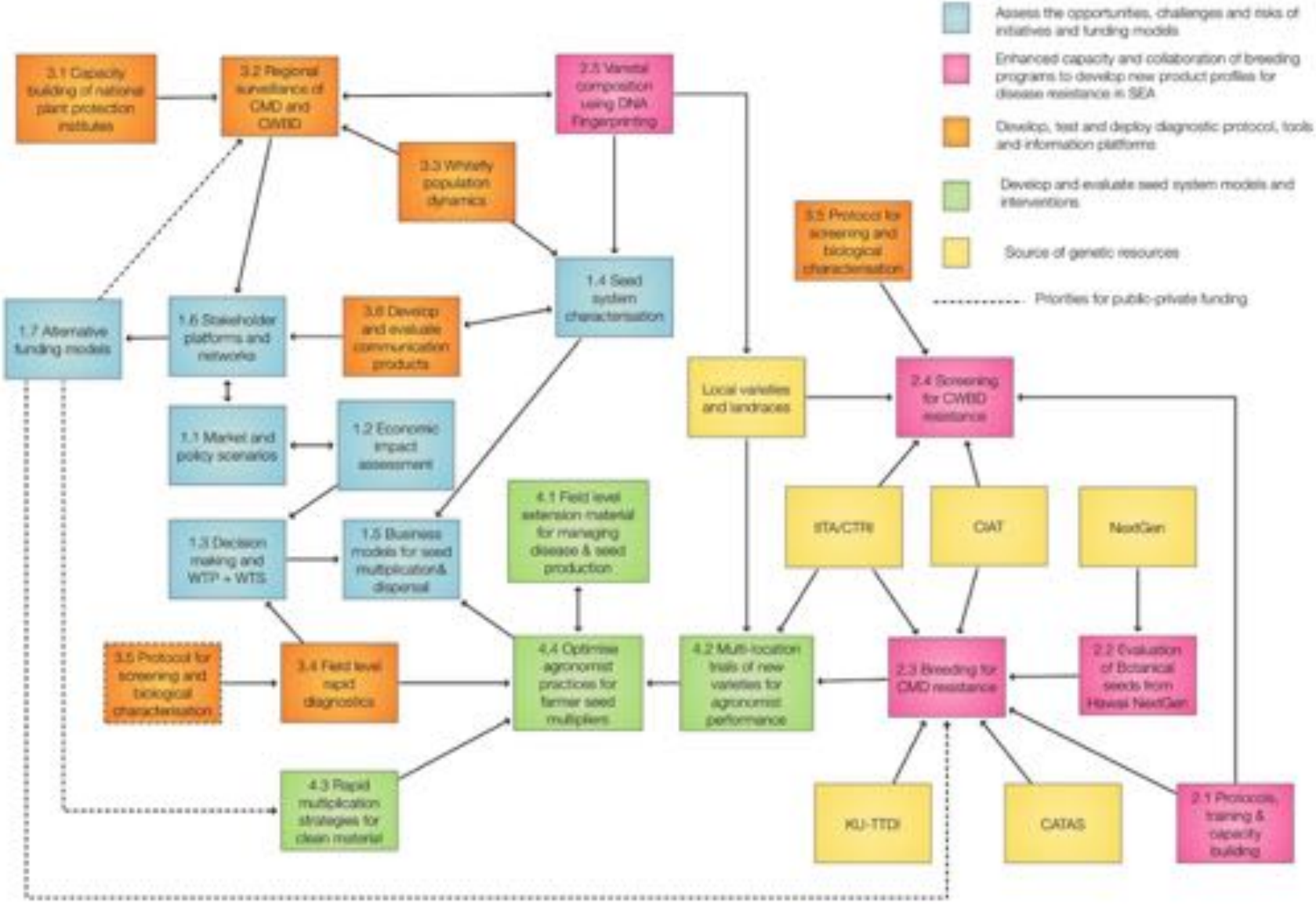
Four project objectives

Objective 1: Assess the opportunities, challenges and risks for the development of ***sustainable regional solutions*** for cassava disease management in mainland SEA including coordinated policy development, sustainable business and public-private funding models;

Objective 2: Enhance the capacity and collaboration between breeding programs in mainland Southeast Asia to develop new product profiles for ***commercially viable cassava varieties*** by identifying and incorporating known and novel sources of resistance to Cassava Mosaic Disease (CMD) and Cassava Witches Broom Disease (CWBD) into national breeding programs:

Objective 3: Develop, test and deploy ***diagnostic protocols***, tools, and information platforms fit for purpose in ***monitoring, surveillance***, and certification applications; and

Objective 4: Develop and evaluate technically feasible and economically sustainable cassava ***seed system models*** for the rapid dissemination of new varieties and clean planting material to smallholder farmers in different production systems and value chains.


Assess the opportunities, challenges and risks of initiatives and funding models
Enhanced capacity and collaboration of breeding programs to develop new product profiles for disease resistance in SEA
Develop, test and deploy diagnostic protocol, tools and information platforms
Develop and evaluate seed system models and interventions
Source of genetic resources
Priorities for public-private funding
3.1 Capacity building of national plant protection institutes
3.2 Regional surveillance of CMD and CWBD
2.5 Varietal composition using DNA Fingerprinting
3.3 Whitefly population dynamics
3.5 Protocol for screening and biological characterisation
1.4 Seed system characterisation
1.7 Alternative funding models
1.6 Stakeholder platforms and networks
3.6 Develop and evaluate communication products
Local varieties and landraces
2.4 Screening for CWBD resistance
1.1 Market and policy scenarios
1.2 Economic impact assessment
4.1 Field level extension material for managing disease & seed production
IITA/CTFR
CIAT
NextGen
1.3 Decision making and WTP + WTS
1.5 Business models for seed multiplication& dispersal
3.5 Protocol for screening and biological characterisation
3.4 Field level rapid diagnostics
4.4 Optimise agronomist practices for farmer seed multipliers
4.2 Multi-location trials of new varieties for agronomist performance
2.3 Breeding for CMD resistance
2.2 Evaluation of Botanical seeds from Hawaii NextGen
4.3 Rapid multiplication strategies for clean material
KU-TTDI
CATAS
2.1 Protocols, training & capacity building

Strength and challenge of the project design…

Three key features of this project are:

1. The **transdisciplinary** research team and work packages;
2. The **strong engagement with value chain actors** (core actors - *farmers, traders, processors, exporters*, and supporting - *extension, input suppliers, credit etc*); and
3. The **regional scale** of the partnerships and networks developed.

All three elements are critical to maximising the research outputs and ensuring they are utilised by next users and rapidly scaling to target farmers across borders into the regional cassava economy.

Objective 1 - Assess the opportunities, challenges and risks of initiatives and funding models

cia

Developing a strategic partnership for cassava research between UQ and CIAT

CGIAR RESEARCH PROGRAM ON Roots, Tubers and Bananas

Australian Government
Australian Centre for International Agricultural Research

CIAT
International Center for Tropical Agriculture
Since 1967 *Science to cultivate change*

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

Thank you!

WE'RE PROUD TO
HAVE CELEBRATED 50 YEARS
OF AGRICULTURAL RESEARCH
FOR DEVELOPMENT

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