Adoption of Horticultural Innovations to Small-scale Vegetable Farmers in Cambodia: *Connecting to What I have Learned in IAD*

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Executive Summary

The purpose of this paper is to conduct a 5-year post-project assessment of small-scale vegetable farmers' adoption of net-house horticultural innovations in Cambodia using saving groups as the platform to introduce the technology. This paper summarizes our initial approaches to organizing horticultural technology fairs for farmers and other project stakeholders. Archived project documents and interviews with farmers conducted during different phases of the project were used to assess the project's successes. Land Used System (LUS) analysis was used to predict the economic performance of the net-house system compared with the conventional system. The results of the farmer interviews and LUS analysis suggest that net-house technology is perceived as an effective environmentally friendly alternative to pesticides used in regions with high pest pressure. Additional benefits were a high economic return and the health benefits associated with reductions in pesticides. The wider adoption and spread of information about the net-house technology continues to expand within and to additional regions in Cambodia. Lessons learned from this project will continue to inform and guide my future work in development.

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Acknowledgments

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Introduction

Cambodia is a country in mainland Southeast Asia that covers a total of 181,035 square kilometers and it is bordered by Thailand to the northwest, Laos to the northeast, Vietnam to the east and the Gulf of Thailand to the southwest. Cambodia has a population of almost 14 million in 2008 and estimated to increase up to more than 16 million by 2019 (NIS, 2009; World Population Review, 2019). Cambodia is the second poorest country in South East Asia and ranks fourth in terms of population below the national poverty line. In 2016, Cambodia was reclassified as a lower middle-income country (ADB, 2018; Nag, 2018). Cambodian agriculture is dominated by rice production; however, over the last decade, there has been a trend towards more profitable crops like vegetables, cassava and maize, as well as a trend of starting agricultural side-businesses to enhance farm livelihoods and generate additional income (World Bank, 2015). Agriculture plays an important role in economic growth, enhances food security, reduces poverty and fosters rural development. Among Cambodia's five top crops, vegetable production has the highest gross farm margins and return to labor (1,393$/ha), followed by cassava (505$/ha), maize (303$/ha), dry season rice ($295/ha) and wet season rice ($245/ha) (World Bank, 2015). Even though vegetable production results in higher profitability, less than 1.5% of the total cultivated land is in vegetables and the trend for expansion is low (MAFF, 1999; World Bank, 2015).

There are six (6) factors that limit the expansion of vegetation production in Cambodia. First, vegetable production requires high water inputs throughout the growing season. Due to the lack of irrigation infrastructure, vegetable farmers located near rivers use surface water or wells to irrigate during the dry season. In addition, the soil is typically nutrient rich in these regions, which make it best suited for vegetable growing. In the rainy season, many regions flood and vegetables cannot grow without large investments in drainage. Second, in tropical climates there is a high prevalence of insects and diseases, which damage crops and farmers often invest significant capital in pesticides. Third, many farmers possess limited knowledge of and techniques to grow vegetables. Most vegetable growers have low educational levels and have limited ability to calculate, read or write. This low literacy rate limits farmers' ability to absorb new knowledge and be creative. Most farmers do not know how to properly use agro-chemicals. To deal with insect problems, for instance, they normally apply a mixture of highly toxic insecticides to their vegetable crops without knowing the negative effects. Fourth, there are price fluctuations due to the unpredictable prices, making it difficult for vegetable grower to make decisions and inhibit some new farmers from jumping into the business. The unpredictability of returns results in one of three outcomes: high profits or low profits which generally results in debt or merely breaking even, and rarely a profit margin. Fifth, a lack of market information and access results in many farmers selling their vegetables to the traders at low prices, as they can get higher price if they manage to sell their vegetables in the whole sale market in Phnom Penh. Poor road quality and inadequate facilities also contribute to this constraint. The sixth factor contributing to the lack of expansion of vegetable production is labor shortages. Most vegetable growers are ageing, while many younger people have migrated to larger cities or to other countries for higher wage jobs. Additionally, for those who stay, most get jobs outside the agricultural sector (Le, 2015; World Bank, 2015).

Vegetable Production in Cambodia

Cambodian vegetable farmers supply about 20% of current demand with 80% or more coming from neighboring countries which supply approximately 200 to 400 tons of vegetables daily (60% from Vietnam and 20% from Thailand) (Goletti & Sin, 2016). In term of daily consumption, Cambodian's consume the least vegetables in their diet relative to other Southeast Asia countries (173g/capita/day of the 200g/capita/day minimum required). As a result, many micronutrients are missing from their daily diet, which contributes to high malnutrition among woman and children. For instance, according to a study released in December 2013 by the Council for Agricultural and Rural Development (CARD), WFP and UNICEF estimated there are about 5 million undernourished Cambodian citizens, among which about 560,000 children under five. This vulnerable population suffers from chronic malnutrition and costs Cambodia between US$250 million and US$400 million annually (Ali, 2002; USAID, 2018).

In terms of food safety, many consumers are fearful of imported produce as they believe it contains high agro-chemical residues (e.g., pesticide, plant growth hormone and preservation elements) and believe that local produce is chemical free and safer. This assumption is somewhat accurate because studies on Vietnamese vegetable production have found food safety concerns. Pham, Arthur , & Peter, 2013 reported a study from 2006 to 2008 that Vietnam experienced an exponetial growth in both the quantiy and the value of imported pesticides and, in many cases, observed the misuse of pesticide by farmers such as high dosages, cocktailing of pesticides, inadequate pre-harvest intervals, etc. The Vietnamese Ministry of Agriculture and Rural Development (MARD) also reported that by 2009 less than 8.5% Vietnamese vegetables grown met the standards for safe production set by MARD.

Cambodian consumer's perception that local produce is safer or chemical free is unfounded. Only a small portion of vegetable farmers participate in organic- or chemical free production, while most conventional vegetable farmers apply higher doses or cocktail pesticides and often times do not follow recommended pre-harvest intervals of application of argo-chemicals (Informal conversation with farmers, 2013-2016).

Small-holder Cambodian vegetable farmers require more knowledge and skills to improve production, deal with pests and disease, increase soil fertility management, enhance market linkages, and improve pre- and post-harvest handling, etc. Knowledge and skill enhancement often come from governmental extension programs or internationally funded agricultural development projects and NGOs. Such interventions can enhance farmer's productivity, which is directly linked to income generation, nationwide health improvements and environmental protection efforts. In the following section of this paper, I explain the rationale for site selection for a unique, community driven agricultural project funded in part the USAID Horticulture Innovation Lab.

Project Target Area and Project Overview

*Why Sa`ang district, Kandal province?* Sa`ang district is about 45 minutes motorbike-ride from the southern edge of Phnom Penh. For people living along the riverbank, the main source of agricultural income is growing leafy vegetables, mainly from the *Brassicaceae family*. The soil is very fertile which is suitable for vegetable production. Long-term mono-cropping systems in this hot and humid region have led to tremendous pest pressures. As the result, farmers spray a lot of pesticides to minimize risk of crop loss due to insect damage, mainly from the flea beetle, moth caterpillar and tiny snail. As a result, insecticide resistance has been reported. Most farmers sell to vegetable distributors who serve as middlemen for the Derm Kor or Chbar Ampov markets.

The USAID Horticulture Innovation Lab at the University of California, Davis, funded a project called *Safe Vegetable Production in Cambodia and Vietnam: Developing HARE-Network to Enhance Farmer Income, Health and Local Environmen*t. The project was carried out from 2012 to 2015 and targeted the hotspot needs of Cambodia's vegetation production sector. Additionally, an augmentation to the HARE-Net budget was provided for a complementary sub-project titled *Rural investments in agricultural technologies: Farmer education and savings groups in Cambodia*. Both projects working cooperatively with Royal University of Agriculture with the main goal of promoting safe vegetables production to enhance farmers' income in Kandal province by introducing many different horticultural innovation technologies and using Savings groups at the Platform for education and capital accumulation. The project targeted two vegetable growing communes (Svay Proteal and Tirkwill) in Sa`ang districts of Kandal province.

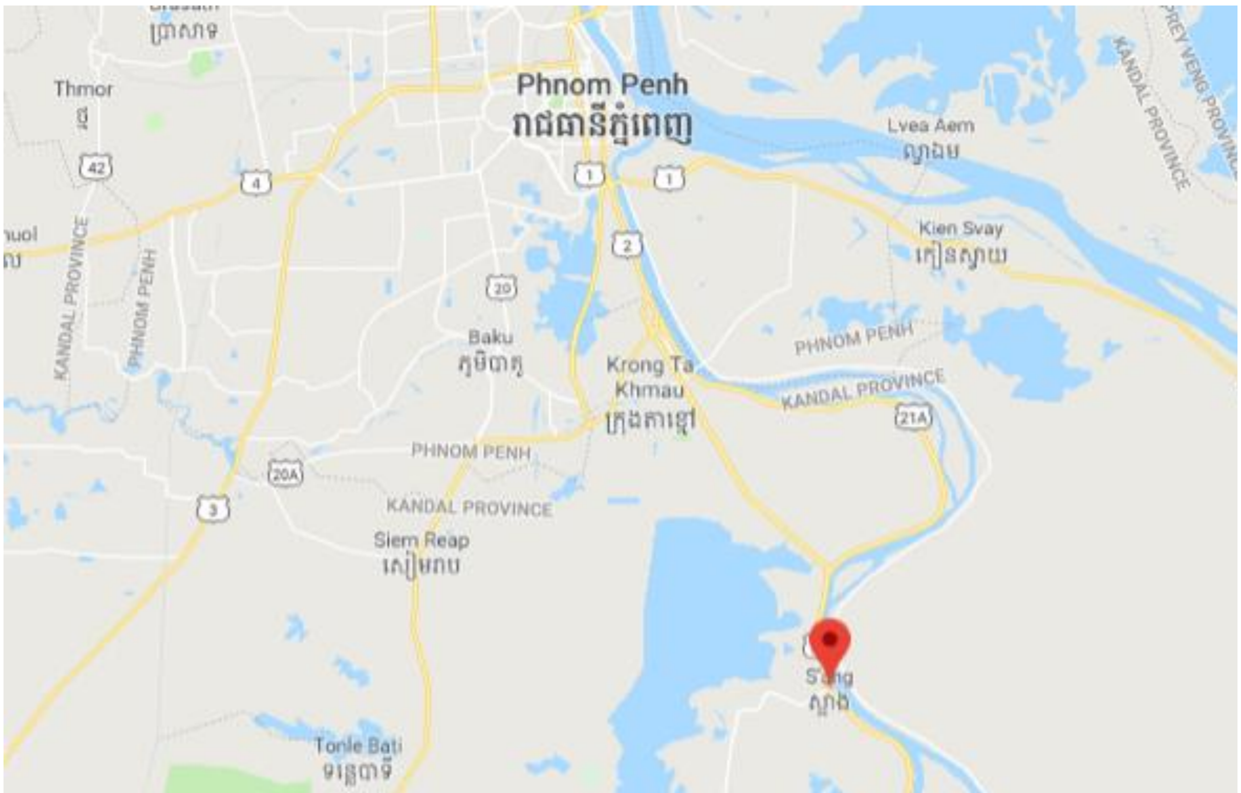

Figure 1: Sa`ang district, Kandal province was the project target area for introducing Saving for Change and Horticultural Innovations.

Saving groups were formed by field facilitators who received training from OXFAM-Cambodia. A saving group is formed when people collectively organize and meet weekly to save money and give loans to members. In the project's savings groups 95% of the members were vegetable growers. By November 2013, 12 Saving groups were formed with a total of 199 members and they reached their 6-month old operations minimums. On November 24th 2013, the project organized a horticultural innovation technology fair that brought 39 farmers from 12 savings groups and 11 Phnom Penh-based vegetable shops and wholesalers together at the Royal University of Agriculture. The objectives of this workshop were to: (1) share information on market demands, prices and vegetable production constraints, (2) demonstrate agricultural technologies to support safer and more profitable vegetable production, and (3) provide examples of promising technologies for further experimentation. The technologies were displayed at the university's research sites and included: low net tunnels, soil solarization, cool storage using a Coolbot, drip irrigation, solar dryer, solar pump, drying beads, and composting. After observing a demonstration, the participants of the workshop were asked to vote on the technologies that were the most relevant to their farming practices and needs. Low net tunnels were selected (*Figure 2A*), and the group agreed to use this technology for further experimentation on campus and more importantly in the villages. The farmers discussed the pros and cons of this technology and they expressed their concern that the net tunnel was too low and impractical because it only covered a single row. What farmers wanted was a larger structure that covered more space area; this idea led to what we call a net-house.

Soon after the technology fair ended, with the consideration of low tunnel net-house seem impractical for farmers' in Kandal, the project teams started to install two net-houses to cover three-row of vegetables in the village as shown in *Figure 2B* (4m x 12m, flat roof-shape) and one at RUA (4m x 10m, triangle roof-shape) for research purposes with local net materials and a bamboo structure.

Research findings showed, the Chinese Kale under the 3-row net-house made of poor-quality netting grew very well. Soon after, the project imported higher quality net material from Vietnam and expanded trails to nine net-houses (4m x10m) in three different villages. These new net-houses had improved structure (roof-shape structure) which took into account feedback from farmers, the project team and UC Davis project leaders. Farmers involved in the first trail donated part of their land for a new study, while the project set up the structures and funded materials cost. The trial net-houses were developed through shared labor between farmers, student interns and the project staff. By the time the projected was ended, there was no adoption or scale up by any farmers. However, the net-houses were picked up and continue by a private social enterprise (co-founded by former project team members) known as the Net-house provider. I myself have been the main person managing the team since then.

Figure 2: Different net-house and designs and structures were used: A) During the technology demonstration at RUA, B) First net-house version on-farm field trail with local net material, C & D) On-farm field trail with high-quality net material and roof shape structure.

Purpose and Objectives of this Capstone study

The main purpose of this paper is a 6-year post-project assessment of small-scale vegetable farmers' adoption of net-house horticultural innovations in Cambodia. The objectives are to:

(1) Evaluate the fitness of saving groups with small scale vegetables farmer and discover if they can be used as a platform to deliver education on horticultural innovations.

(2) Identify the factors that led to both the successful adoption of the technologies introduced and those factors that led to non-adoption (e.g., economic, contract farming, investment…)

(3) Draw lessons learned that can inform similar projects in the future.

Literature Review

Introducing new agricultural production technologies or innovations to farmers in developing countries though international aid via developmental projects or NGOs seems to offer an opportunity to increase production, income and improve people lives. However, in the case of this project, not all introduced technologies were adopted by farmers. In this literature review, I will focus on the factors and constraints that may contribute to adoption or non-adoption of new agricultural innovation technologies by smallholder farmers in developing countries.

Technologies per se: Agricultural technologies include all kinds of improved techniques and practices which affect the growth of agricultural output (Jaina, Arobab, & Raju, 2009). Many agricultural technologies have been developed and introduced to growers to enhance crop production, yield, soil fertility, pests and disease management (i.e., Intergraded Pest Management) and irrigation (i.e., sprinkler and drip irrigation). The purpose of agricultural technology enhancement is to lower or reduce the input costs, while maintaining or improving productivity, enhancing output qualities, increasing market price and income and profitability (Challa, 2013). A case study looking at the impact of green evolution in Asia showed that through the introduction and widespread adoption fertilizer-responsive modern rice varieties in combination with agricultural mechanization helped Bangladesh to achieve self-sufficiency in rice production in 2001 from a heavy import dependence in 1971, despite the doubling of the country's population and a reduction in arable land (Prabhu, Hossain, & Gerpacio, 1997). After receiving formal training on integrated pest management techniques, Bangladeshi vegetable growers had better knowledge about insect pests and the proper use of pesticides, adopted more IPM practices, and reduced the frequency of spraying and mixing of different pesticides. Yields were not dramatically improved relative to the conventional systems, but results correlated with the opening of new market linkages by selling safe vegetables (Shriniwas , Pepijn , Md. Nasir , & Ramasamy , 2017).

Household Education: Educational programs are help farmers think critically about the innovation's suitability to existing condition and their potential impacts if adopted. A study by Alene & Manyong (2007) on the effects of education on agricultural productivity under traditional and improved technologies in northern Nigeria used an endogenous switching regression analysis, and found education had a positive and significant influence on adoption of improved cowpea varieties. Another survey, using double-hurdle method approach, also found education had a strongly positive and significant correlation with inorganic fertilizer technology adoption in Northern Ethiopia (Beshir, Emana, Kassa, & Haji, 2012).

Age and Farming Experience*:* Age is closely linked with farming experiences though continuing practices and observation. Experience of farmers is likely to have a range of influences on adoption because the longer a farmer farms, the more understanding they have about the system. Farmers with more experience appear to have more information and better knowledge and skills to evaluate advantages of a technology. Herbert & Johnny (2014) found the extent of farming experience correlated to the early stages of technology adoption for some crops, especially when farmers were testing potential benefits. These experienced farmers were more likely to abandon a technology if the benefits were perceived as less than the efforts expended, especially if the technology was labor intensive and required an expansion of the farm size. Conversely, farmers might expand to use an innovation if the benefit outweighed costs.

Other research has found age to have a negative correlation with technological adoption Maria, Jeff, & Victor (2005) explained that as farmers grow older, there is an increase in risk aversion and a decreased interest in long- term investment on the farm. On the other hand, younger farmers are typically less risk-adverse and are more willing to try new technologies. For instance, Alexander & Mellor, (2005) found that adoption of genetically modified maize increased with age for younger farmers as they gained experience and increased their stock of human capital, but declines with age for those farmers closer to retirement.

Farm size: Many studies have found farm size is one of the most important significantly positive correlations that affected adoption decisions. Studies of farmers who have relatively large farms indicate they are more likely to adopt new agricultural production technologies, and the reverse is true for small sized farm. Subsistence oriented farmers are highly risk averse to try innovations due to limited holdings and uncertain outcomes of technologies (Akudugu, Guo, & Dadzie, 2012; Mendola, 2007 ; Salasya, Mwangi, Mwabu, & Diallo, 2007). Conversely, De Souza Filho, Young, & Burton (1999) found that the probability of adoption was reduced by increases in farm size when looking at the factors influencing the adoption of sustainable agricultural technologies in the State of Espirito Santo, Brazil.

Asset and Credit Availability: Assets or available credit are very important factors to enable farmers to test or use technologies such as farming equipment, higher yielding seed varieties, exotic high value crops, as well as pesticides and fertilizers. For this reason, farmers who do not have required assets generally face more challenges to accept a new technology even if they possess enough knowledge about the technology (Yigezu, A., Amin, M., Aden, A.-H., Tamer, E.-S., Piggin, C., Haddad, A., . . . Loss, S., 2018; Beshir, H., Emana, B., Kassa, B., & Haji, J., 2012). Off-farm income is also considered a valuable contributer to farmer asset accumulation. Beshir *et al* (2012) found off-farm income having a strongly positive and siginicant effect on purchasing chemical fertilizer, initial seeds, and other essential agricultural inputs in the northeastern highlands of Ethiopia.

Training and Extension Services: Providing farmers with trainings about an innovation, combined with available extension services, help farmers fully understand and perceive how an innovation can work within and fit to and benefit farming systems. The use of farmer field schools, participatory research or farmer to farmer approaches as well as on-farm field demonstrations can help the farmers learn and gain confidence about an innovation, thereby contributing to the adoption of a new technology. Extension services provide information and knowledge-rich resources and bridge information flows between research institutes and farmers (Magnan, 2015; Srinivas, 1988; Gershon, Richard , & David , 1985).

Methodology

Data Collection and Analysis

The data used for the analysis in this study were obtained from the various sources. First, the data was drawn from an interview dataset emanating from individual vegetable growers mainly in

Kandal province and few in other Cambodian provinces. Interview data was collected in three different phases. In 2012, 144 vegetable farmers were interviewed by the Rural Innovations in Agricultural Technology (RIAT) project team which served as the baseline survey in Kandal province. This survey covered a broad range of information, however only partial of information that related to farming practices (e.g., pesticides use, fertilizer application, input cost, labor, marketing price, etc.) was filtered and used for the Land Use Land system analysis of both net-house and conventional systems.

In 2016, follow up interviews were conducted on 37 individual farmers lead by UC Davis fellow Katie Hoeberling. I assisted Katie in the interview process. The interviews were videotaped, and I translated and transcribed them from Khmer to English. Among the 37 farmers interviewed, 9 farmers were pre-identified as having once joined on-farm net-house trial, 5 were net-house adopters, 19 farmers from the saving members were assumingly have heard about the net-house via other members and 4 farmers whose sere not saving group members ever since. The questions used in this interview are detailed in Appendix A. This data set was used to evaluate the general status of saving groups in the targeted areas and to learn about farmers' perceptions and the spread of information on net-house technology. The data was also used to evaluate farmer adoption of net-houses by comparing numbers of net-house farmers in 2016 to numbers of net-house farmers in 2019.

In January-April 2019, interviews were again conducted but focused on all farmers that adopted the net-house technology. I conducted the interviews on a total of 42 net-house adopters via phone calls:

- 22 net-house adopted farmers (Kandal province)

- 3 net-houses adopted farmers (Siem Riep province)
- 3 net-house adopted farmers (Svay Rieng province)
- 1 net-house adopter (Takeo province), Saint Paul Institute representative
- 1 net-house adopter (Phnom Penh), military unit representative
- 12 Saving group chairs

The 12 saving group chairs and four Kandal province net-house farmers were additionally asked about feedback on the 2013 technologies fair at RUA. and all contacts were obtained from net-house provider staff, archived saving group MIS[1] files and exchange emails between and other stakeholders. I chose to include all net-adopters (Kandal and other provinces) with a goal to learn about how net-house information was spread; Where people heard from about net houses; How they paid for the first initial set up; And where they sell their produces. Details of this questionnaire are in Appendix B.

A second source of data came from the Natural Agricultural Village Shop (NAVS) and I myself as the net-house provider manager. NAVS provided information on contract farming, buying order, price lists of different vegetable grown in net-houses, NAVS potential growth and future planning, while the net-house provider provided the information on farmers location, decision making on net-house investment, market linkages, net-house costs, and the evolution of the net-house technology over time.

Third source of data came from project artifacts such as the project proposal, annual reports, semi-annual reports, site visits reports, project team meeting notes, seminar summary

[1] MIS stands for Management Information System

records, project staff reports, agendas, emails and Horticulture Innovation Lab webpage. Lastly, much of the information I present also comes from personal field observations and both formal and informal discussions with various stakeholders including the project team members from the University of California, Davis, and the Royal University of Agriculture, employees of the Natural Agricultural Village Shop, employees of net-house provider and especially local farmers.

Land Use System (LUS) Analysis of Net-house and Conventional Practices

Because the net-house technology was adopted by some vegetable growers in Kandal and other different provinces in Cambodia compare to other once-introduced horticulture innovation by the project team, the Land Use System (LUS) analysis approach was conducted to determine the economic performance of both net-house and conventionally grown vegetables. The technologies' suitability to the Cambodian vegetable farmer context and economic performance were hypothesized as the main contributing factors to the horticultural innovation adoption by small holder vegetables growers.

The Net-house and Conventionally Grown Land Use System Description

A net-house Land Use System (LUS) analysis was conducted on the new hybrid net-house structures with land covered of $500m^2$ as the model shown in *Figure 3*. This size is the most representative of many net-house farmers and the prospective net-house adopters. The type of vegetables grown inside the net-house was predetermined by marketer and rotated from one crop to the next, however all were in Brassicaceae family. By rotating the crops grown, the marketer could insure all its contract farmers had a chance to grow higher and lower price crops equally. For the conventionally grown produce, farmers sold their produce at the farm or at the wholesale market in Phnom Penh. To simplify the LUS analysis, it is assumed this farmer only grew Green Bak Choy and/or Choy Sum (35days life cycle from seed broadcasting to harvest) for the course of a year. With the improved structure, farmers reported that they could grow their crop up to nine-cycles per year. To avoid overestimating profit, it was assumed a seven-cycle of Bak Choy, or Choy Sum grown per year for both systems

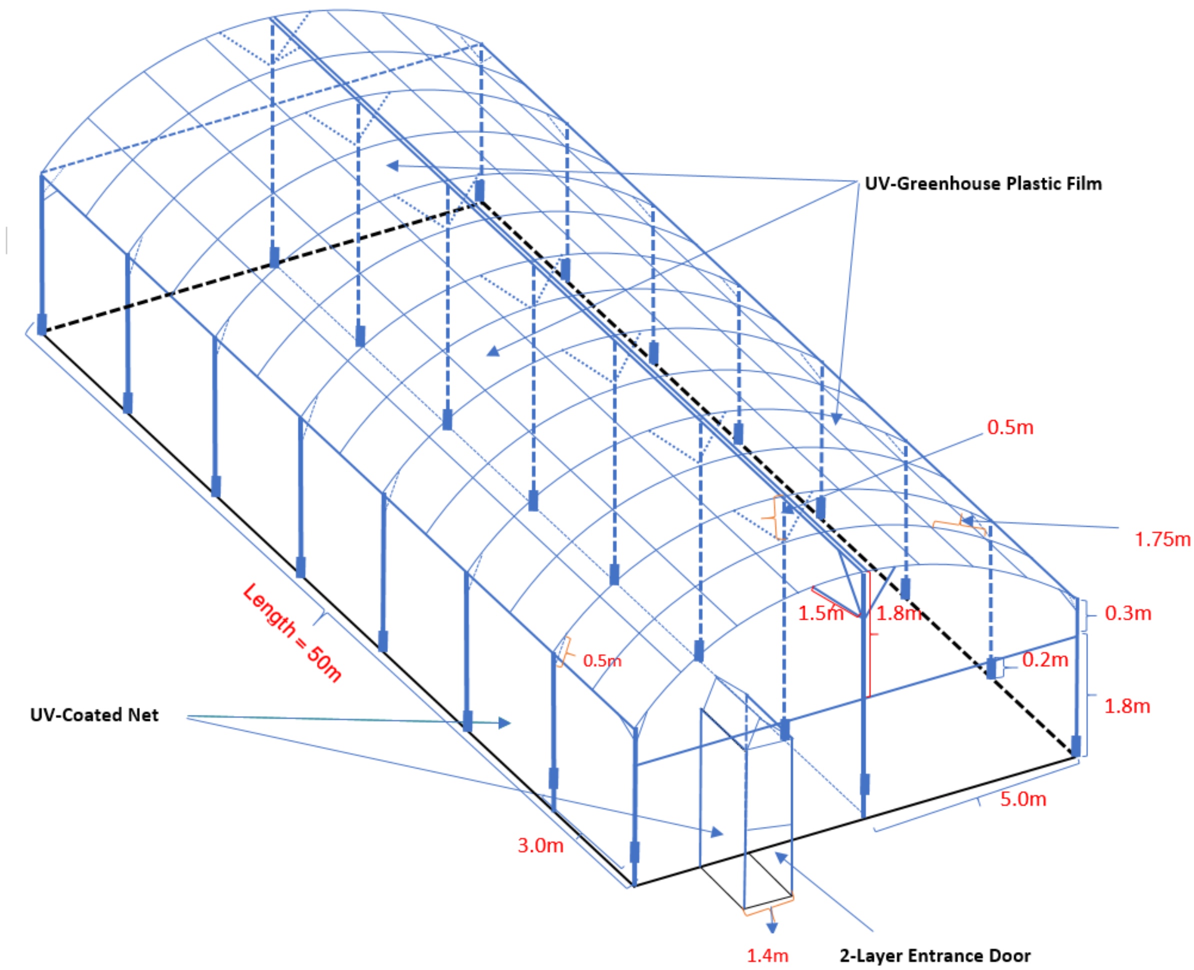

Figure 3: Net-house model. The structure made by metal. UV-Greenhouse Plastic Film covered on the top and surrounded by UV-Coated Net on the sides

Inputs and Prices*:* Inputs were categorized as startup and annual inputs. The startup inputs consisted of net-house materials, drilling a well, rake, hoe, knife, electric wire, and water pump.

The annual input consisted of cow manure for composting, vegetable seed, electricity, greenhouse film plastic, net material, rental of a tractor, organic fertilizers and rice straw for mulching. Greenhouse film plastic was estimated to have a two-year lifespan and netting on the sides was estimated to have a five-year lifespan (this estimation was based on personal experiences). Projected material costs and output prices were based on farmers interviews data and annual inflation rates in Cambodia. The inputs of the conventionally grown system were the same as the net-house system, except for the exclusion of net-house materials cost and included pesticides. Urea was used as an alternative to organic fertilizer.

Labor: Labor requirements were estimated to be the same as both systems. There are three main types of laborers which contribute to this land use system: skilled, unskilled and family labor. For the net-house system, skilled labor is needed for installing net-house materials for the first time and changing the roof plastic and the side netting after two and five-years respectively. Hiring skilled labor with tractor to plow the field twice per year for both systems. The skilled labor, unskilled labor and family labor wage for the entire LUS life span increased from year to year of 2.8% which is the average of Cambodia inflation rate from 2009 to present as in *Figure 4* (Tradingeconomics, 2019).

Figure 4: The fluctuation of Cambodia inflation rate from 2009 to present with an average of 2.8%

Output and Price: Based on the three-year historical data from NAVS and farmers, the price of the net-house produced vegetables has remained relatively constant and the NAVS renews most farmer contracts annually. The annual average price for vegetables grown with the net-house system was 3000riel/kg. Prices for conventionally grown vegetables, however, were highly volatile from season to season and year to year. The estimated price of 1,550riel/kg was used and is slightly higher than average for this time period. For this analysis and future price predictions, the price was adjusted 2.8% annually for inflation. Based on the inflation estimate, over 10 years the market price would be 4,000riel/kg and 2,000riel/kg for net-house and conventionally grown vegetables, respectively. There are two types of products harvested from each cycle of net-house and conventional systems. Immature vegetables, which farmers typically sell to the open market and the price fluctuates at the same rate as conventional production. The mature vegetables (after 35 days of seed broadcasted) are sold to NAVS under contracted prices. Farmers reported yield of

Bok choy or Choy Sum grown under both net-house and conventional systems average of 1.8-2.2kg/m2. For this analysis, a yield was considered constant of 1.5kg/m2. The annual discount rate is 20% which is derived from 1.6% monthly interest rate of a loan from typical microfinance institution with the maximum loan of less than $5,000.

Findings

Saving group - Platform for Horticultural Technology Dissemination

Twelve saving groups with a total member of 199 people were formed by November 2013, by this date 12 groups operated for 6-months at a minimum. In addition, 2 saving groups (40 members in total) was considered as self-replicated with the support from the older group's chairwoman in one year. Under course of the project timeframe, all groups were fully functioning, and most loans were taken for agricultural purposes.

The results of the interview in 2019 on saving group chairs showed 3 groups among the 12-original group dissolved (discontinued) due to the internal conflicts and that could not be resolved during the closing cycle in 2017. All three former group chairs mentioned that they liked the saving group and most the group members wanted to gather and form saving groups again, but the lack of external support from a facilitator to reorganize committee structure and re-create rules inhibited their replication. Interestingly, those groups which continued their saving groups gained more members. By early 2019, there were 14 saving groups (9 original groups and 5 self-replicates) with a total membership of 416. These groups continue their regular weekly savings meetings.

Nearly 5-years after technologies were introduced and farmers and project staff experimented with technologies though saving groups, only 4 out of the original 9 volunteer farmers chose to adopt the net-house technology. They scaled up their net-house size and entered into contract farming with NAVS. Looking broadly among saving group members, less than 2 per cent (4 out of 240 members) chose to adopt the net-house system and contract farming (comparing number of net-house farmers and also being saving group membership from 2016 and 2019). None of the new net-house farmers were from saving groups. The interview in 2016 shown that many non- adopters (farmers in saving group member) perceived contract farming with NAVS would not generate enough income to sustain their family need. Most of them also mentioned that they want to wait and see how the net-house technology and new marketing linkages worked with the earlier adopters. By April 2019, none of whose farmers (32 farmers in total) who once said "Wait and see" adopted net-houses as part of their farming.

Farmers' Feedback on Different Horticultural Technologies

Farmers who participated in the technology fair at RUA in 2013 (9 saving group chairs and 5 original net-house adopters) all appreciated the event. Prior to the technology fair, most farmers believed growing leafy green vegetables without using chemicals seemed to be almost impossible in the high pest pressure environment which resulted from years of mono-cropping of *Brassicaceae family* crops; however, the idea of using nets to exclude insect pests seemed to be very practical and promising. One farmer said, "exclusive net is not any new idea, we use net to protect ourselves from mosquito all the times and now we just change what will stay inside, for our cases vegetables need to stay inside". The most main constraint in vegetable production was pest damage from flea beetles and caterpillar moths, the use of net-houses was viewed as an alternative to pesticide use.

When same farmers were asked about their thought of other technologies introduced at the fair, responses were almost consistent across all the farmers. The composting technology was viewed as the second most important, especially all five net-house adopted farmers. They mentioned that for the conventional practice, farmer has to refill their field (added top layer soil) every 3-5 years to get good yield. All 14 respondees mentioned soil nutrient management would let them save soil refilling costs and also to prevent delays to growing crops. Other technologies such soil solarization, solar pumping, Coolbot, solar dryer, drip irrigation, solar dryer was viewed as impractical with their current situation. One farmer has mentioned that “I harvest my vegetables then sell it to the market right away, no storage is necessary”. Solar pumping was viewed as not strong enough to pump from the 20-30m water dept or 100-200m away from the riverbanks and maybe too expensive for initial investment.

Net-house Technology Adoption

The net-house technology evolved since it first introduced to farmers in 2013 by project team. The first version was tunnel shaped *(Figure 2A)* and farmers thought it was impractical due it covered only one row. Farmers believed it was difficult to get into to weed control and perform overhead irrigation. The second trial modification (4m x 10m, roof-shape, *Figure 2C & D*) was perceived by farmers as better but was still not big enough family commercial scale. After the project ended, at first, the net-house provider treated itself as an extended supporter to farmers with a hope that private sector would take over soon after. It was not a private business sector in this value chain. It purchased net materials from Thailand and re-sold it to farmers with little profit and continued working with farmers in the same manner as when the project was still fully functioning with any external incentive. Both the net-house providers and farmers tried to build net-houses with local materials such wooden frames, bamboo frames, concrete pillars and bamboo on the top with different roof-shapes. In the tropical climate, however, all net-houses collapsed after one to two years. Farmers also reported heavy soil water logging for vegetables grown under net-house structures due to slower evaporation.

By 2018, the net-house provider transformed itself to become a private social enterprise named "LUCKY HOUSE". The LUCKY HOUSE staff and farmers worked closely together with considered lessons learned from the initial challenges and designed a new hybrid house where the frame was constructed out of metal and surrounded by net material (32 mesh hole size) on the sides and covered on the top by greenhouse plastic film (200 micron thickness). The LUCKY HOUSE social enterprise now provides the whole package of building new hybrid net-house to farmers in Kandal province and other regions as well.

Marking Demand for Vegetables under Net-house Production

NAVS has sold and distributed many food-based products in Phnom Penh. For produce, and specifically leafy greens, it only purchases from net-house farmers and requires farmers to have net-houses set up as a prerequisite to contracting. The interview with NAVS shows that NAVS has been distributing produce to supermarkets such as Lucky, Aeon Mall and many others. It also provides home delivery services. Table 1 below summarizes NAVS 's current and future demand on net-house vegetables.

Table 1: Vegetable market demand and contracted price

Vegetable names:	NAVS's Demand (kg/day)		Price (Riel/kg)
	2018-2019	2020-2021	
Chinese broccoli (Gai Lan)	100	300	5,500
Bok Choy (Green Bok choy)	100	200	3,000
Pai-Tsai (Curly mustard)	100	200	3,000
Yu Choy Sum (Chinese oil mustard)	100	200	3,000
Amchoi	100	100	2,500
Heading Cabbage	100	200	4,000
Leaf mustard (Bamboo mustard)	100	200	2,800

NAVS reported the above amount is the target demand from net-house farmers, however, it has never received enough supply from them. NAVS is responsible for collecting vegetables from each individual farmer and transporting them to its headquarter in Phnom Penh for packaging and distribution. The supply has not only been lower than expected for all kind of vegetables, but has also been very inconsistent over the past couple years. Currently, there are 24 net-house farmers with total of approximately 10,000 square meters of land covered. However, to satisfy the current market demand, a minimum of 15,000 - 20,000 square meters needs to be cultivated in net-houses and the farmers would need to strictly implement a cropping calendar cooperatively. For the 2020-2021, NAVS must look for more farmers to join net-house production contracts and to increase the scaling up of net-houses to at least 30,000 – 50,000 square meters. The NAVS also mentioned that it is currently expanding its market by opening a new shop in Phnom Penh, increasing home delivery, and reaching out to other supermarkets and restaurants. In the next 3-year, it hopes to buy approximately 500kg/day of each kind from net-house growers.

Economic Performance of Net-house and Conventional Vegetable Production

The estimated cost and net present value acquired from the land use system analysis on both the net-house and conventional cropping systems over the course of a ten-year production period is shown in *Figure 5*.

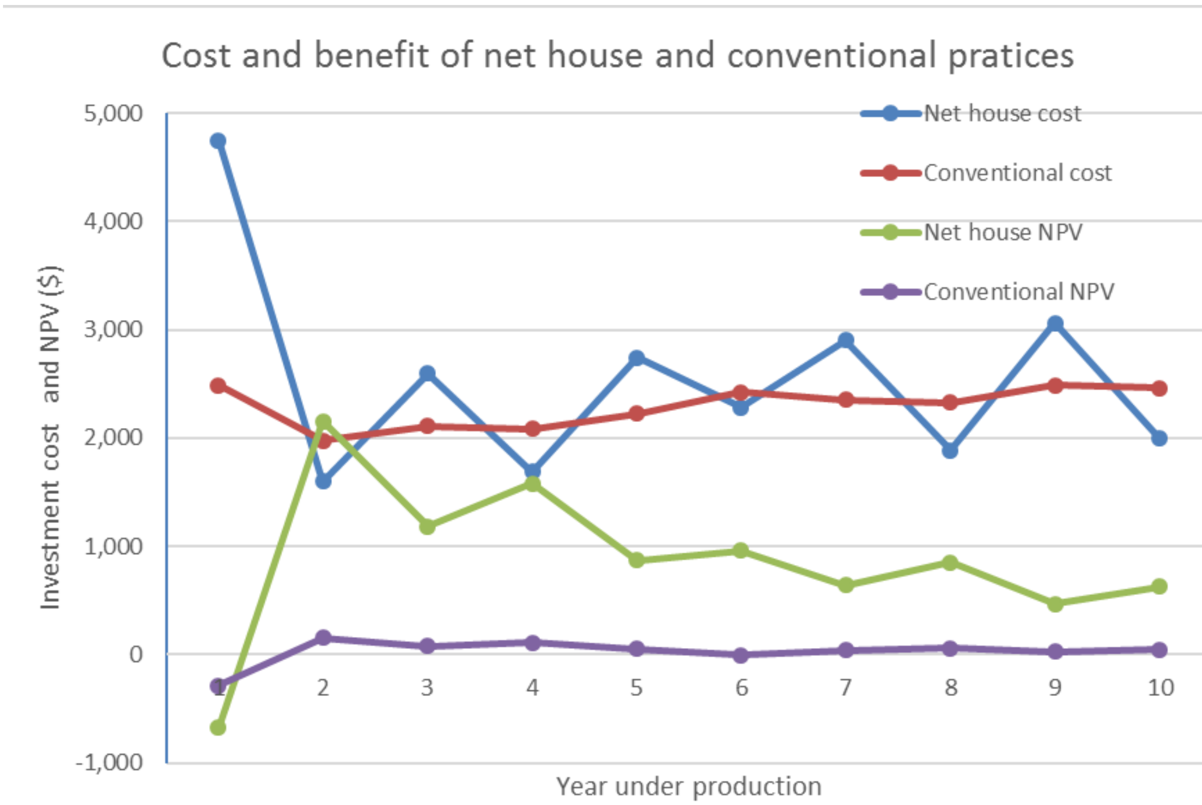

Figure 5: The trend of costs and NPV of net-house and conventional system over the course of 10-years period projection

First, in terms of costs, the net-house system requires higher upfront investment, which is close to $5,000 for the first year and then drops dramatically to approximately $1,600 for the second year. After that, the cost fluctuates on a two-year and five-year cyclical basis due to the required reinvestment in plastic film and net replacements. These upkeep costs range between

$1,600-$3,000. The costs associated with the conventional system do not change much year to year; they stay in the range of $2,000 – $2,500 annually.

The net present value (NPV) of both systems is understandably negative for the first year. However, the NPV of the net-house sharply increases in the second year. In subsequent years, the net-house NPV gradually decreases but stays positive and should be higher than $500/year. The NPV of the conventional system is not as favorable; it slightly increases in the second year and stays close to zero for the rest of the course. The summary of each LUS's economic performance

over a ten-year period are shown in Table 2.

Table 2: Summary statistic of economic performance of different cropping system

	Net-house system	Conventional system
Total costs ($)	25,518	2,2953
Total revenue ($)	46,290	2,3959
Total net benefits ($)	20,772	1,005
Total net benefits with 20% ADR subjected ($)	8,674	286

The input costs of vegetable production under the net-house system are only 11% higher than the input costs of conventional system. The total revenue of the net-house system is, however, almost double that of the conventional system. The total net benefit of the net-house system, when subjected to a 20% annual discount rate (ADR), is 30 times higher than the conventional system. The average annual returns to land are $867 ($17,340/ha/year) for the net-house and $28 ($560/ha/year) for the conventional system.

Return to family labor:

Both systems require the same skilled labor for plowing the fields. The extra labor costs associated with the net-house system, mainly for replacing the net and plastic film, the cost of labor for placements were already embedded inside the materials cost. The rest of the labor required by these systems comes from family labor. Considering all of these, the NPV for the net-house and conventional systems are $32,569 and $12,802, respectively. Total labor hours are 15,297 hours for net-house and 12,225 hours for the conventional system. Based on these calculations, the return to family labor is $2.13/hour for the net-house system and 1.04$/conventional system. The average wage of unskilled labor in the current market in Cambodia is about $0.75/hour. Therefore, the ratio of the returns to family labor to the current market wage is $2.84 to 1 for the net-house system and $1.39 to 1 for the conventional system.

Net-house investment

After finishing the first-year net-house trial on farmers' fields, four farmers choose to adopt the technology by scaling up to the family commercial size. Since then, the net-house has been perceived as a promising alternative which reduces the need for heavy pesticide use in leafy green production in Cambodia. However, in term of the investment, the net-house provider and NAVS played a very important role in bringing this technology to farmers' practice. To date, 24 farmers in Kandal province have received loans from the net-house provider in the form of net-house materials – sometimes for the entire cost, other times as part of the total cost. Farmers have scheduled loan payments to the net-house provider at the end of each crop cycle though NAVS.

The spread of net-house technology

In Svay Rieng province, three (3) net-house farmers received subsidies from Stichting Nederlandse Vrijwilligers Netherlands Development Organization (SNV) and in Siem Riep province three (3) net-house farmers received subsidies from the Deutsche Gesellschaft für Internationale Zusammenarbeit Organization (GIZ) to pay for net-house materials and installation cost. Likewise, the Saint Paul Institute (SPI) purchased two net-houses and paid the full amount to the net-house provider. However, SPI used the net-houses for educational purposes only. A Cambodian military base unit in Phnom Penh also purchased 15 net-houses from the net-house provider. The net-houses were used for vegetable hydroponic production for internal consumption on the base. Interestingly, since last year the net-house technology has been catching attention of the Kandal Province Department of Agriculture (PDA). The Kandal PDA chose to give subsidies to existing net-house farmers via Agriculture Services Program for Innovation, Resilience and Extension (ASPIRE).

Discussion and Recommendation for next steps

Saving group and net-house adoption

Many social researchers and developmental practitioner have used the theory of adoption and diffusion of innovations by Rogers as a framework to describe rates of adoption. Rogers (1962) claimed that the diffusion of innovation occurs progressively within one market when information and opinions about a new technology are shared among potential users through communication channels. The increase in membership in the existing savings groups happened in this manner. At the beginning of saving group formation, many people decided to wait and see rather than to join the group immediately. After observing some successes and gaining information about the saving groups, the soft technology spread throughout the local communities via word of mouth starting from the members of the group as people gained more confidence in the saving group concept and membership increased. The same process also happened with the self-replicating groups.

The adoption of net-house technology among saving group members was initially very low (4 in 416 saving group members). Furthermore, the project ended five months after the introduction of innovation to farmer representatives. There was not enough time to allow for farmers to learn about the innovation. Some limited learning activities were picked up by the net-house provider, but due to the lack of resources, the net-house provider only worked with farmers who were introduced to the net-house technology and already formed a connection with the NAVS (both informal and formal) marketer. All in all, both the NAVS and net-house provider were not intentional in using the saving group as the platform for introducing innovation as one of the main project's objectives. More trainings about net-house benefits, small business planning, and how to take advantage of capital availability from the saving group in horticultural innovation could potentially allow for the technologies to benefit growers at the household level and benefit the community as the whole. Therefore, at this point is difficult to conclude that saving groups not a good platform for introducing horticultural innovations.

Contributing factors to the adoption of net-houses

Given that NAVS offers premium prices for chemical-free and organically grown vegetables, a net-house became a prerequisite for farmers to enter the contracted farming with NAVS. The average prices for organically grown produce offered by the NAVS were twice as high as in the conventional systems. Net-house annual profits were much higher than conventional and the return to family labor was fairly high compared to Cambodia market wages. In addition, since most of the cost for starting the net-house system was given as a no interest loan by net-house provider and the payments were due at end of each crop cycles, most of the economic risk to farmers was reduced. Other indirect benefits such as health benefit due to less exposure to pesticides and consuming more home-grown vegetables was also seen as beneficial for farmer families, the community, and the environment. The combination of factors of lower risk investment, suitability of the innovation within grower's practical system, and high potential economic return contributed to the early adoption of net-house technologies. The result of the study also suggested that growers with more experience in chemical-free or organic farming tended to look for alternative ways to reduce or replace pesticides.

Potential future risk

Net-house design & structure: The latest version of net-house's structure is made of metal with greenhouse plastic film and net material as the fence barrier and roof. Net-houses as a whole are more stable and productive than previous models. However, the net-house provider technical team itself is very new to the construction process and there is no guarantee that the structure would last up to 10 years. The net-house provider technical team was learning while testing. The design and structure were not held to any certain standard, therefore, the net-house structure might function temporarily but require future improvements. Furthermore, the tropical climate may potentially accelerate metal oxidation. Kandal province has recently experienced strong winds and storms, and a couple of net-house were damaged. Such events are unpredictable and this likely added another layer of risk to net-house vegetable farmers.

Pest and disease: Net-houses serve as a barrier to exclude insects from entering the vegetable growing inside and causing damage to vegetables. However, the net-house do not kill insect pest that are already inside. Even a small population of insect pests can be reproduced very quickly inside the net-house. Warmer temperatures normally shorten insect life cycles but increase their reproduction rates throughout the year. In some cases, farmer still occasionally spray pesticide inside the net-house which lead to controversy over whether the produce was market as pesticide-free or organically grown. The warm temperatures and high humidity environment inside the net-house is also promotes fungal and bacterial pathogen growth. The net-house farmers themselves however had relatively limited knowledge on strategies to prevent or control vegetables pests and diseases without using synthetic pesticides. The promotion of using biological control method such as natural enemy, botanical pesticides or Trichoderma is very necessary.

Soil health: Soil health is very important for the success of net-house cropping systems. Farmers need to enhance soil with high quality compost and organic fertilizers for production of high-quality produce. Some farmers experienced poor crop growth, stunted growth, pale-color leaves, and were unsure of the reasons.

Conclusion

Saving groups served as effective platform for networking between the project team and vegetable farmers. The groups supported farmers in overcoming financial constraints for farming capital. The saving groups served as a way to organize farmers and helped to identify groups of interested farmers to attend project activities such as the horticultural technology fair at Royal University of Agriculture. They also served as a mechanism for project staff to identify farmers to volunteer to set up on-farm net-house trials. The net-house technology was perceived by farmers as a practical, suitable and profitable production; however, the adoption of net-house technology among saving group member was very low. Farmers having experience growing chemical-free and organic produce were more likely to adopt net-house technologies. The net-house not only enhanced farmers' income, but also offered health and environmental benefits due to the reduction or even elimination of pesticides. However, the investment by local farmers was still limited by high input costs. The success of the project depended on the introduction of the technology, field trials led by the project team, an ongoing partnership between net house providers, marketers, and enthusiastic participation from local farmers even beyond the project's end. The early adopters of the net house technology served as a great showcase of the technology and allowed for the spread of information both within the community in Kandal province and to other vegetable growing region throughout Cambodia. This net-house technology successes also caught attention of other agriculture development agencies and the provincial agricultural authorities, which provided incentives to farmers by to pay partial costs of net-houses and claim it as their success.

References

Akudugu, M. A., Guo, E., & Dadzie, S. K. (2012). Adoption of modern agricultural production technologies by farm households in Ghana: What factors influence their decisions? *Journal of Biology, Agriculture and Healthcare* .

Alene, A. D., & Manyong, M. V. (2007). The effects of education on agricultural productivityunder traditional and improved technology in northernNigeria: an endogenous switching regression analysis. *Empirical Economics, 32*, 141–159. doi:10.1007/s00181-006-0076-3

Jaina, R., Arobab, A., & Raju, S. (2009). A Novel Adoption Index of Selected Agricultural Technologies:Linkages with Infrastructure and Productivity. *Agricultural Economics Research Review*, 109-120.

Salasya, B., Mwangi, W., Mwabu, D., & Diallo, A. (2007). Factors influencing adoption of stress-tolerant maize hybrid (WH 502) in western Kenya. *African Journal of Agricultural Researc*, 544-551.

ADB. (2018). *Basic Statistics 2018.*

Alexander, C. E., & Mellor, T. V. (2005). Determinants of corn rootworm resistant corn adoption in Indiana. *AgBioForum*, 197-204.

Ali, M. (2002). *The vegetable sector in Indochina countries: farm and household perspectives on poverty alleviation.* Asian Vegetable Research and Development Center: Bangkok Aian Regional Center.

Beshir, H., Emana, B., Kassa, B., & Haji, J. (2012). Determinants of chemical fertilizer technology adoption in north eastern highlands of Ethiopia: the double hurdle approach. *Journal of Research in Economics and International Finance (JREIF)*, 39-49.

Challa, M. (2013). *Determining Factors and Impacts of Modern Agricultural Technology Adoption in West Wollega.* Munich: GRIN Publishing GmbH. Retrieved from https://www.grin.com/document/280336

De Souza Filho, H. M., Young, T., & Burton, P. M. (1999). Factors Influencing the Adoption of Sustainable Agricultural Technologies: Evidence from the State of Espírito Santo, Brazil. *Technological Forecasting and Social Change*, 97-112. doi:10.1016/S0040-1625(98)00040-7

Gershon, F., Richard , J. E., & David , Z. (1985). Adoption of Agricultural Innovations in Developing Countries: A Survey. *Economic Development and Cultural Change*, 255-298. Retrieved from https://www.jstor.org/stable/1153228

Goletti, F., & Sin, S. (2016). *Development of Master Plan for Crop Production in Cambodia by 2030. Final Report.* Prepared for Ministry of Agriculture Forestry and Fisheries (MAFF), Tonle Sap Poverty Reduction and Smallholder Development Project (TSSD).

Herbert, J. A., & Johnny, M. (2014). The Role of Farming Experience on the Adoption of Agricultural Technologies: Evidence from Smallholder Farmers in Uganda. *Journal of Development Studies*, 666-679. doi:10.1080/00220388.2013.874556

Le, L. (2015). *A policy study on vegetable subsector for smallholder farmers in Cambodia.*

MAFF. (1999). *Agricultural Statistics. 1998.* Department of Planning and Statistics, Ministry of Agriculture, Forestry and Fisheries, Phnom Penh, Cambodia.

Magnan, N. (2015, August 7th). *OUPBlog*. Retrieved from Are small farmers in developing countries stuck on stubble?: https://blog.oup.com/2012/08/small-farm-develop-country-no-till-agriculture-stubble/

Maria, M., Jeff, A. G., & Victor, B. (2005). Adoption of Integrated Pest Management Technologies: A Case Study of Potato Farmers in Carchi, Ecuador. *Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting.* Providence, Rhode Island.

Mendola, M. (2007). Agricultural technology adoption andpoverty reduction: A propensity-scorematching analysis for rural Bangladesh. *Food Policy*, 372–393.

Nag, O. S. (2018, Frebruary 3). *The Richest and Poorest Countries of Southeast Asia*. Retrieved from worldatlas: https://www.worldatlas.com/articles/the-richest-and-poorest-countries-of-southeast-asia.html

NIS, N. I. (2009). *2008 General Population Census of Cambodia.*

Pham, H. V., Arthur , M., & Peter, O. (2013). State governance of pesticide use and trade in Vietnam. *ELSEVIER*, 19-26. doi:10.1016/j.njas.2013.09.001

Prabhu, P. L., Hossain, M., & Gerpacio, R. V. (1997). *Asian Rice Bowls: The Returning Crisis?* Wallingford: CAB INTERNATIONAL.

Shriniwas , G., Pepijn , S., Md. Nasir , U., & Ramasamy , S. (2017). Impact of training vegetable farmers in Bangladesh in integrated pest. *Crop Protection*, 161 - 169. doi:10.1016/j.cropro.2017.08.022

Srinivas, R. M. (1988). Agricultural Extension and the Small Farmer: Revealing the Communication Gap in an Extension Project in Kenya. *The Journal of Developing Areas*, 239-252. Retrieved from http://www.jstor.org/stable/4191648

Tradingeconomics. (2019, May 15). *Trading Economics*. Retrieved from Cambodia Inflation Rate: https://tradingeconomics.com/cambodia/inflation-cpi

USAID. (2018, May 18). *Cambodia: Nutrition Profile*. Retrieved from https://www.usaid.gov: https://www.usaid.gov/what-we-do/global-health/nutrition/countries/cambodia-nutrition-profile

World Bank. (2015). *CAMBODIAN AGRICULTURE IN TRANSITION:OPPORTUNITIES AND RISKS.*

World Population Review. (2019, April 1). *Cambodia population*. Retrieved from World Population Review: http://worldpopulationreview.com/countries/cambodia-population/

Yigezu, A., Amin, M., Aden, A.-H., Tamer, E.-S., Piggin, C., Haddad, A., . . . Loss, S. (2018). Enhancing adoption of agricultural technologies requiring high initialinvestment among smallholders. *Technological Forecasting and Social Change, Elsevier, 134(C)*, 199-206. doi:10.1016/j.techfore.2018.06.006

Appendix A

2016 Interview Questions

All Interviewees	**Net-house Farmers**	**Savings Group Members**
What does a successful farmer look like? OR What makes that farmer successful?	Can you tell us about your whole experience with the net-houses? (Ask the following only if not addressed here…)	Can you tell us about your whole experience with the savings group? (Ask the following only if not addressed here…)
What successes have you had as a farmer? OR What have you been most proud of since you began farming?	How did you find out about the net-houses? (for non-savings group net-house farmers) • What was your first impression about the net-houses?	How did you find out about the savings group? • What was your first impression about the savings group? How have your impressions changed? (interested in trust building)
What is the most difficult problem you face as a farmer? Has this changed?	Why did you decide to use them or to scale up? OR What benefits/advantages have you had from using the net-house? • (If reducing pesticide use is a factor, then) What made you want to use less pesticide?	Why did you decide to join a savings group? OR What benefits/advantages have you had from?
Where would you like to see yourself (or your family) in 5 to 10 years?	Can you tell us about how the experiments went?	What changes has your group made since it was formed? What made your group want to make those changes?
	Can you think of a time when something with the net-house was not working well? What did you do to try to solve this?	Can you think of a time when something was not working well in the savings group? What did you do to try to solve this?
	Have you ever talked to another farmer about using a net-house? What made you want to talk to them about it? How did it go? (Are they interested? If not (or if they are, but cannot) what makes them not want to (or unable to)?)	Have you ever talked to another farmer about joining a savings group? What made you want to talk to them about it? How did it go? (Are they interested? If not (or if they are, but cannot) what makes them not want to (or unable to)?)

Appendix B

Net-house Farmer:

1. How do you leant or heard about the net-house technology?
2. When did you first set up your net-houses and how big?
3. How to you chose to grow your crop inside the net-house?
4. How to you pay or arrange payment for the net-house cost?
5. Do you have employees working for you on the farm? How do you pay them?
6. Where/who do you sell your produce to?
7. Are you a contract farmer? How do you learn about the contract marketer?
8. How often does your contract renew?
9. Are you making your own compost for your net-houses? How long it takes?
10. Do you buy addition organic fertilizer? How do you apply? and how much it cost?
11. Recall back the technology fair at RUA in 2013, what is your feedback that event and each technology?

Saving group chairs

1. Does your group still function? How many memberships does your group has?
2. Does your group gain more members? How do people like about saving group?
3. How is your saving group performance overall?
4. Is any replication group from your group? Of so, when was it happening and how many members does it has?
5. How did last year (2018) closing cycle go? How much does your group had saved?
6. What is the majority load used for?
7. Anyone in your group taking loan to invest in net-house technology? Or planning to invest in nethouse?
8. Recall back the technology fair at RUA in 2013, what is your feedback that event and each technology

NAVS Representative

1. How do you get more net-house farmers to join you contract?

2. What kind of vegetables do normal buy from net-house farmer? How much? How often?
3. How to do you order them to grow?
4. How much do you pay for each vegetable kind?
5. How and where do you resell those produces?
6. What is your future plan like?