PROJECT NEWSLETTER: ACIAR CSE/2015/044

Sustainable intensification and diversification in the lowland rice system in Northwest Cambodia

October 2018

Newsletter No. 03

This volume presents:

- **Project summary**
- **Fieldwork research updates**
- **Student project updates**
- **Gender analysis in rice production**
- **Farmer hubs**

Australian Government

Australian Centre for International Agricultural Research

Australian AID

PROJECT SUMMARY

Sustainable Intensification and Diversification in Lowland Rice System in Northwest Cambodia (CamSID), an ACIAR funded project, commenced in late 2016 and will be running for five years. This project aims at improving productivity and livelihood security of Cambodia's farming communities through enhancing sustainable intensification and diversification within lowland rice ecosystems. The specific project objectives are to: (1) identify the local socio-economic and agronomic trends, constraints and opportunities for sustainable intensification and diversification; (2) establish participatory on-farm trials to test sustainable intensification options; (3) comparative evaluation of different scaling models for sustainable intensification and diversification; and (4) build the capacity of local farming communities and tertiary agricultural educational institutions. The project locations are based in the largest rice producing provinces of Battambang, Banteay Meanchey and Pursat which accounts for approximately 27% of the country's wet season rice production.

The project began with a stakeholder workshop, participated in by a wide range of audiences from different institutes and backgrounds. We gathered the participants' experiences, ideas and suggestions and incorporated them into the project strategy formation, planning and implementations. Later in 2017, the project team accomplished a number of data collection activities; including Participatory Research Approval from all the targeted villages, Diagnostic Baseline Survey from 524 farming community household representatives and Different Stakeholder Interviews for Value Chain and Social Network Analysis. Also in 2017, the agronomic team commenced its fieldwork research to explore different innovative farming technologies and practices, such as mechanised seeding, use of quality seed, higher yielding varieties of crops of higher value, integrated pest management and fertiliser protocols that are an integral part of the research strategy in crop intensification and diversification. The agronomic team will be continuing testing and examining a range of innovative cropping systems and options for dry season rotations with rice in years 2&3, before commencing piloting scale-up the research findings in years 4&5. We are curry in year 2 of the project implementation (Figure 1).

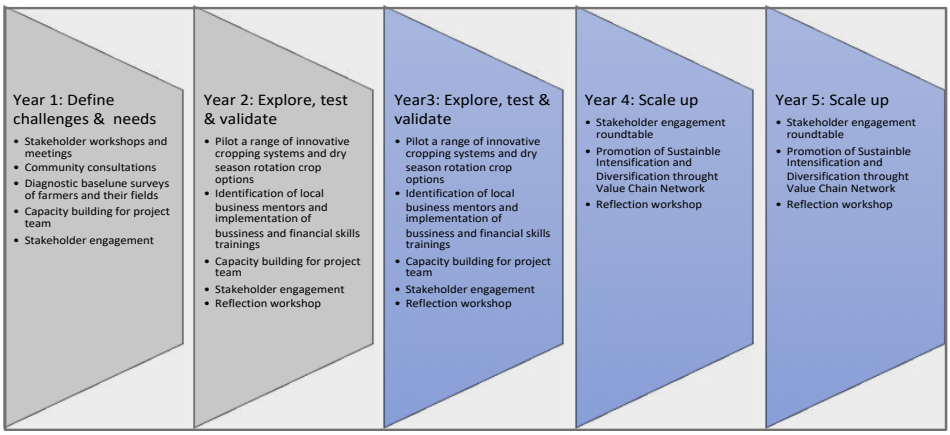


Figure 1 Annual flows of research project

FIELDWORK RESEARCH UPDATES : On-farm experiments and demonstrations

The most common planting methods are hand-broadcasting (problems of high seeding rate and variable plant density) for paddy production and hand-transplanting (problem of using a lot of labour and high cost) for pure rice seed. The CamSID project is testing and demonstrating various mechanised direct planters as alternatives to hand broadcasting for paddy and transplanting pure seed production over three cropping seasons; the Early Wet Season 2017 (EWS: May - June), Main Wet Season 2017 (MWS: July - September) and Late Wet Season 2017 (LWS: October - November) in the provinces of Battambang and Banteay Meanchey. The tested direct planters include Cambodian-invented Eli air seeder (a), Cambodian modelled Drum seeder (b), manual Drum seeder (c) and Vietnamese Drum seeder (d), which are ideal for wet seeding small to medium farm sizes. While the 4WD Thai kid seeder (f) is suitable for dry seeding in small, medium and large scale farms that will be reported in the next newsletter.

Field activity updates

Battambang - Svay Cheat (EWS): Seed Production

Comparing traditional transplanting with mechanised Drum (b) and Eli seeder (a) under wet-seeded conditions with regard to agronomic and economic considerations was the main objective of the seed production experiment. The trial was planted on 28 June and harvested on 10 November 2017. The rice variety used was Phka Rumduol (fragrant rice). The smmarised results are presented in the table below.

Treatment	Row-spacing (cm)	Target seeding rate (kg/ha)	Actual Seeding rate (kg/ha)	Yield (t/ha)
Drum seeder (high)	20	80	54	5.1
Drum seeder (20/45 cm)	20/45	40	40	4.6
Eli air seeder (20/45 cm)	20/45	40	53	4.6
Eli air seeder (low)	25	40	40	3.2
Eli air seeder (high)	25	80	81	3.9
Transplanting 2-3 seedlings/hill	20/45	31	31	4.8
Transplanting 3-4 seedlings/hill (farmer practice)	25	56	56	4.8

There was no significant difference for net benefit ($/ha) between drum seeder at 80 kg/ha, drum seeder at 40 kg/ha and Eli seeder at 40 kg/ha compared to transplanting.

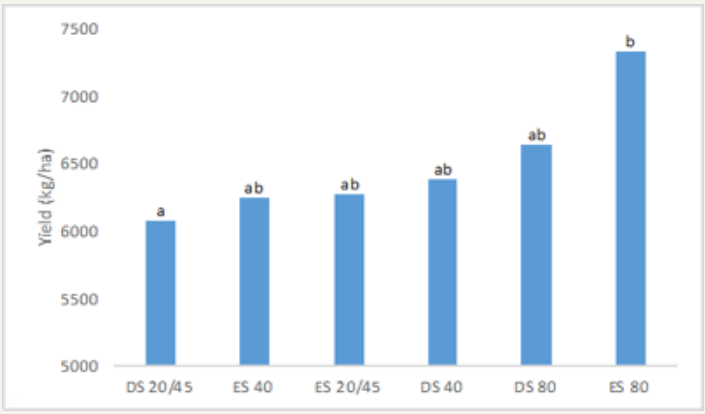
Although machine planting reduced the cost of planting from $200/ha to $29/ha, the cost of registered seed ($1/kg) reduced the advantage of the DS 80 treatment.

There was no economic advantage of replacing transplanting with machine planting for production of certified seed. However, labour shortage might be a factor to consider if there is insufficient labour for transplanting. The farmer, however, is strongly in favour of using either the drum or Eli seeders to replace transplanting.

Battambang - Don Bosco (MWS): Paddy Production

This trial was to test and demonstrate the mechanised Drum (b) and Eli air seeder (a) as alternatives to hand-broadcasting for wet-seeded rice. The variety Chul'sa was planted on 5th July 2017 and harvested on 18th October 2017. The table below and figure summarise the results.

Treatment	Row spacing (cm)	Target seeding rate (kg/ha)	Actual seeding rate (kg/ha)	Yield (kg/ha)
Drum seeder (high)	20	80	65	6.7
Drum seeder (low)	20	40	62	6.6
Drum seeder	20/45	40	41	6.4
Eli air seeder	20/45	40	60	6.4
Eli air seeder (low)	25	40	56	6.6
Eli air seeder (high)	25	80	73	7.0



Higher yields were obtained with the Eli seeder, and the 80 kg/ha seeding rate yielded more compared to 40 kg/ha. Alternating row spacing of 20/45 cm at 40 kg/ha resulted in lower yields compared to regular row spacing at 80 kg/ha.

In future, harvest date for treatments 40 kg/ha and 20 x 45 cm may need to be delayed due to delayed maturity for these treatments. The results were not conclusive and further trials are required to determine the optimum seeding rate for drum and Eli seeders.

Banteay Meanchey - Kouk tonlaop (MWS): Paddy Production

This trial demonstrated the mechanised Drum and Eli air seeder as alternatives to hand-broadcasting for wet-seeded rice at Kuok Tonlaop village, Banteay Meanchey province. Variety Sen Kra Ob was planted on 10th July 2017, and sample yields were harvested on 13th October 2017. Summarised results are presented in tables below.

Description	Target Seed rates	Seed rate (kg/ha)	Sample yield (t/ha)	Plot yields* (t/ha)
Eli air seeder	50	50	6.6	5.6
Mechanised Drum	50	53	6.9	6.5
Manual Drum	20	18	8.0	7.3
Hand broadcasting	FP	178	5.6	5.7

**Plot yields are based on machine harvested whole plot yields (data received 9 Dec 17).*

Treatment	Yield* (kg/ha)	Income (US$/ha)	Production cost (US$/ha)	Gross margin (US$/ha)	Return on investment (US$)
Eli Seeder	6,600[b]	1,980	395	1,585	4.0
Mechanized Drum	6,900[b]	2,070	399	1,671	4.2
Manual Drum	8,000[a]	2,400	365	2,035	5.6
Farmer practice	5,554[c]	1,662	509	1,153	2.3

**Yield figures followed by the same letter are not significantly different at P<0.05.*

The Kuok Tonlaop site is a very fertile Kampong Siem soil (vertosol) with good water control, and this allowed the 18 kg/ha manual drum seeder treatment with precision planting to achieve the highest sampled yield of 8 t/ha (7.3 t/ha plot yield). The production cost under farmer practice was much higher compared with other treatments.

Battambang - Svay Cheat (MWS): Paddy Production

This trial was planted on 14th September 2017 with the main objective to compare the drum and Eli seeders with hand broadcasting for paddy production. The variety used in this experiment was Sen Kra Oub. The results were:

Treatment	Plants per m^2	Panicles per m^2	Grains per panicle	1000 grain weight	Yield (t/ha)
Drum seeder 40	195	268	56	20	2.90
Drum seeder 80	264	259	74	19	3.14
Eli seeder 40	211	231	77	19	3.23
Eli seeder 80	252	238	80	19	3.59
Broadcast 80 (-blast)	253	240	86	19	3.72
Broadcast 80 (+blast)	244	233	85	19	3.23

The average paddy yield was 3.3 t/ha. The highest yield was obtained from the treatment where fungicide was applied, and this treatment yielded significantly more (0.5 t/ha) than the broadcast treatment with no fungicide. The extra yield was worth $250/ha at a price of $500/t (graded seed). It was, therefore, very economically beneficial to apply fungicide to control blast.

Upcoming updates ...

Upcoming updates on fieldwork research in the next newsletter will be covering:

- Demonstration of Vietnamese designed Drum seeder tested on a farmer field in Kuok Tonloap village, Banteay Meanchey, planted in the Main Wet Season 2017.
- Demonstration of Vietnamese Drum seeder tested on a large rice farmer field in Daksasa village, Battambang, planted in the Late Wet Season 2017.
- Experiment on mungbean variety evaluation for diversification, planted in the Dry Season 2018 in Don Bosco research station, Battambang.
- Watermelon variety experiment and watermelon production demo planted in the Dry Season for diversification with rice.
- Experiments and demos for paddy production planted by 4-WD Thai kid planter in 2018.

STUDENT PROJECT UPDATES

" Good agronomic strategies, panacea for a sustainable rice production in northwest Cambodia."

Name: Chinaza Beatrice Onwuchekwa-Henry
Institution: The University of Sydney
Degree: Doctor of Philosophy
Principle Supervisor: A/Prof Daniel Tan
Co-supervisors: Dr Floris Van Ogtrop and Dr Bob Martin

The use of remote sensing for rice phenotyping is a current trend in research, providing both spatial and temporal information that depict the ecosystem dynamics in a changing environment. A good agronomic option is one of the key factors required to enhance food security, mainly where poor agronomic practices are prevalent. Seed broadcasting, weeds, low fertilizer input and wrong fertilizer timing are the major agronomic problems identified in northwest Cambodia that contribute to low rice yields. Hence, this research will use some spectral reflectance technologies to monitor rice growth, biomass and guide our decisions on fertilizer applications and as well collect information required for sustainable rice production.

Through this novel approach, I aim to achieve the following:

- Identify good agronomic traits for rice phenotyping in the field;
- Develop new agronomic options that farmers can easily adopt such as optimum seeding rates, time of fertilizer application and the amount required;
- Establish and validate data for monitoring ecosystem dynamics in rice fields;
- Develop a policy document for the Cambodian government to promote the best agronomic package for lowland rice farming systems; and
- Increase food security in northwest Cambodia.

" Developing an integrated understanding of the insect pest, predator and farm management networks that influence Cambodian rice production."

Name: Lucinda Dunn
Institution: The University of Sydney
Degree: Doctor of Philosophy
Principle Supervisor: A/Prof Daniel Tan
Co-supervisors: Dr Tanya Latty and Dr Mark Stevens

Production of rice, Cambodia's most economically important staple crop, is being significantly hindered by insect pest damage and the ineffective management of these pests. Currently, farmers are relying solely on chemical insecticides to control pests, with most farmers being unaware of alternative or integrated pest control methods. This highlights the necessity for further in-depth research into insect pests and their management. The paucity of research lies within an absence of insight into the diversity and abundance of insect pests and predators within the rice agroecosystems in Cambodia, and how current farmer perceptions and their management approaches are affecting rice and ecosystem productivity.

My research will investigate the socio-ecological networks that makeup and influence rice production in Cambodia. I will study the social aspects by surveying over 100 smallholder rice farmers on their knowledge, attitudes and practices regarding insect pests, predators, insecticide use and farm management. These survey results will be linked to my fieldwork where I have currently benchmarked 17 farmer rice fields in the early wet season for abundance and diversity of insects (pests, predators, parasitoids) within the fields and on the bunds. I endeavour to develop an understanding of the whole rice agroecosystem network which can be used to develop a balanced and sustainable integrated pest management regime for smallholder rice farmers in Cambodia.

STUDENT PROJECT UPDATES

Achieving Sustainable Intensification of Rice Production in Northwest Cambodia, Using Alternatives to Toxic Fungicides

Name: Daniel Howell
Institution: The University of Sydney
Degree: Bachelor of Science (Honours) in Biology
Supervisors: A/Prof Rosanne Quinnell, A/Prof Daniel Tan and Dr Bob Martin

Rice blast, a pathogenic fungus, significantly hinders rice productivity by reducing the yield and quality of crops. It is critical to devise sustainable and non-toxic practices to manage rice blast in Northwest Cambodia, in line with the recent country-wide ban of the fungicide Tricyclazole. Silica has been shown, in independent glasshouse and field experiments, to reduce the severity of blast.

My project involves a glasshouse experiment in Sydney in parallel with a field trial in Cambodia to assess the efficacy of applying rice husk ash (RHA, 0 - 4000 kg/ha), a silica-rich by-product of rice production, to reduce blast severity. The amount of RHA required in the greenhouse environment to provide the equivalent of field applications ranging from 0- 4000 kg/ha has been determined and will be used in trials to measure uptake of silicon by potted rice seedlings. The potential for using RHA to control blast will be measured in the field by assessing disease severity in rice plants exposed to the same range of RHA treatments. I am currently developing a novel technique for measuring silicon concentration in individual rice leaves in situ using a portable X-ray fluorescence analyser.

Composition of Parasitoid Wasp of insect Pests in Rice (Rice Leaf Folder)

Name: Khem Sokkheng
Institution: University of Battambang
Degree: Master Degree in Sustainable Agriculture
Supervisors: Dr Yorn Try

Rice is the dominant crop in Cambodia's agriculture, with approximately 80% of Cambodian people who are farmers. Cambodian farmers have a lot of experience in rice production, and have developed various rice farming systems; such as rainfall lowland rice, rain fed upland rice, deep water rice and irrigated dry season rice.

Two major factors affecting rice production are adverse weather (floods, drought, typhoons, etc.) and pest epidemics. The major insect pests that cause significant yield losses are rice leaf folders, rice bugs, leafhoppers and plant hoppers, which cause direct damage as well as transmit viruses, stem borers, and a group of defoliator species. To control rice insect pests, Cambodian farmers have traditionally applied only chemical methods which killed not only insect pests but also their natural enemies; this results in secondary pests becoming key insect pests, insecticide residue in the product, and lost ecological balance in the rice field.

To reduce insecticide application, it is crucial to employ biological controlling method. The basis of biological control is the understanding of natural enemies of insect pests. Egg parasite wasp species are known to play an important role in suppressing insect pest populations in rice ecosystems. Therefore, a study to determine egg parasite wasp composition is very important for building and starting biological control for rice. My study aims to identify the number of parasitic wasp eggs and determine the most important species in supporting biological control. One of the expectations from this study is to be able to ecognise the most important egg parasitoids species that can support the applied biocontrol in the rice plant.

GENDER ANALYSIS IN RICE SECTOR

CamSID and Voluntary Service Overseas (VSO) are strengthening their technical and financial collaboration by planning a joint gender analysis before forming women's consultative groups for the CamSID project. Preliminary key informant interviews were conducted with eleven key stakeholders in the rice sector by the joint team to provide a basis for more in-depth research. A joint gender analysis on gender roles in the rice value chain will be conducted with 4 agricultural cooperatives (Angsang Sok, Svay Cheat, Prey Totoeng and an SRP village) in Battambang by the team in August/Sept 2018.

In general, Cambodian society and its agriculture sector are highly gendered. The strong gender roles and norms relegate women to household activities while men are involved in more income generating activities outside the household. In the agricultural sector, the rice value chain is perceived as male dominated. The activities that women carry out in the sector are perceived as 'minor' and 'supporting'.

However, the understanding of women's role and contribution in the rice sector as well as the knowledge of the constraints preventing women from fully participating in the rice sector is weak. This lack of or weak knowledge partly leads to gender blind services provided by agricultural extension workers that sometimes can contribute to strengthen gender norms and roles. The proposed joint gender analysis aims at filling this knowledge gap.

The analysis will be conducted to get a better understanding of women's and men's role in the rice sector while exploring the key constraints/challenges women farmers face in participating in the sector. By identifying the reasons underlying a weak participation of women, the analysis aims at identifying recommendation and sustainable solutions for recognizing and/or increasing women's participation in the rice sector. The identified solutions will provide the IMA4P/CamSID staff with concrete guidelines, tools and approaches to integrate the findings of the analysis in the projects.

Agricultural Cooperatives (AC) will be identified as a key entry points to make IMA4P/CamSID work more social inclusive and gender sensitive.

Before conducting the gender analysis on the field, there was a need to first build the capacity of on-ground staff in both projects for producing qualitative gender-focused research. In order to increase capacity, a specialised workshop was held over two days in July.

Around 15 participants, from CamSID, VSO-IMA4P (Improving Market Access for the Poor), University of Battambang, and the Provincial Department of Women's Affairs (PDWA), based in Battambang, took part in the workshop. Indeed, the workshop provided the 2 organizations with the opportunity to get involved in a preliminary discussion with PDWA for future possible collaboration, in particular for gender related trainings and awareness activities with the communities.

Flavia Ciribello, VSO gender and social inclusion specialist presented the first half of the workshop on day 1. She focused on gender as a cultural product, gender roles and expectations, and gendered understandings of work in farming households. Participants were asked to reflect on gendered bias in their own lives and completed group tasks to discuss the expected roles of men and women in Cambodian society.

Rebecca Cross, CamSID human geographer/social researcher then presented the second half of day 1 by introducing quantitative and qualitative research methodologies, interview and focus group design, and ways to produce qualitative research with a specific focus on gender. Participants were asked to reflect on the benefits of different research methods, design research questions and participate in a photovoice activity.

On the second day, participants shared their photovoice images with each other to discuss personal/everyday understandings of gender in their lives.

They were then presented with the outline of the different gender analysis activities planned for the August/September research trip. These include:

- Creating a safe space for talking as a focus group plus an ice-breaker activity
- Value chain mapping of gender roles in rice production
- Focus group discussion on the capacity and functioning of the AC from different gendered perspectives and member/non-member perspectives.

Participant groups were asked to design the execution of these activities and conducted a role play with the rest of the participants to practice/demonstrate how they would best introduce the activity to the AC focus group and generate discussion and results. The team also discussed the logistics and finalised aspects of sampling and planning for the August/September gender analysis.

PLAN FOR FARMER HUB DEVELOPMENT & QUALITY SEED PRODUCTION

Syngenta Foundation for Sustainable Agriculture (SFSA) is focusing on two key projects: "farmer hub development and quality rice seed production". In 2017, DX Cuong together with CamSID team conducted conclusive field trials on seeding rate and Clive Murray engaged discussions with Ockenden to establish a seed production platform in North East Cambodia. After the CamSID annual review in February 2018, Syngenta Foundation proposed to support the establishment of a rice seed production platform for small-holders in collaboration with Ockenden and Syngenta Seeds. The main objective is to increase rice seed yield and quality in the fields while establishing a seed processing pilot line. The SFSA also proposed to share its experience in establishing farmer hubs in Cambodia by leveraging its network in Bangladesh.

The Syngenta Foundation has developed commercially viable business models to facilitate access to a range of agricultural services from production to market, including input and output 'hubs'. Machinery rental options form a part of these business models. Greater mechanization enables farmers to raise productivity, reduces drudgery, and frees up time for additional off-farm employment. The services also cover training on agronomy and compliance with the quality standards required for access to more lucrative markets, input buying and output sales. The hub farmer model is based on empowering rural entrepreneurs to fulfill the needs of the farming community.

At the CamSID Workshop held at MCU on 7-8 June 2018, a roadmap/research plan has been designed to get community engagement to evaluate the Farmer Hub concept. This will be done in a number of villages having different attributes, as a means of stimulating adoption of locally-tailored intensification and diversification innovations, within the existing value chain and community network.

CONTACT INFORMATION

For more information, please contact

EDITOR

Dr Van Touch
Postdoctoral Fellow
University of Sydney
E: van.touch@sydney.edu.au

ACTIVE CONTRIBUTORS

A/Professor Daniel Tan
Project Leader
University of Sydney
E: daniel.tan@sydney.edu.au

Dr Rebecca Cross
Postdoctoral Fellow
University of Sydney
E: r.cross@sydney.edu.au

Dr Bob Martin
Senior Research Fellow - Battambang
University of Sydney
E: bob.martin@sydney.edu.au

Dr Yorn Try
Project Coordinator - Banteay Meanchey
Meanchey University
E: yorntry@yahoo.com

Mr Thieblemont Herve
Regional Seed Business Development Lead
Syngenta Foundation for Sustanable Agriculture
E: herve.thieblemont@syngenta.com

THE UNIVERSITY OF SYDNEY