Annual report

project
Developing cassava production and marketing systems to enhance smallholder livelihoods in Cambodia and Laos

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July 2016 – June 2017

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1 Progress summary

The overall aim of the project “Developing cassava production and marketing systems to enhance smallholder livelihoods in Cambodia and Laos” is to identify the socio-economic conditions under which improved technology and market booms in commercial crops such as cassava can be harnessed to increase the profitability and sustainability of smallholder farming systems in Mainland Southeast Asia and thereby contribute to poverty reduction.

The project officially began on 1st January 2016, but a project variation was required in order to postpone the inclusion of Myanmar, and as such financial resources could not reach partners until March-April. However, partners were able to pre-finance several activities to minimise slippage in the timeline. During the first 6 months of the project activities were mostly at progressing Objective 1.

Project activities from July 2016 to June 2017 have covered all three objectives, but with a greater concentration on progressing Objective 1: Assess the current production, marketing, and institutional arrangements for cassava in major agro-economic zones and value chains in Laos and Cambodia and Objective 2: Increase the adoption of improved cassava production, resource management, and post-harvest practices by strengthening linkages between farmers and research, extension, and industry actors.

The regional cassava market has continued to experience significant price declines resulting from the reductions in maize price supports in China in early 2016. During 2016 farm-gate prices fell significantly in Cambodia and Laos, although the value of cassava exported remained well above all previous years, indicating the large area expansion in the crop year.

During 2017, farm-gate prices in both Cambodia and Laos continued to decline with prices reflecting developments in the regional markets in Thailand and Vietnam. The regional cassava market has continued to experience price declines with a major driver being the reductions in maize price supports in China in March 2016. During 2016, root prices fell significantly in the neighbouring markets of Thailand and Vietnam where a large percentage of roots and dry chips are destined before export to final destinations. Despite the correction in prices, export of starch from Vietnam remain at all-time high levels reflecting the growing demand. A large percentage of cassava from Cambodia’s eastern Provinces are exported into Tay Ninh as fresh roots for processing. Alternatively, the demand for cassava chips has fallen significantly as China deals with huge maize stocks. This has particularly impacted the western Provinces of Cambodia and Bolikhamsay in Lao PDR.

Official Vietnamese imports from Cambodia and Laos have continued to increase. Thailand’s imports from Laos have also increase however Thai imports from Cambodia have declined relative to the same period in 2016 (see Appendix 1 for more details).

In Lao PDR, local value chain assessment was undertaken in Xayabouli during October 2016. This assessment included farmer focus groups and semi-structured interviews with value chain actors in Kenthao and Paklai Districts. The value chain assessments undertaken in Bolikhamsay, Xayabouly and Kratie have shown a large variation in production systems and household livelihoods within and between the sites. New starch factories have been built recently in Lao PDR, however they have strong competition for feedstock from the dry chip market. Working capital is a problem throughout the value chain in both countries, resulting in delay in payments, with farmers often opting for value chains with quicker payment. The production of cassava in Kratie is completely dependent on export to Vietnam, either into Tay Ninh or Bình Phước Provinces. Farmers tend to sell fresh roots to traders, unless they are more remote, in which case transporting chips is considered more viable.
In all sites farmers report declining cassava yields and very limited adoption of soil fertility and soil conservation management practices. Preliminary analysis of the household survey data shows almost 100% of household do not use any inorganic fertiliser. There have been several new pests and diseases occurring in the past few years, which farmers also reported as having a negative impact on yields. Market fluctuations, including intra-day fluctuations in Cambodia, were identified as a problem that creates an uncertain investment environment.

Baseline household surveys to determine current farm-household types, livelihood activities, production practices, market linkages, decision-making, and constraints to adoption of improved practices have been developed in conjunction with partners in Laos and Cambodia. Surveys have been translated into Lao and Khmer and loaded onto electronic tablets running the Commcare app. Training on the household survey and the use of electronic tablets for surveys was undertaken for the Laos survey team in Vientiane in April 2017. Household surveys were completed in Bolikharn and Viengthong districts of Bolikhamsay in May-June 2017, with a total of 180 surveys undertaken for the province. Surveys were undertaken in Xayabouly in July 2017 with total of 180 surveys. Household survey training and pre-testing will be undertaken in Cambodia in late July 2017, with surveys planned to be carried out in Kratie in August.

Variety, fertiliser and intercropping trials have been planted in Kratie, variety and fertilizer trials have been planted in Bolikhamsay, and variety, fertiliser and intercropping trials have been planted in Xayabouly. The trials were planted in April-May 2017 and are expected to be harvested in February-March 2017. The results of these trials will form the basis of economic analysis and participatory evaluations with farmers.

The project has had strong engagement with provincial governments in Xayabouly and Bolikhamsay in Laos, and Kratie in Cambodia. Private sector actors have been involved in the agronomic training activities and participated in value chain assessments in all sites. The value chain assessments have shown that some private sector actors have strong incentives to collaborate with the project and are indicate a willingness to provide some in-kind support. However, the opportunities, threats, and sustainability of different levels of engagement require further analysis over the next year. Some actors were seen as too high risk for activities in 2017-18 season due to high levels of debt and likelihood of not being able to pay farmers in the near future.
2 Achievement against activities and outputs/milestones

The project has made significant progress in some areas that are documented here, although not yet fully reported.

*Objective 1: Assess the current production, marketing, and institutional arrangements for cassava in major agroeconomic zones and value chains in Laos and Cambodia.*

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<th>No.</th>
<th>Activity</th>
<th>Outputs/ milestones</th>
<th>Due date of output/milestone</th>
<th>Applications of outputs</th>
<th>Comment</th>
</tr>
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<tbody>
<tr>
<td>1.1</td>
<td>Review information on global and national cassava production, utilisation, trade, and policies.</td>
<td>Review report</td>
<td>Annually</td>
<td>Analysis of market and policy environment (including risks) of smallholder cassava production at the regional and global scale, including implications for local project activities.</td>
<td>Database maintained. ACIAR blog/Facebook updates Presentations: -World Roots and Tuber congress (China) -Starch World (HCMC) -CIAT Cassava Retreat (Hanoi) -AMC (Mandalay) -ASEM meetings (Vientiane, Phnom Penh)</td>
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<td>1.2</td>
<td>Conduct value chain analyses in case study areas (primary and supporting actors, local policy environment).</td>
<td>Value chain reports</td>
<td>February 2017</td>
<td>(1) Assess current production and marketing systems for cassava in different value chains. (2) Provide baseline data for project evaluation. (3) Spatial analysis of product and information flow for selection of villages in Activity 1.3. (4) Identify and recruit participants for activities under Objective 2.</td>
<td>Value chain assessment was undertaken in Xayabouli during October 2016. This assessment included farmer focus groups and semi-structured interviews with value chain actors in Kenthao and Paklai districts. Assessments in Bolikhamsai (Lao PDR) and Kratie (Cambodia) reported in last report.</td>
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</table>
1.3 Conduct key informant and group interviews in case study areas to ascertain socio-economic relations affecting access to and collective management of farm resources and access to input and output markets. Socio-economic analysis reports April 2017  (1) Assess current production and marketing systems in different household types and value chains, including varieties, planting material, soil and nutrient management, intercropping, labour utilisation (including gender division), post-harvest practices, and constraints to adoption of improved technologies. (2) Provide baseline data for project evaluation. Farmer focus groups were conducted in Xayabouly in conjunction with the value chain assessment.

1.4 Conduct household surveys in case study areas to determine current farm-household types, livelihood activities, production practices, market linkages, decision-making, and constraints to adoption of improved practices. Household survey reports July 2017 Household surveys were completed in Bolikhan and Viengthong districts of Bolikhamsay in May-June 2017, with a total of 180 surveys undertaken for the province. Surveys complete in Xayabouly Province in July 2017. With 180 surveys complete. 30 surveys were complete in each of the 12 villages.

1.1 Review information on global and national cassava production, utilisation, trade, and policies

The project has been monitoring developments in the global/regional cassava market and communicating the information to stakeholders. Analysis was presented in a number of workshops, conferences, and blogs via social media. A small example of the current key information is contained in Appendix 1. A database has been created to monitor price and trade flows utilising published data, online national databases, and industry contacts. The project is currently considering options to crowd source local price information and provide that information back to farmers and policy makers. However, price series data is more difficult to construct in Laos and Cambodia relative to Vietnam and Thailand.

In summary, the regional cassava market experience significant price declines driven largely by the reductions in maize price supports in China in March 2016. During 2016 root prices fell significantly in Vietnam and Thailand and given the majority of roots and chips from Laos and Cambodia are exported into these countries the price of roots largely reflect the Thai or Vietnam price minus the freight and logistic costs. Household surveys in Laos revealed that farmers remain optimistic that the price will return to higher levels for the 2017-18 harvest, with little appreciation of what has caused the price decline. Having said that, many farmers indicate a low threshold price where they would switch to another crop due to limited other know options.

Despite the correction in prices, export of starch from Vietnam remain at all-time high levels, reflecting the growing global demand. On the otherhand, the demand for cassava chips has fallen significantly as China seeks to deal with huge maize stocks. This means that there will be pressure of starch processors in Thailand and Vietnam to utilise more of the domestic supply and pressure of governments to develop protect for domestic producers.
1.2 Conduct value chain analyses in case study areas

Participants in the value chain training in Vientiane in May 2016 learned basic principles of value chain analysis and conducted a preliminary value chain mapping exercise. This formed the foundation for site selection of key production and value chains for more detailed analysis in the field.

Members from NAFRI Policy Research Centre and Agricultural Research Centre and representatives of PAFO and DAFO conducted value chain analyses in Kenthao and Paklai districts in Sayabouly. The team from NAFRI worked independent from the UQ-CIAT team after the completion of activities in Bolikhamxai in last reporting year. Information was gathered from value chain actors through face-to-face interviews using a standardized questionnaire. Value chain actors interviewed included large and medium scale starch and dried chip processors, small-scale collectors and assemblers, medium scale traders and larger scale traders and brokers.

The questionnaire covered both value chain and technical aspects including the following topic areas:

- Purchasing
- Sales
- Cost Structure
- Access to and provision of credit
- Access to information and training
- Cassava Varieties
- Fertilizer use
- Land Preparation
- Soil Conservation
- Pest and Disease Management
- Weed control

1.3 Conduct key informant and group interviews in case study areas

In conjunction with the value chain analyses, focus group discussions were conducted with small (10-15) groups of farmers. Some activities were conducted as a single group, others in mixed gender groups, and some by gender groups.

The key activities were:

1. Key village information (village chief and committee)
2. Listing of all livelihood activities (agricultural, non-farm, off-farm, migration)
3. Ranking of relative importance of activities for food security, cash income, labour utilisation (smaller groups by gender)
4. History of cassava production and marketing in the village and other key events
5. Seasonal calendars (smaller mixed gender groups)
6. Cassava production enterprise budgets (smaller mixed gender groups)
7. Mapping of the cassava value chain (smaller mixed gender groups)
8. Discussion of production and marketing problems (smaller groups by gender)
   - Ranking of these problems
9. Discussion on potential solutions and interventions (smaller groups by gender)
   - Ranking of these solutions
Objective 2: Increase the adoption of improved cassava production, resource management, and post-harvest practices by strengthening linkages between farmers and research, extension, and industry actors.

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<tr>
<th>No.</th>
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<tbody>
<tr>
<td>2.1</td>
<td>Conduct workshops with identified stakeholders in each site to plan, prepare for, and review cooperative activities.</td>
<td>Workshops successfully conducted and reported.</td>
<td>February 2017</td>
<td>Plan of cooperative activities; elements of innovative agribusiness models.</td>
<td>In Feb 2017 a small planning workshop was held in Vientiane with NAFRI, Province and District staff to plan activities and responsibilities. Team planning meeting was held at CARDI in March 2017 to plan activities and develop protocol.</td>
</tr>
<tr>
<td>2.2</td>
<td>Establish on-farm demonstration trials of improved cassava cultivation practices and conduct participatory evaluation of new varieties, fertility management, pest and disease management, intercropping, and post-harvest practices with farmers and other industry stakeholders.</td>
<td>On-farm trials successfully established Evaluation reports prepared</td>
<td>Establish Mar-Apr 2017</td>
<td>Locally adapted technologies tested. Economic analysis to contribute to Activity 2.3.</td>
<td>Variety, fertiliser and intercropping trials have been planted in Kratie, Variety and fertiliser trials have been planted in Bolikhamsay.</td>
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### 2.1 Identification of priorities
The value chain analysis and focus groups have provided some initial ideas from different stakeholder perspectives on the key limiting factors and potential interventions. These were discussed at the annual review and planning meetings to develop the strategy for 2017.

After the value chain assessment, it was decided that while some value chain actors would benefit from increasing productivity it was risk for strong engagement this early in the project due to the current market uncertainties, high level of debt, and weak existing relationships. This is different to the situation in the parallel AGB project. Therefore a stronger partnership with local government and NGOs in being pursued initially with private sector actors invited to participate in training and harvest field days.

### 2.1 Establish on-farm demonstration trials
Variety, fertiliser and intercropping trials have been planted in Kratie, variety and fertilizer trials have been planted in Bolikhamsay, and variety, fertiliser and intercropping trials have been planted in Xayabouly. The trials were planted in April-May 2017 and are expected to be harvested in February-March 2017.
Variety trials in Laos will involve a total of 7 varieties of cassava to be evaluated with cassava collectors and cassava companies:

1. Kasatsad 50 (KU 50)
2. Rayong 9 (R9)
3. Rayong 11 (R11)
4. Rayong 72 (R72)
5. KM 140
6. KM 21-12
7. Local variety

Fertilizer trials in Laos involve a split-plot design with 3 Replications with 6 treatments and 2 varieties. The objective is to study the response of two cassava varieties to the application of various combinations of fertilizers (N, P and K) in order to find the best and most economic fertilizer rate to obtain and maintain high cassava yields. Risk assessment will be conducted and an effort to evaluate different households' attitudes to risk and debt. This includes assessing variations based on ethnicity, gender and age.

Intercropping trials in Laos aim to study the different legume intercrops with cassava to find the best and most economic option for farmers in Xayaboury province. The trial has three replications and four treatments (peanut, mung bean, Yard-long bean, no treatment). During the analysis, a strong emphasis will be on changes in labour utilization by gender and age, as well as production and market risk.

Variety trials in Cambodia aim to evaluate the improved cassava varieties to obtain the best adopted varieties in order to improve cassava production systems in Kratie. Varieties evaluated are:

1. Rayong 72(Thai variety)
2. Huay Bong 60 (Thai variety)
3. KM98-1 (Vietnam variety)
4. KU50 (Thai variety)
5. SC 9 (China variety)
6. SC8 (China variety)
7. Local variety

Fertilizer trials in Cambodia involve a split-plot design with 3 Replications with 7 treatments and 1 variety (KU50). The objective is to study the response of KU50 to the application of various combinations of fertilizers (N, P and K) in order to find the best and most economic fertilizer rate to obtain and maintain high cassava yields.

Intercropping trials in Cambodia aim to study the different legume intercrops with cassava to find the best and most economic option for farmers in Kratie province. The trial is being conducted at two sites and has three replications and four treatments (maize, peanut, mung bean, no treatment).
Objective 3: Develop capacity for farming systems research and policy analysis and promote policy dialogue on the opportunities for industry development and livelihood enhancement through supported smallholder models.

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<tbody>
<tr>
<td>3.1</td>
<td>Review and document local and national policies with regard to smallholder cassava and identify opportunities for scaling up research outcomes.</td>
<td>Review report</td>
<td>February 2017</td>
<td>Options for scaling up technologies and organisational arrangements.</td>
<td>Frequent discussion with stakeholders. Formal report to be drafted</td>
</tr>
<tr>
<td>3.2</td>
<td>Conduct workshops to develop local capacities for on-farm research in cassava, farming systems evaluation, value chain analysis, and evidence-based policy analysis and dialogue.</td>
<td>Training workshops conducted, evaluated, and reported</td>
<td>February 2017</td>
<td>Capacity to implement activities under Objective 2.</td>
<td>Training on household livelihood surveys and use of electronic tablets for gathering information conducted with partners in Vientiane in April 2017. Training to be conducted in Cambodia in late July.</td>
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</table>

3.1 Review of national policies

Laos PDR: Cassava in Lao PDR has become one of the national ‘priority crops’. However, there are very few direct policies supporting this and there is limited experience on the government side regarding the cultivation of the crop. The high profile failure of a starch factory in Vientiane Capital Prefecture has received the attention of MAF. The NAFRI project team has been involved in ongoing research and briefing MAF on problems and potential interventions.

Cambodia: There are several international agencies working on cassava in Cambodia. The largest in a program run by the UNDP. The project team have been involved in these discussions and will continue involvement during the next meeting in July 2017. The aim is to provide evidence to support the development of policies by these larger projects.

3.2 Capacity building of local staff

This activity is reported on in the capacity building section.

3 Project Outcomes and Impacts

With the project only having just started variety and fertiliser trials and not yet harvesting and evaluating the results of those trials, there have been no farm-level outcomes at this stage. However, there have been some preliminary research outcomes and capacity impacts.

3.1 Research Outcomes

The ACIAR blog post has highlighted some of the connections between global policy changes and impacts on smallholder livelihoods.
3.2 Scientific impacts
There have been no significant scientific impacts of the project at this early stage.

3.3 Capacity impacts
A key feature of year one of the project was capacity building of project staff, local government partners, and private sector partners.

Both CARDI and NAFRI have a long history of conducting socio-economic research in rice-based systems. To date there has been very limited research conducted by these institutions of the livelihood and marketing aspects of cassava. The involvement of both technical cassava researchers and social scientists has increased the knowledge of cassava production of the research teams. This is of critical importance for developing ongoing interactions. Some staff from the agronomy related research sections participated in the value chain assessments and focus group discussions.

Training on household livelihood surveys and use of electronic tablets for gathering information conducted with partners in Vientiane in April 2017.

3.4 Community outcomes and impacts
There have been no community-level outcomes or impacts at this stage. However, preliminary analysis has helped to identify various opportunities and risks that will be taken into account in further community-level activities.

3.4.1 Economic impacts
There have been no economic impacts of the project at this stage.

3.4.2 Social impacts
There have been no social impacts of the project at this stage.

3.4.3 Environmental impacts
There have been no significant environment impacts of the project at this stage.

3.4.4 Policy impact
There have been no significant policy impacts of the project at this stage.

3.5 Stakeholder engagement and Communications
The project has made strong efforts to include stakeholders in the initial activities at the District and Provincial levels, as indicated in Section 3.3.
The Facebook group “ACIAR Cassava Value Chain and Livelihoods Program” now has more than 550 members. Members include key national policy makers, national level researchers, Provincial and District staff, private sector actors (processors and traders), and farmers. At the moment the content is in English, but it will provide a useful way to point stakeholders to results as they become available in different languages. Some statistics on the use of the group are in Appendix X. [https://www.facebook.com/groups/1462662477369426/](https://www.facebook.com/groups/1462662477369426/)

The CRP RTB continues to give visibility to the project activities. In CRP II the project will be mapped to Flagship 5 – “Improved Livelihoods at Scale”.

Conference presentations:


Posters:

### 4 Training and capacity building activities

<table>
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<tr>
<th>Date</th>
<th>Capacity Building Type</th>
<th>Location</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>Capacity Building on Household surveys and electronic information gathering</td>
<td>Lao PDR</td>
<td>NAFRI staff</td>
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</table>

*See appendix for full list of participants.

### 5 Intellectual property

NA
6 Amendments to personnel and project activities

In March 2017 the decision was made to not continue trying to include Myanmar in the project as there had been no significant progress towards sign-off by Myanmar partners. This will free up funds to bring Myanmar researchers to Cambodia/Laos for training/capacity building at the discretion of the project leader and team.

Dr Dominic Smith will take over project leadership from Professor Rob Cramb from July 1st 2017. Professor Cramb will continue to be involved in the project over the coming two years as he moves towards retirement from the University of Queensland.

Dr Tin Maung Aye has been replaced as the CIAT agronomist on the project by Dr Imran Malik from 1st May, 2017. Dr Aye will continue to be involved with the project on a consulting basis as required. Any activities in Myanmar in 2017-2018 will be managed on a consulting basis by Dr Aye.
Problems and opportunities

Opportunities

Phanthasin Khanthavong is currently conducting some research funded by the ACIAR LARF program in one of the target districts in Xayabouli Province. The project is supporting this activity with technical advice in the establishment of trials and analysis of data.

There have been some interactions with a private company in Cambodia growing cassava on land not suitable for rubber. The company has a CSR program and is potentially interested in focusing some of this effort on cassava farmers in the surrounding communities. This could include establishing trails and demonstrations, training of NGO staff, and producing clean planting material. The project is exploring the opportunities and risks of this model. Contact has been made with the NGO that was commissioned to develop the CSR program with an open invitation to attend future field days and training events.

A new cassava starch processing factory is being built in Kratie Province, with a chance it will be completed for the processing of the current crop. The company is already looking at providing extension in villages and will provide a new potential private sector partner. It will be interesting to explore farmers’ decisions to sell to the local factory versus the existing market into Vietnam.

The Deputy Head of PDAFF in Kratie was a strong supporter of the program and has been redeployed as the Head of PDAFF in Strung Treng Province. Should funding permit the project may expand some activities into that Province. This will also provide links to the ACIAR Cassava Mosaic Disease SRA that has identified Strung Treng as a key target location.

Some new cassava clones have been delivered to CIAT Asia in Hanoi. It will take at least two seasons for this material to be available in Laos and Cambodia, but we are exploring how to include some evaluations of this genetic material in the ACIAR project. This includes some improved sweet varieties which will be evaluated for agronomic performance and consumer preference. However, it will take several seasons to get the material into farmer’s fields so it will be towards the end of the project.

Problems

The delay in beginning of the project will delay the completion of some activities by a few months.

The change in local government staff can slow the progress of capacity building. The Deputy Director of Kratie PDA who was a strong supporter of the project has recently moved to Stung Treng Province. However, this will create new opportunities for linkages to the new Province as the project progresses.
8 Evaluative Learning

The team has evaluated several options for collecting data on tablets including ODK and CommCare. The project staff are currently discussing with partners the option of using tablets for the household surveys and for value chain actor surveys.

9 Budget

The project has undergone some financial pressure due to the lower Australian dollar. The impact is less pronounced due to slight increase in the budget to allow for a lower exchange rate in the final stages of project development and the moderate increase in the AUD/USD exchange rate over 2017. The project budget assumes an exchange rate of $0.80. The first transfer to partners were made at around $0.72, but by mid 2017, the transfers are expected to be made at around $0.75-$0.76. CIAT staff salaries are in USD making them vulnerable to a depreciating AUD.

Local partners (NAFRI and CARDI) have also received less money than expected due to exchange rate movement. At this early stage the impacts are not significant, but has lead to some reduced sample sizes in household surveys and the decision to focus work in Cambodia on the eastern provinces with the links to the Vietnamese market. With further improvements in the exchange rate, consideration could be given to expanding to Stung Treng province in addition to Kratie province.
Appendix 1: Market Information

Fig 1 – Thai domestic and Export tapioca starch price. Prices fell from around $450USD/t in late 2015 to a low of around $315USD/t in late 2016.

Fig 2 – The price of cassava chips and cassava starch (tapioca)
Fig 3 – Price support for domestic maize in China created additional demand for cassava products from SE Asia as a cheap alternative to the utilisation of domestic maize. The Chinese policy has resulted in significant maize stocks within China. The removal of the price support has seen the price of cassava products fall significant in SE Asia and now more closely reflect the import parity price.

Fig 4 – Weekly maize price (FOB US Gulf, FOB Gulf + Freight to China + VAT, Nearby Futures (DCE) and Cassava Starch Price (FOB Bangkok).
Fig 5 – Impact on root prices. The fresh root price in Thailand drop 70 USD/t in early 2015 to below $50/t. Previous highs shown in this graph were during the mealybug outbreak in Thailand that significantly reduced production before control measures were implemented.

Fig 6 – As the benchmark cassava starch price (FOB Bangkok) fell from over $450 USD/t to a low of $315 USD/t the FOB HCMC price follows closely with little spread between the min and max weekly price. There is significant spread for the DAF prices quote at the Chinese Border (Mong Cai/Lang Son) which is how much of the starch makes its way into southern China. Starch from the southern and central provinces of Vietnam is often shipped to Hai Phong port and then travels overland into China.
Fig 7 – Weekly fresh root prices in Vietnam in 2016 – June 2017. Price in Vietnam vary significantly from the north, central and southeast. Competitions for feedstock between starch producers is high in Tay Ninh pushing up prices, whereas the only competition for feedstock in Sonla is the dry chip market.

Fig 8 – Cassava Fresh root prices in Lampung, Indonesia. Prices at the factory fell to below $40 USD/ton. It is important to remember that farm gate prices are lower and farmers and traders are subject to a ‘refraction’ based on root quality.
Fig 9 – Tapioca versus US corn starch. During the period when the maize market support was influencing cassava price, tapioca starch became relatively expensive compared to maize starch. For applications where the functional properties were less important this created pressure on deep processors producing products such as glucose or sorbitol and then having to compete against corn based products on the world market.

Fig 10 – Cassava root price and ethanol. The high costs of cassava roots and low oil prices put pressure on biofuel manufacturers using cassava as a feedstock. This figure shows the cost of cassava roots used to produce a litre of ethanol (using a conversion of 1ton=160Litres) relative to the price of Ethanol (Nearby Futures CBOT). Many biofuel factories closed due to this problem. The reduction in the price of cassava roots has made biofuel production more viable.
Fig 11 – Value of Vietnam cassava exports and value of exports to China. The Vietnam industry is heavily reliant on the Chinese market for both starch and dried cassava chips.

Fig 12 – Monthly cumulative volume and value of cassava starch exports from Vietnam and Thailand. Despite falling prices, Vietnam cassava exports remain at all-time high levels.
Fig 13 – Monthly cumulative volume and value of cassava chip exports from Vietnam and Thailand. There has been a major decline in the quantity and value of cassava chips exported from Vietnam.
Fig 15 – Monthly cumulative Thai import volume and value of cassava (fresh or dried) from Cambodia and Lao PDR

Fig 16 – Monthly cumulative Vietnam import volume and value of cassava (fresh or dried) from Cambodia and Lao PDR
Appendix 2: LISTS OF PARTICIPANTS IN TRAINING WORKSHOPS

**Table 1.** List of participants at the training on household survey and using electronic tablets for information gathering (Vientiane, 14-16 April 2017)

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<thead>
<tr>
<th>ATTENDEE</th>
<th>GENDER</th>
<th>SECTION</th>
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<tbody>
<tr>
<td>Touyai Hutsady</td>
<td>Female</td>
<td>NAFRI-AFPRC</td>
</tr>
<tr>
<td>Laothao Youbee</td>
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<td>CIAT</td>
</tr>
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<td>Phanthasin Khanthavong</td>
<td>Male</td>
<td>NAFRI - ARC</td>
</tr>
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<td>Female</td>
<td>NAFRI-AFPRC</td>
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<td>Soulieck Kingkeo</td>
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<td>NAFRI-AFPRC</td>
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<td>Vongpaphane Manivong</td>
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<td>NAFRI-AFPRC</td>
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<td>Saythong Oudthachit</td>
<td>Male</td>
<td>NAFRI - ARC</td>
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<tr>
<td>Souksavanh Sengdaheuanghoung</td>
<td>Male</td>
<td>NAFRI-AFPRC</td>
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</tbody>
</table>
Appendix 3: Trial Protocols Lao PDR and Cambodia 2017

Cambodia 2017-18: Cassava Varietal Evaluation Trials

Objective: to evaluate the improved cassava varieties to obtain the best adopted varieties in order to improve cassava production systems in Kratie province of Cambodia.

Location:
Chet Bori district and Snuol district in Kratie province

Varieties:
Total 6 varieties of cassava
Top 6 varieties from cassava varieties from CARDI/CIAT and one local variety

8. Rayong 72 (Thai variety)
9. Huay Bong 60 (Thai variety)
10. KM98-1 (Vietnam variety)
11. KU50 (Thai variety)
12. SC 9 (China variety)
13. SC8 (China variety)
14. Local variety (Farmer using)

Design and Replication:
Full plots of each variety (30 plants/plot) with 3 replications or with 4-5 farmers (no replication)

Plot size: $5 \times 6 \text{ m} = 30 \text{ m}^2$
Effective plot size: $3 \times 4 = 12 \text{ m}^2$

Planting distance:
1.0 x 1.0 m; border rows at 0.5m from plot borders

Planting method:
Vertical: 8-10 cm underground with buds facing up

Stake length:
20 cm

Stake requirements for tested varieties:
$6 \times 5 \times 3 \times 2 = 180 \text{ stakes/test variety (For 2 sites): Total 250 stakes would sufficient.}$

In addition to the tested varieties, we need 196 stakes/site (200 stakes) of a local variety to be planted in border rows of each plot

Fertilization:
Apply 80N, 20P, 80 K fertilizers per ha rate, in holes about 5-8 cm from each stake at planting time as follows:
- Urea (46 % N) 175 kg per ha
- TSP (20% P) 100 kg per ha
- KCl (50%) 160 kg per ha

**Land preparation:**
1-2 plowing or discing

**Weed control:**
2-3 hand weedings at 4-5 weeks, 8-9 weeks and 12-13 weeks after planting

**Harvest:**
10-11 months; pull out 12 plants of test variety, cut of roots, weight fresh roots and fresh tops (stems + leaves + stump)

**Yield:**
Kg of fresh roots x 10/12 = tons/ha

**Treatment (variety)**

A. Rayong 72 (Thai variety)
B. Huay Bong 60 (Thai variety)
C. KM98-1 (Vietnam variety)
D. KU50 (Thai variety)
E. SC 9 (China variety)
F. SC8 (China variety)
G. Local variety
Figure 1. Plot (above) and experimental layout (below) for testing cassava in Kampong Cham, Cambodia in 2004/05.
Cambodia 2017-18: Balanced N-P-K fertilizer trial

Soil fertility management

Cassava yields can be markedly increased by the application of right source and right rate of plant nutrients (fertilizers). Deficiency of particular essential minerals (i.e. N, P, K) reduce both quality and quality of cassava roots. The optimum fertilization rates for specific locations is still lacking as cassava crop response to fertilization depends on individual variety, soil characteristics, climatic conditions and crop management practices. Balanced fertilizer application is one of the most effective ways to increase root yields, and net income and maintain soil fertility.

All fertilizers can be applied at the time of planting or at one month after planting. But to get better fertilizer use efficiency, Urea and KCl fertilizers should be applied 2 times. Split 2 times: half at planting and another half at 8-10 weeks after the second weeding, especially on sandy soils with high rainfall patterns.

Location: 2 sites in Kratie province

Objective: to study the response of two cassava varieties to the application of various combinations of fertilizers (N, P and K) in order to find the best and most economic fertilizer rate to obtain and maintain high cassava yields.

Variety:
Selected improved cassava variety will be used in the experiment

V = KU50

Experimental design and Treatments:

Design: RCBD design with 3 Replications (or 4-5 farmers without replication)

Total treatments: 7

1. Farmers’ practice (no fertilizer application)
2. Farmers’ rate (20-20-15=100kg/ha)
3. Balanced NPK High rate (80 N- 20P – 80 K)
4. Balanced NPK Low rate (40 N- 10P – 40 K)
5. Balanced NPK Low rate (40 N- 10P – 40 K) + Manure (5 t/ha)
6. NP Low rate without K (40 N- 10P – 0 K)

Triple super phosphate will be applied at the time of planting. However urea and KCl will be applied at 30 days after planting.

Planting distance: 1mx 1m (Standard).
Plot size: $5 \times 6 \text{ m} = 30 \text{ m}^2$
Effective plot size: $3 \times 4 = 12 \text{ m}^2$

Weed control:
2-3 hand weeding, as necessary (i.e 4-5 weeks, 8-9 weeks and 12-13 weeks after planting)

Harvest:
10-11 months after planting
At harvest measure yield (t/ha) and starch content of roots in each treatment.
Cambodia 2017-18: Cassava intercropping demonstration trial

Objective: The objective to conduct an intercropping experiment in Cambodia is to reduce the risk of crop failure, to provide diversity of crops, to reduce the weed control and to obtain food or income at different times of the year for smallholder farmers.

Location: 2 sites in Kratie province

Design and Layout of intercropping trial

The experiment design is randomized design with 6 treatments and 3 replications (or 3-4 farmers without replication).

Variety:
Cassava variety (KU 50) and selected improved intercrop varieties will be used in the experiment

Time for planting intercrop: Plant intercrop at the same time of cassava or one week after planting cassava.

Planting distance of cassava:
1 m x 1 m = 10,000 plants/ha (need to adjust)

Treatment
Total treatment 4 (Please check with farmers’ practices?)

1. Cassava stand alone
2. Cassava intercrop with maize (one row of maize between cassava rows; plant to plant 10 cm between maize row)
3. Cassava intercrop with peanut (two rows of peanut between cassava rows; plant to plant 30 cm between peanut row)
4. Cassava intercrop with mungbean (two rows of mungbean between cassava rows; plant to plant 30 cm between mungbean row)

Each plot size: 5 x 6 m = 30 m²

Planting method:
Vertical: 8-10 cm underground with buds facing up

Stake length:
20 cm

Fertilization:
For cassava: apply 80N, 20P, 80 K fertilizers per ha rate, in holes about 5-8 cm from each stake

Land preparation:
1-2 plowing or discing

Weed control:
2-3 hand weedings at 4-5 weeks, 8-9 weeks and 12-13 weeks after planting
Harvest:
10-11 months; pull out 12 plants of test variety, cut of roots, weight fresh roots and fresh tops (stems + leaves + stump)

Yield:
Kg of fresh roots x 10/12 = tons/ha
Lao PDR 2017-18: Cassava Varietal Evaluation Trials

Objective: to evaluate the improved cassava varieties to obtain the best adopted varieties in order to improve cassava production systems in Xayaboury and Borlikhamxay provinces of Lao PDR.

Location: Xayaboury province and Borlikhamxay province

Varieties: Total 7 varieties of cassava will be evaluated with the cassava collectors and cassava companies

Top 6 varieties from cassava varieties from NAFRI and one local variety

15. Kasatsad 50 (KU 50)
16. Rayong 9 (R9)
17. Rayong 11 (R11)
18. Rayong 72 (R72)
19. KM 140
20. KM 21-12
21. Local variety

Design and Replication: Full plots of each variety (30 plants/plot) with 3 replications

Plot size: 5 x 6 m = 30 m²
Effective plot size: 3 x 4 = 12 m²
Replication: 30 x 7 m = 210 m²

Planting distance: 1.0 x 1.0 m; border rows at 0.5m from plot borders

Planting method: Vertical: 8-10 cm underground with buds facing up

Stake length: 20 cm

Stake requirements for tested varieties:
6 x 5 x 3 x 4 = 360 stakes/test variety (For 4 sites): Total 450 stakes would sufficient.

In addition to the tested varieties, we need 196 stakes/site (200 stakes) of a local variety to be planted in border rows of each plot

Fertilization:
Apply 80N, 20P, 80 K fertilizers per ha rate, in holes about 5-8 cm from each stake as follows:
- Urea (46 % N) 175 kg per ha (Split 2 times: half at planting and another half at 8-10 weeks after the second weeding)
- TSP (20% P) 100 kg per ha (apply at planting)
- KCl (50%) 160 kg per ha (Split 2 times: half at planting and another half at 8-10 weeks after the second weeding)

Land preparation: 1-2 plowing or discing

Weed control: 2-3 hand weedings at 4-5 weeks, 8-9 weeks and 12-13 weeks after planting

Harvest: at 10-11 months; pull out 12 plants of test variety, cut of roots, weigh fresh roots and fresh tops (stems + leaves + stump)

Yield: kg of fresh roots x \[\frac{10}{12}\] = tons/ha

Treatment (variety)
A. Kasatsad 50 (KU 50)
B. Rayong 9 (R9)  
C. Rayong 11 (R11)  
D. Rayong 72 (R72)  
E. KM 140  
F. KM 21-12  
G. Local variety

Lao PDR 2017-18: Balanced N-P-K fertilizer trial

Soil fertility management

Cassava yields can be markedly increased by the application of right source and right rate of plant nutrients (fertilizers). Deficiency of particular essential minerals (i.e. N, P, K) reduce both quality and quality of cassava roots. The optimum (ที่เหมาะสมที่สุด) fertilization rates for specific locations is still lacking as cassava crop response to fertilization depends on individual variety, soil
characteristics, climatic conditions and crop management practices. Balanced fertilizer application is one of the most effective ways to increase root yields, and net income and maintain soil fertility.

All fertilizers can be applied at the time of planting or at one month after planting. But to get better fertilizer use efficiency, Urea and KCl fertilizers should be applied 2 times. Split 2 times: half at planting and another half at 8-10 weeks after the second weeding, especially on sandy soils with high rainfall patterns.

**Location:** 2 sites in Xayaboury province and 2 sites in Borlikhamxay province

**Objective:** to study the response of two cassava varieties to the application of various combinations of fertilizers (N, P and K) in order to find the best and most economic fertilizer rate to obtain and maintain high cassava yields.

**Variety:**
Two improved cassava varieties will be used in the experiment

\[ V1 = \text{KU50} \quad V2 = \text{Rayong 72 (R72)} \]

**Experimental design and Treatments:**

**Design:** Split-plot design with 3 Replications (fertilizers in main plots, varieties in subplots).

**Total treatments:** 6 (New Update information)

**Design 1:**
1. No application (control)
2. Balance fertilizer available in local market (15-15-15) at 80N-80P₂O₅-80K₂Okg/ha
3. Balance fertilizer same cost with available fertilizer in local market (80N-20P-97K)
4. Balanced NPK high rate (80 N-20P-80K)
5. Balanced NPK low rate (40N-10P-40K) + Manure (5 t/ha)
6. NP low rate without K (40N-10P-0K)

*Note: Treatment 3 and 4 very similar (Unnecessary)*

**Design 2:**
1. No application (control)
2. Fertilizer available in local market (15-15-15) at 80N-80P₂O₅-80K₂Okg/ha
3. Balanced NPK high rate with available fertilizer in local market (80 N-20P-80K)
4. Balance NPK meddle rate (60N-15P-60K)
5. Balanced NPK low rate (40N-10P-40K)
6. Balanced NPK low rate (40N-10P-40K) + Manure (5 t/ha)

*Note: Design 2 does not have “NP low rate without K (40N-10P-0K)“. We can compare treatment 2 and 3 because similar costs.*

**Similar Design 2 (changing high rate NPK to meddle rate)**
1. No application (control)
2. Fertilizer available in local market (15-15-15) at 60N-60P₂O₅-60K₂Okg/ha
3. Balance NPK meddle rate same cost with available fertilizer in local market (60N-15P-60K)
4. Balanced NPK high rate (80 N-20P-80K)
5. Balanced NPK low rate (40N-10P-40K)
6. Balanced NPK low rate (40N-10P-40K) + Manure (5 t/ha)

**Design 3:**
1. No application (control)
2. Fertilizer available in local market (15-15-15) at 60N-60P₂O₅-60K₂O kg/ha
3. Balance NPK meddle rate same cost with available fertilizer in local market (60N-15P-60K)
4. Balanced NPK high rate (80 N-20P-80K)
5. Balanced NPK low rate (40N-10P-40K) + Manure (5 t/ha)
6. NP low rate without K (40N-10P-0K)

*Note: Design 2 does not have “NPK (40N-10P-40K) low rate without Manure”.*

**Design 4:**
1. No application (control)
2. NP low rate without K (40N-10P-0K)
3. Balanced NPK low rate (40N-10P-40K)
4. Balanced NPK low rate (40N-10P-40K) + Manure (5 t/ha)
5. Fertilizer available in local market (15-15-15) at 60N-60P₂O₅-60K₂O kg/ha
6. Balance NPK meddle rate same cost with available fertilizer in local market (60N-15P-60K)

*Note: Design 4 does not have high rate NPK.*

**Design 5**
1. No application (control)
2. NP low rate without K (40N-10P-0K)
3. Balanced NPK low rate (40N-10P-40K)
4. Balanced NPK low rate (40N-10P-40K) + Manure (5 t/ha)
5. Fertilizer available in local market (15-15-15) at 40N-40P₂O₅-40K₂O kg/ha
6. Manure (5 t/ha).

*Note: All treatments the same rate (low rate), no K value, with K value, with K and manure and only manure.*

Triple super phosphate will be applied at the time of planting. However urea and KCl will be applied at 30 days after planting.

**Planting distance:** 80cm x 90cm (Farmers’ practice) or 1mx 1m (Standard).
**Effective plot size (subplot):**  
3.6 x 2.4 = 8.64 = 12 plants

**Planting distance:** 80 x 90 cm = 13,889 plants/ha (need to adjust)

**Weed control:** 2-3 hand weeding, as necessary (i.e 4-5 weeks, 8-9 weeks and 12-13 weeks after planting)

**Harvest:** at 10-11 months after planting  
At harvest measure yield (t/ha) and starch content of roots in each treatment.
Lao PDR 2017-18: Intercropping demonstration trials

Traditionally many farmers in Lao PDR like to grow cassava together with other crops on the same piece of land. Cassava is commonly intercropped with other food crops such as maize and upland rice, or with cash crops such as sesame, beans, peanuts, cowpeas and other crops. The productivity of cassava and its associated crops is often low in many of the traditional cropping systems. The main reasons for the low productivity in these systems are: 1) unsuitable combination of cassava and associated crops in terms of plant type and/or growth habits; 2) excessive interspecific competition due to inappropriate planting patterns and/or relative planting time; 3) inefficient land use because of inappropriate planting density of cassava and/or other associated crops; 4) low soil fertility, insufficient soil moisture, inadequate temperature and excessive light competition.

Intercropping seems to have many advantages for smallholder upland farmers, as a way to reduce the risk of crop failure, to provide diversity of crops, and to obtain food or income at different times of the year. It may improve use of available farm land and labor. Intercrops reduce weed growth during the early stages of cassava development and also protect soils from the direct impact of rainfall, and reduce the speed of runoff water when the cassava canopy is not yet closed, thus reducing soil erosion. Intercropping cassava with short-duration legume crops has the advantage of providing both carbohydrates from the cassava roots and protein from the legume crops. In addition, the legumes may fix nitrogen from the atmosphere, and cassava may benefit from this symbiosis.

**Objective**: to study the different legume intercrop with cassava to find the best and most economic option for farmers in Xayaboury province of Lao PDR.

**Location**: One site in each district in Xayaboury province
Design and Layout of Intercropping Experiment

The experiment design is randomized design with 4 treatments and 3 replications (Table 1).

Table 1. Treatments in the intercropping experiments

<table>
<thead>
<tr>
<th>No.</th>
<th>Legume</th>
<th>Cassava pacing</th>
<th>Legume row</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Peanut</td>
<td>0.8 m x 1.20m</td>
<td>2 rows</td>
</tr>
<tr>
<td>2</td>
<td>Mung bean</td>
<td>0.8 m x 1.20m</td>
<td>2 rows</td>
</tr>
<tr>
<td>3</td>
<td>Yard-long bean</td>
<td>0.8 m x 1.20m</td>
<td>2 rows</td>
</tr>
<tr>
<td>4</td>
<td>no Intercrop</td>
<td>0.8 m x 1.20m</td>
<td>no intercrop</td>
</tr>
</tbody>
</table>

Cassava variety: Rayong 11 (R11).
Appendix 4: Insights into Facebook group membership and participation

![Chart showing membership distribution by country]

Age and Gender

- **25.6% Women**
- **74.4% Men**
- **0% Custom**

![Chart showing age distribution]

- **25.6%** Women
- **74.4%** Men
- **0%** Custom