Testing Innovative Models of Extension in Cambodia

PADEE & ASPIRE

Pre-Analysis Plan

Miguel Almanzar, Alan de Brauw, and Eduardo Nakasone

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1 Overview of the Project

Agricultural productivity and profitability are keys to improving the livelihoods of rural households and to poverty reduction. Governments of developing countries have allocated considerable resources to improve agricultural practices, encourage the use of improved intermediate outputs, and induce the adoption of new available technologies among farmers. These objectives relate to a broad set of institutional and market constraints (e.g. imperfect input and output markets, credit restrictions, ill-functioning land markets, etc.).

However, one likely explanation is that farmers – with low average levels of education, living in remote and poorly connected areas – just do not know about improved practices or new production processes; even when access exists, farmers sometimes do not know how to use those technologies optimally. This notion has led governments and other agencies to invest considerable resources in agricultural extension programs. Despite considerable investments, we know very little about the actual impact of extension programs on farmers' agricultural productivity. Studies on the topic find a significant and positive impact of extension, with returns being quite variable; estimates range between 13 and 500 percent (Birkhauser et al 1991). However, these studies are plagued by various methodological limitations, such as selection of the farmers who seek for extension advice, contamination through farmer-to-farmer information flows, placement bias, and the influence of other parallel programs confounded with the effect of extension.

Lack of solid evidence about the impact of agricultural extension programs has led to skepticism about their effectiveness. For example, Gautam (2000) argues that "the effectiveness of the extension approach adopted by the projects has been a subject of debate because of the perceived high cost and an apparent lack of impact on agricultural production". He investigates the impact of the extension programs supported by the World Bank in Kenya during the 1980s, and finds that the extension system was overall inefficient, ineffective and not financially sustainable.

There is also a perception that extension programs have several challenging features that may hinder their effectiveness. Extension workers in developing countries have inadequate levels of education and training and have limited skills to provide farmers with adequate agricultural advice (Feder et al 1999, Swanson and Rajalahti 2010). Ideally, they would receive training, periodical

refresher courses, and be introduced to new technologies. However, budget constrained governments in developing countries usually do not provide any of these. Moreover, extension workers in developing countries are usually not subject to any monitoring of their effort. Because of the remote locations where extension workers are located, governments have traditionally been unable to set in place any mechanism to assess the performance and increase the accountability of extension workers.

We will investigate two potential mechanisms to address come of the problems of extension systems in developing countries. First, we will test the impact of incorporating **Information and Communication Technologies (ICTs)** into extensions services: (1) to overcome extension agents' low levels of technical education and training; and (2) to directly provide agricultural advice to farmers. For (1) we will provide extension agents with tablets equipped with specialized software with information about soil testing, seed recommendations, fertilizer application, and identification and treatment of crop diseases. When specific problems cannot be found in the software, the tablets will also allow the extension agents to contact subject matter specialists in the district agricultural offices. For (2) we will provide voice messages to farmers about rice and vegetables production techniques, poultry productions and care. For example, the messages provide tips and reminders about soil management practices, pest management, seed varieties, poultry feed, vaccination, etc.

The ICTs might offer a cost-effective alternative to costly formal training courses for extension workers, that might help them overcome low levels of technical skills, and costly direct training of farmers or other forms of providing information to farmers.

Access to specialized technical information through software may, by itself, enhance the performance of extension workers. However, more information might fall short if there are no incentives to use this software to provide better advice to farmers. Therefore, as a second innovation we will test whether **performance-based incentives** can incentivize extension workers to make use of information available in the software to increase their effectiveness. For these purpose, we will gauge farmers' knowledge of practices that are related to agricultural advice that extension services should provide. Each extension worker will be provided with monetary bonuses based on the percentage of correct answers of farmers in their catchment areas. While we will not test the sole impact of incentives, we will test if more technical

information is sufficient to improve extension workers' performance or if this information needs to be complemented with increased accountability.

We will investigate the impact of these innovative schemes to provide agricultural extension within two agricultural extension projects in Cambodia: the **Project for Agricultural Development and Economic Empowerment (PADEE)** and the **Agricultural Services Program for Innovations, Resilience and Extension (ASPIRE)** Program[1]. PADEE is a program that was implemented in five provinces of Cambodia, in 2016 and 2017. ASPIRE was launched in 2017 in five provinces that were not targeted by PADEE (see details in Section 3).

Due to the timing of both projects, our research will be conducted in two stages. In a first stage (2016-2017), we will conduct our research in PADEE villages, where we will implement the specialized software and incentive schemes with extension agents working in PADEE. In a second stage (2017-2018), our research will be focused on ASPIRE villages, where we will implement the information diffusion scheme that provides voice messages with agricultural information directly to farmers that participate in ASPIRE and other farmers in the area.

This pre-analysis plan describes our research design, data collection strategy, hypotheses, and empirical approach. The remaining of this plan is organized in seven sections. Section 2 provides more details about the PADEE and ASPIRE agricultural extension projects. Section 3 describes our sample. Section 4 outlines our randomized research design for the interventions in PADEE and ASPIRE. Sections 5 and 6 list our main data sources and provide a timeline, respectively. Our main testable hypotheses and our empirical methods are described in Sections 7 and 8.

2 The Intervention

The intervention is taking place within the context of the PADEE and ASPIRE projects of MAFF in Cambodia. While there are differences in their implementation and mechanisms, both projects aim to increase smallholders' agricultural productivity through extension components. In a sense, both

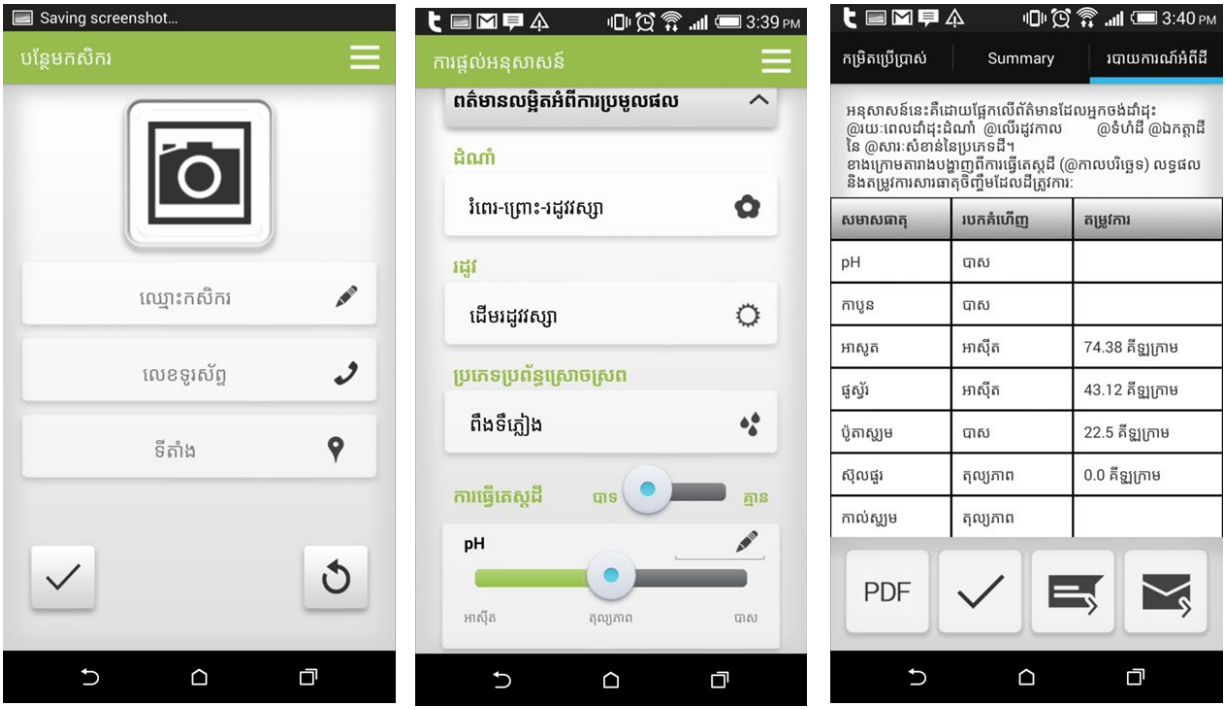
[1] The International Fund for Agricultural Development (IFAD) – in collaboration with the Ministry of Agriculture, Forestry and Fisheries (MAFF) – is currently implementing these two projects in Cambodia related to agricultural extension.

PADEE and ASPIRE follow a Train-and-Visit extension model, with visits from extension workers.

PADEE was launched in five southern provinces (Kampot, Takeo, Kandal, Prey Veng, and Svay Rieng) of Cambodia in mid-2012 and will operate in the country until 2017 (see Figure 1). Farmers in PADEE villages are grouped in learning groups with 50 members and receive agricultural extension advice from a member of the Mobile Support Teams (MSTs). MSTs are itinerant extension workers and are civil servants staffed by MAFF's District Agricultural Offices. Each MST is assigned to specifically work with a learning group in a village.

As part of the PADEE operations, MAFF – in collaboration with Grameen Intel – developed ePADEE, a specialized software for extension workers to provide them with information about seed choices, fertilizer application, and plant disease control. The ePADEE software includes a module to perform individual plot soil tests to provide personalized recommendations based on each farmers' needs. The software's content was developed by MAFF's specialists based on Cambodia's local agricultural conditions. Figure 1 shows some screenshots of the ePADEE software.

Figure 1 ePADEE Screenshots



A small group of MSTs were provided with tablets loaded with ePADEE and the software was tested in a small pilot by two NGOs (the SNV Netherlands

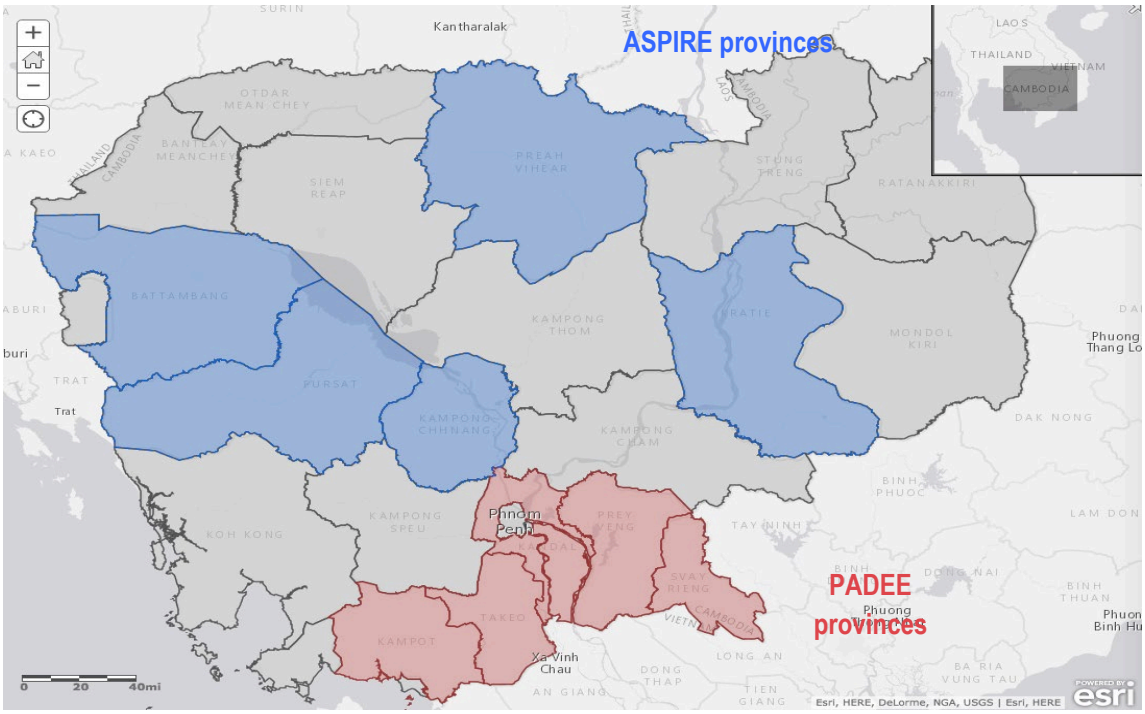
Development Organization and International Development Enterprises - IDE) throughout 2015. Testing of ePADEE allowed MAFF and Grameen Intel to ensure that extension workers were able to use the software and that the information provided was locally relevant. During the testing phase, ePADEE was restricted to provide advice related to rice (the largest staple crop in Cambodia).

During 2017, MAFF closed the PADEE project. ASPIRE operations began slowly in 2016, and were more widespread in 2017. In the second phase of ASPIRE the provinces targeted in PADEE will be added to ASPIRE. Hence, lessons from this project can be directly brought into ASPIRE when it is launched in the PADEE provinces.

ASPIRE is being implemented in five provinces that were previously not targeted by PADEE (Batambang, Pursat, Kampong Chhnang, Preah Vihear, and Kratie; see Figure 2). The extension model in ASPIRE is similar to the one in PADEE: farmers are organized in learning groups and extension workers provide them with agricultural advice. However, ASPIRE incorporates local community members that act as liaisons between extension workers and farmers. Each village has a Commune Extension Worker (CEW) to facilitate extension workers' relations with farmers.

Our intervention will test the impact of financial incentives and ePADEE on extension workers' performance within the PADEE project and the information campaign through voice messages directly to farmers in the ASPIRE project.

Figure 2 Map of Cambodia: PADEE and ASPIRE Provinces



3 Sample Selection

Our power calculations are based on three outcomes: a technology adoption proxy (use of plough in fields), an intermediate outcome (agricultural yields), and a final outcome (food expenditures). We calculate the mean, variance, and intra-cluster correlation coefficients of these variables from the 2009 round of the Cambodia Socio Economic Survey (CSES).

Parting from an assumed framework of 150 villages with 20 farmers each (for a total sample size of 3,000 households), we estimated the optimal number of control villages with equally distribute number of villages in treatment arms by simulation. Our calculations showed that power increased with more villages in the control group and the rest of the remaining villages distributed equally among the treatment arms. With this information, we divided the impact evaluation sample in 60 villages for the PADEE area (with 3 treatment arms).

For the ASPIRE sample we initially planned for 60 villages with 3 treatment arms (including the control or status quo). However, because of changes

during the implementation and the questions we wanted to explore in this area we increased the sample to 72 villages with 4 treatment arms (including the control or status quo).

3.1 Selection of PADEE villages

Throughout the length of the project, PADEE aims to covers 2,367 villages in the provinces of Kampot, Takeo, Kandal, Prey Veng, and Svay Rieng. However, the villages are rolled in and out of the program in different stages. For the purposes of our analysis, we restricted our sample to villages in which: (a) PADEE would operate in 2016 and 2017, (b) MAFF had confirmed MSTs assigned to them by early 2016. As a consequence, our sampling framework consisted of 170 villages.

Based on the power calculations we randomly selected 60 out of the 170 villages in our framework for our study. The number of villages selected in each province was proportional to the share of villages each province had in the framework. As a result, the sample for our study in the PADEE project comprises 12 villages in Kampot, 10 in Kandal, 14 in Prey Veng, 11 in Svay Rieng, and 13 in Takeo.

MAFF provided us with the lists of 50 farmers that would participate in the learning groups in each of the 60 villages in our study. From the 50 farmers in each learning group, we randomly chose 20 farmers for our household surveys. Therefore, our PADEE sample consists of 1,200 farmers across 60 villages in these 5 provinces.

3.2 Selection of ASPIRE villages

Beginning in 2017, IFAD and MAFF launched ASPIRE in Cambodia. In the first year of operations, the project operated in 326 villages in the five provinces targeted by the project: Kratie (65), Kampong Chhnang (72), Preah Vihear (51), Battambang (70), and Pursat (68).

However, by the time of the initial pre-analysis plan, we are not able to fully confirm if the project will be able to meet its ambitious goal for its first year. For this reason, we decided to conduct the sampling of villages and households in the last quarter of 2016. By this time, we were able to determine the availability of extension workers to work on this project and if these workers have already committed to work in specific villages.

Once we confirmed that the ASPIRE project would start in the provinces of Battambang and Pursat in 2017, we selected a sample of villages to participate in our research project. First, we determined a sampling framework of villages that would be targeted by ASPIRE in these two provinces during the initial phase of the project and randomly select 72 villages.

The sample for our study in the ASPIRE project comprises 40 villages in Battambang and 32 villages in Pursat. MAFF and IFAD provided us with the lists of farmers that were organized in farmer groups to participate inn ASPIRE. In each village, the farmer groups were comprised of between 17 and 51 farmers. From this list, we randomly selected 10 farmers for our household surveys. In addition, we randomly selected 14 farmers not participating in ASPIRE from the village roster (see section 4 for the role of this group in the research design). Therefore, our ASPIRE sample consists of 1,728 farmers across 72 villages in these 2 provinces; 10 farmers in ASPIRE learning groups and 14 outside of the ASPIRE learning groups.

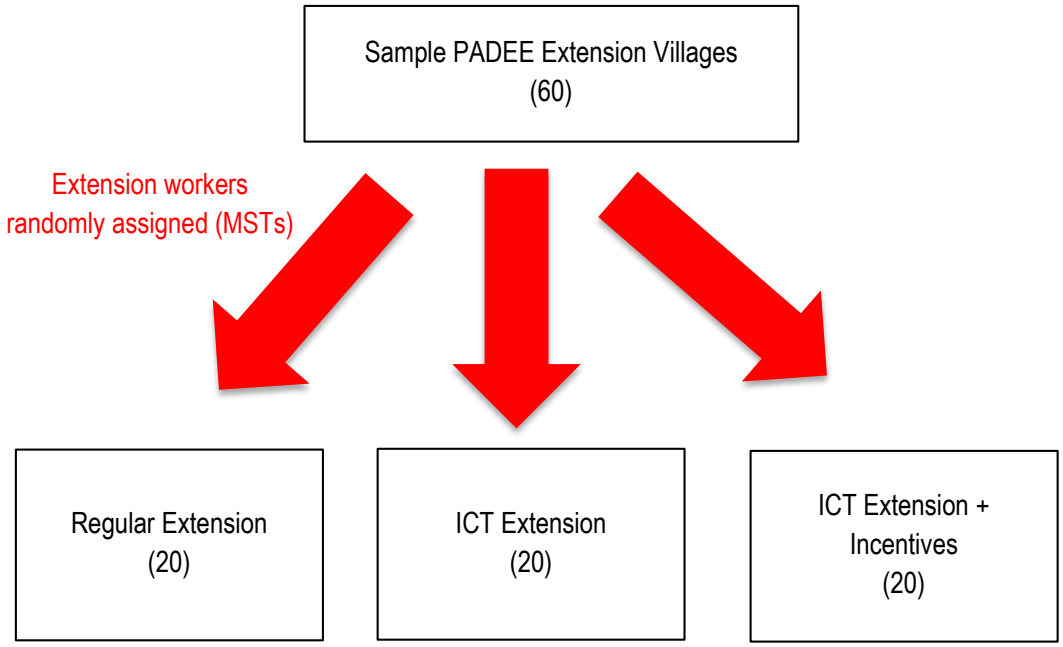
4 Experimental Design

Given the differences in the interventions we implement in PADEE and ASPIRE, in what follows we separated each design for clarity. The research design for both consist of a cluster randomized control trial (C-RCT) where each village in the sample is assigned to a treatment condition based on random number or lottery. In both cases the treatment is an innovation on top or in addition to the project in question. In the case of PADEE, the treatment condition assigns the ePADEE software and incentives to a group of villages in the sample; while in the case of ASPIRE, the conditions assign the voice messages information campaign to a group of villages.

4.1 ICT and Performance-Based Incentives for PADEE Extension Agents

We randomly assign each of the 60 PADEE villages in the sample in one of three groups shown in Figure 3 and described below.

Figure 3 Treatment Assignment: PADEE Villages and MSTs



(1) A group of 20 villages is assigned to a **control group or regular extension group**. Villages in this group receive, similar to the other two groups, regular PADEE extension with an MST assigned to work with the learning groups. MSTs in this group do not receive tablets with the ePADEE software and are not eligible to receive performance-based bonus payments.

(2) A group of 20 villages is assigned to an **ICT treatment arm (ICT)**. In this arm, the MSTs assigned to work in these villages receive a tablet with the ePADEE software. Each MST receives a monthly payment through a popular mobile banking provider in Cambodia to finance their visits to the farmers group and their base pay.

(3) A group of 20 villages is assigned to and **ICT plus incentives treatment arm (ICT+)**. In this arm, the MSTs who work in these villages receive a tablet with the ePADEE software and receive bonus payments (in addition to their base salary) based on their performance.

The performance of MSTs in this group is evaluated through phone calls to the farmers they have been assigned to advise. Our impact evaluation sample (i.e., the one for which baseline and end-line outcomes will be collected) is comprised of 20 farmers in each learning group. A concern is that MSTs might focus on farmers that have been

contacted (during the baseline) and not on the complete learning group (i.e., MSTs might be redistributing their effort and not necessarily increasing it).

For this reason, the MST that participated in this intervention were only assigned to work to with the 20 farmers that were included in our intervention. We include all the 20 members in our sample as a part of our performance-monitoring scheme. Each month, we selected a random sample of 6 farmers in each group and test them with a ten-question quiz over their mobile phones. Three of them were "soft" questions assessing whether the farmer had interacted with the MST in the village during the previous month, and if they had received any useful advice from the MST. The other seven questions were based on knowledge on seed recommendations, fertilizer application, and pest and disease control practices depending on the week and theme that the MST was expected to be advising the farmer on.

At the end of the season, each MST receives a bonus payment based on the average of their performance across the agricultural season. Each MST is monitored 3-4 times during the season and these monitoring calls/visits are timed consistent with the timelines proposed in the software for fertilizer applications and pest development. For example, one visit after the second fertilizer application or one visit at the time of pesticides application, etc. Each MST receives payments through mobile money provider; a monthly allowance to finance their visits to the farmers group (lower than the regular pay in the ICT only group) and a lump sum payment at the end of the agricultural season with the details of their performance.

In the ICT and the ICT+ treatment groups Grameen Intel staff, MAFF, and IFPRI staff held workshops to teach the MSTs how to use the software, explain the incentive scheme, and implement the (public) lottery to assign the MSTs to each group.

Additionally, the treatment assignment was stratified at the province level (i.e., approximately one third of the villages in each province was assigned to each treatment arm). Appendix 1 has a list of the villages and the treatment group they were assigned to.

4.1.1 Timing of Extension Visits for Farmers and Payments to Extension Agents

The extension visits were done in 2 groups of 10 farmers from a list of farmers surveyed in the village.

The MST for each village visited each group of 10 farmers 5 times (each visit can be multiple days to cover all farmers assigned to them):

Visit 1. During seed selection and planting period. During this visits the MST's will use the **seed selection module** of the tablets to advice their farmer group. In addition, MST's will perform a **soil test** and provide an initial **fertilizer recommendation**.

Visit 2: Visit before first fertilizer application to remind farmers identify information and inputs needs.

Visit 3: Visit before second fertilizer application to remind farmers of initial fertilizer recommendation and check for pests using the **pest module** of the software.

Visit 4: Visit before third fertilizer application and check for pests

Visit 5. Before harvesting to check for pests and identify post-harvest needs.

The payments will be given in 3 blocks:

Initial for visits 1 and 2

- Month 1 - Set up and initial costs to travel for first visits
  - ICT : Base pay
  - ICT Plus : 90% of base pay
- Month 2
  - ICT : Base pay
  - ICT Plus : 90% of base pay

Second for visits 3 and 4

- Month 3/4
  - ICT : Base pay
  - ICT Plus : 90% of base pay

Third for last visit and incentives

- Month 4/5
  - ICT: Base pay

- ICT Plus: Base pay + Incentive based on average score of the farmer groups during the season.

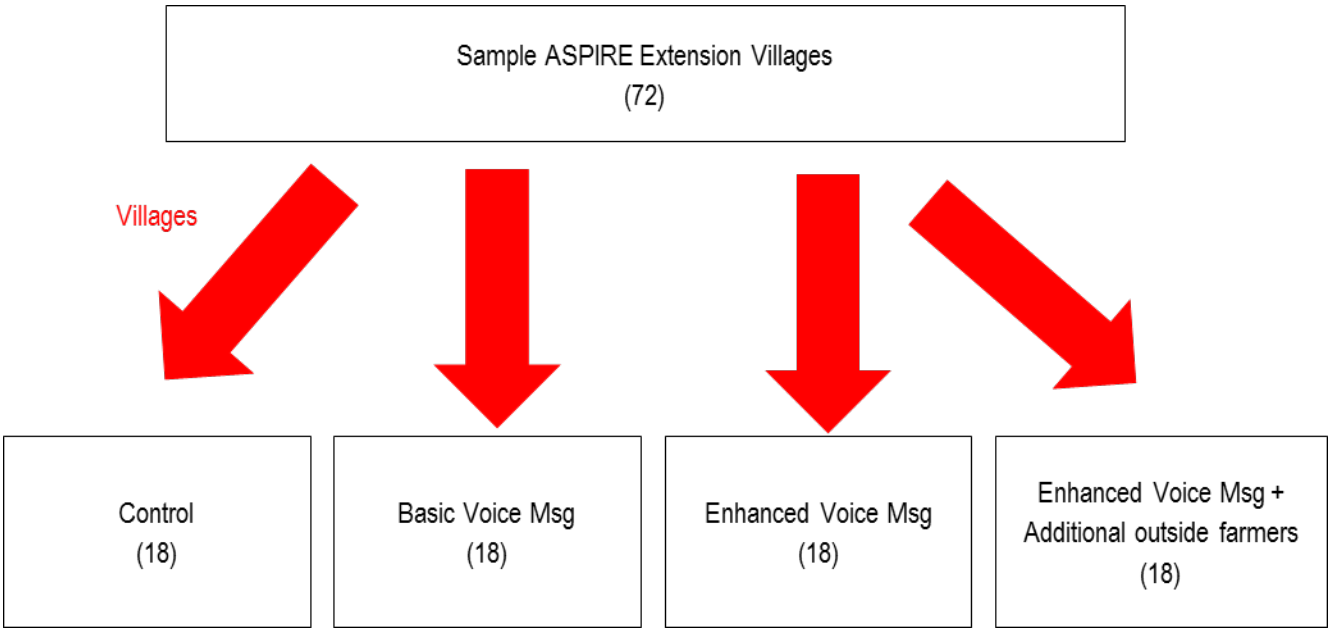
4.2 ASPIRE Experimental Design

In the ASPIRE model, there are no MSTs but Community Extension Workers (CEW) take a larger role in connecting farmers to the project. The main difference between the PADEE and ASPIRE models is that there is a in both models with different roles, as well as different financing. In the PADEE model, the CEW both acts as a community facilitator for extension and in a microfinance scheme included in this extension model; in ASPIRE, the role is more as a facilitator, and the individual is partially paid by the local committee, rather than being funded by the government.

Since the CEW does not have an expertise in agricultural extension, it is unlikely that the CEW (as had originally been proposed) should play an important initial role in providing tablet-based extension. Consequently, the intervention in this study for ASPIRE consists in the delivery of agricultural information about rice production, vegetable production (cucumbers and long beans), and poultry/chicken maintenance directly to farmers.

The experimental design for ASPIRE consist of the C-RCT with 4 treatment arms. We randomly assign each of the 72 ASPIRE villages in the sample to one of four groups shown in Figure 4 and described below.

Figure 4 Treatment Assignment: ASPIRE Villages



(1) A group of 18 villages is assigned to a **control group or regular extension group**. Villages in this group receive, similar to the other groups, regular ASPIRE extension with a CEW assigned to act as a liaison between the farmer learning groups and the ASPIRE project. Farmers in this group do not receive voice messages.

(2) A group of 18 villages is assigned to an **Basic Messages treatment arm (BASIC)**. In this arm, the farmers in the ASPIRE farmer groups and the 14 farmers not organized in ASPIRE farmer groups in the sample receive basic information messages at the beginning of the agricultural season.

(3) A group of 18 villages is assigned to an **Enhanced Messages treatment arm (ENHANCED)**. In this arm, the farmers in the ASPIRE farmer groups and the 14 farmers not organized in ASPIRE farmer groups in the sample receive basic information messages at the beginning of the agricultural season and receive reminder messages throughout the agricultural season. These additional messages are meant to reinforce the information relayed in the initial basic messages.

(4) A group of 18 villages is assigned to an **Enhanced Messages plus additional outside farmers treatment arm (ENHANCED+)**. In this arm, the farmers in the ASPIRE farmer groups, and up to 50 farmers not organized in ASPIRE learning groups (including the 14 farmers not

organized in ASPIRE farmer groups in the sample), receive basic information messages at the beginning of the agricultural season and receive reminder messages throughout the agricultural season as in the ENHANCED group before. These additional farmers outside of the ASPIRE project who receive the information are meant to both reinforce the information relayed in the initial basic messages by increasing the number of people that have the information in the village and to explore how farmers that do not participate in the ASPIRE project might differ on information interests and needs.

In all treatment arms, the villages have farmers that participate in the ASPIRE project and our intervention provides additional information to support the project. In one case we increase the number of people in the village that receive the information and in the other case the frequency the information may be salient, through the reminders.

4.2.1 Voice Messages Content and Timing

To implement the information campaign through voice messages, IFPRI partnered with VOTO (now *viamo*). Viamo is a social enterprise created by VOTO Mobile that aims to connect individuals and organizations using digital technology. We use their platform to send out the messages to the farmers in ASPIRE and the farmers of the outside the learning groups we targeted in this intervention.

With support of the Cambodian Development Research Institute (CDRI), we collected a list of mobile phone numbers for ASPIRE farmer groups in the sample villages and in the ENHANCED+ group of villages, we collected the mobile phone numbers of the farmers outside the ASPIRE learning groups during the baseline survey. In total, the lists included 2,012 ASPIRE farmers and 863 farmers outside of the learning groups. After depurating the lists and identifying working mobile phone numbers, we identified 1,201 farmers in ASPIRE learning groups with valid mobile phone numbers (in 54 villages/3 treatment arms), 753 farmers outside of the learning groups in the 18 villages of the ENHANCED+ treatment group (see Table 1, about 68 percent of the list with valid phone numbers).

Table 1 Farmers Distribution for ASPIRE information Campaign

Treatment Assignment	ASPIRE Farmer	Outside Farmers	Total
Basic Message	433	0	433
Enhanced Message	358	0	358
Enhanced Message + Outside Farmers	410	753	1,163
Total	1,201	753	1,954

The campaign started with a consent survey (see appendix 3 for the survey script) that was sent to the 1,954 farmers with valid phone numbers. In this survey farmers selected the products that they were interested in receiving messages or if they wanted to opt out of the information campaign. There was no cost to the farmers for receiving the messages.

The messages for the intervention were created by IFPRI, IFAD and MAFF based on the learning materials used in ASPIRE and are meant to reinforce the knowledge that the farmers learning groups were receiving through ASPIRE. The messages are included in Appendix 3 for rice, vegetables and chickens.

The messages were sent during the periods that they could be useful to the farmers. The voice messages were sent between the first week of September and the second week of December 2017. Table 2 and Table 3 show the week each treatment group received each message.

Table 2 Information Delivery Schedule for Rice and Chicken

Rice

	Sep 2017				Oct				Nov				Dec			
	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
Basic	GI-M1	GI-M2	GI-M3													
Enhanced	GI-M1	GI-M2	GI-M3	GI+R-M1	GI+R-M1	GI+R-M2	GI+R-M2	GI+R-M3		GI+R-M3				GI+R-M3		
Enhanced + additional farmers	GI-M1	GI-M2	GI-M3	GI+R-M1	GI+R-M1	GI+R-M2	GI+R-M2	GI+R-M3		GI+R-M3				GI+R-M3		

Chicken

	Sep 2017				Oct				Nov				Dec			
	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
Basic	GI-M1		GI-M2	GI-M3	GI-M4											
Enhanced	GI-M1 / GI+R-M4	GI+R-M1	GI-M2 / GI+R-M2	GI-M3	GI-M4 / GI+R-M4	GI+R-M1	GI+R-M2	GI+R-M3	GI+R-M4			GI+R-M3	GI+R-M2			
Enhanced + additional farmers	GI-M1 / GI+R-M4	GI+R-M1	GI-M2 / GI+R-M2	GI-M3	GI-M4 / GI+R-M4	GI+R-M1	GI+R-M2	GI+R-M3	GI+R-M4			GI+R-M3	GI+R-M2			

Legend

GI: General Information
GI+R: General Information + Reminder
M1: Message 1
M2: Message 2
M3: Message 3

Table 3 Information Delivery Schedule for Vegetables: Cucumbers and Long Beans

Cucumbers

	Oct 2017				Nov				Dec			
	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
Basic			GI-M1	GI-M2	GI-M3							
Enhanced			GI-M1	GI-M2	GI-M3 / GI+R-M1	GI+R-M3	GI+R-M2	GI+R-M1	GI+R-M2	GI+R-M3		
Enhanced + additional farmers			GI-M1	GI-M2	GI-M3 / GI+R-M1	GI+R-M3	GI+R-M2	GI+R-M1	GI+R-M2	GI+R-M3		

Long beans

	Sep 2017				Oct				Nov			
	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
Basic	GI-M1	GI-M2	GI-M3									
Enhanced	GI-M1	GI-M2	GI-M3	GI+R-M1 / GI+R-M3	GI+R-M2	GI+R-M1 / GI+R-M3			GI+R-M3			
Enhanced + additional farmers	GI-M1	GI-M2	GI-M3									

Legend

GI: General Information
GI+R: General Information + Reminder
M1: Message 1
M2: Message 2
M3: Message 3

5 Data Sources

To collect data for the project, IFPRI has established an agreement with the Cambodian Development Research Institute (CDRI), and CDRI will take on an important role. As a local institution, IFPRI's partnership with CDRI will be instrumental to the successful implementation of the impact evaluation. CDRI will arrange to collect a two-wave panel farmer/household survey to evaluate the impact of the ICT and incentives interventions in the PADEE project, and another two-wave panel survey to evaluate the effects of the voice messages information campaign in the ASPIRE project.

In the PADEE intervention, a village-CEW survey and periodic monitoring surveys are implemented and used in determining the incentives that the MSTs are eligible for. These are timed to follow-up on the extension agents' visits described in section 4.1.1.

In the ASPIRE intervention, weekly monitoring data from the voice message platform are used to track the success of call and listening time throughout the implementation.

Below we describe the timing and content of the data sources we will use.

Baseline and End-line Farmer Survey: Prior to the implementation of each intervention, we will collect a baseline survey of the farmers that will participate in the learning groups. The baseline will include information about household demographic characteristics; housing characteristics; land ownership; rice and vegetable production, sales, agricultural practices, and input use; access to formal agricultural advice through extension systems; access to informal agricultural advice through social networks; knowledge of agriculture practices for rice and vegetables; household labor; and asset ownership.

The baseline survey of the 1,200 farmers in our PADEE sample was implemented in May-June 2016 and the end-line in May-June 2017.

The baseline survey of 1,728 farmers in the ASPIRE sample was implemented in July-August 2017, followed but the end-line in April-May 2018.

PADEE Extension Workers' Baseline Survey: Prior to the implementation of the ICT and ICT + incentive treatment arms in PADEE, we collected a baseline survey of the 60 extension workers assigned to the PADEE areas in our intervention. This survey gathered information about extension workers' demographic characteristics; education; experience in agriculture; ICT

literacy; employment and income (outside PADEE), distance and transportation to the villages they serve as extension agents; and risk aversion and time preferences (through hypothetical games). These surveys were collected jointly with the farmer baseline surveys for PADEE.

Mobile phone surveys/Farmer Quizzes: We collected data from mobile phone surveys conducted among farmers to measure learning from extension. However, these quizzes were only administered in villages assigned to the treatment arm with performance-based incentives for extension workers (due to costs considerations).

Three mobile surveys/quizzes took place between September and December 2016 (during the wet season).

Qualitative Surveys: These smaller surveys will gather information about extension workers' perceptions about ePADEE (usability, constraints to adequately use the software; satisfaction, etc.), satisfaction with the incentive scheme; main obstacles to perform their extension duties; perceptions about farmers' knowledge gains; and satisfaction with the type of information provided in the voice messages.

6 Timeline of the Project

Figure 5 shows the timeline of activities for the ICT and incentives intervention in the PADEE project. This intervention was implemented in the wet season of 2016 and focused on rice production.

Figure 6 shows the timeline of activities for the voice messages information campaign intervention in the ASPIRE project. This intervention was implemented in the wet season of 2017 and focused on rice production, vegetable production and poultry rearing practices.

Figure 5 Timeline of ICT + Incentives intervention in PADEE Project

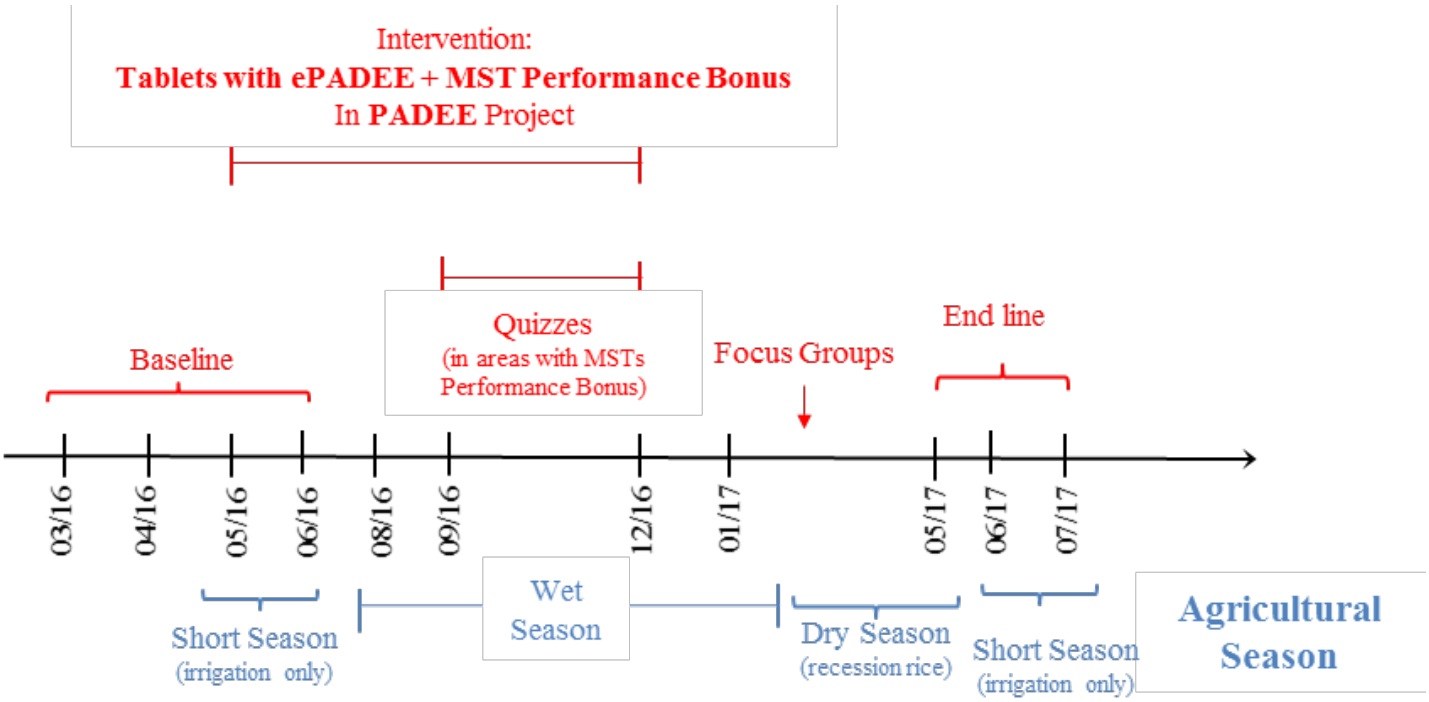
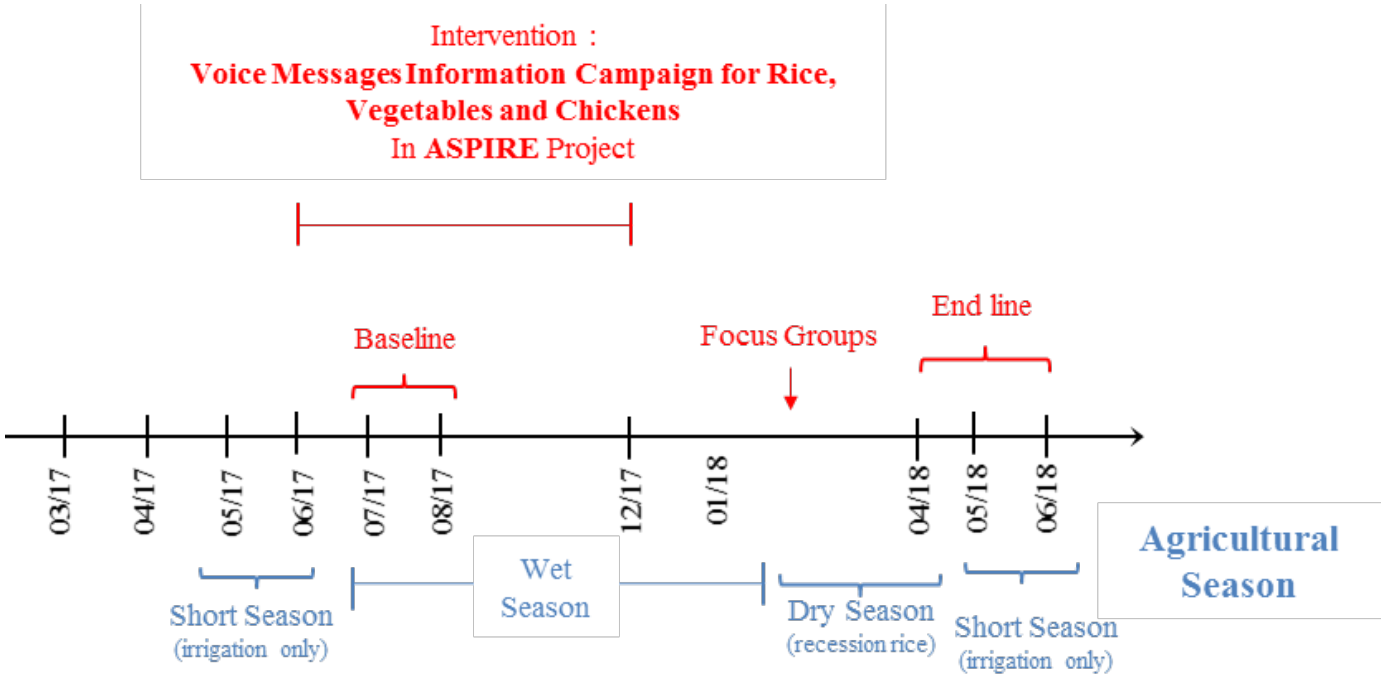


Figure 6 Timeline for Voice Messages Information Campaign in ASPIRE Project

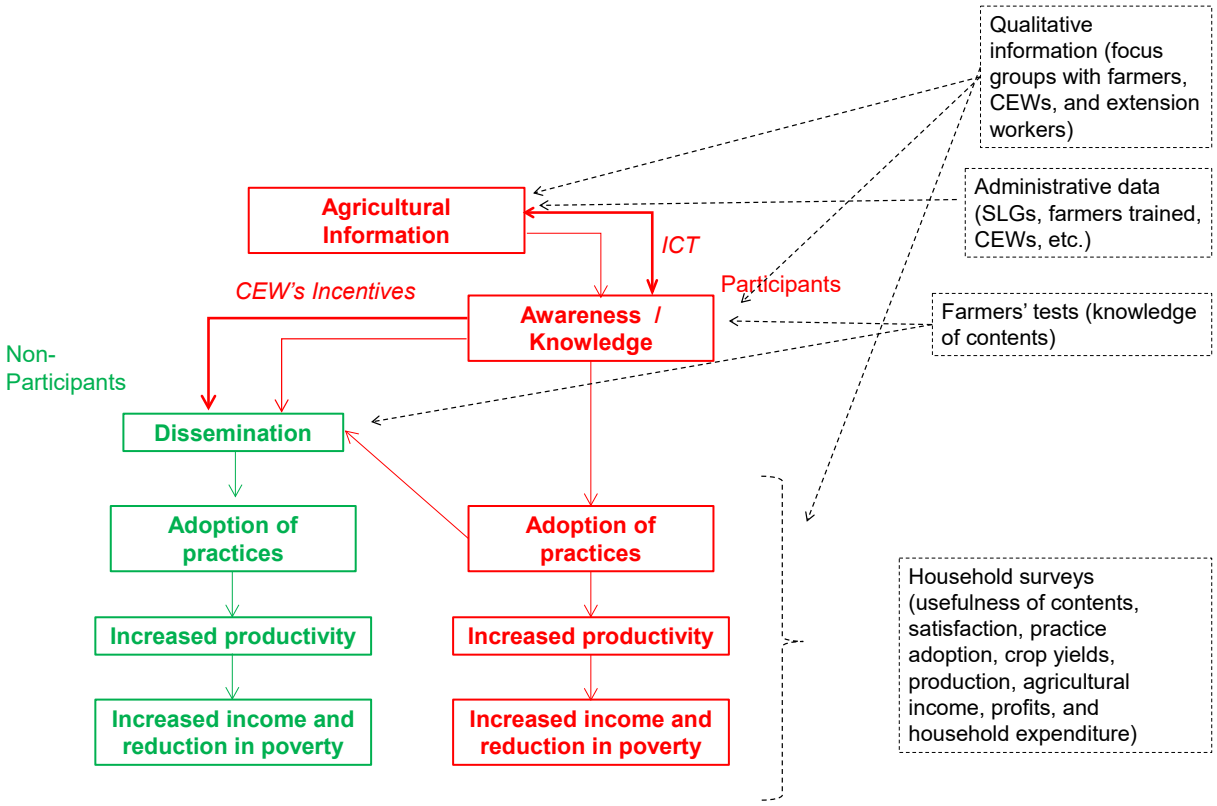


7 Theory of Change and Hypotheses[2]:

7.1 Theory of Change:

The theory of change for improving extension in Cambodia is relatively straightforward (Figure 7). We hypothesize that improved extension will lead to increased awareness of knowledge of better agricultural techniques. We are specifically thinking about the use of improved technologies (e.g. seeds) or inputs and practices. Improved knowledge will lead more farmers to adopt these technologies and practices, and improved practices will lead to increased agricultural productivity. Increased productivity then leads to higher welfare levels, which would increase resilience against shocks through self-insurance.

Figure 7 Schematic of Theory of Change



[2] Disclaimer: ePADEE has been successfully tested to provide farmers with advice for rice growing. In this line, our analysis will be focused on farmers' knowledge and adoption of practices for rice growing and rice yields. A new version of ePADEE is being developed to incorporate advice for vegetables. We will incorporate vegetable outcomes in our analysis inasmuch as we are able to confirm that the sections of the software for vegetables are working appropriately.

We posit that increases in the information through ICTs and the performance-based incentives will increase PADEE and ASPIRE extension workers' effort and enhance the quality of the agricultural advice they provide, as well as increasing the amount of contact between extension agents and farmers. Therefore, as farmers become more knowledgeable about potentially beneficial agricultural practices, the goal is that they will adopt at least some of these practices, which would increase crop yields and boost their agricultural income.

7.2 Hypotheses for ICT + Incentives Intervention in the PADEE Project

We will test the following hypotheses along our proposed theory of change. We will test whether ICTs and ICT combined with performance-based incentives:

Increase the interaction and farmers' satisfaction with extension agents and the information campaign: We will measure these outcomes through the number of visits of extension workers (self-reported by the farmers) and farmers' perception of the usefulness of the advice that they received from extension workers and the information campaign.

Increase the interaction between farmers organized in learning groups and those outside learning groups: We will measure these outcomes through the number of interactions to share the information received from extension workers and the information campaign with other members in the community (self-reported by the farmers).

Have a positive effect on farmers' knowledge of agricultural practices: We will collect farmers' knowledge of different "families" of practices: adequate fertilizer application, seed selection, and management of crop diseases; vegetable production techniques; chicken rearing knowledge, etc. We will create indexes for each family using the methodology outlined by Kling et al (2007), who propose creating summary measures by adding normalized outcomes[3]. We will also create an aggregate measure that will include practices in all families created for each intervention.

[3] Any particular outcome will be excluded when there is limited variation in the answers (e.g., everyone answer "Yes" or everyone report too similar values)

Lead to adoption of new agricultural practices: Similarly, we will measure adoption by creating indexes for the adoption of practices across families of practices (adequate fertilizer application, seed selection, and management of crop diseases, vegetable production, chicken rearing knowledge) and an aggregate measure of the three families. This outcome will reflect the intensive measure by which farmers are adopting potentially beneficial practices.

Lead to larger expenditures in selected agricultural inputs: To measure the extensive measure of this adoption, we will also investigate whether our interventions addition to the extension model also increase farmers' expenditures in selected agricultural outcomes. This will be measured by the households' expenditures in adequate fertilizers, seeds, and recommended inputs required to treat or prevent crop diseases.

Increase agricultural yields: We will measure agricultural yields by dividing the total harvest achieved by farmers during an agricultural season by the number of hectares allocated to crops, at least for rice. We will test both the yield as well as the logarithm of yields.

Increase farmers' agricultural income: We will measure farmers' income from agricultural activities, including cropping and poultry income. We will compute agricultural income by adding up the value of crops produced, using prices either internally generated by the survey (average prices for sold product within the household, or the median at the village level if the household did not sell) or from detailed surveys conducted by our partners, the Cambodian Development Research Institute, if not available for some rarely traded vegetables. We will then subtract input costs.

Increase value of production per hectare. Finally, we will take both gross and net values of agricultural production and divide by land size, to measure whether households increase crop income on a per land unit basis.

8 Estimation Methodology

Our main specifications will follow an ANCOVA (analysis of covariance) approach in our end-line surveys:

$$Y_{iv} = \beta_0 + \boldsymbol{\beta} \cdot \boldsymbol{T}_v + \delta_v + \alpha X_{iv} + \mu_{iv}$$

where Y_{iv} is an outcome variable of household i in village v (i.e., visits by extension workers, farmers' level of satisfaction, knowledge and adoption of agricultural practices, expenditure in selected agricultural inputs, yields, and agricultural income); $\boldsymbol{T}_v$ is a vector of indicators of the treatment assignment; they indicate if village v is assigned to each treatment arm (1x2 in the case of PADEE, and 1x3 in the case of ASPIRE); δ_v are stratification variables to adjust for the sample design and randomization; X_{iv} is a set of control variables and μ_{iv} is an error term. We will cluster the standard errors at the village level (randomization level).

Our set of control variables X_{iv} will include: the baseline value of the outcome [4] ; farmers' education, gender, age; and baseline household characteristics (i.e., shocks, non-agricultural income, and asset index). While we do not expect significant imbalances between the characteristics of households assigned to each treatment arm, X_{iv} will also include a set of variables at baseline for which we find significant differences between treatment arms.

We will also estimate heterogeneous effects on the treatment based on the following variables:

(a) farmers' level of education, (b) farmers' gender, (c) farmer and MST's previous agricultural experience, (d) farmer and MST's ICT literacy, (e) MST's income outside PADEE and ASPIRE, (e) MST's distance to assigned learning group, and (f) MST's risk and time preferences.

9 References

Birkhauser, D., R. Evenson and G. Feder (1991). The Economic Impact of Agricultural Extension: A Review. Economic Development and Cultural Change 39(3): 607-650

Feder, G., A. Willett, and W. Zijp (1999). Agricultural Extension: Generic Challenges and Some Ingredients for Solutions. Policy Research Working Paper 2129. Washington, DC: The World Bank

Gautam, M. (2000). Agricultural Extension: The Kenya Experience. Washington, DC: The World Bank

[4] Note that the baseline values will not be available for some of the outcomes (i.e., visits by extension workers, levels of satisfaction, knowledge and adoption of practices, etc.).

Kling, J. R., Liebman, J. B. and Katz, L. F. (2007), Experimental Analysis of Neighborhood Effects. Econometrica, 75: 83–119.

Swanson, B.E. and Rajalahti, R. (2010). Strengthening Agricultural Extension and Advisory Systems: Procedures for Assessing, Transforming, and Evaluating Extension Systems. Agriculture and Rural Development Discussion Paper 45. Washington, DC: The World Bank

Appendix 1 - List of PADEE Villages and Treatment Assignment

Province	Village	Treatment
Kampot	Trasek Kaong	Control
Kampot	Trapeang Ruessei	Control
Kampot	Prey Chek	Control
Kampot	Tuol Doun Tei	Control
Kampot	Thnong	ICT
Kampot	Doun Teav	ICT
Kampot	Trapeang Bei	ICT
Kampot	Trapeang Chheu Teal	ICT
Kampot	Ou	ICT + Incentives
Kampot	Krang Ampov	ICT + Incentives
Kampot	Boeng Ta Roung	ICT + Incentives
Kampot	Bos Trabaek	ICT + Incentives
Kandal	Kampong Trea	Control
Kandal	Prey Koul	Control
Kandal	Koun Chreae	Control
Kandal	Ta Nu	Control
Kandal	Preah Prasab	ICT
Kandal	Thum	ICT
Kandal	Tuol Spueu	ICT
Kandal	Dol	ICT + Incentives
Kandal	Khpob	ICT + Incentives
Kandal	Kakab	ICT + Incentives
Prey Veng	Prey Phngeam	Control
Prey Veng	Prey Phchet	Control
Prey Veng	Kandal	Control
Prey Veng	Tra Laeuk	Control
Prey Veng	Kreul	ICT
Prey Veng	Meun Poan	ICT
Prey Veng	Srah	ICT
Prey Veng	Khyaok Cheung	ICT
Prey Veng	Thnal Chey	ICT
Prey Veng	Angkal	ICT + Incentives
Prey Veng	Trapeang Run	ICT + Incentives
Prey Veng	Pring	ICT + Incentives
Prey Veng	Prey Rung	ICT + Incentives
Prey Veng	Ou Kandaol Cheung	ICT + Incentives
Svay Rieng	Ta Pa	Control
Svay Rieng	Preah Ponlea	Control
Svay Rieng	Trapeang Kampis	Control
Svay Rieng	Meun Chey	ICT
Svay Rieng	Prey Preaek	ICT
Svay Rieng	Ta Kot	ICT

Province	Village	Treatment
Svay Rieng	Ta Mom	ICT
Svay Rieng	Angk Sala	ICT + Incentives
Svay Rieng	Chhuk Sa	ICT + Incentives
Svay Rieng	Trapeang Thlok	ICT + Incentives
Svay Rieng	Thnong	ICT + Incentives
Takeo	Krang Touch	Control
Takeo	Dei Kraham	Control
Takeo	Daeum Phdiek	Control
Takeo	Roneam Tnaot	Control
Takeo	Tramaeng	Control
Takeo	Champa	ICT
Takeo	Ou	ICT
Takeo	Ruessei Chum	ICT
Takeo	Trapeang Rumpeak	ICT
Takeo	Rumlok	ICT + Incentives
Takeo	Ponsang	ICT + Incentives
Takeo	Trapeang Khchau	ICT + Incentives
Takeo	Cham Pol	ICT + Incentives

Appendix 2 - List of ASPIRE Villages and Treatment Assignment

province	district	commune_name	village_name	treat
Battambang	Bor Vel	Khdol Tahen	Ta Kout	Basic Msg
Battambang	Bor Vel	Khlaing Meas	Kampong Mkak	Basic Msg
Battambang	Bor Vel	L' Vear	Ream Sena	Basic Msg
Battambang	Bor Vel	Prey Khpos	Ta Hee	Basic Msg
Battambang	Bor Vel	Khdol Tahen	Sann	Control
Battambang	Bor Vel	Khlaing Meas	Anlong Raing	Control
Battambang	Bor Vel	L' Vear	Donn Ork	Control
Battambang	Bor Vel	Prey Khpos	Ta Mat	Control
Battambang	Bor Vel	Khdol Tahen	Kdol Kroam	Enhanced Msg
Battambang	Bor Vel	Khlaing Meas	Ou Donn Pov	Enhanced Msg
Battambang	Bor Vel	L' Vear	L' vea Chas	Enhanced Msg
Battambang	Bor Vel	Prey Khpos	Dang Kor Pen	Enhanced Msg
Battambang	Bor Vel	Khdol Tahen	Ta Hen	Enhanced Msg + Addtl Farmers
Battambang	Bor Vel	Khlaing Meas	Bous Sang Kreach	Enhanced Msg + Addtl Farmers
Battambang	Bor Vel	L' Vear	L' vea	Enhanced Msg + Addtl Farmers
Battambang	Bor Vel	Prey Khpos	Pou	Enhanced Msg + Addtl Farmers
Battambang	Sangkae	Kampong Preang	Kach Rotes	Basic Msg
Battambang	Sangkae	Roka	Ambeng Thngay	Basic Msg
Battambang	Sangkae	Kampong Preang	Sala Trav	Control
Battambang	Sangkae	Roka	Ta Hen 2	Control
Battambang	Sangkae	Kampong Preang	Ous Touk	Enhanced Msg
Battambang	Sangkae	Roka	Ta Hen 1	Enhanced Msg
Battambang	Sangkae	Kampong Preang	Sambok Ork	Enhanced Msg + Addtl Farmers
Battambang	Sangkae	Roka	Roka	Enhanced Msg + Addtl Farmers
Battambang	Thmar Kol	Anlong Roun	Sla Slak (Preah Sre)	Basic Msg
Battambang	Thmar Kol	Bansay Treng	Prey Leav	Basic Msg
Battambang	Thmar Kol	Ou Takie	Prey Dach	Basic Msg
Battambang	Thmar Kol	Roung Chrey	Roung Chrey	Basic Msg
Battambang	Thmar Kol	Anlong Roun	Krous	Control
Battambang	Thmar Kol	Bansay Treng	Spean	Control
Battambang	Thmar Kol	Ou Takie	Ou Takee	Control
Battambang	Thmar Kol	Roung Chrey	Pra Keab	Control
Battambang	Thmar Kol	Anlong Roun	Sla Slak	Enhanced Msg
Battambang	Thmar Kol	Bansay Treng	Bansay Treng	Enhanced Msg
Battambang	Thmar Kol	Ou Takie	Veal Trea	Enhanced Msg
Battambang	Thmar Kol	Roung Chrey	Toul	Enhanced Msg
Battambang	Thmar Kol	Anlong Roun	Cha	Enhanced Msg + Addtl Farmers
Battambang	Thmar Kol	Bansay Treng	Koang Kang	Enhanced Msg + Addtl Farmers

province	district	commune_name	village_name	treat
Battambang	Thmar Kol	Ou Takie	Popeal Khae	Enhanced Msg + Addtl Farmers
Battambang	Thmar Kol	Roung Chrey	Baklang Kroam	Enhanced Msg + Addtl Farmers
Pursat	Ba Kann	Kna Toteung	Bak Mek	Basic Msg
Pursat	Ba Kann	Ou Tapoarng	Robors Raing	Basic Msg
Pursat	Ba Kann	Kna Toteung	Derm Roka	Control
Pursat	Ba Kann	Ou Tapoarng	Chamka Khloy	Control
Pursat	Ba Kann	Kna Toteung	Chroch Serch	Enhanced Msg
Pursat	Ba Kann	Ou Tapoarng	Ouknha Moan	Enhanced Msg
Pursat	Ba Kann	Kna Toteung	Khna Toteung	Enhanced Msg + Addtl Farmers
Pursat	Ba Kann	Ou Tapoarng	Chamka Ou	Enhanced Msg + Addtl Farmers
Pursat	Kra Ko	Kampong Po	Moat Prey	Basic Msg
Pursat	Kra Ko	Kbal Trach	Kra Lanh	Basic Msg
Pursat	Kra Ko	Sna Ansa	Veal Vong	Basic Msg
Pursat	Kra Ko	Thnoat Chum	Krabei Sor	Basic Msg
Pursat	Kra Ko	Kampong Po	Po Kod	Control
Pursat	Kra Ko	Kbal Trach	Samroang	Control
Pursat	Kra Ko	Sna Ansa	Beng	Control
Pursat	Kra Ko	Thnoat Chum	Kandal	Control
Pursat	Kra Ko	Kampong Po	Lous Kert	Enhanced Msg
Pursat	Kra Ko	Kbal Trach	Trapaing Romdenh	Enhanced Msg
Pursat	Kra Ko	Sna Ansa	Chee Ches	Enhanced Msg
Pursat	Kra Ko	Thnoat Chum	Dang Teuk Lorch	Enhanced Msg
Pursat	Kra Ko	Kampong Po	Sna Reach	Enhanced Msg + Addtl Farmers
Pursat	Kra Ko	Kbal Trach	Sre Russey	Enhanced Msg + Addtl Farmers
Pursat	Kra Ko	Sna Ansa	Kraing Veng	Enhanced Msg + Addtl Farmers
Pursat	Kra Ko	Thnoat Chum	Prey Khla	Enhanced Msg + Addtl Farmers
Pursat	Pursat	Chamrern PhaL	Kampong Stong	Basic Msg
Pursat	Pursat	Sangkat Dob Bath	Wat Loung	Basic Msg
Pursat	Pursat	Chamrern PhaL	Kdei Khvav	Control
Pursat	Pursat	Sangkat Dob Bath	Dob Bath	Control
Pursat	Pursat	Chamrern PhaL	Ou Tong	Enhanced Msg
Pursat	Pursat	Sangkat Dob Bath	Damnak Ampil	Enhanced Msg
Pursat	Pursat	Chamrern PhaL	Svay Meas	Enhanced Msg + Addtl Farmers
Pursat	Pursat	Sangkat Dob Bath	Khmar	Enhanced Msg + Addtl Farmers

Appendix 3 – Voice Messages Script for Information Campaign ASPIRE

Consent/Validation Voice Message

S.No.	Survey	Logic
Introduction	Hello! This is a phone call from Ministry of Agriculture Forest and Fisheries. We have prepared text messages that will be sent by phone call soon to introduce farmers to the main agricultural techniques and markets in contributing to increasing household incomes for Cambodian farmers. Before starting the project, we have two questions that will take only a few minutes to answer. Please press the button to answer the question. We would like to thank you for answering the following questions:	Go to Q1
Q1	Are you a farmer? If yes, press 1 If no, press 2	Go to Q2
Q2	Please listen to the following list of villages. When you hear the name of your village please press the corresponding number- If you live in Chroch Serch, Press 1 If you live in Khna Toteung, Press 2 If you live in Bak Mek. Press 3 If you live in Chamka Ou. Press 4 If you live in Ouknha Moan, Press If you live in Robors Raing, Press 6	Go to Q3

Q3	Would you like to receive messages that would benefit your farming techniques/production to help increase family increase family income? If you want to receive a message, Press 1 If you do not want to receive the message, Press 2	If option 1, go to info message If option 2, go to exit 2
Info Message	Which crops would you like to receive messages on? You can select "yes" for more than one crop.	Go to Q3a
Q3a	Would you like to receive messages about rice? If yes, press 1 If no, press 2	Go to Q3b
Q3b	Would you like to receive messages about vegetables? If yes, press 1 If no, press 2	Go to Q3c
Q3c	Would you like to receive messages about chicken? If yes, press 1 If no, press 2	Go to thank you
Exit 1	We are sorry you do not qualify to participate in the survey!	
Exit 2	We are sorry to know that you do not want to receive messages	
Thank you	Thank you for your consent, we will be sending you the voice messages in the future.	

Voice messages for Rice farmers

Overall Messages	Reminder message	Time for sending the message	
Hello! This is the message from your agricultural extension worker. We would like to remind you some key points for improving your rice production.			
High yield rice varieties (not include in the message)			
We want to introduce some good rice varieties where are tolerant to climate varieties and giving good yields: CAR15, 100 days, can be cultivated anytime of the year, the yield is between 4.2 to 7.4 ton/ha, Sen Pidor, 110 to 120 days, an aromatic rice with high quality grain, the yield is between 3.5 to 5.5 ton/ha, Raing Chey, 120 days, can cultivate only in wet season, the yield is between 3.5 to 5.5 ton/ha, Phakar Rumduol, 120 days, mostly is suitable for wet season, the yield is between 3.5 to 5.5 ton/ha, Phakar Romeat, 120 days, mostly is suitable for wet season, the yield is between 3.5 to 5.8 ton/ha,		1st week of May	1st week of Sep
Land preparation		**Wet rice**	**Dry rice**
To get high yield you must cultivate a good quality seeds and follow key steps in your rice cultivation. You must plow and level your field well before broadcasting the seeds.	To get high yield you must cultivate a good quality seeds. However, there is no guarantee that a good rice varieties will give you high yield. You must follow important steps in order to get high yield. The first stage is to plough your field twice. The second plowing should be one week after the first plowing. And the seed broadcasting must be one week after the second plowing. And you have to level your field so that you can control the water well enough, and fertilizer will spread	1st week of May	1st week of Sep

	evenly in the field which makes your paddy grow well entire the field.		
Seeds cleaning			
You must prepare your seeds 2 to 3 days before the seeds broadcasting. To get a good seeds you must follow the process by boiling water in a medium or big pot to 60^0C, keep your seeds in a bag making from net, and soak them in the hot water for 10 minutes, stir it well so that bad seeds will be floating on the surface, then remove them from the pot, after that take out the good seeds from the pot and soak them in the normal water to cool them down. This is the way to get good seeds and also to kill bug at the same time. Once the seeds cooled down, you must soak it in the a new water with normal water for 24 hours, then take the seeds out of the water and keep them hidden in a dry place for another 24 hours before it is ready for sowing or broadcasting. Other approach is to winnow the seeds well to ensure bad seeds are separated from the good seeds. Then you must dry your seeds in the sun for 30 minutes between 8 and 9 am. After that you keep you seeds to the normal temperature, and soak them in the water with normal temperature for 24 hours, take them out and keep them hidden for another 24 hours before it is ready for broadcasting.	You must clean and prepare your seeds 2 to 3 days before the seed broadcasting. You can winnow the seeds well to ensure bad seeds are separated from the good seeds. Then you must dry your seeds in the sun for 30 minutes between 8 and 9 am. After that you keep you seeds to the normal temperature, and soak them in the water with normal temperature for 24 hours, take them out and keep them hidden for another 24 hours before it is ready for broadcasting.	1st week of May	1st week of Sep
Seed broadcasting			
You need 60-80kg of good seeds for spreading over an area of 1 ha, For the first 21 days after the seed broadcasting, it is important that you remove snail from your field,	You need 60-80kg of good seeds for spreading over an area of 1 ha, For the first 21 days after the seed broadcasting, it is important that you remove snail from your field,	3rd week of May	2nd week of Sep
Managing your field			
You must regularly remove weeds from within your paddy field on the dikes surrounding your field, Weeds are source of diseases destroying your rice plant, And also, too much weeds will block sunlight from reaching your rice field bed,	Build dike around your field for control the flow of water to and from your field, Weed control is important in preventing losses in yield and	Every week during May and Aug	Every week during Sep and Dec

Build dike around your field for control the flow of water to and from your field,	production costs, and to preserve good grain quality If there is enough sunlight reaches your rice field bed, it makes your rice healthy which boost for high yield, Experiments show that weeds absorb away 50% of nutrients from your fertilizers,		
Soil fertility management			
Applying nutrients to your rice field is essential in managing your soil fertility so that your rice can grow well and give high yield, Beside compost or manure you can apply chemical fertilizer as the following: Apply 50kg/ha of the DAP mixes with powdered herbicide one month after the seeds broadcasting, Urea (N) (46-0-0), for boosting, during the PI stage, apply 50kg/ha, When applying fertilizer, you must ensure that there is enough water in your field, Before applying fertilizer you must remove weeds from your field, Do not apply urea when the rice leaves are wet, Do not apply urea when there is certainty that rain will come soon,	Beside compost or manure you can apply chemical fertilizer as the following: Apply 50kg/ha of the DAP mixes with powdered herbicide one month after the seeds broadcasting, Urea (N) (46-0-0), for boosting, during the PI stage, apply 50kg/ha, When applying fertilizer, you must ensure that there is enough water in your field, Before applying fertilizer you must remove weeds from your field, Do not apply urea when the rice leaves are wet,	Early June and July	Early Oct and Dec
Pesticide and herbicide			
There are pesticide and herbicide where you can use. But it is better that you consult with your CEW before applying any one of it. Pesticide and herbicide can be well applied when there is good sunlight, you can apply it in the middle of the day when the leaves are dried up, and be sure to spray it in parallel with the wind direction.	Pesticide and herbicide can be well applied when there is good sunlight, you can apply it in the middle of the day when the leaves are dried up, and	Every week during May and Aug	Every week during Sep and Dec

When applying chemicals, you must wear protective gears, i.e., hat, goggle, mask, plastic gloves, long sleeves shirt, pants, and boots.	be sure to spray it in parallel with the wind direction. When applying chemicals, you must wear protective gears, i.e., hat, goggle, mask, plastic gloves, long sleeves shirt, pants, and boots.		

References:

1. MAFF/JICA, Basic knowledge for rice cultivation, 2nd edition
2. MAFF/JICA, Calendar for rice growing
3. IRRI, Rice knowledge bank, http://www.knowledgebank.irri.org/step-by-step-production/growth/pests-and-diseases (assessed on June 6th, 2017)

Voice message for vegetable growing farmer

OVERALL MESSAGE for cucumber and long bean	**Reminder Messages**	**Time for sending the message**
Hello! This is the message from your agricultural extension worker. We would like to remind you some key points for improving your vegetable production.	Hello! This is the message from your agricultural extension worker. We would like to remind you some key points for improving your vegetable production.	
Soil preparation: Before growing vegetable you must always prepare your land. Firstly, you must remove all weeds. Then, 10 to 15 days before growing, you must plow your field. The depth of the plow is between 15 to 20 cm.		
Ridge preparation: If you grow cucumber, and long bean you must prepare ridge with 1 m width and the length should not exceed 15 m as this would make it easy for watering and weeding. The height of the ridge, for dry season cultivation, should be between 20 cm – 30 cm. For wet season cultivation, the height should be between 30 cm – 50 cm. When preparing the ridge, you must apply manure or compost between 1 kg to 2 kg for the area of $1m^2$. After that you can cover your vegetable ridge with rice hay or plastic sheet. The distance from one ridge to another should be 0.5 m.	When preparing the ridge, you must apply manure or compost between 1 kg to 2 kg for the area of $1m^2$. After that you can cover your vegetable ridge with rice hay or plastic sheet.	
Producing seeding: When producing seedlings you can prepare the soil by mixing 1 part of fertile soil, 2 parts of compost or dried manure, and 2 to 4 parts of ash from hay. *Note: the ash from hay must be soaked in water for 3 to 4 nights.* Then fry these mixture well so that all parts are getting hot. After that you have to keep it cool, and later on you can put it into small bowl or tray for producing seedling. Then put each seed into the		

small bowl or tray filled with the mixture, put more mixture to cover the seed, watering the small bowls or the seeding tray. Keep watering it once or twice a day. If the soil dries your seed may not grow. Your seeding bowl or seeding tray must be kept in an area with enough shading and cover with net for protecting insects.		
Transplanting: One ridge can be transplanted for two rows, you can make small pits for transplanting the seedlings, the distance between each small pit for transplanting the seedlings is 0.5 m.		
Watering: You must watering your vegetable by pumping water into the surface between each ridge in the morning. You cannot water your vegetable at noon as it makes the ground too wet at night which could damage their roots. You must watering your vegetable regularly especially, after the transplanting to prevent the ridge too dry. When you observe the soil around the vegetable dries where you cannot roll it together you must put more water. But if you apply too much water the ground is too wet where your vegetable's roots may damage.	You must watering your vegetable regularly especially, after the transplanting to prevent the ridge too dry. When you observe the soil around the vegetable dries where you cannot roll it together you must put more water. But if you apply too much water the ground is too wet where your vegetable's roots may damage.	
Installing trellis: You must install trellis and nets to support the vine. The vine must be tied to the trellis so that it can climb. You must cut out leaves that touch the ground for preventing diseases.		
Weeding: you must remove weeds from the ridge. Weeds are enemy to the vegetable. It absorbs fertilizer you apply for your vegetable and it is the refuge for insects that destroy your vegetable. Weeds is also an agent bringing diseases to your vegetable.	you must remove weeds from the ridge. Weeds are enemy to the vegetable. It absorbs fertilizer you apply for your vegetable and it is the refuge for insects that destroy your vegetable. Weeds is also an agent bringing diseases to your vegetable.	

Cucumber: **Transplanting:** After your cucumber seed has germinated for 7 days, it is ready for Transplanting. However, after 3 days of the germination you must put your seedling expose to sun light for 4 days so that the seedlings are stronger and ready for transplanting. During this period you must also reduce giving them water. You can transplant the seedling in the afternoon. You have to remove your seedling from the bowl or tray carefully preventing their roots from damaging. You must put it in each small pit in your vegetable ridge just below the top soil of your seedling to prevent it from rotten. **How to apply fertilizer:** 15 days before transplanting, you can apply compost or rotten manure for 1 to 2 kg per $1m^2$; 5-7 days before transplanting you must apply 20-20-15 for 5 g per the small pit you made for the transplanting the seedlings; 7 days after the transplanting you can apply 40-0-0 for 5 g per bush into the two small pits you just made 5 cm to 16 cm on each side of the bush; 14 days after transplanting, you can apply 20-20-15 for 5 g per bush into a small pit along the line you made 18 cm to 25 cm from the bush;	To get high yield you must apply fertilizer and watering them regularly. You must apply fertilizer for boosting the growth every 7 or 15 days.	

18 to 19 days after the transplanting you can apply 30-5-5 for the ratio of 50 g into 16 l of water. This amount of solution can be sprayed for the area of 500 m^2. You can spray this solution into the leaves and the vine; 21 days after the transplanting you can apply 20-20-15 for 5 g per bush, put into a small pit aligned with the row for 18 cm to 25 cm from the bush; 29 to 31 days after the transplanting you can spray fertilizer 11-9-40, boosting for flower and fruit for 5 g per bush. The ratio for making the solution is 50 g of the fertilizer into 16 l of water for spraying the area of 500 m^2. 35 days after the transplanting you can apply 0-0-60 in combination with 16-20-0 for 5 g per bush into a hole you make 18 cm to 25 cm per bush; 43 days after the transplanting you can apply 0-0-60 in combination with 16-20-20 for 5 g per bush into a small pit aligned with the row you make 18 cm to 25 cm from the bush; 51 days after the transplanting you can apply 0-0-60 together with 16-20-0 for 5 g per bush into a mall pit aligned with the row you make 18 cm to 25 cm from a bush 52 to 54 days after the transplanting you must spray the solution of 11-9-40 for boosting flower and fruit. The ratio is 50 g of the fertilizer into 16 l of the water for spraying the area of 500 m^2 60 days after the transplanting you must apply 0-0-60 for 5 g per bush into a small pit aligned with the row you make 18 cm to 25 cm from a bush	If you grow your cucumber on sandy soil you must apply fertilizer more frequently but the amount of the fertilizer you apply each time is less than you grow on other soil type. Fertilizer cannot apply when it is hot as the fertilizer may evaporate faster and as it is hot it could burn your cucumber's leaves. After applying the fertilizer, you must watering your cucumber immediately.	

Diseases: Yellow leaf, the disease can be seen appearing on the cucumber leaves with yellow dots and later on the yellow dots turn to brown. On the other side of the leaf we can observe black dots if you contrast the leave with the sunlight. **How to treat this disease:** 1. Remove the yellow dot leaves from the vine by hand or by a tool such as knife and scissors, the leaves must be buried in the ground 2. Spray the vine with Metalaxyl for one time and Mancozeb for another time. You can spray only in late afternoon 3. Do not give you cucumber too much water **How to prevent the yellow leaves disease:** 1. the distance of the row must be wide enough, and hole for transplanting seedlings must be also expanded, 2. remove weeds, 3. remove leaves with yellow dots and burry in the ground, 4. Spray Metalaxy or Fosetyl-Al to prevent this disease **Note:** *you can spray chemical preventing yeast one time every 3 to 7 days in late afternoon (if you spray in the morning or lunch time, it can burn your cucumber's leaves). The chemical*		

must be mixed with sticky water so that the chemical can present longer time). **Pest:** thrips are agent bringing virus to your cucumber. They are too small to be observe by naked eyes. They like to live in the tip of the new leaves. Therefore, it is hard to kill them. **How to prevent the strip and kill them:** - your seedling must be covered with net, - select only healthy seedling for transplanting, - grass and remains of your vegetable must be burned out, - you can trap the strips with blue sticky blue **How to make the sticky trap:** - paint small size of a plastic sheet with blue sticky glue, and place the sheet around your field between 7 m to 10 m each. - you can take turn in applying chemicals, i.e., Imidacloprid, Thiamethoxan, Abamectin, and Azadirachtin; the chemical must be sprayed thoroughly, and they must be applied only in late afternoon. **Note:** *the chemicals must not be mixed together as there might be chemical reaction where the effectiveness is less, you must*		

mix the chemicals with sticky water so that it can present in your field for longer time When harvesting, you must place your cucumber in a plastic bag with small holes so that air can flow in and out preventing your cucumber from degraded sooner.		
Long bean		
Overall message as above		
Transplanting: After the seedlings grown for 3 days you have to put them exposing to sunlight for 3-4 days and reducing watering. This is the way making the seedling stronger before transplanting. You make small pits for two rows per ridge, the small pits of both rows should be aligned to each other in rectangle shape or triangle shape; the distance between one small pit to another in the same row is 0.5 m; you must put chemical fertilizer in each small pit by mixing them with the soil; put water into the surface between each ridge; then you can transplant the seedlings in late afternoon. You can put Dinotefuran for 2 g per small pit before transplanting to prevent insect from destroying your seedlings.		

Direct seeding: in case your soil is good which can make your seeds germinate easily you can grow the long bean by direct seeding. If you can do this it saves your money and time in producing seedlings. To do this you must make small pits (2 rows per ridge, the distance between each small pits is 0.5 m), pure water into the surface between each ridge, then put Dinotefuran in each small pit for 2 g to prevent insects; then you can put 2 dried seeds into each small pit; you can also use the germinated seeds for direct seeding as well. **How to apply fertilizer:** 15 days before transplanting/seeding, apply compost or rotten manure for 1 to 2 kg for the area of $1m^2$ (for mixing with the soil); 5-7 days before transplanting, apply 20-20-15 for 5 g per hole for transplanting (put into the hole); 7 days after transplanting, apply 20-20-15 together with 46-0-0 for 5 g per hole into 2 holes with 10 cm on both sides of the vine; 14 days after transplanting, apply 20-20-15 and 46-0-0 for 5 g per hole into 2 holes with 10 cm on both sides of the vine; 21 days after transplanting, apply 20-20-15 and 16-20-0 for 5 g per hole into a hole with 18 to 25 cm from the vine; 28 days after transplanting, apply 20-20-15 and 16-20-0 for 5 g per hole into a hole with 18 to 25 cm from the vine;	**Taking care of your long bean:** you must apply chemical fertilizer and	

35 days after transplanting, apply 20-20-15 and 0-0-60 for 5 g per hole into a hole with 18 to 25 cm from the vine; 42 days after transplanting, apply 20-20-15 and 0-0-60 for 5 g per hole into a hole with 25 cm from the vine; 49 days after transplanting, apply 20-20-15 and 16-20-0 for 5 g per hole into a hole with 18 to 25 cm from the vine; 56 days after transplanting, apply 20-20-15 and 0-0-60 for 5 g per hole into a hole with 25 cm from the vine; 63 days after transplanting, apply 20-20-15 and 16-20-0 for 5 g per hole into a hole with 25 cm from the vine; You must keep applying the fertilizer until the vine gives no more yield. Amount of fertilizer can be varied according to soil type. **Note:** *you must spray fertilizer solution to boost the growth of it leaves after 7 days of the transplanting until it gives flowers. You must spray it once in every 7 days. Then you must spray fertilizer solution to boost flower and fruit after it gives first flower. You must keep doing this once for every 7 days.* **Diseases and insects:** Thrips cause the flower to brown, dry and easily fall down from its stem. The new leaves and old leaves curl down and die. **How to protect:**	watering your bean regularly so that it can give higher yield. You must apply fertilizer every 7 days. To get high yield you must apply fertilizer and watering them regularly. You must apply fertilizer for boosting the growth every 7 to 15 days. If you grow your long bean on sandy soil you must apply fertilizer more frequently but the amount of the fertilizer you apply each time is less than you grow on other soil type. Do not apply fertilizer when it is hot as fertilizer may evaporate quickly. Watering immediately after applying chemical fertilizer.	

Do not grow the same species in the same field; Use plastic sheet with blue sticky glue to trap the trhips, the sheet must be installed 7 m to 10 m from each other. You can also take turn to spray the following pesticides thoroughly into your long bean: Imidacloprid, Thiamethoxan, Abermectin, and Fipronil. **Aphid:** Remove it by hand; use plastic sheet painted with yellow sticky glue to trap them. The sheet must be install 7 m to 10 m from each other. **Worm that destroys flower and fruit:** you must remove the flower and fruit with the worm and have them burnt. If you don't do that worm that become butterfly will lay more eggs and the worm from these eggs are more destructive. The last effort is apply pesticide – Abermectin, and Cypermethrin. **Harvest:** you must harvest in the morning by using scissors cutting the stems.		

Eggplant		

Overall Messages

Hello! This is the message from your agricultural extension worker. We would like to remind you some key points for improving your vegetable production.

Soil preparation:

Before growing vegetable you must always prepare your land.

Firstly, you must remove all weeds. Then 10 to 15 days before growing, you must plow your field. The depth of the plow is between 15 to 20 cm.

Ridge preparation:

If you grow eggplant you must prepare ridge with 1 m width and the length should not exceed 15 m as this would make it easy for watering and weeding.

The height of the ridge, for dry season cultivation, should be between 20 cm – 30 cm. For wet season cultivation, the height should be between 30 cm – 50 cm.

When preparing the ridge, you must apply manure or compost between 1 kg to 2 kg for the area of $1m^2$.

After that you can cover your vegetable ridge with rice hay or plastic sheet.

The distance from one ridge to another should be 0.5 m.

Producing seeding:

Hello! This is the message from your agricultural extension worker. We would like to remind you some key points for improving your vegetable production.

When preparing the ridge, you must apply manure or compost between 1 kg to 2 kg for the area of $1m^2$.

After that you can cover your vegetable ridge with rice hay or plastic sheet.

The distance from one ridge to another should be 0.5 m.

When producing seedlings you can prepare the soil by mixing 1 part of fertile soil, 2 parts of compost or dried manure, and 2 to 4 parts of ash from hay. *Note: the ash from hay must be soaked in water for 3 to 4 nights.* Then fry these mixture well so that all parts are getting hot. After that you have to keep it cool, and later on you can put it into small bowl or tray for producing seedling. Then put each seed into the small bowl or tray filled with the mixture, put more mixture to cover the seed, watering the small bowls or the seeding tray. Keep watering it once or twice a day. If the soil dries your seed may not grow. Your seeding bowl or seeding tray must be kept in an area with enough shading and cover with net for protecting insects.		
Transplanting: After one month of the germination, the seedlings are ready for transplanting. But before transplanting you must put your seedlings exposing to sunlight for 5 days to strengthen them. During this period, you must reduce giving them water. The distance between the ridge is 0.5m, and the width of the ridge is 1 m. You can transplant the seedlings for 2 rows in one ridge. The distance between one seedling to another is 0.75m. You can transplanting the seedlings in triangle or rectangular shape.		

Before transplanting, you can put 2 g of Dinotefuran into each hole for transplanting to prevent pest (fly, thrips) **Taking care of your eggplant:** You can put fertilizer into 2 small pits you made on each side of the seedling; After 10 days of the transplanting, you can put fertilizer into the 2 small pits 10 cm from the tree; After 3 weeks of the transplanting you can put fertilizer into the 2 small pits 18 cm to 25 cm from the tree; After 42 weeks, you can put fertilizer in the small pits in the middle of each tree along the row. Fertilizer must be applied regularly in the interval of 7 days to 15 days (depends on the soil type). For sandy soil, you must apply fertilizer more frequently. Fertilizer must not apply when it is hot as the fertilizer may evaporate faster. After applying the fertilizer, you must watering your eggplant **Type of fertilizer:** 15 days before transplanting, apply compost or rotten manure by mixing them with the soil for 1 kg to 2 kg per $1m^2$ of the area;	Fertilizer must be applied regularly in the interval of 7 days to 15 days (depends on the soil type). For sandy soil, you must apply fertilizer more frequently, but the amount of the fertilizer you apply each time is less than you grow on other soil type. Fertilizer must not apply when it is hot as the fertilizer may evaporate faster. After applying the fertilizer, you must watering your eggplant	

5 to 7 days before transplanting, apply 20-20-25 into the small pits for transplanting, 5 g per pit, for transplanting the seedlings; 7 days after transplanting, apply 20-20-15 in mixture with 46-0-0, 5 g pre tree, put the fertilizer into the small pits 10 cm from the tree; 14 days after transplanting, apply 20-20-15 in mixture with 46-0-0, 5 g per tree, put them into the mall pits 10 cm from the tree; 21 days after transplanting, apply 20-20-15 in mixture with 16-20-0, 5 g per tree, put them into the small pits 18 cm to 25 cm from the tree; 28 days after transplanting, apply 20-20-15 in mixture with 16-20-0, 5 g per tree, put them into the small pits 18 cm to 25 cm from the tree; 35 days after transplanting, apply 20-20-15 in mixture with 0-0-60, 5 g per tree, put them into the small pits 18 cm to 25 cm from the tree; 42 days after transplanting, apply 20-20-15 in mixture with 16-20-0, 5 g per tree, put them into the small pits 25 cm from the tree; 49 days after transplanting, apply 16-20-0 in mixture with 0-0-60, 5 g per tree, put them into the small pits 25 cm from the tree; 56 days after transplanting, apply 20-20-15 in mixture with 16-20-0, 5 g per tree, put them into the small pits 25 cm from the tree; 63 days after transplanting, apply 16-20-0 in mixture with 0-0-60, 5 g per tree, put them into the small pits 25 cm from the tree; **Note:** *you have to apply fertilizer until it give no more fruit. Giving right fertilizer can give higher yield.*	You can spray fertilizer solution for supporting the grow of its leaves every 7 days until it start to give flower; after that you can spray fertilizer solution for boosting flower and fruit every 7 days; When transplanting you must install structure for supporting the trees preventing them from falling down; you must remove all branches and leaves than can touch the ground so that wind can flow freely. You must watering your eggplant every day for two weeks after the transplanting so that the tree can grow well; do not leave the soil dries for more than 3 days, especially when it start giving flower and young fruit; to watering is to put water into the surface between each ridge.	

You can spray fertilizer solution for supporting the grow of its leaves every 7 days until it start to give flower; after that you can spray fertilizer solution for boosting flower and fruit every 7 days; When transplanting you must install structure for supporting the trees preventing them from falling down; you must remove all branches and leaves than can touch the ground so that wind can flow freely. **Watering:** You must watering your eggplant every day for two weeks after the transplanting so that the tree can grow well; do not leave the soil dries for more than 3 days, especially when it start giving flower and young fruit; to watering is to put water into the surface between each ridge. **Worm control:** Worm cutting fruit and trunk – butterfly, usually, lays her egg beneath the leaves, flower and trunk. After that it becomes worm cutting the fruit and the trunk. You have to remove young leaves/young fruits, burn or burry them in the ground. If you don't do that these worms will become butterfly and lay eggs on your eggplant again. This time the level of destructive is even worse. To be effective you can also spray chemicals (chlorphyrifos + cypermethrin), fipronil, Bacillus thuringiensis when the eggs become worms		

Worm cutting leaves: you can spray chemicals – chlorphyrifos+cypermethrin, fipronil, and Bacillus thuringiensis. **Red spider:** this insect invades vegetable like eggplant, chilly, bitter gourd, watermelon, cucumber and tomato. It can burn old leaves. They invade when the weather is hot and dry. You have to observe you vegetable everyday finding the sing of the red spider, remove leaves that the spider cuts and burn; you can spray homemade pesticide (leaves from neem tree + chilly, or garlic); you can also apply chemicals on both sides of the leaves, i.e., Imidacloprid, Diazinon, and Abermectin **Aphid:** aphid can destroy all types of vegetable. The sign of the presence of aphid is by observing that more ants the vegetable. After 3 to 4 days of its presence vegetable leaves will shrink and curl downward that causes the vegetable to grow slowly. Aphid is known to be an agent bringing virus to vegetable. How to prevent aphid: you can remove them out by hand, you can trap them by using yellow glue; you can apply Dinotefuran for 2 g per hole for transplanting the seedlings. You can apply before transplanting, If you have to apply after the transplanting, it should not be over 7 days after the transplanting; you can also spray Imidacloprid, Methomyl and Abermectin.		

Harvesting: you can harvest in the morning by using scissors cutting its stem		

References:

MAFF/DAE. 2013. Tonle Sap Technology Demonstrations for Productivity Enhancement

(Cofinanced by the Government of Finland and the Republic of Korea e-Asia and Knowledge Partnership Fund). *Vegetable Growing Technique Manual.* Phnom Penh.

Voice message for chicken rearing farmer

Overall Messages	Reminder Messages	Time for sending the message
Hello! This is the message from your agricultural extension worker. We would like to remind you some key points for improving your chicken production.		
Fencing your chicken		
Your chicken can grow well if you keep them inside an areas with good fencing. This is because you can supervise and feed them well. If you let your chicken roaming around your house, you cannot feed them well and your chicken can get diseases easily. The place where you grow your chicken must be on high ground and there must be enough sunlight. You must spread compost in the premises for the growth of insects which can provide feed for your chicken. You must sweep and clean the premises very often. You can use rice-hush, saw dust, dry grass or hay laying on the floor inside your chicken house as they can help keeping the area dry.	Your chicken can grow well if you keep them inside an areas with good fencing. This is because you can supervise and feed them well. You must spread compost in the premises for the growth of insects which can provide feed for your chicken. You must sweep and clean the premises very often. You can use rice-hush, saw dust, dry grass or hay laying on the floor inside your chicken house as they can help keeping the area dry.	
How to select a cock		

If you have to select adult chicken for raising, you must know how to select good cock and good hen. A good cock that is suitable for breeding is physically big, and it has no history of getting diseases. It should be 2 kilograms or over in weight. For hen, it should lay egg of at least 12 eggs per generation. If you have to select good chick for raising, you must ensure the chick is big in physique, shrill voice, agile, and broad shoulder, and manure does not cling to the rump.		
How to feed your chicken		
There are 4 main groups of feed that chickens need: body building feed, energy giving feed, protective feed and mineral feed. Lack of any element of the said feed leads to changes in functions of organs and the organs will grow slowly. - for chicks below 7 or 14 days, you must feed them with commercial feed (buy from market) only, - for chicks between 14 to 30 days, you can feed them with half with commercial feed and half with feed that is available around your house, - for chicken above 30 days, you can feed them with one part of commercial feed and 3 parts with feed available around your house,	You must feed your chicken so that they can grow up well: - for chicks below 7 or 14 days, you must feed them with commercial feed (buy from market) only, - for chicks between 14 to 30 days, you can feed them with half with commercial feed and half with feed that is available around your house, - for chicken above 30 days, you can feed them with one part of commercial feed and 3 parts with feed available around your house,	
How to make chicken feed by yourself		
- soak paddy for one to two days until it germinate, chop vegetable to small pieces, grind snail/crab shells to be		

powder like, and mix them together then you can feed your chicken,		
Common chicken diseases in Cambodia		
***Newcastle (sign)* -** gaping beak, coughing, sneezing, gurgling, rattling …, ***Fowl Pox (sign)* -** characterized by proliferative lesions in the skin that progress to thick scabs (cutaneous form) and by lesions in the upper GI and respiratory tracts (diphtheritic form), ***Fowl Cholera (sign)* –** dejection, ruffled feathers, loss of appetite, diarrhea, coughing, ***Parasite chicken (signs)* –** grow slowly, skinny …		
Vaccination		
Vaccinate healthy chicken regularly, Each vaccine should be given one to two weeks after another, Each chicken, at least, should be given three types of vaccine (Newcastle, fowl pox, and fowl cholera)	Vaccinate healthy chicken regularly, Each vaccine should be given one to two weeks after another, Each chicken, at least, should be given three types of vaccine (Newcastle, fowl pox, and fowl cholera)	
Schedule for vaccination		
3-5 days (age) – drop Newcastle vaccine on their eyes or nose, 10-14 days (age) – shot on the left wing (fowl pox), 2 months (age) - shot through the muscle (fowl cholera),	3-5 days (age) – drop Newcastle vaccine on their eyes or nose, 10-14 days (age) – shot on the left wing (fowl pox),	

2 months and 2 weeks (age) – deworming (mix with feed)	2 months (age) - shot through the muscle (fowl cholera), 2 months and 2 weeks (age) – deworming (mix with feed)	

IF you have doubt on any point, you can contact your CEW for advice.

References:

1. NCDD, Chicken raising poster,
2. Teacher training center, Content of Agricultural Life Skills for Teacher Training Centers,
3. MAFF, Chicken raising technique