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Using digital data software to benchmark socio-economic and production characteristics in our target villages

Our project conducted a baseline survey in May of this year in four target villages and one non-target village (control) in each of our provinces, Banteay Meanchey and Battambang. To do this we embarked upon a journey of methodological innovation and adopted a digital data collection program for use in the field.

In February of this year, one of the project’s post-docs, Rebecca Cross from the University of Sydney, attended an ACIAR RAID (young researchers network) workshop entitled ‘MAD’ – Mobile Acquisition of Data. Commcare, an online software program developed by Dimagi for building and executing surveys in the field, was introduced at this workshop. It is a revolutionary data collection and tracking program designed to be useable in a remote, developing world context. It was first developed for health and nutrition research, but is increasingly being used in agricultural research, specifically via ACIAR projects.

The ability of this software to streamline data collection including capturing pictures, GPS locations and ethics consent, to negate the need for data input and dealing with tonnes of paper, and to track participants over time meant that it was an ideal tool for our project.

However, a journey it was! Learning to build surveys, replete with question logic, validations and hidden calculations, was a journey in itself which turned out to be an ongoing process both before and during the survey period. A second post-doc, Van Touch, was instrumental in the uploading of masses of translations before and throughout the survey process, and somehow managed to pick up the art of Commcare survey building at the same time! The diagram below was presented at the aforementioned workshop...how true this turned out to be.

![App Building Learning Curve](image)

Figure 1. Slide presented by Jess Hall, AgImpact at the ACIAR RAID MAD workshop, Melbourne, February 2017. (Credit: ACIAR RAID).
Purchasing and transporting all the tablets, charging them and ensuring their booster chargers were also charged was a mission, especially as all required Australian socket plugs and Cambodian hotels are not known for their great number of electricity sockets (or electricity for that matter).

While we had prepared well, we then had to contend with training our 60 student enumerators in two days; 30 from Meanchey University (MCU), led by Dr Yorn Try, Kong Vannak and Khim Nheb (many of whom had also been interviewers/ translators during the Participatory Rural Appraisal conducted in November 2016) and 30 students from the University of Battambang (UBB), organised by Dr Pao Srean. Both organisations are project partners and the baseline survey had a two-pronged aim, to first benchmark practices and socio-economics in our target regions and second, to increase the capacity of students at these universities by training them in enumeration and data collection.

The training was led by our Baseline Survey team leader, Dr Clemens Grünbühel along with his research assistants Soe Soe Htway and Sandar Phyo, who detailed the what why and how of each question before Van and Rebecca introduced the Commcare program and technology to the students. The students were amazingly receptive to the technology, albeit a few major and minor technical glitches along the way! They showed dedication and many practiced each night after the day’s training.

Clemens, Try, Van, Sandar and Soe Soe were also instrumental with smoothing over problems we faced and persevering with the technology.
the logistics of the whole trip ran like clockwork, not an easy feat when transporting, feeding and accommodating that many people!

Figure 6. Students conducting surveys in Ta Aam village (Credit: Rebecca Cross)

While we were busy making changes to the survey throughout the process, night and day (to make it more user-friendly and avoid technology overloads), the end result was 524 surveys automatically entered into the program after an intense 11 days of non-stop surveying (because of issues with the program, the students had to survey one village twice). The students and staff made it happen and patiently adapted to the daily changes and requests. Their involvement made the experience particularly enriching and we enjoyed many meals and good times together as a team.

Figure 7. Rebecca Cross making changes to the survey in the field (Credit: Daniel Tan)

In Battambang, we were also joined by Dr Bob Martin, Assoc/Prof Daniel Tan and Ratha Rien (Project Officer) for some of the village surveys. We were also joined by a number of students from Sydney University who were there to collect data for their projects: Jamie Loveday, Business student focused on understanding entrepreneurship; Yi Ling, Agribusiness student focussed on the rice value chain; Bhakti Haldankar, Environmental Systems student focused on land use and the flooded forest; and Bintu Moseray, Masters of Agriculture student focussed on fertiliser application.

Figure 8. Some of the 60 students enjoying a well-deserved team dinner at the end of the surveying (Credit: Rebecca Cross)

Figure 9. Jamie Loveday, Soe Soe Htway, Sandar Phyoe, Clemens Grünbühel, Yorn Try and Van Touch having a lunch cooked by a smallholder using only homegrown produce (Credit: Rebecca Cross)

Our first foray into Commcare was both a frustrating and rewarding experience, however its value as a data collection tool is undeniable. We look forward to sharpening our Commcare skills and realising the full potential of tracking smallholder farmers and other project participants’ progress throughout the project’s life by employing the program in our monitoring and evaluation strategy.

Author: Rebecca Cross
CamSID baseline survey results so far

The CamSID baseline survey was implemented by students from Meanchey University (MCU) and the University of Battambang (UBB) in the project target villages in May 2017.

The objectives were to:

• Assess the socio-cultural context, identify local needs and opportunities and build cohesion and a shared vision for project staff and stakeholders, who are primarily small-scale farming households;
• Quantify system components and likely impacts of interventions in full consultation with community groups;
• Assess market opportunities in the future including value chain network analyses in close consultation with community groups;
• Refine priority agronomic and institutional research priorities, interactions and interventions in partnership with leading farmers, respecting their place as equal research colleagues on the R4D team.

Methods

Thirty students from MCU and UBB were trained to enumerate the baseline survey using paper and electronic data collection using the CommCare mobile acquired data system. A one-day pilot test was conducted in one village to make sure that the students (enumerators) understood the questions and had experience using the digital data collection method. A total of 524 household representatives were interviewed from 10 villages from Banteay Meanchey and Battambang provinces.

Table 1. Main crops grown

<table>
<thead>
<tr>
<th>Crops commercially grown</th>
<th>Percentage of farmers growing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>97.5</td>
</tr>
<tr>
<td>Vegetable</td>
<td>9.2</td>
</tr>
<tr>
<td>Legume</td>
<td>8.0</td>
</tr>
<tr>
<td>Maize</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Figure 12. Rice cropping intensity

Farmers quickly switch from a single cropped long-duration rice variety to two double
cropped short-duration varieties when they gain access to wet season irrigation. The transition to double cropping happens immediately when the water arrives.

Table 2. On-farm area of irrigated and rainfed rice

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cropped area (ha)</td>
<td>4.0</td>
<td>2.8</td>
</tr>
<tr>
<td>Irrigated Rice (ha)</td>
<td>1.7 (43%)</td>
<td>0.5</td>
</tr>
<tr>
<td>Rainfed Rice (ha)</td>
<td>2.3 (57%)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Farmers with small land holdings and larger families were more likely to migrate to earn extra income rather than attempt to intensify rice production compared to farmers with larger land holdings. Further study might be required to determine the importance of land size in choice of enterprise at the household level. The mean household number for both provinces was five persons but households could include up to 10 persons.

**Rice production**

The total yield of rice paddy per farm was 8.33 t/year and the amount sold was 6.84 t/year, paddy kept for consumption was 0.97 t/year and kept for sowing, 0.54 t/year.

More than 40 varieties of rice are grown in NW Cambodia. However, Sen Kra Oub was by far the most popular. Sen Kra Oub is a short duration non-photoperiod sensitive jasmine variety and can be used as an indicator of the extent of double cropped rice in the region. Note that Phka Rumduol is the only variety in the top five that is an official export rice variety for Cambodia.

![Figure 13. Average rice yield (t/ha)](image)

**Figure 13. Average rice yield (t/ha)**

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![Figure 14. Rice varieties grown](image)

**Rice varieties grown**

**Land preparation**

The cost per pass with the disc plough is $30/ha for the 4-wheel tractor and this is typically done by contractors. However, 2-wheel tractors are still commonly used for land preparation, especially in Banteay Meanchey.

Research questions include:

- What are the benefits of two or more times of land preparation?
- Can farmers grow rice with no soil disturbance?
- Will yields decrease with reduced tillage?
- Seventy % of farmers prepare the land twice before planting, can this number be reduced?
Rice seeding method

Ninety-seven % of farmers are hand broadcasting rice. The main reasons given for hand-broadcasting were low cost ($10/ha) and because it is quick and easy. Problems cited were high seeding rates (150-250 kg/ha); uneven plant densities; and more weeds. It should be noted that the cost of farm-kept seed (around $50/ha) was not included in the farmer’s costing of direct-seeding. Farm-kept seed is also heavily contaminated with weed seeds, therefore increasing seeding rate might increase the weed problem rather than reduce it (Martin et al., 2017).

The few farmers that transplant rice are generally seed producers who use low seeding rates of around 50 kg/ha. Transplanting enables good plant population distribution and easier weed management. Transplanting costs $120/ha and including removing seedlings from the nursery ($44/ha), the total transplanting cost is $164/ha. Therefore, seed producers are looking for cheaper alternatives such as transplanting machines, drum or Eli seeders.

Figure 16. Mechanised drum seeder (Credit: Van Touch)

Seed and grain storage

Table 3. Seed and grain storage of rice (%)

<table>
<thead>
<tr>
<th>Store</th>
<th>Not store</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice seed</td>
<td>46</td>
</tr>
<tr>
<td>Rice grain</td>
<td>21</td>
</tr>
</tbody>
</table>

Farmers complain about lower price at harvesting time but the majority of farmers (79%) sell rice grain right after the harvest. Possible reasons are that loans must be repaid and lack of storage facilities. However, further enquiries could be made on the reasons for lack of storage and the problems/risks of keeping seed for the next season’s crop. Will farmers make more profit from storing their grain?

Household income and expenditure

The average total household income is $3,650 per annum, however the average total household expenditure per annum is $4,000 per annum. Off-farm income accounts for 52% of total household income. Further information might be gained from looking at the farm size * income source interaction.

Thirty-seven % of households had current loans averaging $2,047 with an interest rate of 2% per month. The majority of loans were for crop production and household expenditure. Only 9% of households were members of savings groups.

Conclusions

The baseline survey has revealed some of the challenges facing diversification and intensification in the rice-based systems in NW Cambodia.

There are opportunities to introduce field crop legume (mungbean) and watermelon in rotation with rice in the active floodplain but soil constraints might limit diversification in rice fields in the old alluvial terraces. Vegetables are not generally grown in rice fields but in home-based gardens where they can be grown year-round. Vegetables are a diversification option for household income but on separate plots, not in rice fields.

Forty-six% of farmer respondents keep their own rice seed for re-sowing and the average stored is 540 kg. What can be done to help farmers reduce the seed rate to below 80 kg/ha?

The majority of farmers (79%) sell rice grain right after the harvest. Can farmers make more profit from storing their grain?
Yield potential under farmer practices and conditions is greater than 6 t/ha, but the average yield and the yield received by most farmers are below 3 t/ha.

Figure 18. The MCU/UBB baseline survey team (Credit: Van Touch)

Authors: Rebecca Cross, Clemens Grünbühel, Try Yorn, Van Touch, Bob Martin and Daniel Tan

CamSID frontline team: Ratha Rien

Ratha Rien using a laboratory dehuller at UBB to enable detection of weedy rice (red) seeds in seed for sowing (Credit: Bob Martin)

The CamSID frontline team appointed in July 2017 include Mr Khim Nheb, Ms Seyma Ngann in Banteay Meanchey and Mr Ratha Rien, Ms Sophea Yous in Battambang.

In this edition of KRM we introduce you to Ratha Rien whose homeland is Praek Norint commune in Aek Phnum district where CamSID has two target villages, Rohal Soeung and Svay Chhrum. Ratha completed his bachelor degree at UBB in 2013, majoring in horticulture in the Faculty of Agriculture and Food Processing.

Ratha is currently doing his master degree with “Implementing quality of education & training of the Young UNIversities in rural area of CAMbodia” (UNICAM, http://unicamedu.com/en/). Ratha’s masters field research program is being aligned with CamSID priorities and he will focus on determining the production and economic benefits of rotating mungbean with rice.

Ratha was appointed to CamSID in June 2017. However, he has been working with Bob since late 2016. Firstly, on a study of the potential of radio agricultural programs to assist small-scale farmers in the adoption of conservation and climate-smart agricultural practices.

Secondly, Ratha played a key role in a survey of weedy rice and weed seed contamination in fresh paddy and seed kept for sowing earlier in 2017. This survey showed that almost 90% of rice seed sown is farmer-kept and that this is highly contaminated with weedy rice and weed seeds. Seed producer seed is also highly contaminated. Helping farmers improve their seed quality is now a priority for CamSID as a result of this work.

Author: Bob Martin

Weed research challenges and solutions for Cambodia

Bob Martin was invited to present a paper on “Weed research issues, challenges, and opportunities in Cambodia” at the 26th Asian-Pacific Weed Science Society Conference in Kyoto, Japan, 19-22nd September 2017. The following is the abstract of the paper published in the Crop Protection journal.

The area of cultivated agricultural land in Cambodia is 3.7 million hectares with 76% of this planted to lowland rice and 24% planted to upland crops such as cassava, maize, soybean, sugar cane and vegetables.
Cambodia’s average rice paddy yield at around 3 t/ha is around 50% of the yield potential and losses caused by weed competition have been shown to be a significant constraint. The most important issues currently affecting weed management in Cambodia’s cropping systems are (a) increased climate variability and climate change, and (b) migration of labour from the rural workforce and consequent rapid mechanisation of agriculture.

As a result of climate change, the wet season in Cambodia now begins and ends approximately one month later, and the bimodal rainfall distribution has strengthened, resulting in more extreme events of drought and flood during the wet season.

A decline in the availability of agricultural labour has resulted in rapid mechanisation of land preparation, broadcast seeding, herbicide use and machine harvesting of rice and these changes have had significant repercussions for weed management.

The resultant challenges and opportunities for weed management are presented and discussed in the paper. The main weed management challenges are associated with rice crop intensification, transition from transplanting to direct-seeded rice, changed planting dates and tillage practices in response to climate change, over-reliance on post-emergence herbicides, excessive inversion tillage, and lack of knowledge about the safe and efficacious use of herbicides.

Opportunities for improved weed management in Cambodia’s cropping systems include the development of integrated weed management for double crop intensive rice systems, transition from hand broadcasting to drill-seeded rice, new seeding windows and minimum tillage, non-transgenic herbicide resistant crops and education and training of input sellers and farmers to improve safety and efficacy of herbicide use.

Author: Bob Martin

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**Survey of weed seed contamination in rice paddy**

![Rice is mostly harvested by combine machine in Cambodia (Credit: Bob Martin)](image)

To reduce costs, farmers keep their own seed for sowing with the risk of greater weed seed contamination of the sowing seed. A survey of weed seed contamination in harvested rice paddy was conducted in Battambang and Takeo provinces at the end of the wet season in 2016.

Farmers were interviewed about rice-seeding practices, and a total of 110 farmers’ fresh paddy samples were inspected for weed seed contamination from the two provinces.

Sowing seed samples collected from 28 seed producer lots and 71 samples of farmer-kept seed were also analysed for weed seed contamination. In both provinces, the majority of farmers kept their own seed or bought seed from a neighbour.

Farm-kept seed for sowing accounted for 88% of sown seed in Battambang and 89% in Takeo. Seeds of 41 different weed species from 13 plant families were found in the farmers’ freshly harvested paddy samples.

Overall, farmers managed to reduce the number of weed propagules by 60% and seed producers by 95%. There was no significant difference between farmer-kept seed and seed producer/seed company seed for the total number of weed seeds present. When shown photos, farmers' rankings of the 10 most common weed species found in freshly harvested paddy did not closely correspond to the actual weed seed frequency in the paddy.

When farmers were asked to rank the frequency of weeds in their fields without the option to choose from a list, they ranked the weeds differently. Farmers ranked *Ischaemum rugosum*, *Echinochloa* spp. and *Fimbristylis*...
miliacea as the three most frequent weed species in their fields. The most frequent weeds in harvested paddy, apart from weedy rice, were I. rugosum and Melochia corchorifolia. Farmers did not rank M. corchorifolia as a frequently occurring weed, and most farmers could not recognise M. corchorifolia from photographs.

The priority for improved seed hygiene is to place the emphasis on assisting farmers to further improve their seed purification techniques and to caution them to inspect seed before purchasing from neighbours, seed producers and seed companies in the absence of the implementation of seed certification regulation.

Authors: Bob Martin, Floris Van Ogtrop, Kiel Henson, K Broeum, Ratha Rien, Pao Srean, Daniel Tan

**Effect of establishment methods on yield of rice**

In some ways CSE/2015/044 (CamSID) is a follow-on ACIAR project to CSE/2009/037 “Improved rice establishment and productivity in Cambodia and Australia” which was conducted between 2010 and 2014 in southern Cambodia (http://aciar.gov.au/publication/fr2016-08).

CSE/2009/037 addressed rice production issues in Cambodia such as the uptake of direct-seeding, a significant increase in irrigated wet season rice, and the uptake of mechanisation to replace animal draught for land preparation. The project successfully completed a large number of field experiments and demonstrations as well as socio-economic surveys and database development. These activities have produced a large volume of useful new information which, if adopted, will improve rice crop establishment, productivity and profitability in Cambodia.

It is imperative that reference be made to the CSE/2009/037 Final Report to ensure that CamSID trials and demonstrations are designed to build on, and not duplicate, the findings of CSE/2009/0037. Here results are presented and discussed on 20 experiments with regard to the effect of weed control and crop establishment method on rice yield.

**Crop establishment method and seeding rate treatments**

1. FP 180: Farmer direct seeding traditional practice at 180 kg/ha
2. BC 250: Direct seeding (wet seed broadcast) at 250 kg/ha
3. BC 200: Direct seeding (wet seed broadcast) at 200 kg/ha
4. BC 150: Direct seeding (wet seed broadcast) at 150 kg/ha
5. BC 100: Direct seeding (wet seed broadcast) at 100 kg/ha
6. BC 60: Direct seeding (wet seed broadcast) at 60 kg/ha
7. DS 80: Drum seeder at 80 kg/ha
8. DS 60: Drum seeder at 60 kg/ha
9. TP 20: Transplant 2-3 seedling/hill (20 day old seedlings) with 20 cm x 20 cm spacing
10. TP 25: Transplant 1 seedling/hill (10 day old seedlings) with 25 cm x 25 cm spacing

**Experimental details and assumptions**

The experiments were conducted in Kampong Thom, Kampong Speu, Kampot, Prey Veng and Takeo provinces. Twenty experiments: 10 in wet and 10 in dry season 2010-2011. The establishment treatments were with and without weed control.

Assumptions: cost of seed for sowing, $0.225/kg; labour, $8/person/day; transplanting 20 person days/ha; drum seeder, 4 person days/ha; broadcasting 3 person days/ha; price of paddy, $225/t (current price for Sen Kra Oub).
Results

Figure 22. Effect of broadcast seeding fate in rice yield, with and without weeds

Figure 23. The net benefit curve for rice seeding options for all treatments (above) and broadcast treatments (below)

Conclusions

- Transplanting rice for paddy production in Cambodia is now economically out of the question and 98% of farmers now plant rice by broadcast seeding.

- The average farmer broadcast seeding rate of 180 kg/ha is not justified with regard to economic returns. Farmers should be encouraged to progressively reduce broadcast seeding rates, at least down to 90 kg/ha and eventually to 60 kg/ha. This will require better seed quality and better crop management, especially of weeds.

- Use of the drum seeder at 60 kg/ha gave a Marginal Rate of Return (MRR) of 409% over broadcasting at 60 kg/ha. Drum seeder at 80 kg/ha gave a further MRR of 1752% over drum seeder at 60 kg/ha.

- Increasing broadcast seeding rate from 60 to 100 kg/ha gave a MRR of 315%. Increasing the rate from 100 to 150 kg/ha gave a MRR of only 55% and is not likely to be attractive to farmers. The net benefit for the 150 kg/ha seeding rate with weeds was $125/ha less than for without weeds. Therefore, increasing seeding rate alone is not an economically viable option for weed control.

- These results suggest that:
  - The recommended seeding rate for drum seeder should be retained at 80 kg/ha.
  - The recommended seeding rate for hand broadcasting is not more than 100 kg/ha.
  - Further efforts should be made to convince farmers to reduce broadcast seeding rates below 100 kg/ha in combination with improved seed quality and improved crop and weed management practices.

Author: Bob Martin

WeedID App

WeedID is an app developed by the CamSID team to assist Cambodian farmers in identifying weeds in rice fields. It contains a "photo dictionary" of various weed species in different stages of growth.
Cambodian farmers in most areas have shifted their rice planting method towards direct seeding. Yet, direct seeding systems are more prone to weed infestation. Without proper management, weeds can cause seed contamination and yield loss.

As weed species in rice fields are diverse, the effective control strategy can be different for each species; being able to identify the weed species that are present is therefore essential. A mobile application (App) may be an effective tool to empower farmers with the information needed to identify and control weeds.

A survey regarding weed seed contamination in harvested rice paddy in two provinces was undertaken to determine common weed species of rice in Cambodia. A WeedID prototype App with the ten most common weeds was subsequently designed and developed.

Figure 25. WeedAP example

The mobile application was evaluated through a survey conducted in Northwest Cambodia. Moreover, more weed species were added to the database to make a total of 30 different weeds. WeedID received interest from enthused Cambodian farmers; it could be an effective information tool to offer better farming decision support and to improve practices to control weeds in rice. You can install WeedID app from the links below:


Authors: Yehezkiel Henson, Bob Martin, Rosanne Quinnell, Floris Van Ogtrop, Yorn Try, Daniel Tan and Nicholas Barker

CamSID publications


A patent (record of invention) was lodged/submitted for the Cambodian WeedID app (available both on iOS and Android) #CT19091

### References


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