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Objective 4 and 5: Overview of seed system and agronomic activities

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Final Review AGB-2018-172

5th October 2023

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Develop and evaluate economically sustainable cassava seed system models for the rapid dissemination of new varieties and clean planting material to farmers in different value chains and production contexts

CMD

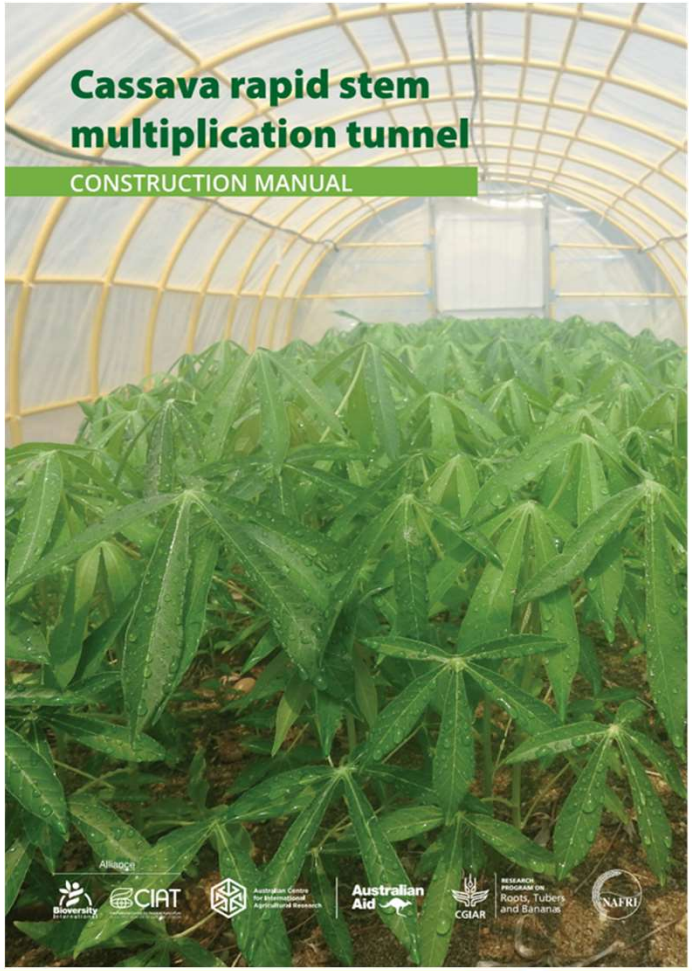
CWBD

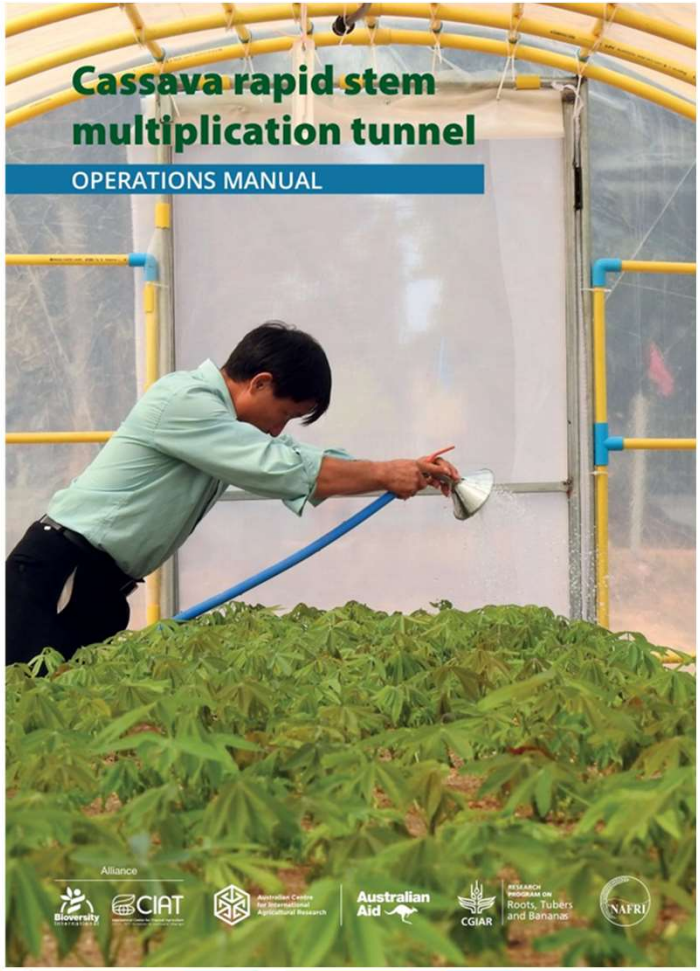
Activity 4.1
Developing communication products for effective field level management of cassava diseases (i.e. CMD, CWBD)

- **Publication & distribution of brochures, video cds, posters:**

- **Training materials developed for use within the region:**

Activity 4.1Tunnel manuals – detailed construction and operation guides





1st print run financed by BMGF through PROSSIVA project in SSA

Name	Description	Type (Link)
Cassava rapid stem multiplication tunnel: construction manual	A step-by-step guide for constructing cassava multiplication tunnels (English, Lao, Vietnamese, and Khmer versions)	Manual (Link)
Cassava rapid stem multiplication tunnel: operations manual	A step-by-step guide for constructing cassava multiplication tunnels (English and Lao versions)	Manual (Link)
Tool description sheet to experimental auctions of vegetatively propagated seed	Tool description sheet for experimental auctions of RTB seed.	Manual (Link 1)
Experimental auctions. RTB Seed System Toolbox Course: 26, 28, 29 July 2021.	A training presentation supporting the use of the experimental auction tool.	Presentation (Link 1)
Building cassava rapid multiplication tunnels	A training video on how to build cassava rapid multiplication tunnels. (Lao language version)	Video (Link 1)
Cassava mosaic disease (CMD in Lao PDR)	A farmer training video about farmer about the newly arrived cassava mosaic disease, focusing on Lao PDR. (English version)	Video (Link 1)
A farmer training video about cassava witches broom in Southeast Asia, focusing on Lao PDR. (English version)	A farmer training video about Cassava Witches Broom in Southeast Asia, focusing on Lao PDR. (English version)	Video (Link 1)
Managing cassava witches broom disease (CWBD)	A farmer training video about Cassava Witches Broom in Southeast Asia, focusing on Lao PDR. (English version)	Video (Link 1)
Cassava mosaic virus	A poster identifying the symptoms, causes, vectors, and strategies for coping with CMD in Lao language	Poster
Cassava witches broom disease	A poster identifying the symptoms, causes, vectors, and strategies for coping with CWBD in Lao language	Poster
A decision support model for landscape-level management of cassava mosaic disease in Southeast Asia	A presentation detailing the use of a machine learning model to determine the most effective strategies for dissemination of clean seed to reduce CMD pressure at regional level	Presentation (Link)

Activity 4.2

Evaluation and on-farm demonstration of CMD resistant exotic cassava varieties from IITA (Africa) and ICAR-CTCRI (India) against clean available SEA varieties

Country	Location	Disease	Variety	Output	Recommendations
Cambodia	Chamkar Leu Up-land farm (GDA station)	CMD CMD & CWBD	KU50, Rayong11, SC8, HuayBong60, KM98-1, Rayong 5 KU50 and Rayong 5	A scientific manuscript has been publised	Asymptomatic plants tested PCR positive for CMD virus at the end of the season CMD resistant varieties are essential for maintaining productivity Until sources of disease resistance are available clean seed sources are essential to keep cassava production sustainable and profitable
Laos	Naphokh, NAFRI research station	CWBD	Rayong11, KU50		
Vietnam	Tay Ninh, Province	CMD	KM94, KM140, KM419, HLS11, HLS 14 and HLS 12		

Activity 4.2

Evaluation and on-farm demonstration of CMD resistant exotic cassava varieties from IITA (Africa) and ICAR-CTCRI (India) against clean available SEA varieties

Conducted participatory evaluation of IITA clones and also discussed soil and nutrient management during field days

TMEB 419 and KU50 fresh root yield and starch content was similar in two locations in Loas and one location in Cambodia. TMEB419 developed CWBD symptoms much higher by the end of the season compared to KU50 in Cambodia.

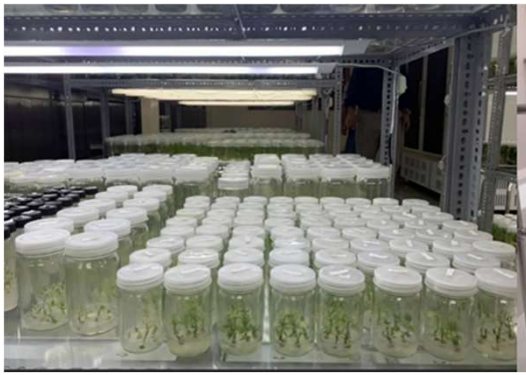
Activity 4.3 Evaluation and comparison of rapid multiplication innovations in SEA context

- Desktop review of cost and output different technologies (SAH, Jiffy etc)
- Setting up viable technologies in collaboration with National partners in Vietnam and Laos; compare and modify accordingly
- Capacity building for the rapid multiplication technology in the region

Capacity building for *in vitro* multiplication in Laos and Cambodia

Steps of rapid multiplication

Mother plant for tunnel



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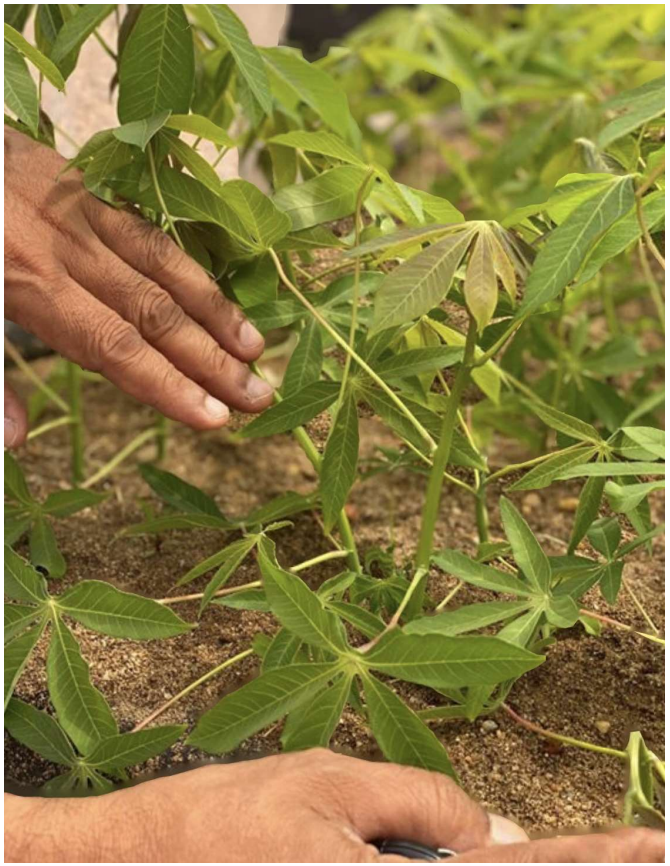
Capacity building for tunnel multiplication

Two node stem-cutting horizontally placed in the sand bed

Viable sprout are with 5 to 6 nodes, average height of KU50 sprouts are couple cm taller compared to Rayoung11



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Interest in tunnel systems from private stakeholders

- Khousap Company Bachiang District from Champasak Province

Productivity of tunnels

Variety	Number of seedlings per season per tunnel	No of viable sprout in each cutting	No of days to get new plantlets	No of days to transplant to field (from Tunnel)	Number of plants in the field	Transplantation field Success rate (%)
KU50	3840	768 ± 74	[a]50 ± 4.6	[b]96 ± 15	*2690	100
Rayong11	5040	840 ± 123	[a]49 ± 3.0	[b]95 ± 4	4210	100

- Lost one batch to mealybugs, a= delayed by 7 day due to unavailability of substrate, b= delayed by 10 to 15 days due to delayed in irrigation system set up.
- 700 two node cutting in each tunnel

Multiplication rate from mother plants is 6-10x under traditional field multiplication
In tunnel multiplication it is 100-125x over the course of a season

Productivity of tunnels (examples)

Location	No of two nod cuttings	No of Plantlets transplant to field	Comments
HLARC	4,598	35,646	Successfully optimized the production system
GDA	2906	5659	Had difficulties with rooting medium and temperature control/ Sprinkler systems

Tunnel multiplication and successful field transplant of TMEB419 and retail to farmers at HLARC research Station, Dong Nai, Vietnam. From January to December 2022, six tunnels produced about 35K plantlets, out of these, 2k was used for different experiments, 4.2k were planted on station for multiplication purpose and rest of the 29.4k plantlets were sold to farmers at 0.2 USD plantlet-1 (1 USD =23,745 VND)

Activity 4.3 Evaluation and comparison of rapid multiplication innovations in SEA context (setting up viable technology)

Cassava rapid multiplication tunnels in Asia (Sep. 2023)

Other infrastructure

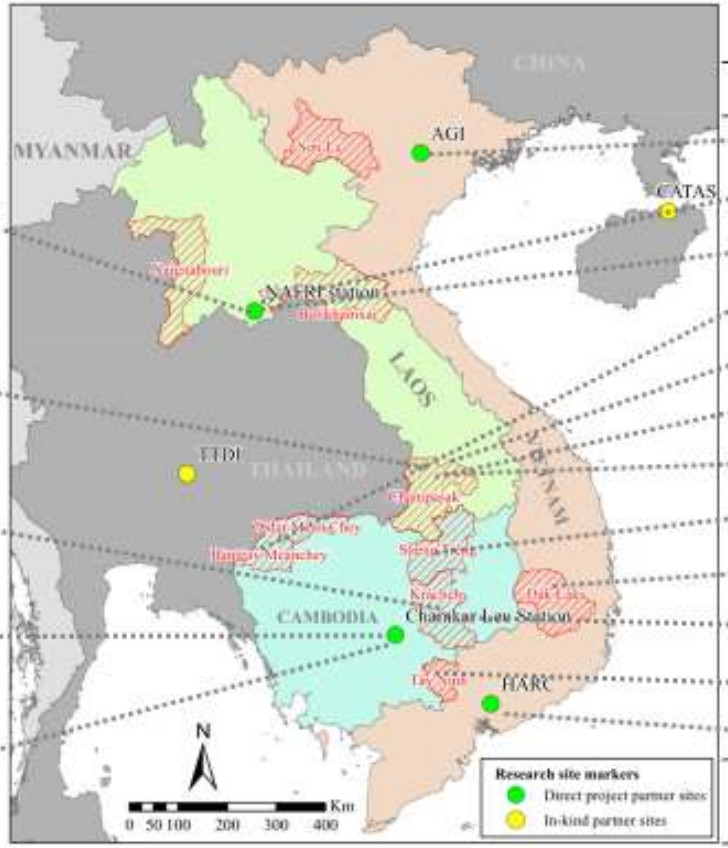
Screenhouse - Future Stems (Vientiane)

Fibercell - LCA (Laongarm)

Screenhouse - GDA (Chamkar Leu)

Fibercell - CARDI (Phnom Penh)

Screenhouse (2) – CARDI (Phnom Penh)



Tunnels constructed

#	Name	Place	Funder
1	Hanoi Nat. Uni.	Hanoi	Public
4	Private traders	Vientiane	Private/Winrock/USDA
6	NAFRI	Vientiane	Public
4	PDAFF	Banteay Meanchey	Public
*10	Khounsub	Paksong	Private
6	LCA	Laongarm	Winrock/USDA
3	Skyvision	Thateng	Private
4	PDAFF	Stung Treng	Public
4	Company	Dak Lak	Private
4	GDA	Chamkar Leu	Public
4	Private traders	Tay Ninh	Private
4	HLARC	Hung Loc	Public

Total 54 + 4 screenhouses

Summary

- Capacity, equipment and facilities for in vitro and tunnel rapid multiplication innovation have been setup and/or upgraded in Laos, Cambodia and Vietnam.

- Effective and efficient production of clean seeds and rapid dispersal of new varieties into the seed system is progressing, however, management of filed multiplication need to be coordinated and optimized.

Activity 4.4

Optimize agronomic practices (variety, density, fertilizer) for the economic production of both cassava roots and clean planting material

Country	Location and variety	Variety Treatments Planting density/fertilizer	Lesson learnt/recommendation
Cambodia	Chamkar Leu Up-land farm (GDA station) KU50	10,000, 20,000 and 13,333 plants ha^{-1} X different fertiliser	80-20-80 NPK and 10k and 20k plant ha-1 yield similarly. Stem multiplication purpose 20k density economiically profitable. Comaprison between stem cutting and tunnel plantlets yield simlary in 10k pants ha-1
Laos	Naphokh, NAFRI research station Rayong11 Stem cutting and Tunnel plantlets	10,000, 20,000 and 13,333 plants ha^{-1} X different fertiliser	Yield was not significantly different when compared with stem cutting and tunnel grown plantlets Starch content demonstrated difference (~15%) lower; however, harvest of Tunnel cuttings were done after a rain event (2 days difference between harvest) In another location stem cutting demonstrated higher yield.
Vietnam	Hungloc Agricultural research center TMEB419	10,000, 20,408 and 12,500 plants ha^{-1} X different fertiliser	Cassava growing from stem cutting yielded significantly higher compared to tunnel plantlets.

Different duration of crop and different planting date

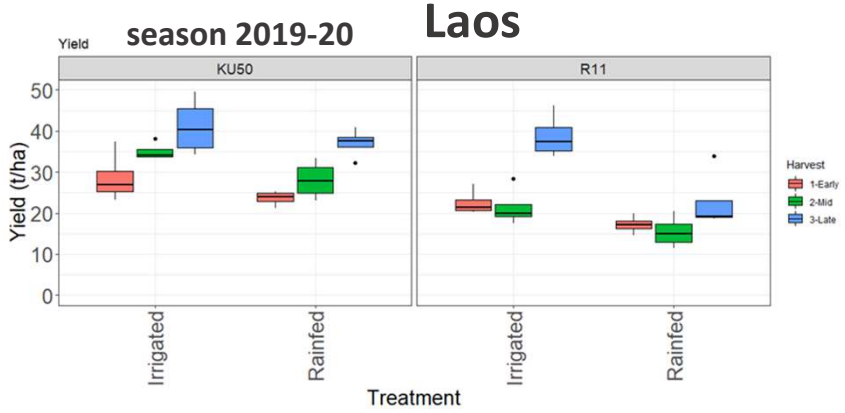
Objective: To determine the effect of time of planting and time of harvesting on the growth and yield of different cassava varieties and thus contribute to a better understanding of sustainable cassava production systems in specific agro-ecological areas.

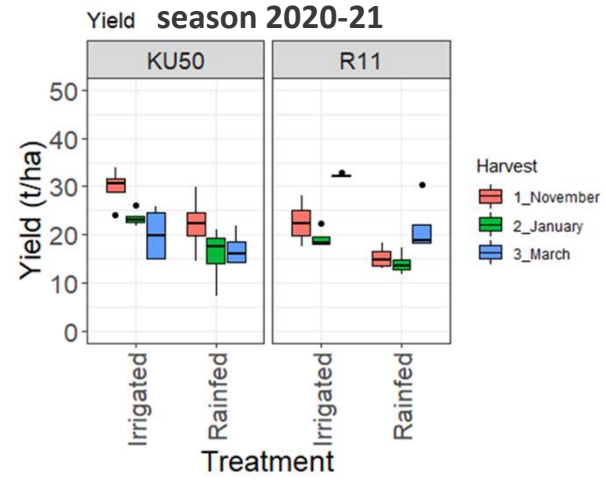
Country	Location	Variety	Treatments	Lesson learnt
Cambodia	Chamkar Leu Up-land farm (GDA station)	KU50	Rainfed, Hravest after 6, 8 and 10 months	Longer duration crop yielded highest
Laos	Naphokh, NAFRI research station	Rayong11, KU50	Rainfed and with irrigation, Plant at 3 different time (Jan, Mar, May) and harvest after 10 months	Late planting may have lower yield and have higher disease incidences in of diseases (CWBD)
Vietnam	Hungloc Agricultural research center	KM94, D7	Rainfed and with irrigation, Plant at different time and harvest after 10 months	Dry season planting can lead to crop failure

Summary results

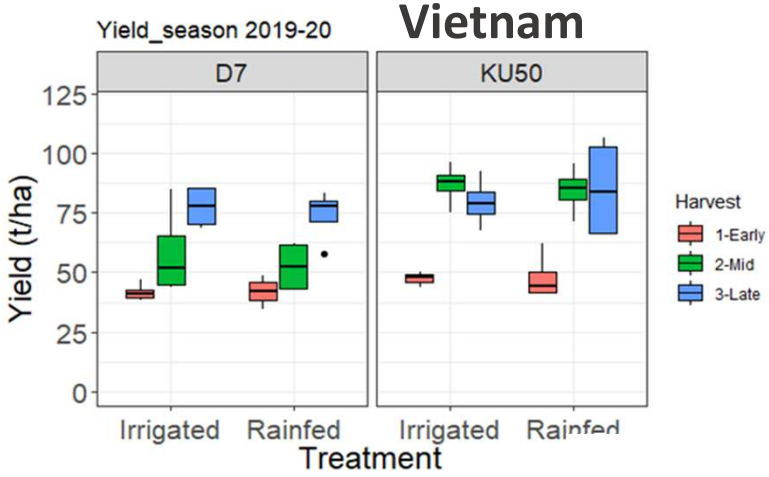
Longer duration crop yielded highest

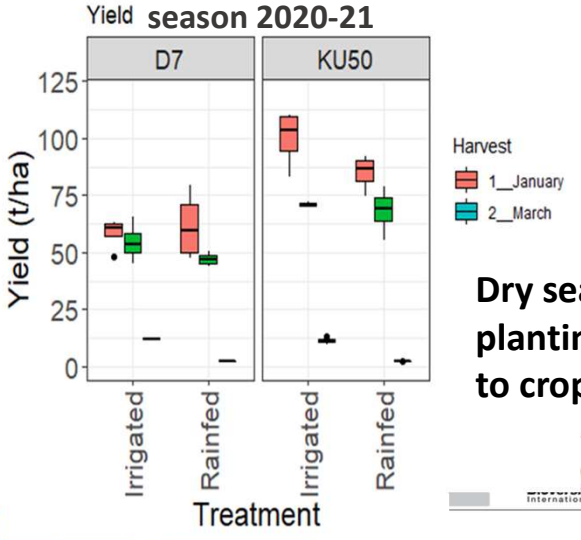
Laos





Vietnam

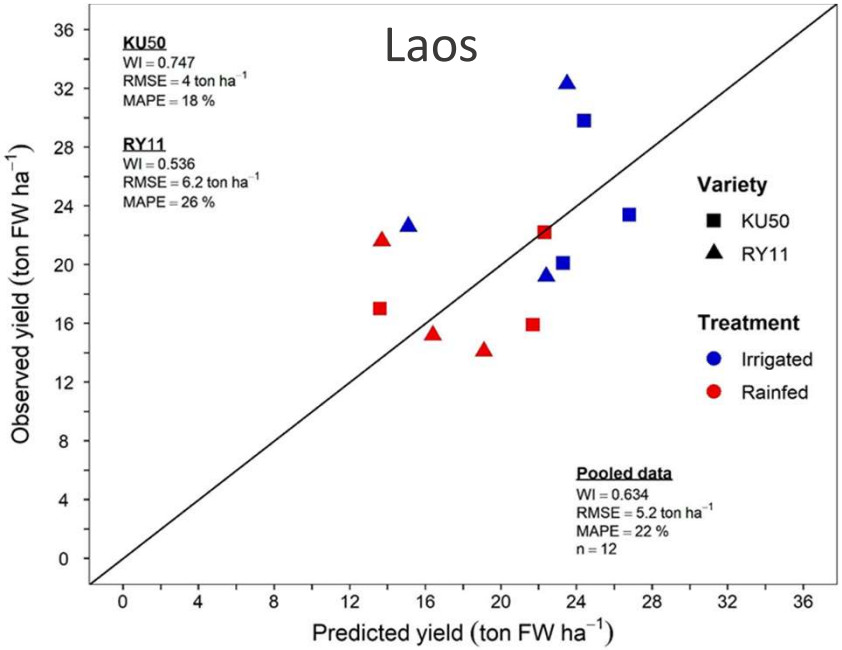




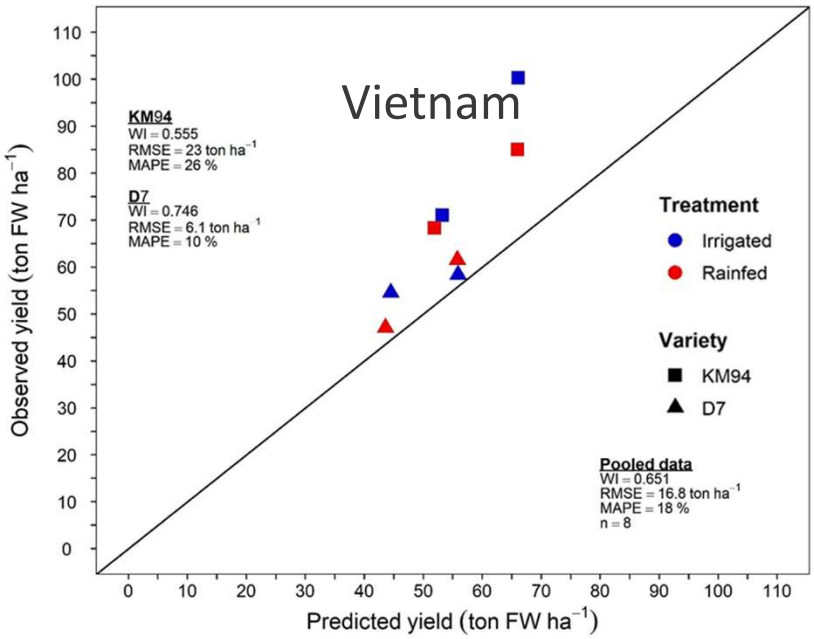
Late planting may have lower yield

Dry season planting can lead to crop failure

Performance of the DSSAT-CSM-MANIHOT for predicting cassava root yield under different water regimes



Model seemed to capture not well the irrigation impact on yield, with predicted irrigated yields mostly underestimated



The calibrated model can be used, for yield potential analysis for climate risk assessment, at least for the study region.

In collaboration with Louis Kouadio, Jochen Eberhard and Michael Scobie, USQ and International Climate Initiative (IKI) of the German Federal Ministry for the Environment

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Objective 5:
Evaluate the impact of soil fertility and management practices on the prevalence, incidence, and severity of cassava disease.

Develop and evaluate alternative cropping-system options relevant for different biophysical, social and market contexts that mitigate the impact of disease and improve the overall sustainability of smallholder cassava production.

Crotalaria juncea

Sunnhemp a quick growing leguminous crop cultivated for green manure

Activity 5.1 - Conduct review of current practices, constraints, and opportunity

- "Institutional arrangements for cassava (Manihot esculenta Crantz) early generation seed production in Southeast Asia" – manuscript submitted 2023 and under review
- Summary of cassava production status (regional scale), institutional analysis of formal cassava seed multiplication in the Mekong region, synthesis of 10 key informant interviews.
  - Thailand: Kasetsart University + TTDI
  - Cambodia: UBB + SATREPS + GIZ
  - Vietnam: HLARC
- Public and private actor participation, technological stages of multiplication, costs by stage

- "Regulation of Southeast Asia's seed commons: a local to global chronological analysis" – manuscript submitted 2023 and under review
- Desktop review of 137 seed laws, regulations, policies in 5 countries of the Greater Mekong subregion from 1947-2021
- Results inform the legal context for production and dissemination of seed, regulations implicated

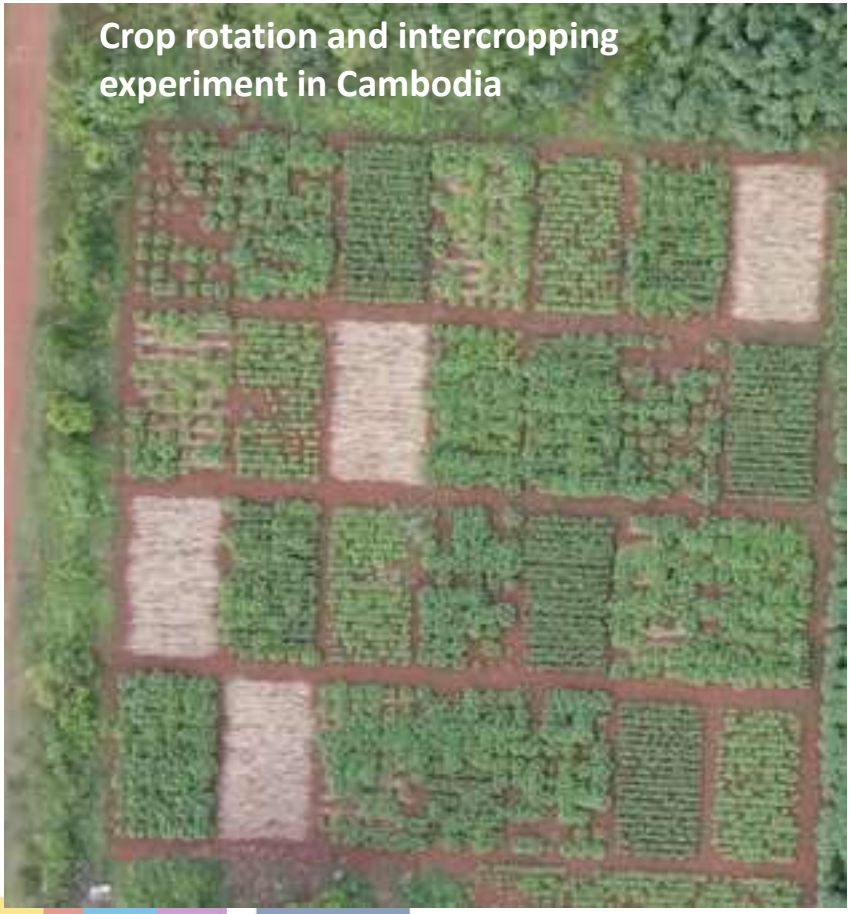
Activity 5.2 Establish the relationship between current crop management, soil fertility and soil physical properties, and cassava pest and disease

- On station soil sampling has been carried out at the beginning of the season in Laos and Cambodia (chemical analysis has been completed). Farmers' field soil sampling has been done from couple of sites where multilocation trial was on in southern part of Laos, with end of season along with yield data and disease severity.
- The new findings on CWBD have resulted in new research questions – some of which have been moved to the SRA and subsequent project under development.

Activity 5.3 On-farm trial for evaluating alternative cropping systems and management

- Protocol development is on going (On-farm participatory trials)
- Pilot on-farm experiments are on going in Laos and Cambodia.


Weed management experiment in Laos


Crop rotation and intercropping experiment in Cambodia

Activity 5.4 Develop and implement a ‘research station management and investment plan’

- Project rainfall meters, soil moisture probes, and precise temperature monitoring have provided high-precision climate data on the microclimate at the Napok, Laos, station. In addition to soil samples collected (see Activity 5.2).
- The development of a sustainability plan for the production of disease-free cassava stems has continued with investments made in improvement of the molecular-pathology labs to support the on-station tunnel system.
- With different projects and initiatives controlled by partners or outside there will be some limits to the degree of long-term planning that can occur. Agreements are being developed for areas for long term activities for the next 5 year

Activity 5.4 Develop and implement a 'research station management and investment plan'

- Results of the manuscripts reported under Activity 5.1 provide detailed cost breakdown of three cassava seed multiplication initiatives in the Greater Mekong subregion
- In addition, submitted manuscript "Increased farmer willingness to pay for quality cassava (Manihot esculenta Crantz) planting materials: evidence from experimental auctions in Cambodia and Lao PDR" provides information on market demand conditions *in-situ*
- In combination with information on the economics of rapid cassava stem tunnel operations, provides the basis for evaluating the profitability of integrated clean seed production systems on station

Seed system and Agronomy team members

- Mr. Laothao Youbee (CIAT-Laos)
- Mr. Sophearith Sok (CIAT-Cambodia)
- Mr. Saythong Oudthachit (NAFRI)
- Ms. Soukphathay Simeuang (NAFRI)
- Ms. Pham Thi Nhan (HLARC)
- Mr. Hung Ngoc Nguyen (HLARC)
- Mr. Tung Nguyen Ba (HLARC)
- Mr. Troung Minh Hoa (HLARC)
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- Ms. Sopha Kan (GDA)
- Mr. Meng Rithea (GDA)
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Thank you!

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