USDA **Food for Progress**

U.S. DEPARTMENT OF AGRICULTURE

THAILAND

Regional Agriculture Innovation Network Baseline Evaluation Report

June 2024

Evaluation Submitted by:
Capacity Building Service Group and
RISE International Consulting LLC

Report Authored by:
Dr. Jasbir Kaur, Baseline Evaluation Team Lead

Regional Agriculture Innovation Network

Baseline Evaluation Report

Program: Food for Progress

Agreement Number: FCC-493-2022/013-00.
Funding Year: 2022
Project Duration: 2022-2027
Implemented by: Winrock International

Baseline Evaluation Authored by: Capacity Building Service Group, RISE International Consulting LLC, and Rapid Asia.

Report Prepared by:
Baseline Evaluation Team Lead: Dr. Jasbir Kaur

Cover Photo credit: Terraced rice field in Chiangmai, Thailand Chatrawee Wiratgasem @Shutterstock

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDIX TABLES

LIST OF FIGURES

LIST OF APPENDIX FIGURES

ACRONYMS AND ABBREVIATIONS

BAAC	Bank for Agriculture and Agricultural Co-operatives
BBS	beneficiary
CAPI	computer-assisted personal interviewing
CBSG	Capacity Building Service Group
CRM	climate risk management
CSA	climate-smart agriculture
CSi	climate-smart innovations
DEPA	Digital Economy Promotion Agency
DOAE	Department of Agriculture Extension
EQ	evaluation question
EWS	early warning systems
FFPr	Food for Progress
GAP	Good Agricultural Practices
GHG	greenhouse gas
ICT	information and communication technology
KII	key informant interview
KSI	key stakeholder interview
KU	Kasetsart University
LOP	life of project
M&E	monitoring and evaluation
MEL	monitoring, evaluation, and learning
MOAC	Ministry of Agriculture and Cooperatives
MSU	Michigan State University
NRM	natural resource management
NSF	National Savings Fund
NSTDA	National Science and Technology Development Agency
PII	personally identifiable information
PPS	probability proportional to size
PSU	primary sampling unit

QC	quality control
RAIN	Regional Agriculture Innovation Network
RoI	return on investment
RTG	Royal Thai Government
SI	Standard Indicators
SO	strategic objective
SOW	statement of work
SRP	Sustainable Rice Platform
SSU	secondary sampling unit
USAID	U.S. Agency for International Development
USD	U.S. dollar
USDA	U.S. Department of Agriculture
WI	Winrock International

EXECUTIVE SUMMARY

PROJECT BACKGROUND AND PURPOSE

Winrock International, in partnership with Michigan State University and Kasetsart University (KU), implements the Thailand Regional Agriculture Innovation Network (RAIN) project. The project aims to increase agricultural productivity, profitability, and trade opportunities in the Thai agriculture sector while reducing greenhouse gas (GHG) emissions and natural resource depletion. To help farmers transition to climate-smart agriculture (CSA), RAIN identifies, validates, scales, and shares CSA technologies and practices, referred to as climate-smart innovations (CSi).

RAIN targets 30,000 farmer beneficiaries cultivating seven crops: rainfed rice, irrigated rice, cassava, durian, longan, mangosteen, and coconut. The targeted areas are 11 provinces in four regions—Northern (Chiang Rai, Chiang Mai, and Lamphun); Northeastern (Chaiyaphum, Khon Kaen, and Nakhon Ratchasima); Central-Eastern (Chanthaburi, Samut Sakhon, and Ratchaburi); and Southern (Chumphon and Nakhon Si Thammarat).

RAIN is expected to increase competitiveness and expand opportunities for agricultural trade. This improved outlook will result from climate-smart production—specifically, facilitating local, regional, and international trade; improving agricultural and farmer income sustainability; and reducing negative environmental impacts in Thailand.

EVALUATION QUESTIONS, DESIGN, METHODS, AND LIMITATIONS

The RAIN baseline evaluation used a mixed-methods approach to establish baseline values for six outcome indicators, provide contextual information for four financial indicators, and inform the project's eight evaluation questions—relevant to production, finance service, sales and trade, and other categories—in a complementary fashion. The purpose of the quantitative survey was to provide baseline estimates for the USDA standard, nonzero indicators, which will be monitored via annual participant-based surveys and serve as a point of comparison at midterm and endline. The purpose of the qualitative research was to contextualize the estimates from the quantitative survey.

Data collection modalities included a quantitative survey of 4,743 farmers, 49 key informant interviews (KIIs) with target farmers (seven for each of the commodities), and key stakeholder interviews (KSIs) with 24 stakeholders (two researchers, one entrepreneur, nine extension officers, three crop collectors, and nine input suppliers).

The quantitative survey questionnaire included nine modules on (1) landholdings and shocks, (2) rice, (3) cassava, (4) coconut, (5) durian, (6) longan, (7) mangosteen, (8) decision making, and (9) finance and services, along with a cover page to collect the informed consent and relevant demographic information of the farmer. The qualitative tool for the KIIs aligned with RAIN's performance indicators and evaluation questions. The KSI tool included seven question lists with a focus on those actors who introduce new technologies and practices to farmers. The quantitative survey questionnaire and qualitative tools were translated into Thai.

The translated quantitative survey questionnaire was loaded into Survey Solutions, a computer-assisted personal interviewing (CAPI) data collection system. To ensure that the approved quantitative survey questionnaire was sound, a questionnaire pretest was conducted to identify potential problem areas relating to skip patterns, wording, sequencing of questions, instructions to interviewers, and clarity of the questionnaire. The quantitative survey questionnaire pretest was implemented by a select group of experienced interviewers who were thoroughly trained on the approved questionnaire. The data collection took place from July 16 to August 28, 2023, in 155 clusters across 10 provinces[1] and four regions across Thailand.

FINDINGS

Key findings from the quantitative baseline survey are as follows.

The mean age of the farmers surveyed is 54.4 years and almost all farmers are aged 30 years and older. The percentage of female farmers is higher (56 percent) compared to male farmers (approximately 44 percent). A vast majority (97 percent) of the farmers in the sampled clusters are smallholder farmers,[2] and cassava is cultivated by approximately 93 percent of smallholder farmers. The average area of cultivated crops ranged from 0.8 hectares (ha) to 2.3 ha. In the 12 months preceding the survey, farmers of rice (rainfed), cassava, durian, longan, and mangosteen reported one production cycle and rice (irrigated) farmers reported two harvests, while coconut farmers reported an average of 25 harvests.

The yield of rice was 2.4 metric tons per hectare (mt/ha), and that of irrigated rice was over twice that of rainfed rice—that is, 5.0 mt/ha. The yield for cassava was 13.3 mt/ha. In the 12 months preceding the quantitative survey, the number of coconuts produced by the farmers in Ratchaburi was 320,580 coconuts, resulting in 30.8 mt/ha yield. The yield for durian was 6.7 mt/ha, and the yield for mangosteen was 3.8 mt/ha.

The percentage of farmers in the sampled areas who had applied one or more improved management practices or technologies was 94 percent. However, the percentage of farmers who applied specific technologies ranged from 4 percent to 100 percent. On average, farmers working in high-value crops such as coconut and durian applied a higher percentage of technologies compared with lower value crops such as rice (rainfed), mangosteen, and longan.

The percentage of farmers accessing agriculture-related financing (debt and nondebt[3]) was estimated for both cash and in-kind loans. Overall, 33.5 percent of farmers accessed any type of loans. The average value of the debt accessed per farmer was higher (USD3,618) for male farmers compared with female farmers (USD3,458). In the year preceding the

[1] The baseline evaluation excluded Samut Sakhon from the sampling, as the number of longan farmers was low.

[2] Although country-specific definitions for smallholder farmer may vary, we used the Feed the Future definition of a smallholder producer, which is a producer who holds 5 hectares of less of arable land. The producer/farmer does not have to own the land.

[3] Debt financing includes accessing cash loans through formally registered financial institutions and in-kind lending. Nondebt financing includes accessing any financing other than cash loans and in-kind lending.

survey, about 8 percent of sampled farmers took loans from savings, microfinance, or lending programs.

The total weighted annual sales by the farmer population ranged from USD81,810,120 for rice (irrigated) to USD1,565,709,903 for durian. The corresponding range for average sales per farm was USD729 for rice (irrigated) and as high as USD28,295 for durian. Most farmers sell their harvest to middlemen, and sometimes to mills, warehouse agents, and customers in China (for durian). However, they were all open to selling the harvest to any buyer who would give them a "better price."

The vast majority of farmers reported shocks and stressors related to climate change. For horticultural (mangosteen, durian, and longan) crops (except coconut), farmers experienced shocks and stressors related to drought or too little rain and heat waves or higher than usual temperatures, followed by storms. More than 50 percent of rice (rainfed and irrigated) and cassava farmers also reported shocks and stressors related to climate change, including flooding (too much rain), drought (too little rain), higher than normal temperatures, and storms. Soil erosion was reported for 7 percent (coconut) to 28 percent (cassava) of farmers in the year preceding the survey. In fact, farmers perceive climate events as the biggest threat to farming.

CONCLUSION

The baseline evaluation investigated the evaluation questions related to the project's relevance, coherence, effectiveness, efficiency, impact, and sustainability. The summary findings are as follows:

Relevance. RAIN is well designed to support Food for Progress (FFPr) specific objectives of improving productivity and expanding trade through partnering with eligible organizations in Thailand. RAIN is also relevant to Thailand's 2017–2026 Agriculture Development Plan that aims to increase competitiveness in the agriculture sector through technology and innovation.

Coherence. There is potential for interventions related to CSi, as farmers are interested in new technologies, including solar cells to conserve electricity, and drones to reduce labor costs and protect crops from pests and diseases.

Effectiveness. The specific objectives, targets, and intermediate outcomes of RAIN's Results Framework are well articulated. Achieving RAIN's life of project (LOP) outcomes will require close coordination with the partners and government agencies. Overall, an "increased use of improved agriculture techniques and technologies" (FFPr 1.2) might be challenging because the reported use of one or more improved practices or technologies is high at the baseline. However, opportunities exist to increase adoption rates for specific practices (in particular, adoption of CSi).

Efficiency. The efficiency of the project cannot be assessed at baseline, as the project is in the early stages of implementation. However, for successful adoption of CSi, the innovations

must be affordable, easy to use, accessible, save time and carry low risk. The rate of return must also be promising and apparent to the farmers.

Impact. Given some barriers in production and sale of crops, opportunities exist for a potential impact of RAIN in facilitating local, regional, and international trade, improving agricultural and farmer income.

Sustainability. RAIN activities will result in sustainability, especially if the project is successful—that is, knowledge transfer, use of technologies for increased production, including water/resource management, and more outlets for farmers to sell crops, cutting out the middleman.

RECOMMENDATIONS

The RAIN evaluation team presents the following target setting recommendations and project-specific recommendations, which are based on the baseline results and findings of this evaluation.

Target setting-specific recommendations:

1. The difference in the proposed value of crop yields and the observed estimates from the baseline quantitative survey has implications across a number of the project's FFPr Standard Indicator (SI) targets, especially value and volume of sales (SI-18 and SI-19). Indicator targets from the proposal should be revised using the yield figures and additional data captured through the RAIN baseline.
2. RAIN has an ambitious target to track the progression of 30 CSi through the Five S (five-stage process)—Source, Support, Scale, Sell, and Share—for 30,000 adopters and to have at least 1,000 farmers adopt at least one of the 30 CSi. Since at the time of baseline only a few CSi have started the Five S process, indicator targets relevant to CSi application should be reviewed.

Project-specific recommendations:

3. RAIN should identify CSi for which the rate of return is promising. It must reduce the workload and result in better quality and quantity of the product with reasonable investment.
4. To ensure accountability and support for testing and adoption of CSi, RAIN should work with scale partners to educate, train, monitor, and measure the use of CSi by farmers.
5. For increased trade, RAIN aims to expand and validate technologies and CSi. Consider providing good-quality inputs (improved seeds), market linkages, and quality/standard certifications, which will result in adoption of improved agriculture techniques and technology, increased yield, and expansion of markets.

I. INTRODUCTION AND PURPOSE

Food for Progress (FFPr) is an international development program at the U.S. Department of Agriculture (USDA) that helps to improve agricultural productivity and profitability and expand trade of agricultural products. FFPr projects have trained farmers in animal and plant health, improved farming methods, developed road and utility systems, established producer cooperatives, provided microcredit, and developed agricultural value chains (USDA, 2020). In September 2022, the U.S. Government, through the U.S. Department of Agriculture, made a historic investment in FFPr projects to expand markets for climate-smart commodities; leverage greenhouse gas (GHG) benefits of climate-smart commodity production; and provide direct, meaningful benefits to agricultural production, including benefits for small and underserved producers. In 2022, Winrock International was selected to implement FFPr projects in Malawi and Thailand.

1.1 PROJECT CONTEXT

Thailand is in the heart of mainland Southeast Asia, surrounded by Cambodia, Myanmar, the Lao People's Democratic Republic, and the Gulf of Thailand. Demographically, about 17 percent of the population is age 14 or younger, 71 percent is between 15 and 64 years old, and 12 percent is over 65 years. The population is ethnically diverse: the largest ethnic group is Thai, followed by Chinese, Malay, and Khmer. Traditionally, an agrarian society, agriculture and tourism are the most important industries in Thailand. With one-third of the labor force employed in the agriculture sector, agriculture is highly competitive and diversified. Almost 50 percent of women are economically active and employed in the agriculture sector. A study on gender roles and use of technology found that while women were involved in all aspects of agricultural production, men dominated mechanized tasks. Women also have reduced access to resources, including inputs, credit, seeds, and information and knowledge (Langford, 2016).

Over 60 percent of farmers cultivate rice, making Thailand a leading exporter of rice, which accounts for about 17.5 percent of all food exports, followed by chicken, sugar, processed tuna, tapioca flour, and shrimp. However, agriculture is also the second largest source of GHG emissions in Thailand and contributes to only 6 percent of the country's gross domestic product (UNDP, 2022; ITA, 2022) The growing population and climate change threaten all key sectors of Thailand's economy—agriculture, tourism, and trade. Climate-smart agriculture (CSA) can help Thailand overcome food insecurity while supporting rural populations as they adapt to climate change. CSA helps economies manage natural resources sustainably and curb rising temperatures (Neufeldt et al, 2015)

1.2 PROJECT DESCRIPTION

The Thailand Regional Agriculture Innovation Network (RAIN) project is a 5-year (September 2022 to August 2027), USD16,454,520 project that will expand and strengthen

the use of CSA across four regions in Thailand. Winrock International, in partnership with Michigan State University and KU, implements RAIN in those four regions.[4]

RAIN aims to increase agricultural productivity, profitability, and trade opportunities in the Thai agriculture sector while reducing GHG emissions and natural resource depletion. To help farmers transition to CSA, RAIN identifies, validates, scales, and shares CSA technologies and practices, referred to as climate-smart innovations (CSi). These technologies and practices have been validated through a rigorous, evidence-based, participatory process known as the *Five S*: Source, Support, Scale, Sell, and Share. RAIN will (1) implement a five-stage process that will **source**, **support**, and **scale** technically and financially validated climate-smart technologies and practices to farmers through customized support-service bundles; (2) ensure that selected climate-smart technologies and practices address market opportunities to **sell** more production locally, regionally, and internationally; and (3) **share** data, information, and resources related to climate-smart technologies and practices with national and regional stakeholders, programs, and networks.

RAIN is expected to increase competitiveness and expand opportunities for agricultural trade. This improved outlook will result from climate-smart production—specifically, facilitating local, regional, and international trade; improving agricultural and farmer income sustainability; and reducing negative environmental impacts in Thailand. RAIN uses these activities and their respective outputs and outcomes to address the elements of FFPr strategic objectives (SO), in particular SO 1, and SO 2. **Annex 3** presents RAIN's SO 1 and SO 2 results framework. A summary description of the activities is as follows:

Activity 1: SOURCE *existing and emerging CSi and conduct rigorous, science-based technical and financial validation trials to identify those that will best respond to the social, economic, and environmental needs of Thai farmers and of the Thai agriculture sector—and ultimately, those of the region. RAIN will form a research consortium and CSi Evidence Panels to design criteria and validation processes to oversee the collection and confirmation of evidence linked to each innovation prior to validation.*

Activity 2: SUPPORT *all technically and financially validated CSi by identifying and improving support services critical for CSi adoption and for packaging of CSi and associated services into service bundles. RAIN will design service bundles for each validated innovation, customized according to the social, economic, and environmental needs of farmers.*

Activity 3: SCALE *CSi solutions by building the capacity of private and public sector partners to understand, promote, and market CSi and associated services. RAIN will provide technical, business development, and marketing support to agricultural businesses and service providers to expand their knowledge of CSi and improve their strategic business skills. By demonstrating the economic value of pooling services and resources, RAIN will help businesses design CSi service bundles and bundle partnerships that deliver a single CSi "package" that is based on the needs of farmers in their service areas, thus leveraging economies of scale and expanding their markets more efficiently.*

Activity 4: SELL *greater volumes of Thai agricultural products through increased national, regional, and international trade by regularly coordinating with private sector agricultural stakeholders to*

[4] Northern, Northeast, Central-Eastern, and Southern Thailand.

identify and align CSi prioritization with market demand. RAIN will help Thai processors to increase their competitiveness by reducing facility and process inefficiencies that contribute to GHG emissions and by providing technical analysis and efficiency plans.

***Activity 5: SHARE** meaningful CSi data, information, and resources with national and regional stakeholders.*

RAIN's theory of change states that through project activities, actors in the Thai agriculture sector will increase their productivity and profitability, improve and expand market linkages and trade opportunities, and contribute to national climate-change mitigation and adaptation efforts with reductions in natural resource depletion and GHG emissions.

Figure 1. Map of target commodities in the select provinces of Thailand

RAIN's theory of change is; ***By*** (1) technically and financially validating climate-smart technologies and practices as viable for the agriculture sector; (2) ensuring that timely and actionable climate, production, and market data, information, and resources are available and accessible to stakeholders to predict, plan, and make informed decisions and to innovate, adapt, and promote climate-smart technologies and practices; and (3) enhancing and scaling the technical and marketing capacities of agricultural businesses, service providers, and extension officers to increase producers' adoption of these technologies and practices, ***then*** actors in the Thai agriculture sector will increase productivity and profitability, improve and expand market linkages and trade opportunities, and contribute to national climate change mitigation and adaptation efforts with reductions in natural resource depletion and GHG emissions. This will result in a more resilient, sustainable Thai agriculture sector, capable of withstanding and adapting to the effects of climate change locally and serving as a knowledge leader and training hub for climate-smart agricultural solutions regionally.

RAIN's theory of change is predicated on the assumption that 1) market expansion will occur, and that the expansion will be a direct result of adoption of improved agricultural techniques and technology; and 2) the control group is not using specific features or receiving similar services through a different program or is contaminated through the reach of RAIN program.

RAIN targets 30,000 farmer beneficiaries cultivating seven value chain crops: rice-rainfed, rice-irrigated, cassava, durian, longan, mangosteen, and coconut. RAIN will also interact with co-farming group leaders, government partners, local private partners, academic university staff, trade association management, agricultural businesses and entrepreneurs, climate-smart innovators, financial partners, data partners, and other value chain partners through the Five S process. This diverse group of stakeholders has specific roles, for example, 1) the private agriculture sector stakeholders help identify and align CSi prioritization with market demand; 2) local private partners, universities and other stakeholders serve on evidence panels to review data on CSi and provide recommendations that help review and refine program targets, identify anticipated challenges during implementation; and 3) USDA, government partners, producers, trade association managers contribute by providing evaluation questions and concern for continued support of the innovation. In short, stakeholders' perspectives are important for operational and strategic planning, improving RAIN's design, getting continuous feedback for improving the program, and in measuring effectiveness and sustainability of the program. The targeted areas are 11 provinces in four regions—Northern (Chiang Rai, Chiang Mai, and Lamphun); Northeastern (Chaiyaphum, Khon Kaen, and Nakhon Ratchasima); Central-Eastern (Chanthaburi, Samut Sakhon, and Ratchaburi); and Southern (Chumphon and Nakhon Si Thammarat). See **Figure 1.**

Overview of RAIN's Target Commodities

This section provides basic contextual information for RAIN's target commodities.

Rice. Thailand has two annual rice-growing periods—the wet-season (main) and the dry-season (off-season). The wet-season rice harvest is the larger of the two annual crops, and accounts for approximately 80 percent of total annual production. The main season (rain-fed) rice area is in the Northeast region. Lowland rainfed and irrigated rice production are the dominant systems. The dry-season rice is mainly irrigated and produced in the North and Central Plains region (USDA, 2021). Smallholder farmers cultivate rice by transplanting, harvesting, and threshing, which is increasingly mechanized using combine harvesters. Although rice is the main staple food in Thailand, the country remains a dominant exporter of rice. Sticky rice is generally used for household consumption and *Hom Mali* (KDML 105 and RD15) rice is for sales and export.

Cassava. Thailand is the second largest producer of cassava in the world followed by Nigeria. The main cassava-growing region is the Northeast, accounting for 60 percent of production. The Central Plains and Northern Regions also grow cassava. Thailand is the leading exporter of cassava products, mainly in the form of dried chips or starch powder. The processed products are often referred to as "tapioca" (Arthey et al, 2018). The vast majority of cassava production is carried out by smallholder farmers. Because of the high starch content, environment adaptation, and ease for machine-harvesting, the majority of farmers grow Kasetsart 50 (KU50). Typically, mechanical lifting of cassava takes place using tractor or other lifting equipment followed by cutting and loading of cassava roots, which is done by hired labor. Cassava is transported straight from field to the local chip factories.

Coconut. Thailand is the world's main exporter of aromatic coconuts. The high-quality coconuts come from four provinces—Ratchaburi, Samut Sakhon, Nakhon Pathom, and Samut Songkram (Jeenkerdsup, 2019). In addition to coconut water packaged in bottles and cartons, ready-to-drink fresh coconuts are widely consumed. Thai coconuts are also processed into coconut milk, ice cream and canned coconut juice. To prevent the nut from cracking or turning brown, growers hand-harvest the young coconuts 6 to 9 months after flowering while the skin is still green (Paull and Saichol, 2015). On average, coconuts are harvested 15 times in a year with 10–40 coconuts picked in each harvest.

Durian. Durian is widely known in southeast Asia as the "king of fruits." Thailand is the largest durian producer and exporter in the world market. Up to 90 percent of durian is exported (both fresh and frozen) to China. It is cultivated in the eastern and southern regions. Harvesting durian off the tree is common in Thailand—that is, fruits are harvested at a mature stage and then are artificially ripened in 5–7 days for the markets. Care is taken to prevent the fruit from falling off the tree because durians are sensitive to mechanical injury and fruit spines. It is often harvested in buckets to avoid contact with dirt/ground or infection by pathogens (Horticulture Reviews, 2019) Durian is eaten fresh, as durian sticky rice and in desserts, ice cream, pancakes, and pastillas (candies).

Longan. Longan, also known as "lam-yai," is grown with varying yield in Chiang Mai and Lamphun provinces of Thailand. More than three-fourths of the farmers have small- longan orchards (Yakam et al, 2012). Trees are generally drip-irrigated during the first four years of planting. The period of bloom to harvest is about 5–7 months. The production of longan takes place all year round, but its production outside of June, July, and August is classified as off-season longan. Longan fruit is generally eaten fresh. Because of the short shelf life, longan is frozen, canned, or dried (Choo, 2000).

Mangosteen. Chanthaburi in the East, and Chumphon and Nakhon Si Thammarat in the South, are the major producers of mangosteen in Thailand. The production season in the East is from April to June and in the South from July to September. Mangosteen is harvested from stage 2 (of 5 stages) when the fruit shows greenish with reddish purple patches. Major countries importing mangosteens are Hong Kong, United States, Republic of Korea, United Arab Emirates, and Australia. Technology to produce high-quality mangosteen has been established by the Thailand Department of Agriculture (Anupunt, 2015). **Table 1** provides an overview of RAIN's target commodities.

Table 1. Overview of RAIN's target commodities

Commodity	Main use(s) of commodity	Primary producers in Thailand	Net importer/ exporter status	Main market(s) for commodity	Number of harvest(s) per year	Commodity pain points/key constraints for KIIs
Rice	Consumption as cooked rice and processed into flour, noodle, snacks, baked foods, desserts, and beverages, including alcoholic beverages	Smallholder farmers	Exporter	Iraq, South Africa, China, U.S., Japan, and other Africa countries	Wet season (main) – November to December Dry season (off-season) – March to June	Rice yields are negatively affected by frequent and intense floods and droughts every year. Rainfed rice is more likely to be damaged because of flooding. For sustainable rice production, farmers need high-yielding varieties with high-quality grain.
Cassava	Cassava products in the form of dried chips and starch powder	Smallholder farmers	Exporter	China and other South Asian countries	One (November to March) A small proportion of farmers (approx. 15 percent) plant twice in a year with the second harvest from August to October	Physical deterioration of cassava begins within 24 hours of harvest. However, there is often no farm storage. Some storage techniques extend the life by up to 8 weeks, but these are labor and capital intensive. Hence, little adoption by smallholder farmers.
Coconut	Coconut water is used as a beverage; coconut flesh is used for milk, flour and food; and coconut oil.	Smallholder farmers	Exporter	China, U.S., Singapore, Hong Kong	All year–on average 15 harvests a year (~every 23 days)	Challenges for smallholder coconut farmers include decline in prices, labor problems, and massive debts.
Durian	Consumption as fresh fruit, processed as paste, chips, fritters, beverage (juice), and dessert (jelly, custard, ice-cream, cake)	Smallholder farmers	Mainly for domestic consumption but largest exporter in the world	China, Vietnam, and Hong Kong	March to September	Challenges include higher capital costs. No bargaining power to negotiate prices with middlemen/agents or exporters. High benchmarks for certification and high rejection by trading partners. Extremely short shelf life (one week).
Longan	Eaten (fresh, frozen, canned, or dried); longan flesh is used to make a liqueur. Seed can be used as shampoo and dried leaves sold as ingredient in Chinese herbal medicine.	Smallholder farmers	Exporter	China, U.S.	June to August	Extreme climatic events—longan yield is sensitive to cold or very hot temperatures, excessive rain, and strong cyclonic winds.
Mangosteen	It is consumed fresh and used in smoothies, jam, popsicles, sweet paste, ice cream, and salads. It is also used in traditional medicine and skin care.	Smallholder farmers	Most for domestic consumption but exported too.	China, Japan, Taiwan, U.S., Canada, Hong Kong, United Arab Emirates, Australia	East: April to June South: July to September	Climate and certifications. Different technologies for exports—for example, Japan requires vapor heat treated mangosteens whereas those bound for the U.S. market need to be irradiated.

1.3 BASELINE EVALUATION

Food assistance projects such as RAIN are mandated to establish indicator baseline values and targets for select indicators that are consistently tracked through routine monitoring activities and annual beneficiary-based surveys, and validated through periodic assessments, including midterm and endline evaluations. In March 2023, Winrock International awarded the RAIN Baseline Evaluation contract to Capacity Building Service Group (CBSG), RISE International Consulting LLC (RISE International), and a local subcontractor, Rapid Asia, Co. Ltd (Rapid Asia). The Baseline Evaluation was conducted from March 2023 to May 2024. The key dates and milestones are presented below.

- ※ Inception phase: March 2023 – April 2023
- ※ Data collection: July 2023 – September 2023
- ※ Tabulation and analysis: September 2023 – November 2023
- ※ Draft report: December 2023 – January 2024
- ※ Dissemination of findings: February 2024
- ※ Final report: February 2024
- ※ Final approval and submission to DEC: June 2024

1.4 PURPOSE AND OBJECTIVES

The purpose of the baseline evaluation is to collect quantitative data on performance monitoring indicators and qualitative data on impact and effectiveness-related evaluation questions (EQ) based on the Strategic Objectives (SOs) listed in the framework (**Annex 3**).

The objectives of the baseline evaluation are to:

- Establish baseline values for six of RAIN's outcome level indicators to track progress and performance throughout the life of the project, including comparison against the same values to be collected in annual surveys and the midterm and final evaluations.
- Establish baseline values for counterfactuals so that impact can be measured.
- Help review and refine program targets.
- Identify anticipated challenges that may occur during project implementation.
- Provide actionable recommendations regarding the project's design and implementation.
- Acquire and verify data for indicators that are unavailable or outdated.

The intended audience for the baseline evaluation report includes the Winrock staff and management, the implementation team, and USDA. This performance-based evaluation process of program-level results will allow USDA and RAIN to assess the extent to which the project is achieving the FFPr program's overall SOs. Specifically, the Winrock management and staff, along with the evaluation team and USDA, will review the draft baseline evaluation report to determine if RAIN's targets are achievable or need to be refined or adjusted. Hence, the results and recommendations from the baseline evaluation are expected to guide the project team's approach and activities during implementation of the project.

2. EVALUATION DESIGN AND METHODOLGY

The overall objectives for the qualitative study are to *understand the context*—dynamics and perceptions of value chain commodities, agricultural techniques, farmer characteristics, and the enabling environment—to allow for an analysis that contextualizes beliefs, behaviors, practices, and potential for CSi adoption within the project intervention areas. The data collection methodologies will facilitate effective avenues for analyzing the qualitative study and quantitative survey findings in a complementary fashion and thereby *generate valuable data*.

2.1 EVALUATION QUESTIONS

Qualitative Questions

In accordance with the SOs listed in the logic model (**Annex 3**) and aligned to the activities and the terms of reference (TOR) for the baseline evaluation, qualitative data collection provided baseline contextual information using the following evaluation questions (EQs) and the corresponding categories:

EQ 1 (Sales and trade). To what extent did trade expand through the increased adoption of improved agricultural techniques and technology?
EQ 2 (Production). To what extent did agricultural productivity increase through increased farmer capacity resulting from the increased use of improved agricultural techniques and technologies?
EQ 4[5] (Finance service). To what extent did the use of improved agricultural techniques and technologies increase through increased use of financial services promoted by RAIN?
EQ 5 (Overall). How relevant were program activities for the beneficiaries?
EQ 6 (Overall). How will the program activities be sustained by various stakeholders? Is there any evidence of sustainability?
EQ 7 (Production). How did adopted innovations lead to improvements/efficiencies? How were they effective?
EQ 8 (Production). What were characteristics/factors in sourced innovations that were successfully adopted? What were characteristics/factors of sourced innovations that were not adopted?

Annex 6 presents the proposed qualitative study questions by the Organization for Economic Co-operation and Development evaluation criteria. The qualitative study questions and the content of the interview guide stemmed from the goals and strategic objectives of RAIN.

Specifically, the qualitative study included six questions with a focus on those stakeholders/actors who introduce improved technologies and practices to farmers, and two-questions on finance and sales to farmers who own the land used for cultivation of the target commodity. These questions are aligned with the EQs and 10 indicators and were asked for all crops. **Annex 11** Data Collection Instruments: Baseline Evaluation Questions and Study

[5] RAIN reviewed the EQs upon award and dropped EQ 3.

Guide presents the proposed qualitative research questions specific to KII and KSI. Drawing from document review and using a collaborative and iterative process with input from Winrock and stakeholders in the country, Capacity Building Service Group and RISE International developed a preliminary qualitative design.

Quantitative Questions

The quantitative survey questionnaire was designed to collect data for 10 standard performance monitoring indicators under three categories—production, finance service, and sales and trade.

Table 2. Key USDA indicators reported by RAIN's baseline quantitative survey

FFPr Standard Indicators (SI)		Type of Indicator	Unit of Measure	Commodity/ Practice	Baseline (weighted)[6]
Production					
1	Yield of targeted agricultural commodities among program participants with USDA assistance	Outcome	Metric tons/hectare	Rice (rainfed) Rice (irrigated) Cassava Coconut Durian Longan Mangosteen	2.4 5.0 13.3 30.8 6.7 4.6 3.8
2	Number of hectares under improved management practices or technologies that promote improved climate risk reduction and/or natural resources management with USDA assistance	Outcome	Hectares	Total Crop Land NRM Climate mitigation CRM	2,024,579 2,022,201 1,320,981 1,716,532
3	Number of hectares under improved management practices or technologies with USDA assistance	Outcome	Hectares	Total Crop Land Rice (rainfed) Rice (irrigated) Cassava Coconut Durian Longan Mangosteen	2,024,579 1,343,101 44,772 40,4012 10,392 72,848 100,982 48,472
4	Number of individuals in the agriculture system who have applied improved management practices or technologies with USDA assistance	Outcome	Individuals	Rice (rainfed) Rice (irrigated) Cassava Coconut Durian Longan Mangosteen	786,013 24,564 195,083 9,058 55,336 123,206 51,080

[6] Sample-weighted values are extrapolated to the entire farmer population from which the sample was drawn, whereas unweighted values are representative of only the sampled farmers.

FFPr Standard Indicators (SI)		Type of Indicator	Unit of Measure	Commodity/ Practice	Baseline (weighted)[6]
Finance Service*					
5	Number of individuals accessing agriculture-related financing as a result of USDA assistance	Output	Individuals	n/a	0
6	Number of individuals participating in group-based savings, microfinance, or lending programs with USDA assistance	Output	Individuals	n/a	0
7	Number of loans disbursed as a result of USDA assistance	Output	Number	n/a	0
8	Value of agriculture-related financing accessed as a result of USDA assistance	Output	USD	n/a	0
Sales and Trade					
18	Value of annual sales of farms and firms receiving USDA assistance	Outcome	USD	Rice (rainfed) Rice (irrigated) Cassava Coconut Durian Longan Mangosteen	572,722,082 81,810,120 368,641,669 178,164,987 1,565,709,903 215,963,484 229,730,918
19	Volume of commodities sold by farms and firms receiving USDA assistance	Outcome	Metric tons	Rice (rainfed) Rice (irrigated) Cassava Coconut Durian Longan Mangosteen	1,765,925 656,616 4,459,835 316,358 472,430 418,970 176,891

*Indicators 5–8 are zero at baseline according to the *USDA Food Assistance Indicators and Definitions, February 2019.* However, baseline data on farmers accessing agriculture-related financing, savings, and lending will support program design for the RAIN project.
FFPr = Food for Progress
SI = Standard Indicators
USDA = U.S. Department of Agriculture
NRM = Natural resource (or ecosystem) management
CRM = climate adaptation/climate risk management

The questionnaire was based on the USDA's *Food Assistance Indicators and Definitions* and U.S. Agency for International Development's *Feed the Future Indicator Handbook* for relevant modules, including age, gender, landholdings of the farmers, agricultural inputs such as seeds, fertilizer, training received, access to basic services, financing, management practices and technologies, and climate shocks and stressors. The questionnaire development included a series of consultations with Winrock and local stakeholders to adapt it to the local context.

The final questionnaire was initially developed in English and translated to Thai. Similarly, the team prepared training materials, including show cards, to aid full grasp of questions by the enumerators. The translated questionnaire was programmed using Survey Solutions, a free software developed by the World Bank. Checks for consistency were built into the Survey Solutions data entry application and included respondent eligibility, skip patterns, filters, range checks, and other quality control checks. A CAPI pretest was implemented before enumerators were trained. The pretest included data collection from farmers who resided on the outskirts of Bangkok but shared similar characteristics to the project beneficiaries. Errors in the CAPI program were resolved before using the questionnaire for training.

2.2 EVALUATION DESIGN

We used a mixed-methods approach to establish baseline values for six outcome indicators, provide contextual information for four financial indicators, and inform the project's eight evaluation questions—relevant to production, finance service, sales and trade, and other categories—in a complementary fashion.

The purpose of the quantitative survey was to provide baseline estimates for the standard, nonzero indicators, which will be monitored via annual participant-based surveys and serve as a point of comparison at midterm and endline. The purpose of the qualitative research was to contextualize the estimates from the quantitative survey.

2.3 SAMPLING METHODS

Target Population

The target population for the quantitative survey consisted of farmers who cultivate RAIN's target commodities and are members of the co-farming promotion system, also known as large-plot farming facilitated by the Ministry of Agriculture, across 10 provinces (or *Changwat*). The target population for the KIIs included demographically similar beneficiaries in terms of gender, age, location, income, and RAIN involvement. The target participants for KSIs, however, included representatives of each stakeholder type (farmer beneficiaries and co-farming group leaders, government partners, local private partners, academic university staff, trade association management, agricultural businesses and entrepreneurs, climate-smart innovators, financial partners, data partners, other value chain partners, etc.). When applicable, beneficiaries by disaggregated variables, including commodity, gender, and regions, were included.

Sampling Frame

The survey sample was selected using a multistage clustered sampling approach to provide a statistically representative sample of farmers across RAIN's target areas. The sample for the Thailand RAIN Baseline Survey was a stratified, multistage cluster sample design. The sample was stratified by crop. Within each stratum (i.e., crop), (1) a list of sub-districts where the crop is cultivated was compiled, (2) a sample of sub-districts was selected as primary sampling units (PSUs), (3) from each selected PSU, a sample of villages was selected as secondary sampling units (SSUs), and (4) from each selected village, a sample of farmer households was selected, and farmers were interviewed.

The baseline evaluation dropped Nakhon Ratchasima, Chaiyaphum, and Khon Kaen provinces from sampling for irrigated rice because RAIN does not target these provinces for this commodity. The baseline evaluation also excluded Samut Sakhon from the sampling for longan because the number of farmers was low. Hence, the baseline yield estimates for longan from Chiang Mai and Lamphun cannot be generalized to production in Samut Sakhon. See **Annex 7**: Sampling Design for the allocation of selected villages by crops and provinces.

First Stage: Selection of sub-districts. In the first stage, sub-districts were selected by probability proportional to size (PPS) selection. We used the number of farmers per sub-district as the size for the PPS selection. Before the sample selection, to achieve an implicit stratification by different administrative levels, we sorted the list of sub-districts by provinces, district codes and sub-district codes. For each crop, five sub-districts were selected as primary sampling units (PSUs).

Second Stage: Selection of villages. In the second stage, four or five villages were randomly selected from each selected sub-district. Those villages were assigned as the "original selection" where interviewers should start. A total of 155 villages were selected. Another two villages were selected within each selected sub-district as "reserve." A total of 70 villages were selected as reserves. The reserve villages are retained for village replacement in scenarios that will be discussed later.

Table 3. Sample size calculations by commodity

			Sampling methodology - RAIN Baseline Survey					
Commodity	N_1	N_2	$n_{initial}$	Adj_1	Adj_2	Adj_3	n_{final}	Number of interviews
Rice, rainfed	989,786	989,786	525	525	788	875	788	781
Rice, irrigated	120,645	24,564	536	525	788	875	788	775
Cassava	195,610	195,610	526	525	788	875	788	773
Coconut	9,058	9,058	440	420	630	700	630	620
Durian	55,336	55,336	423	420	630	700	630	600
Longan	123,721	123,206	421	420	630	700	630	619
Mangosteen	51,080	51,080	423	420	630	700	630	604
Total	1,545,236	1,448,640	3,294	3,255	4,884	5,425	4,884	4,772

Note. N_1=Number of RAIN farmers in the population; N_2=Number of RAIN farmers in target provinces; n_{final} =Initial sample with 95 percent confidence level and 5 percent margin of error; Adj_1 = Adjustment 1: Finite population correction; Adj_2 = Adjustment 2: Design effect of 1.5; Adj_3 = Adjustment 3: Non-response rate of 10 percent; n_{final}=final sample

Third Stage: Selection of farmers. In the last stage, 35 farmers were selected from each village. See **Annex 7**: Sampling Design for the allocation of farmers by crop. The selection method to use depended on the availability of a list of farmers in the village.

The sample sizes are determined to show statistically significant changes for most indicators between baseline and endline surveys. The selected sample included 155 clusters with 5,425 farmers. We assumed a 10 percent nonresponse and expected to interview 35 farmers in each cluster (**Annex 7**. Sampling Protocol). If field teams interviewed fewer than 20 farmers from any given village/cluster, they selected an additional sample from 70 reserve clusters. The representative sample is expected to have a 95 percent confidence level, a 1.5 design effect, and the statistical power of 0.8. The sample size is sufficient to measure 11 percent change from 50 percent (value of proportion for the most conservative estimate) for rice and cassava, and 12 percent change from 50 percent for other commodities (coconut, durian, longan and mangosteen). To prevent exclusion of potential beneficiaries, the project will assign a treatment and control group at a later stage (**Annex 7**. Sampling Design).

Key informant interviews and key stakeholder interviews included purposive sampling. Specifically, the qualitative research included interviews with the following modalities and stakeholders:

- KIIs with farmers who cultivate the target crops.
- KSIs with stakeholders, including government officials, finance agencies, CSi panel members, and value chain actors such as input sellers who introduce new technologies and practices to farmers.

Table 4. Number of KIIs and KSIs by location

Qualitative Interviews	Commodity/Stakeholder	Province	No. of Interviews
KII	Rice, rainfed	Chaiyaphum, Nakhon Ratchasima and Khon Kaen	7
	Rice, irrigated	Chiang Rai	7
	Cassava	Khon Kaen and Nakhon Ratchasima	7
	Coconut	Ratchaburi	7
	Durian	Chanthaburi	7
	Longan	Chiang Mai and Lamphun	7
	Mangosteen	Chanthaburi and Nakhon Si Thammarat	7
KSI	Researcher	Khon Kaen University and Rice Department, Bangkok	2
	Entrepreneur	Bangkok	1
	Extension officer	Bangkok, Khon Kaen, Chanthaburi, and Chiang Mai	9
	Crop collector	Chiang Mai and Ratchaburi	3
	Input supplier	Samut Sakhon and Ratchaburi	9
Total			73

These interviews provide context to the quantitative survey estimates and identify anticipated challenges that may occur during implementation. The sample for each modality

was large enough to ensure that the perceptions of the relevant community, farmers, and stakeholders were uncovered, yet not so large that the task resulted in repetitive information.

We conducted 73 interviews for the qualitative study—seven interviews per crop (i.e., 49 interviews (KII) with farmers and 24 interviews with key stakeholders).

Selection of Locations

In adopting a purposive sampling approach for the qualitative work, we selected sites for conducting farmer interviews so that the data collected will speak to the objectives for the qualitative study. Overall, we determined the number of communities and sites to visit—and which specific ones to visit—in consultation with RAIN's monitoring, evaluation, and learning (MEL) team and the country team. The selection process considered certain factors and attributes, including appropriate alignment and balance in relation to the project interventions; variations across different communities and sites; practices and innovations unique to specific commodities, communities, and sites; climate and topographical variations; and ease of access and logistical considerations, such as time and budget.

2.4 DATA COLLECTION METHODS

The baseline evaluation data collection used a mixed-method approach—that is, besides desk reviews to inform the baseline evaluation design, it comprised a quantitative survey, a qualitative study of key informant interviews (KIIs) with farmers, and key stakeholder interviews (KSIs) as listed in above section.

We implemented quality assurance and quality control activities before, during, and after qualitative and quantitative data collection. Quality assurance procedures included thoughtful development of training materials, a clear protocol for administering the community questionnaire, a user-friendly interview guide, and a data collection schedule. Training of the data collection teams emphasized, among other aspects, the importance of accurate and ethically sound data collection. All trainers and trainees watched the Human Subject Research training video with an emphasis on protecting the welfare of particularly vulnerable population including the economically or educationally disadvantaged groups and those with limited decision-making capacity. Each slide from the video was summarized in Thai. The training video with the accompanying script, exam, and quizzes were provided by Winrock International. To ensure that vulnerable populations, including emancipated minors aged 15-17 years participate freely in the interviews, training also included a session on the importance of reading the informed consent and receiving consent from farmers without coercion and undue influence. Quality control procedures included clear documentation on how the data were collected, translated, and transferred; in-field monitoring, supervision, and additional training if necessary; daily debriefings and problem-solving sessions; and consistent review of the transcribed interviews.

Table 5. Completion rate for quantitative and qualitative interviews

Data collection modality	Target number of interviews	Number of interviews completed	Completion rate (percent)
Quantitative Survey	4,884	4,772	97.8
KIIs	49	49	100
KSIs	24	24	100

Quantitative Data Collection

Quantitative data collection included a survey of sampled farmers conducted from July 16 to August 28, 2023. The quantitative survey collected information from farmers using a 12-month recall period. It was conducted in Thai, following training and a pilot test to validate the revised instrument and all procedures, logistics, systems, and translations in communities outside of Bangkok, but not part of the sample.

A 4-day training (July 11–14, 2023) included interviewer, supervisor, and moderator training for 25 individuals. It covered an overview of RAIN, steps for CAPI setup; instruments' topical areas/modules; ethics in survey and research; field management procedures; identification and selection of farmers, target areas, and other aspects of field control; and management (safety and security/workload allocation) along with mock interviews. A second targeted 1-day training was conducted on July 26, 2023, for nine additional survey interviewers. The focus of the training was understanding the survey questionnaire for data collection. Interviewers continued to practice and hone their skills and grasp other data collection requirements, including selection of households after joining the first batch of trainees/interviewers in the field.

The composition of and support to field teams—including field supervision, data transmission and management, and data quality control—are critical points to ensure that the field team successfully collects data. Interviewers and supervisors were assigned to two teams: Team 1 comprised 15 interviewers, one supervisor, and one quality control (QC) support staff. Team 2 included four interviewers and a supervisor, and QC staff. The remaining staff served as moderators for qualitative interviews.Working in close partnership with Rapid Asia, the evaluation team ensured high-quality data through a strong focus on training field staff and monitoring data collection. The survey team used electronic data capture, which allowed for frequent uploading of collected data and continuous data quality review. Data was validated at the time of collection through various response constraints (e.g., skip patterns, ranges, etc.) in questionnaire design and programming. In addition, supervisors provided frontline data quality assurance. The supervisors and QC staff monitored interviews in progress and reviewed questionnaires before data

Photo credit: Rapid Asia

transmission. They also provided instructions to the field teams as needed. The Field Manager also monitored and discussed observations with interviewers at the end of each day to correct identified issues and errors. After the survey data was approved by the Field Manager, Rapid Asia QC staff reviewed and approved the data. The final survey dataset was shared with CBSG and RISE International.

Data processing and storage procedures ensured protection of all personally identifying information. Data capture in the field took place on encrypted, password-protected tablets/phones. Secure, cloud-based servers protected and routinely backed up survey data.

We reviewed data each day for the duration of the data collection period. This included conducting frequencies on select variables and checking for data entry mistakes. Collected data included demographic and district information; financial services and debt; profile information about farmers; agricultural capacity; production, volume and values of sales for rice, cassava, and targeted horticulture commodities; total yield and percent of yield lost during production, post-production; number and value of loans accessed; and local extension and information sources and services delivery, as well as any other information required for the indicators, including the required USDA disaggregates.

Qualitative Data Collection

KII and KSI training were conducted concurrently with the quantitative survey training. This training included discussions on agriculture innovation technologies and services. Specific training included a review of KII and KSI moderator guides and role playing. Similar to the survey training, quiz sessions were conducted for the KII and KSI moderators to recap learning, engagement, and motivation. After minor course corrections, interviewers for the survey and moderators for the qualitative interviews collected data for the baseline evaluation.

For KIIs, the survey team identified potential respondents from the quantitative survey and identified questions that will serve as screeners to select suitable participants. At the end of the survey, the interviewer notified respondents if they qualified for a KII. If they did, the interviewer collected contact details from the farmer and a suitable time for a call back. A list of topics for the interviews and questions was finalized ahead of the interviews (**Annex 11**: Data Collection Instruments: Baseline Evaluation Questions and Study Guide).

Six experienced moderators conducted 49 KIIs (seven f or each commodity) with respondents from the quantitative survey. Seven KIIs were conducted in the form of follow-up interviews. Based on farmers' availability, some KIIs were conducted right after the survey interviews while for other KIIs, a call back was required to set up an appointment with the farmers who had agreed to take part in the KIIs.

Photo credit: Rapid Asia

For KSIs, the baseline evaluation team contacted participants from the list of stakeholders provided by Winrock International. An email from Winrock International to all potential participants was shared to ensure participants were aware of the study and that Rapid Asia was appointed as an independent agency to collect the data. The email explained to the recipients that their participation is voluntary, and that all information will be kept confidential. Four experienced moderators conducted KSIs with 24 individuals, which included two researchers, one entrepreneur, nine extension officers, three crop collectors and nine input suppliers.

The qualitative data collection team conducted all interviews in the language that participants were most comfortable with. Each interview lasted for about an hour to an hour and a half. The interviewers' notes in Thai were used to create a transcript of the respondents' answers to the questions. Audio recordings of the interviews were used to finalize transcription in Thai, especially if the notes were not clear or more information was required. The detailed transcribed notes in Thai were then summarized into English. The translated version was analyzed using MAXQDA.

After pilot testing, survey data collection took place July 26–August 28, 2023, in 155 clusters in 10 provinces across four regions. Pilot testing for the survey questionnaire took place in nonsampled rural communities in the target provinces whereas the pilot test for KIIs was conducted as part of the field exploration in Chanthaburi on June 14, 2023. Two interviews each were conducted for durian and mangosteen farmers.

2.5 DATA ANALYSIS METHODS

This section describes the data analysis methods for the qualitative study and the qualitative research.

Quantitative Data Treatment and Analysis

The team cleaned and finalized survey data files by (1) producing and adding weights—survey weights were calculated to account for the selection probabilities in different sampling stages, and to adjust for nonresponse in different levels, (2) documenting remaining inconsistencies, and (3) exporting finalized datasets for analysis. The database was output into SPSS and then into Stata 18.0, which was used to perform all analyses.

The final aggregated dataset was cleaned by conducting frequency tabulations on every variable in the tool and checking for data entry mistakes, outliers, missing values, or coding errors. Quantifiable results and visual statistical distributions, including histograms, were created to check the shape of the data distribution.

Data analysis included cleaning and finalizing survey data files and generating analytic and derived variables. During data processing, variable labels were generated and improved for use during the analysis stage, variables in which respondents could give multiple answers were broken into bivariate variables for each response to a question, and a table with interview result codes was generated for sample weighting, which were used to develop the final sampling weights for the survey.

Survey Weights

Because the sample for the Thailand RAIN Baseline Survey is a complex sample (i.e., a stratified multi-stage cluster sample design), survey weights were calculated and used in the analysis of the survey data. The purpose of the survey weight is to account for the selection probabilities of the sampling units, adjust for nonresponse, and to adjust for noncoverage errors.

First Step: *Account for selection probabilities*

In this step, we calculated a design weight that accounts for all selection probabilities in all stages with the following notations:

P_{1hi}: first-stage sampling probability of the i^{th} sub-district in stratum h
P_{2hij}: second-stage sampling probability of the j^{th} village within the i^{th} sub-district
P_{3hij}: third-stage sampling probability within the j^{th} village in the i^{th} sub-district (farmers)
P_{hi}: overall sampling probability of any farmers of the j^{th} village in i^{th} sub-district in stratum h.

Let a_h be the number of sub-districts selected in stratum h, M_{hi} the number of farmers according to the sampling frame in the i^{th} sub-district, and $\sum M_{hi}$ the total number of farmers in stratum h. The first stage's probability of selecting the i^{th} sub-district in stratum h is calculated as follows:

$$P_{1hi} = \frac{a_h M_{hi}}{\sum M_{hi}}$$

Let b_{hi} be the number of villages selected from sub-district i selected in stratum h, and B_{hi} the number of villages according to the sampling frame in the i^{th} sub-district. The second stage's probability of selecting the j^{th} village within the i^{th} sub-district in stratum h is calculated as follows:

$$P_{2hij} = \frac{b_{hi}}{B_{hi}}$$

Let C_{hij} be the number of farmers listed in village j in sub-district i in stratum h, and let c_{hij} be the number of farmers selected in the village. The third stage's selection probability for each farmer is calculated as follows:

$$P_{3hij} = \frac{c_{hij}}{C_{hij}}$$

The overall selection probability of each farmer in village j of sub-district i of stratum h is therefore the production of the three stages selection probabilities:

$$P_{hij} = P_{1hi} \times P_{2hij} \times P_{3hij}$$

and the design weight for each farmer in village j of sub-district i of stratum h is the inverse of its overall selection probability:

$$W_{hij} = 1/P_{hij}$$

Second Step: *Adjust for Nonresponse*

In this step, we adjusted the design weight for nonresponse, where adjustment factors inflate the design weight to account for the nonrespondents. An adjustment factor *F* is calculated within each stratum *h* as the inverse of the weighted response rates within the stratum. The weighted response rates were weighted by the design weights calculated in the first step.

Third Step: *Calibrate the Weights*

The adjusted weight from the previous step was then calibrated so that the weighted distribution of the farmers in the sample matches the numbers from the sampling frame.

The results were presented using both unweighted and sample-weighted values. The unweighted values were determined based on the data collected from the sample, and sample-weighted values, applicable to the farmer population, were calculated based on the probability of selection of each farmer in the sample. Finally, the survey data file was generated with all personally identifiable information (PII) removed.

Specifically, we conducted the following analysis:

- Generated descriptive summary univariate and bivariate tables. In addition to the required statistical analyses, we conducted quality checks, including frequency checks, to ensure a reasonable distribution of the data and that no out-of-range values existed. We conducted cross-tabulations and created tables with key demographic characteristics.
- Produced bivariate first level and second-level disaggregation variables—for sex (female/male), land holding (smallholder farmers and non-smallholder farmers), age categories (15–29 years and 30+ years). Analysis of the indicators was performed to illustrate associations between indicators, as well as associations between indicators and other important individual factors, including decision making, landholding, loans taken, and so on that influence baseline indicator estimates.
- Conducted test statistics, including differences in mean and proportions between groups and correlation, using appropriate statistical tests.

Variables with missing responses were imputed or included in the calculations for relevant indicators—that is, missing data points were excluded from both the denominator and the numerator for the calculation of all indicators. “Don’t know” and “Refused” responses were excluded from the denominator and the numerator to calculate the indicators.

We prepared a data treatment and analysis plan that included mapping survey variables for each indicator (**Annex 8**: Data Analysis Plan for the Quantitative Survey). For example, data on crop yield was calculated as the total output of production in metric tons (mt) divided by the total units in production, that is, area planted in hectare (ha) during the year preceding the survey. Before analysis, the local units were converted—that is from kilograms (kg) to metric tons for total production and from rai to hectare for land area/area planted.

Qualitative Data Preparation and Analysis

We used thematic and content analysis to extract data that speaks to the overall climate-smart innovation situation for agriculture in the project areas, as well as data that worked to interpret and triangulate the findings from the quantitative survey. This process involved data compilation, during which we entered notes taken from KII and KSI interviews into Microsoft Excel, made the participants' identities anonymous, and organized the data in discrete columns. The notes were translated into English.

The qualitative experts reviewed notes in English to ensure accuracy and identify key themes. We used MAXQDA to code the notes from Excel. We coded data by themes (common trends or ideas) that correspond to the evaluation. A preliminary list of thematic areas for coding was developed on the basis of the evaluation design, and an iterative process was adopted to refine that list. The coding was done separately by two coders/researchers to avoid biases and ensure inter-rater reliability. The qualitative research team held regular debrief meetings to process emerging themes and identified key constructs, coding, and analysis.

The findings from the qualitative data analysis were integrated/triangulated with findings from the survey and contained in this baseline evaluation study report. Qualitative findings will be presented in the subsequent chapters (results, conclusion, and recommendations) and, where possible, supported by relevant quotes or examples from the data.

2.6 LIMITATIONS AND CHALLENGES

Limitations

This section summarizes the issues encountered during the design and implementation of the baseline evaluation. The following items had an impact on the study design and results:

Sample design. Although Nakhon Ratchasima, Chaiyaphum, and Khon Kaen provinces have farmers who cultivate irrigated rice, the baseline evaluation dropped those provinces from sampling for irrigated rice because RAIN does not target these provinces for this commodity. The baseline evaluation also excluded Samut Sakhon from the sampling for longan, as the number of farmers was low. Hence, the baseline yield estimates for longan are based on data collected from Chiang Mai and Lamphun and cannot be generalized to production in Samut Sakhon.

Small sample sizes for disaggregated estimates. The quantitative survey was designed to enable measurement of change over time for the selected performance indicators. Some of the estimates presented in this report are derived from small samples, specifically, for the disaggregate level estimates (non-smallholder farmers, aged 15–29 years, etc.). Estimates generated from fewer than 10 observations are notated in the tables and should be interpreted with caution, as they are not generalizable to the target population.

Challenges

Additional issues and challenges were encountered during data collection and RAIN implementation. Although these did not have an impact on the design of the baseline evaluation, recommended mitigation strategies are presented below under each issue/challenge encountered.

Survey Data Collection. Some farmers did not wish to reveal their actual names. Hence, nicknames were used for the surveys. Interviews were conducted either early in the morning or evening, as farmers were not at home during the day. Further, in some clusters, interviewers were not welcomed because of recent scams. Likewise, in some villages, farmers in the target group were not available. Data collection overlapped with the rainy season in Thailand, which made fieldwork longer for the survey teams.
Recommended Mitigation: 1) Community mobilization ahead of data collection to a) sensitize the target populations with support from village heads and farmers group and b) collect information (ground truth) on crops grown in the target villages. Community mobilization will help ease farmers' concerns and prepare teams for anticipated challenges; and 2) make provision for reserve EAs to replace EAs that are inaccessible or do not have the target population.

COVID-19. Precautions, including face masks and guidelines, were put into place to minimize the risk of COVID-19 transmission among survey staff. However, some field staff contracted COVID-19 during training and fieldwork. Additional field staff were trained to mitigate temporary absences.
Recommended Mitigation: 1) Hire and train 10 percent additional interviewers as back-up to minimize the risks associated with attrition.

Availability of farmers for KII. Availability of farmers right after the survey was limited, hence qualitative interviews with farmers (KII) either did not happen for some or had to be rescheduled for those who agreed. Multiple call backs were made to reschedule the interviews.
Recommended Mitigation: 1) Community mobilization that involves farmers' group/village heads to encourage farmers' participation; and 2) ensure sufficient time for data collection to incorporate at least two call backs.

Stakeholder participation. Despite active engagement, some stakeholders did not show interest in cooperating with the baseline evaluation and refused to do the interviews, while others were difficult to reach via phone call or email. Others who were open to interviews requested an official letter signed by Winrock International and sent to their supervisors or management to seek permission to conduct the stakeholder interviews. Further, some stakeholders could not be contacted, as the contact list provided by Winrock International was outdated.
Recommended Mitigation: 1) Identify stakeholders early on to secure face-to-face interviews in their respective locations; 2) share a letter of introduction from RAIN to sensitize the stakeholders and their superiors; 3) ensure sufficient time to schedule interviews to avoid scheduling conflict; and 4) send a reminder via email and a text message a day before the interview to confirm the appointment.

3. FINDINGS

QUANTITATIVE FINDINGS

In this section, we discuss the data from the quantitative survey and the qualitative interviews with the farmers and key stakeholders. Each section below discusses the findings of the 10 standard FFPr indicators and the required disaggregates across all commodities—six of these indicators establish the baseline values whereas contextual information is provided for the remaining four indicators.

The baseline survey data were successfully collected from 4,743 farmers across 155 clusters between July 16 and August 28, 2023. The field teams conducted 49 key informant interviews (KIIs) with rice (rainfed and irrigated), cassava, coconut, durian, longan, and mangosteen farmers and 24 key stakeholder interviews (KSIs) with researchers, entrepreneurs, agriculture extension officers, crop collectors, and input suppliers.

Note. Of the originally selected 155 clusters, field teams could not conduct survey data collection among rice (rainfed) farmers in three clusters in Chaiyaphum and four clusters in Khon Kaen. In Chaiyaphum, the village head did not permit teams to conduct the survey, and in Khon Kaen, rice (rainfed) farmers were virtually nonexistent in the original clusters. The evaluation team replaced these clusters with reserve clusters from the two provinces.

Indicator estimates—in total and by key disaggregates—are presented in **Annex 6:** Data Analysis Plan for the Quantitative Survey. The findings in this section are presented with both unweighted and sample-weighted values. Unweighted values are representative of only the sampled farmers, whereas sample-weighted values are extrapolated to the entire farmer population from which the sample was drawn. Sample-weights were calculated based on the inverse relationship to the probability of selection and the rate of nonresponse within each cluster. In other words, sample-weighted estimates are population-representative estimates obtained by applying a sample weight that accounts for the survey sampling design and nonresponse among eligible respondents.

3.1 FARMER CHARACTERISTICS

Demographic Characteristics

The quantitative survey data represents approximately 1,244,340 farmers with female farmers and male farmers each making up about half the total (56 percent female to about 44 percent male). More than 97 percent of farmers in the sampled clusters were smallholder farmers[7] across all crops. Cassava is cultivated by approximately 93 percent of smallholder farmers. The mean age of the farmers is 54.4 years (**Table 6**).

[7] Although country-specific definitions for smallholder farmer may vary, we used the Feed the Future definition of a smallholder producer, which is a producer who holds 5 hectares or less of arable land. The producer/farmer does not have to own the land.

Table 6. Demographic characteristics of farmers by target commodities, RAIN Baseline Evaluation, 2023

Commodity	Sex (percent)		Avg. age in years	Avg. house-hold size	Highest level of education attained (percent)				Number of farmers
	Female	Male			Pre-school	Elementary	Secondary	Higher	
Rice, rainfed	47.8	52.2	56.5	4.0	0.4	80.8	16.1	2.9	781
Rice, irrigated	56.4	43.6	57.5	3.7	2.2	80.4	16.2	1.5	746
Cassava	52.0	48.0	54.3	4.1	0.3	73.4	24.8	1.4	773
Coconut	68.1	31.9	50.6	4.8	4.3	40.0	38.9	17.6	620
Durian	60.3	39.7	51.5	4.0	0.3	58.7	31.8	9.2	600
Longan	59.5	40.6	56.5	3.9	1.8	77.7	17.8	2.8	619
Mangosteen	53.3	46.7	52.6	4.0	0.1	55.6	35.9	8.1	604
Total	44.0	56.0	54.4	4.1	1.2	67.9	25.1	5.8	4,743

Key: Avg=Average

Approximately 90 percent of rice farmers and about 80 percent of cassava, longan, and mangosteen farmers have more than 10 years of experience farming, whereas a quarter of durian farmers (25.3 percent) and two-thirds of coconut farmers (65.5 percent) have 5–10 years of experience. Only 2 percent to 3 percent of farmers across all crops have fewer than 5 years of experience (**Annex 9**).

Timing of Harvest

Table 7 presents the average total area cultivated by the farmers and the average area cultivated under the target commodity. The average area of the cultivated crop ranges from 0.8 ha for longan to 2.1 ha for irrigated rice.

Table 7. Farm characteristics for the target commodities, RAIN Baseline Evaluation 2023

Commodity	Average farm size (hectare)	Average farm size (rai)	Average area cultivated under commodity (hectare)	Average area cultivated under commodity (rai)	Number of farmers (unweighted)	Number of farmers (weighted)
Rice, Rainfed	1.8	11.2	1.7	10.8	781	786,013
Rice, irrigated	1.8	11.3	1.8	11.3	746	24,564
Cassava	2.4	14.9	2.1	13.4	773	195,083
Coconut	1.7	10.6	1.6	9.8	620	9,058
Durian	1.4	8.9	1.3	8.4	600	55,336
Longan	0.9	5.9	0.8	5.1	619	123,206
Mangosteen	1.2	7.7	1.1	7.0	604	51,080

Table 8 shows the timing and frequency of the harvest of the selected commodities.

Table 8 Timing of harvest for the target commodities, RAIN Baseline Evaluation 2023

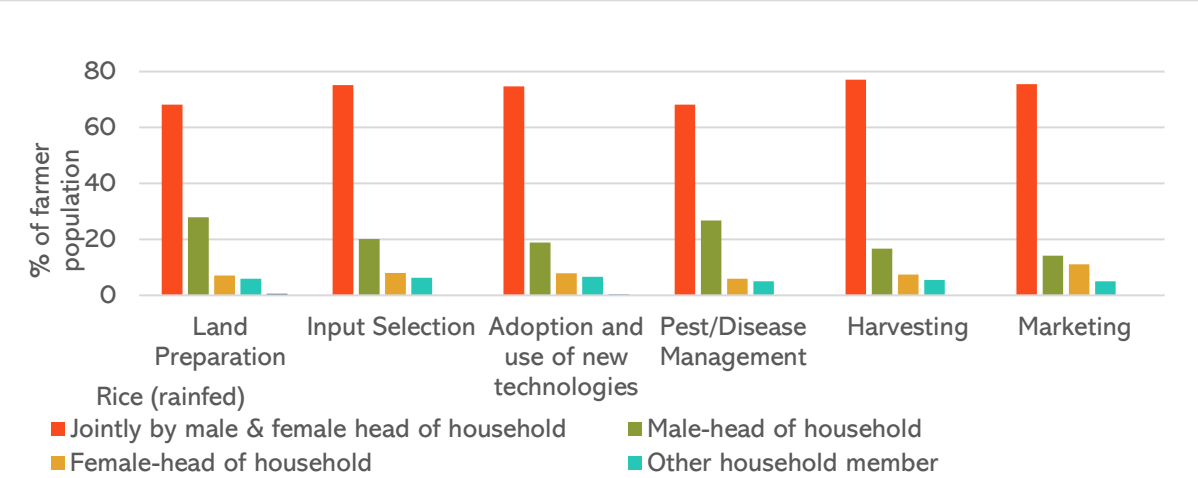
Commodity	Average number of harvests	Main harvest	Number of farmers (unweighted)	Number of farmers (weighted)
Rice, Rainfed	1.0	Wet Season: November - December	781	786,013
Rice, irrigated	1.8	Dry Season: May - June	746	24,564
Cassava	1.0	November - May	773	195,083
Coconut	18.0	All year long	620	9,058
Durian	1.0	March - July	600	55,336
Longan	1.0	June - August	619	123,206
Mangosteen	1.0	April - September	604	51,080

In the target population, the main (wet-season) harvest of rice took place from November to December 2022, and the second (dry-season) harvest was from May to June 2023. The timing of the rice harvests is similar to the harvest timing reported by USDA, 2024. All other target commodities have one production cycle per year.

Agriculture Decision Making

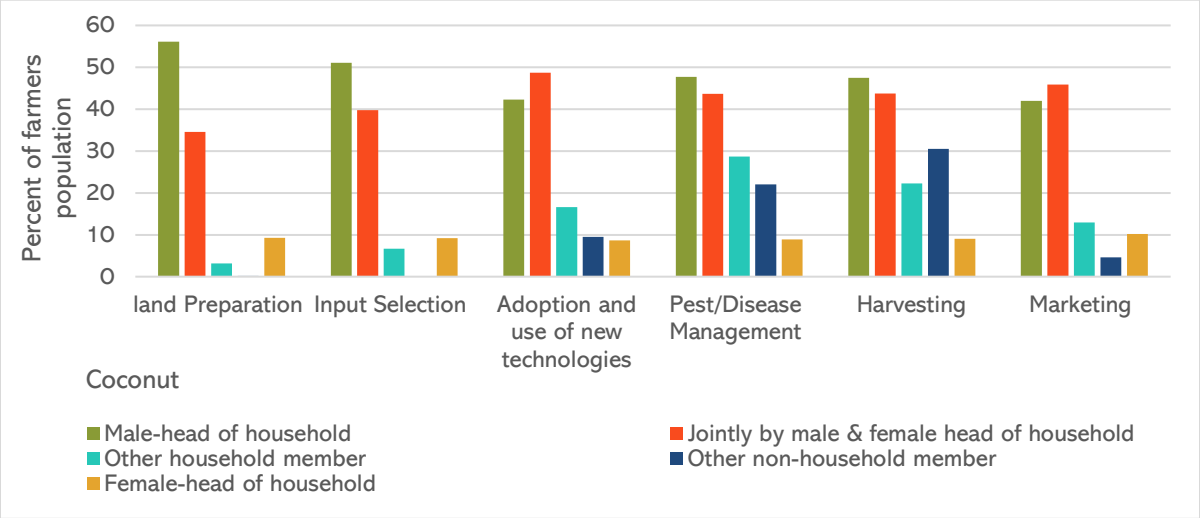
The baseline survey asked farmers about who in the household decides about agricultural production and postproduction processes such as land preparation, input selection, adoption and use of new technologies, pest/disease management, harvesting, and marketing. For all crops except coconut, decision making follows a similar pattern—that is, decisions regarding production and postproduction processes are mostly jointly made by male- and female-heads of the household, followed by the male-head of the households **(Figure 2**; for rice rainfed). Other non-household members make little to no decisions for production or the postproduction of these crops (**Annex 9**).

Figure 2. Agriculture decision making for production and postproduction processes for rainfed rice, RAIN Baseline Survey Evaluation 2023



For coconut, a higher percentage of male-head households make decisions regarding land preparation, input selection, and pest/disease management; while decisions regarding adoption and use of new technologies, and marketing are mostly made jointly by male and female heads of the household. A high proportion of other household and non-household members are also involved in decision making for cultivation of coconuts, specifically when decisions are made regarding pest and disease management, harvesting, followed by adoption and use of new technologies and marketing (**Figure 3**).

Figure 3. Agriculture decision making for production and postproduction for coconut, RAIN Baseline Survey Evaluation 2023



Climate Shocks and Stressors

All farmers except for coconut farmers reported experiencing climate-related shocks and stressors such as flooding or too much rain, drought or too little rain, heat waves/higher than usual temperatures, cold waves/lower than usual temperatures, and storms in a year preceding the survey (**Table 9**).

Pests and Disease

Farmers also reported that pests and plant diseases are occurring at the same frequency, but their severity has changed in the past 3 years. Most farmers reported experiencing shocks and stressors related to diseases or pests affecting their crops (**Table 9**).

Table 9. Percent of farmer population who observed shocks and stressors by commodity, RAIN Baseline Evaluation 2023

Shocks and Stressors	Rice, Rainfed	Rice, irrigated	Cassava	Coconut	Durian	Longan	Mango steen
Flooding/too much rain	67.1	71.5	89.6	0.0	64.4	60.6	63.5
Drought/little rain	84.6	60.3	79.1	0.1	94.0	91.7	90.8
Heat/hotter temperatures†	68.1	59.6	64.7	0.5	96.4	92.3	94.4
Cold/colder temperatures*	30.7	51.5	33.6	0.0	49.8	43.7	49.2
Storms	42.5	51.9	49.4	0.0	82.5	60.0	75.4
Soil erosion	16.8	22.3	28.3	6.7	18.8	22.0	16.5
Unable to access/afford inputs	64.5	65.8	68.3	24.2	60.8	68.4	61.8
Diseases affecting crop(s)	82.9	96.3	87.8	63.2	98.1	99.3	99.5
Pests affecting crop(s)	90.8	97.1	90.0	94.1	99.5	98.7	99.6

Note: †included too much heat/heat waves/higher than usual temperatures; *included too much cold/cold waves/lower than usual temperatures

3.2 PRODUCTION

Crop Yield

Crop yields are the harvested production per unit of harvested area. Yields of products from targeted commodities are a key driver of agricultural productivity. Yield can serve as a proxy for the productivity of these value chains and the impacts of interventions when trends are evaluated over time. Rainfall is one of the primary factors affecting crop productivity, especially for rainfed agriculture.

FFPr Standard Indicator 1 (SI-1). Yield of targeted agricultural commodities among program participants with USDA assistance

Crop yield in mt/ha for the target crops is presented in **Tables 10 and 12**. The crop yield for farmers who cultivated rice was 2.4 mt/ha for rainfed rice and 5 mt/ha for irrigated rice. Female smallholder farmers' rice yield (rainfed) is slightly lower than male smallholder farmers (2.3 mt/ha vs. 2.6 mt/ha).[8] The crop yields for other commodities were—cassava 13.3 mt/ha, coconut 30.8 mt/ha[9], durian 6.7 mt/ha, longan 4.6 mt/ha, and mangosteen 3.8 mt/ha, respectively.

Crop yield in kg/rai for the target crops is also presented in **Tables 11 and 13**.

[8] The sample size for the 15–29 age group for both smallholder and non-smallholder farmers across all crop commodities is too small to yield valid results. Similarly, the crop yields for non-smallholder farmers across all crops except for cassava are too small to generalize or extrapolate the results to the farmer population. Therefore, the results for the age group of 15–29 years and estimates for non-smallholder farmers are not discussed in this section.
[9] Yield calculations assumed the average weight of the coconut as 500 gm.

Table 10. Unweighted harvest quantity and yield (mt/ha) by commodity, RAIN Baseline Evaluation, 2023

Commodity	Unweighted (sampled farmers)				
	Total Production (mt)	Unit of Production (ha)	Yield (mt/ha)	Total production per farm	Number of Participants
Rice, rainfed (wet rice)	3,164	1,348	2.3	4.1	781
Rice, irrigated (wet rice)	12,582	2,529	5.0	16.9	746
Cassava (fresh)	23,500	1,653	14.2	30.4	773
Coconut (green)	29,168	974	29.9	47.0	620
Durian	5,502	807	6.8	9.2	600
Longan	2,287	504	4.5	3.7	619
Mangosteen	2,489	679	3.7	4.1	604

Key: mt=metric ton; ha=hectare

Table 11. Unweighted harvest quantity and yield (kg/rai) by commodity, RAIN Baseline Evaluation, 2023

Commodity	Unweighted (sampled farmers)				
	Total Production (kg)	Unit of Production (rai)	Yield (kg/rai)	Total production per farm	Number of Participants
Rice, rainfed (wet rice)	3,164,100	8,425	375	4,051	781
Rice, irrigated (wet rice)	12,581,680	15,807	796	16,865	746
Cassava (fresh)	23,500,000	10,332	2274	30,401	773
Coconut (green)	29,168,230	6,090	4789	47,045	620
Durian	5,502,010	5,044	1090	9,170	600
Longan	2,286,611	3,153	725	3,694	619
Mangosteen	2,489,260	4,243	586	4,121	604

Key: kg=kilogram

The highlighted column in **Tables 12 and 13** shows the weighted yield estimates that serve as the baseline for yield of the target commodity.

Table 12. Weighted harvest quantity and yield (mt/ha) by commodity, RAIN Baseline Evaluation, 2023

Commodity	Weighted (extrapolated to farmer population)				
	Total Production (mt)	Unit of Production (ha)	Yield (mt/ha)	Total production per farm	Population Total
Rice, rainfed (wet rice)	3,262,672	1,343,100	2.4	4.2	786,013
Rice, irrigated (wet rice)	422,744	84,735	5.0	17.2	24,564
Cassava (fresh)	5,389,049	404,012	13.3	27.6	195,083
Coconut (green)	320,580	10,392	30.8	35.4	9,058
Durian	485,223	72,848	6.7	8.8	55,336
Longan	460,601	100,982	4.6	3.7	123,206
Mangosteen	184,669	48,472	3.8	3.6	51,080

Key: mt=metric ton; ha=hectare

Table 13. Weighted harvest quantity and yield (kg/rai) by commodity, RAIN Baseline Evaluation, 2023

Commodity	Weighted (extrapolated to farmer population)				
	Total Production (kg)	Unit of Production (rai)	Yield (kg/rai)	Total production per farm	Population Total
Rice, rainfed (wet rice)	3,262,672,000	8,394,375	388	4,150	786,013
Rice, irrigated (wet rice)	422,744,200	529,593	798	17,209	24,564
Cassava (fresh)	5,389,049,000	2,525,076	2,134	27,624	195,083
Coconut (green)	320,580,000	64,952	4,935	35,391	9,058
Durian	485,222,900	455,299	1,065	8,768	55,336
Longan	460,601,000	631,136	729	3,738	123,206
Mangosteen	184,669,200	302,951	609	3,615	51,080

Key: kg=kilogram

Annex 9: Rain Baseline Indicator Estimates presents yield of targeted commodities by disaggregates, including land size, sex, and age of the farmer.

Improved Management Practices

Crop yield is influenced by several factors, including improved agricultural practices and technologies, management decisions regarding land preparation, and intensification of cropland management through practices such as irrigation and use of large quantities of inputs like inorganic fertilizers and synthetic chemicals for pest and weed control. Climate-smart agriculture also increases crop yield while facilitating crop production sustainably. This section examines the farmers' use of improved management practices and technologies promoted by USDA that reduce climate risk and improve land, and other natural resources management for the target commodities.

Knowing what management practices and technologies farmers used to cultivate their crops fosters a better understanding of what farmers are already doing well and what they could do better to increase their productivity. Promoted improved management practices or technologies are those supported through USDA. Using example practices and technologies in the USDA's Food Assistance Indicators and Definitions (2019), the improved management practice and technology categories included crop genetics, cultural practices, natural resource management (NRM), pest and disease management, soil-related fertility and conservation, irrigation, agriculture water management (non-irrigation method), climate mitigation, climate adaptation, climate adaptation/climate risk management (CRM), marketing and distribution, postharvest handling and storage, value-added processing, and other practices. The results were also examined by sex, age, and commodity.

For RAIN, CSi are specific climate-smart agriculture practices and technologies that have been identified and will be promoted by the project. Through the Five S process (Source, Support, Scale, Sell, and Share), RAIN will source, support, and scale 30 CSi. At the time of the baseline study, there were only a few potential CSi that were in the first stage (source) of

the Five S process: fertigation for all commodities, use of information and communication and technology (Ricebot for rice, Munbot for cassava, drone and satellite imagery for rice and cassava, Kasettrack for rice, and other production-focused mobile apps for all commodities). Ricebot is an artificial intelligence-enabled chatbot which can diagnose and provide guidance to eradicate diseases during the production of rice. Munbot is an application for collecting cassava disease data. Kasettrack is an application designed to guide farmers through the production process, from planning to marketing and aligned with the GAP standard.

Table 14. Number and percentage of farmers who used RAIN CSi, RAIN Baseline Evaluation, 2023

RAIN CSi practices and technologies	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
	Number of Farmers using CSi	Total farmers in sample	Percent farmers using CSi*	Number of farmers using CSi	Total farmers in population	Percent farmers using CSi*
Fertigation	1,153	4,743	24.3	240,587	1,244,340	19.3
Ricebot	31	1,527	2.0	10,521	810,577	1.3
Drone/satellite imagery	30	4,743	0.6	10,295	810,577	1.3
Mobile apps	51	4,743	1.1	4,868	1,244,340	0.4
Munbot	1	773	0.1	311	195,083	0.2
Kasettrack	1	1,527	0.1	52	810,577	0.0

Key: EWS=early warning system
** Denominators used depend on the CSi: fertigation (all farmers), Ricebot (rice farmers), drone/satellite imagery (rice and cassava farmers),mobile applications (all farmers), Munbot (cassava farmers), Kasettrack (rice farmers).*

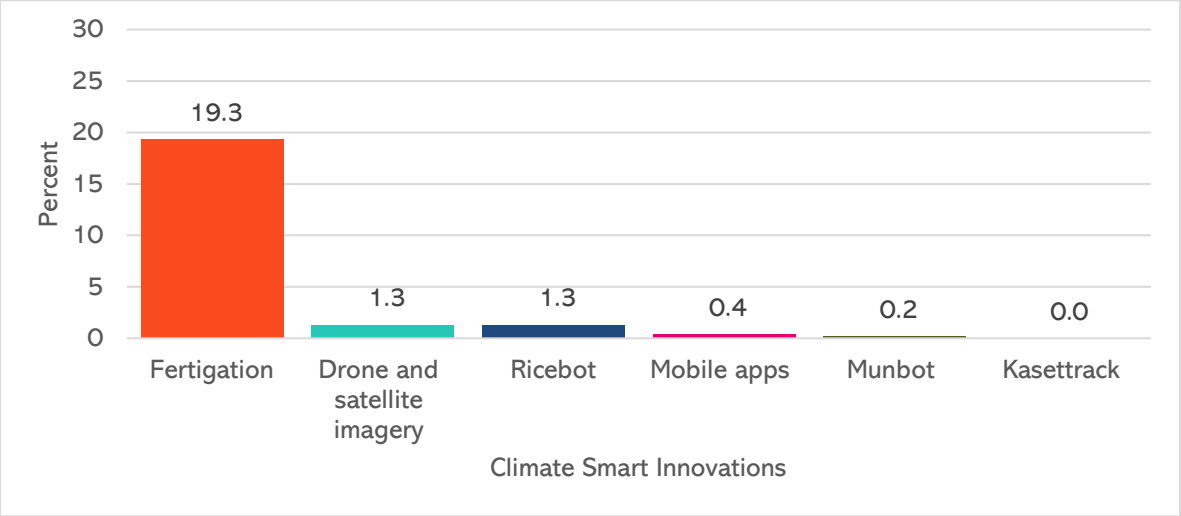
Most rice farmers used straw management/straw bailing (96.3 percent). Fertigation was practiced by 19.3 percent of all farmers. Use of ICT's is low—it ranged from 0.01 percent to 1.3 percent (**Table 14** and **Figure 4**).

More than three-fourths (76.1 percent) of farmers had access to/used weather information or had access to early warning systems[10].

It is still early in the project to know the exact practices and technologies that will be promoted as CSi by RAIN. Therefore, the quantitative survey identified the universe of management practices and technologies to inform the RAIN team of what farmers are currently doing and using to produce their crop.

[10] The quantitative survey asked farmers two questions related to weather and climate information: 1) Do you have access to and use any weather information to inform your agriculture planning; and 2) Do you have access to any early warning systems or information about extreme climate shocks (**Annex 11** Data Collection Instruments: Quantitative Baseline Survey Questionnaire). Therefore, the percent use (76.1) could reflect access or use of weather forecast and/or access to early warning systems or information about extreme climate shocks.

Figure 4. Use of CSi among farmers in the population, RAIN Baseline Evaluation, 2023



A table of all management practices and technologies and their use is included in **Annex 8**.

FFPr Standard Indicator 2 (SI-2). Number of hectares under improved management practices or technologies that promote improved climate risk reduction and/or natural resources management with USDA assistance

Table 15 shows that the weighted number of hectares under improved management practices or technologies that promote improved natural resources management (NRM) or natural ecosystem management is 2,022,201 ha; climate mitigation is 1,320,981 ha; and climate adaptation and climate risk management (CRM) is 1,716,532 ha. A high percentage of smallholder farmers use at least one management practice/technology for NRM, climate mitigation, and CRM compared with non-smallholder farmers.

A high percentage of farmers (90 percent to 94 percent) apply at least one of the improved agriculture practices or management techniques. The percentage of hectares under at least one improved management practice or technology —specifically, NRM (94 percent), climate mitigation (96 percent), and CRM (94 percent)—is high.

FFPr Standard Indicator 3 (SI-3). Number of hectares under improved management practices or technologies with USDA assistance

Table 15 also shows the number of hectares under improved management practices or technologies. The total weighted cropland for all target commodities was 2,154,959 ha. Of this, 2,024,579 ha—that is, 94 percent—were under improved management practices or technologies. The percentage of total hectares under improved management practices or technologies is 90 percent for cassava and almost 100 percent for rice cultivated by irrigation.

Table 15. Number of hectares under improved management practices or technologies by sex, age and commodity cultivated by the farmer, RAIN Baseline Evaluation, 2023

Disaggregates	Number of hectares	Total Hectares	Percent of total hectares	Number of hectares	Total Hectares	Percent of total hectares
	Unweighted			Weighted (extrapolated to farmer population)		
Crop land	7,311	7,825	93.4	2,024,579	2,154,959	93.9
Sex: Female	3,125	3,350	93.3	1,005,118	1,074,943	93.5
Sex: Male	4,186	4,475	93.5	1,019,461	1,080,016	94.4
Age: 15-29	137	143	95.6	22,621	22,933	98.6
Age: 30+	7,174	7,683	93.4	2,001,958	2,132,026	93.9
Management Practice Category						
Crop genetics	4,581	4,967	92.2	834,827	930,621	89.7
Cultural practices	5,419	5,780	93.8	1,328,176	1,387,866	95.7
Natural resource or ecosystem management	7,235	7,746	93.4	2,022,201	2,152,433	93.9
Pest and disease management	7,311	7,825	93.4	2,024,578	2,154,959	93.9
Soil-related fertility and conservation	7,293	7,803	93.5	2,022,624	2,152,720	94.0
Irrigation	5,583	5,969	93.5	952,946	1,035,718	92.0
Agriculture water management (non-irrigation)	4,415	4,649	95.0	598,668	637,199	94.0
Climate mitigation	5,532	5,863	94.4	1,320,981	1,370,516	96.4
Climate adaptation/climate risk mitigation	6,495	6,963	93.3	1,716,532	1,826,725	94.0
Marketing and distribution	6,201	6,681	92.8	1,327,295	1,420,254	93.5
Post-harvest handling and storage	7,256	7,769	93.4	1,975,552	2,104,808	93.9
Value-added processing	3,193	3,458	92.3	455,797	487,303	93.5
Other	3,193	3,458	92.3	455,797	487,303	93.5
Commodity: Rice, rainfed	1,348	1,404	96.0	1,343,101	1,397,427	96.1
Commodity: Rice, irrigated	1,345	1,354	99.3	44,772	45,127	99.2
Commodity: Cassava	1,653	1,839	89.9	404,012	449,651	89.9
Commodity: Horticulture						
Coconut	974	1,053	92.5	10,392	11,250	92.4
Durian	807	853	94.7	72,848	77,406	94.1
Longan	504	582	86.7	100,982	118,423	85.3
Mangosteen	679	741	91.6	48,472	55,675	87.1

FFPr Standard Indicator 4 (SI-4). Number of individuals in the agriculture system who have applied improved management practices or technologies with USDA assistance

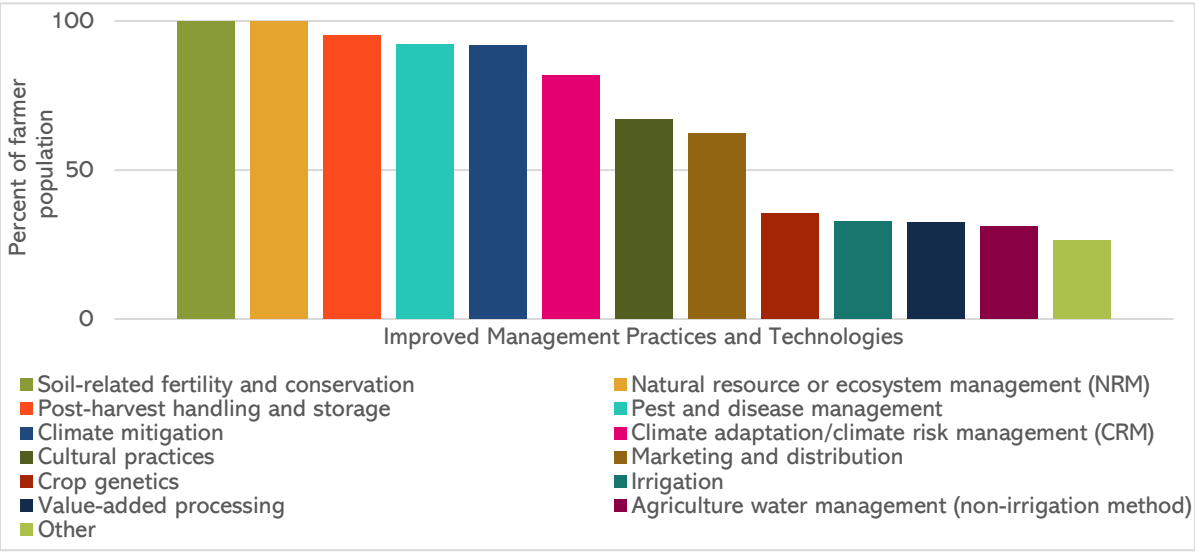
Table 16 shows the number of farmers who applied one or more improved management practices or technology. The percentage of farmers in the sampled areas who applied one or more improved management practices or technology is 100 percent. There is no difference in the use of improved technologies and agricultural practices between smallholder and non-smallholder farmers.

Table 16. Number and percent individuals who have applied improved management practices or technologies, RAIN Baseline Evaluation, 2023

Commodity	Unweighted (sampled farmers)		Weighted (extrapolated to farmer population)	
	Number of individuals	Percent of individuals	Number of individuals	Percent of individuals
Rice, rainfed (wet rice)	781	100	786,013	100
Rice, irrigated (wet rice)	746	100	24,564	100
Cassava (fresh)	773	100	195,083	100
Coconut (green)	620	100	9,058	100
Durian	600	100	55,336	100
Longan	619	100	123,206	100
Mangosteen	604	100	51,080	100

Although the percentage of farmers in the sampled areas who applied one or more improved management practices or technology is 100 percent, the percentage of use of different technologies and practices for each category ranged from 4 percent to 100 percent. Further, farmers cultivating high-value crops such as coconut and durian use more of these technologies than low-value crop farmers. **Figure 4** shows the percentage use of improved management practices and technologies across all commodities by category of practices/technologies.

Figure 5. Use of improved management practices and technologies by category, RAIN Baseline Evaluation, 2023



The number of smallholder farmers and non-smallholder farmers in the agriculture system who have applied at least one improved management practice or technology by sex, age, USDA management practice category, and commodity are presented in **Table 17**.

Table 17. Number of individuals who have applied improved management practices or technologies by landholding size, sex, age, and target commodity cultivated by the farmer, RAIN Baseline Evaluation, 2023

Disaggregates	Number of Farmers, n*	Total Farmers	Percent of total farmers	Number of Farmers	Total Farmers	Percent of total farmers
	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
Total Farmers	4,743	4,743	100.0	1,244,340	1,244,3401	100.0
Smallholder farmer	4,584	4,584	100.0	1,202,861	1,202,861	100.0
Sex: Female	2,009	2,009	100.0	597,540	597,540	100.0
Sex: Male	2,575	2,575	100.0	605,321	605,321	100.0
Age: 15-29	87	87	100.0	14,939	14,939	100.0
Age: 30+	4497	4,497	100.0	1,187,922	1,187,922	100.0
Management Practice Category						
Crop genetics	1,963	4,584	42.8	412,007	1,202,861	34.3
Cultural practices	3,420	4,584	74.6	809,189	1,202,861	67.3
Natural resource or ecosystem management	4,515	4,584	98.5	1,200,464	1,202,861	99.8
Pest and disease management	4,431	4,584	96.7	1,107,492	1,202,861	92.1
Soil-related fertility and conservation	4,584	4,584	100.0	1,202,861	1,202,861	100.0
Irrigation	3,280	4,584	71.6	390,150	1,202,861	32.4
Agriculture water management (non-irrigation)	2,681	4,584	58.5	376,517	1,202,861	31.3
Climate mitigation	4,208	4,584	91.8	1,105,725	1,202,861	91.9
Climate adaptation/climate risk management	3,961	4,584	86.4	979,803	1,202,861	81.5
Marketing and distribution	3,906	4,584	85.2	745,081	1,202,861	61.9
Post-harvest handling and storage	4,262	4,584	93.0	1,143,216	1,202,861	95.0
Value-added processing	2,509	4,584	54.7	397,980	1,202,861	33.1
Other	2,050	4,584	44.7	311,938	1,202,861	25.9
Commodity: Rice, rainfed	760	760	100.0	762,917	762,917	100.0
Commodity: Rice, irrigated	726	726	100.0	23,939	23,939	100.0
Commodity: Cassava	713	713	100.0	181,939	181,939	100.0
Commodity: Horticulture						
Coconut	606	606	100.0	8,994	8,994	100.0
Durian	584	584	100.0	54,039	54,039	100.0
Longan	608	608	100.0	120,855	120,855	100.0

Disaggregates	Number of Farmers, n*	Total Farmers	Percent of total farmers	Number of Farmers	Total Farmers	Percent of total farmers
	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
Mangosteen	587	587	100.0	50,178	50,178	100.0
Non-Smallholder farmer	159	159	100.0	41,479	41,479	100.0
Sex: Female	64	64	100.0	18,380	18,380	100.0
Sex: Male	95	95	100.0	23,099	23,099	100.0
Age: 15-29	4	4	100.0	473	473	100.0
Age: 30+	155	155	100.0	41,006	41,006	100.0
Management Practice Category						
Crop genetics	108	159	67.9	26,315	41,479	63.4
Cultural practices	117	159	73.6	24,108	41,479	58.1
Natural resource or ecosystem management	158	159	99.4	41,433	41,479	99.9
Pest and disease management	157	159	98.7	39,487	41,479	95.2
Soil-related fertility and conservation	159	159	100.0	41,479	41,479	100.0
Irrigation	128	159	80.5	16,591	41,479	40.0
Agriculture water management (non-irrigation)	68	159	42.8	11,217	41,479	27.0
Climate mitigation	136	159	85.5	35,571	41,479	85.8
Climate adaptation/climate risk management	148	159	93.1	37,669	41,479	90.8
Marketing and distribution	145	159	91.2	32,099	41,479	77.4
Post-harvest handling and storage	151	159	95.0	39,544	41,479	95.3
Value-added processing	63	159	39.6	5,881	41,479	14.2
Other	101	159	63.5	15,800	41,479	38.1
Commodity: Rice, rainfed	21	21	100.0	23,096	23,096	100.0
Commodity: Rice, irrigated	20	20	100.0	625	625	100.0
Commodity: Cassava	60	60	100.0	13,144	13,144	100.0
Commodity: Horticulture						
Coconut	14	14	100.0	64	64	100.0
Durian	16	16	100.0	1,297	1,297	100.0
Longan	11	11	100.0	2,351	2,351	100.0
Mangosteen	17	17	100.0	902	902	100.0

**Results not statistically reliable if n<10*

3.3 FINANCE SERVICE

This section presents finance-related indicator estimates for baseline zero indicators. The indicator estimates presented in this section provide additional information that should only be used for contextual purposes.

FFPr Standard Indicator 5 (SI-5). Number of individuals accessing agriculture-related financing as a result of USDA assistance

This section examines the number of individuals accessing agriculture-related debt and nondebt (equity) financing for both cash and in-kind loans from financial institutions. In-kind lending in agriculture is the provision of services, inputs, or other goods up front, with payment usually in the form of product (value of service, input, or other goods provided plus interest) provided at the end of the season. Farmers accessing agriculture-related financing through informal groups such as village savings or loan groups are not included. This analysis captures system-level changes that occur through increased access to formal financial services.

Among the sampled farmers, slightly over one-third (34 percent) of farmers accessed any type of loans—that is, out of 4,743 farmers sampled, 1,611 farmers accessed any type of loans. Farmers accessing agriculture-related financing numbered 1,591, or 33.5 percent (**Table 18**).

Table 18. Number of individuals accessing agriculture-related financing, RAIN Baseline Evaluation, 2023

	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
Disaggregates	Number of Farmers accessing ag-related financing	Total number of farmers	Percent of the total farmers accessing ag-related financing	Number of Farmers	Total Number of Farmers	Percent of the total farmers accessing ag-related financing
Farmers – Total	1,591	4,743	33.5	481,679	1,244,340	38.7
Sex: Female	714	2,073	34.4	250,908	615,920	40.7
Sex: Male	877	2,670	32.8	230,771	628,420	36.7
Age: 15-29	21	91	23.1	4,623	15,411	30.0
Age: 30+	1,570	4,652	33.7	477,056	1,228,929	38.8

Table 19 shows that most farmers across commodities accessed agriculture-related financing as debt. The number of farmers who accessed any loans was 1,611. Of these, the number of farmers accessing agriculture-related loans was 1,591. This corresponds to 98.8 percent of farmers who accessed loans exclusively for agriculture-related purposes.

Table 19. Number of individuals accessing agriculture-related loans from among those who accessed any loans, RAIN Baseline Evaluation, 2023

Disaggregates	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
	Number of farmers accessing ag-related financing	Total Number of farmers accessing any financing, n*	Percent of the total farmers accessing ag-related financing from among those who accessed financing	Number of Farmers	Total Number of Farmers	Percent of the total farmers accessing ag-related financing from among those who accessed financing
Type of financing accessed: Debt	1,591	1,611	98.8	482,183	485,065	99.4
Individuals/microenterprises	1,591	1,611	98.8	482,183	485,065	99.4
Cash	1,539	1,550	99.3	451,527	452,745	99.7
In-kind	65	74	87.8	32,551	34,214	95.1
Sex: Female	714	723	98.8	251,122	252,939	99.3
Sex: Male	877	888	98.8	231,062	232,126	99.5
Age: 15-29	21	21	100.0	4,623	4,623	100.0
Age: 30+	1,570	1,590	98.7	477,561	480,442	99.4
Type of financing accessed: Non-debt	150	182	82.4	33,861	37,496	90.3
Individuals/microenterprises	150	182	82.4	33,861	37,496	90.3
Cash	145	174	83.3	32,801	35,918	91.3
In-kind	6	9	66.7	1,646	2,164	76.1
Sex: Female	61	68	89.7	15,735	16,519	95.3
Sex: Male	89	114	78.1	18,127	20,976	86.4
Age: 15-29	4	4	100.0	339	339	100.0
Age: 30+	146	178	82.0	33,522	37,157	90.2

**Results not statistically reliable if n<10*

Overall, the percentage of farmers accessing in-kind debt such as provision of services, inputs, or other goods, with payment in the form of product, was 95.1 percent of the total numbers of farmers accessing loans. Similarly, farmers accessing agriculture-related cash loans through formally registered financial institutions such as banks represents 99.7 percent of the total number of farmers accessing loans.

Access to agriculture-related financing across target commodities by age and sex is presented in **Annex 9**.

FFPr Standard Indicator 6 (SI-6). Number of individuals participating in group-based savings, microfinance, or lending programs with USDA assistance

Government-owned specialized financial institutions such as the Bank for Agriculture and Agricultural Co-operatives (BAAC), Government Savings Bank, and Islamic Bank of Thailand, or I-Bank, are the key players in the microfinance industry in Thailand. Semiformal microfinance institutions such as cooperative institutions, savings-for-production groups, and village and urban revolving funds also contribute to the microfinance sector in the country. BAAC is more popular in the rural areas and provides financial services for agriculture and agriculture-related activities either directly to farmers or through agriculture cooperative institutions and farmers' associations (Ahmed et al, 2017).

As stated earlier, the quantitative survey gathered contextual information on the number of individuals participating in group-based savings, microfinance, or lending programs and the number of loans disbursed. This information can be used to inform target setting for RAIN. Specifically, the survey asked farmers if they had taken loans from group-based savings, microfinance, or lending programs.

Among the sampled farmers, 8 percent of farmers accessed loans from savings, microfinance, or lending programs in the year preceding the survey—that is, out of 4,743 farmers sampled, 378 farmers accessed loans from savings, microfinance, or lending programs (**Table 20**).

Table 20. Number of farmers who took loans from group-based savings. micro-finance or lending programs by age and sex, RAIN Baseline Evaluation 2023

	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
Disaggregates*	Number of farmers who took loans from SMLP, n*	Total number of farmers	Percent of the total farmers accessing SMLP	Number of farmers who took loans from SMLP	Total number of farmers	Percent of the total farmers accessing SMLP
Total	378	4,743	8.0	132,459	1,244,340	10.6
Sex: Female	187	2,073	9.0	69,296	615,920	11.3
Sex: Male	191	2,670	7.2	63,163	628,420	10.1
Age: 15-29	1	91	1.1	22	15,411	0.1
Age: 30+	377	4,652	8.1	132,437	1,228,929	10.8

**Results are not statistically reliable if n<10; Key: SMLP = savings, microfinance, and lending programs*

Of these, about 65 percent were rice (rainfed) farmers, 17 percent cultivated cassava, and 10 percent were longan farmers. A small percentage of farmers (1 percent to 3 percent) also took loans for other crop commodities (rice (irrigated), coconut, durian, and mangosteen). Of the total number of farmers who accessed loans from savings, microfinance or lending

programs, about 52 percent of female farmers and 48 percent of male farmers took loans from savings, microfinance, or lending programs (**Annex 9**). Farmers who did not take loans 12 months preceding the survey also expressed their desires to take loans for rice, rainfed (67 percent), cassava (17 percent), and longan (7 percent).

FFPr Standard Indicator 7 (SI-7). Number of loans disbursed as a result of USDA assistance

As stated earlier, slightly over one-third (34 percent) of farmers accessed any type of loans—that is, out of 4,743 farmers, about 1,611 farmers accessed any type of loans (**Table 18**). Farmers accessing agriculture-related financing numbered 1,591, or 33.5 percent. Most farmers who accessed agriculture-related loans (debt or nondebt) are aged 30 years and older.

FFPr Standard Indicator 8 (SI-8). Value of agriculture-related financing accessed as a result of USDA assistance

Among farmers who accessed loans, the cash value of agriculture-related debt per farmer was USD3,520 and the cash value of nondebt per farmer was USD1,272 (**Table 22**). The average value of agriculture-related financing per farmer was higher for female farmers (USD3,458) compared to male farmers (USD3,618).

Table 21. Unweighted value of agriculture-related financing accessed by farmers, RAIN Baseline Evaluation 2023

Disaggregates	Unweighted (sampled farmers)				
	Value of agriculture-related financing (USD)	Value of agriculture-related financing (Thai Baht)	Ag financing per farmer (USD)	Ag financing per farmer (Thai Baht)	Total number of farmers (n)*
Type of financing accessed: Debt					
Cash	6,147,375	215,071,009	3,994	139,747	1,539
In-kind	189,905	6,644,000	2,922	102,215	65
Sex: Female	2,586,276	90,483,001	3,622	126,727	714
Sex: Male	3,751,004	131,232,008	4,277	149,637	877
Age: 15-29	102,041	3,570,000	4,859	170,000	21
Age: 30+	6,235,239	218,145,009	3,971	138,946	1,570
Type of financing accessed: Nondebt					
Cash	237,605	8,312,800	1,639	57,330	145
In-kind	4,898	171,350	816	28,558	6
Sex: Female	91,989	3,218,300	1,508	52,759	61
Sex: Male	150,514	5,265,850	1,691	59,167	89
Age: 15-29	5,431	190,000	1,358	47,500	4
Age: 30+	237,072	8,294,150	1,624	56,809	146

**Results not statistically reliable if n<10*

1 Baht = 0.028583 USD (conversion rate is an average of 2022 and 2023)

Table 22. Weighted value of agriculture-related financing accessed by farmers, RAIN Baseline Evaluation 2023

Disaggregates	Weighted (extrapolated to farmer population)				
	Value of agriculture-related financing (USD)	Value of agriculture-related financing (Thai Baht)	Ag financing per farmer (USD)	Ag financing per farmer (Thai Baht)	Total number of farmers, (n)*
Type of financing accessed: Debt					
Cash	1,589,164,410	55,598,237,075	3,520	123,134	451,527
In-kind	115,124,827	4,027,737,718	3,537	123,736	32,551
Sex: Female	868,373,891	30,380,781,962	3,458	120,980	251,122
Sex: Male	835,915,347	29,245,192,831	3,618	126,569	231,062
Age: 15-29	14,715,562	514,836,162	3,183	111,364	4,623
Age: 30+	1,689,573,676	59,111,138,632	3,538	123,777	477,561
Type of financing accessed: Nondebt					
Cash	41,723,039	1,459,715,185	1,272	44,502	32,801
In-kind	979,921	34,283,338	595	20,828	1,646
Sex: Female	17,544,853	613,821,259	1,115	39,010	15,735
Sex: Male	25,158,107	880,177,263	1,388	48,556	18,127
Age: 15-29	513,019	17,948,392	1,513	52,945	339
Age: 30+	42,189,941	1,476,050,130	1,259	44,032	33,522

1 Baht = 0.028583 USD (conversion rate is an average of 2022 and 2023)

The average value of debt accessed per farmer by target commodities was USD3,182 for rainfed rice, USD3,876 for rice irrigated, USD3,770 for cassava, USD1,560 for coconut, USD6,126 for durian, USD3,987 for longan, and USD5,152 for mangosteen.

The value of agriculture-related financing by type of financing accessed, sex, and age is presented in **Annex 9**.

3.4 SALES AND TRADE

This section presents FFPr Standard Indicators 18 and 19. Both indicators correspond to FFPr SO1 (increased agricultural productivity) and SO2 (expanded trade of agricultural products).

FFPr Standard Indicator 18 (SI-18). Value of annual sales of farms and firms receiving USDA assistance

SI-18 examines the value in USD of the total amount of sales from target commodities in the 12 months preceding the survey. The total weighted annual sales for durian were USD1,565,709,903, which corresponds to an average sales per farm of USD28,295. The total weighted annual sales for rice (rainfed) were USD572,722,082. However, the corresponding average sales per farm for rice (rainfed) was USD729. See **Table 23 and 24** for value of total sales and average sales per farm for the target commodities.

Table 23. Total unweighted value of sales by commodities, RAIN Baseline Evaluation 2023

Commodity	Unweighted (sampled farmers)				
	Value of total sales of farms (USD)	Value of total sales of farms (Thai baht)	Average sales per farm (USD)	Average sales per farm (Thai baht)	Number of farmers
Rice, rainfed (wet rice)	544,091	19,035,490	697	24,373	781
Rice, irrigated (wet rice)	2,388,768	83,573,020	3,202	112,028	746
Cassava*	1,657,156	57,976,980	2,144	75,003	773
Coconut (green)	18,070,118	632,198,100	29,145	1,020	620
Durian	17,823,973	623,586,500	29,707	1,039,311	600
Longan	1,070,445	37,450,410	1,729	60,501	619
Mangosteen	3,179,433	111,235,100	5,264	184,164	604

1 Baht = 0.028583 USD (conversion rate is an average of 2022 and 2023)

Table 24. Total weighted value of sales by commodities, RAIN Baseline Evaluation 2023

Commodity	Weighted (extrapolated to farmer population)				
	Value of total sales of farms (USD)	Value of total sales of farms (Thai baht)	Average sales per farm (USD)	Average sales per farm (Thai baht)	Number of farmers
Rice, rainfed (wet rice)	572,722,082	20,037,157,820	729	25,492	786,013
Rice, irrigated (wet rice)	81,810,120	2,862,195,000	3,330	116,520	24,564
Cassava*	368,641,669	12,897,235,040	1,890	66,112	195,083
Coconut (green)	178,164,957	6,233,249,030	19,669	688,148	9,058
Durian	1,565,709,903	54,777,661,640	28,295	989,910	55,336
Longan	215,963,484	7,555,661,880	1,753	61,325	123,206
Mangosteen	229,730,918	8,037,327,000	4,497	157,348	51,080

**99% fresh and 1% dried*
1 Baht = 0.028583 USD (conversion rate is an average of 2022 and 2023)

The average value of sales per farm for the target commodities was highest for durian(USD28,295), followed by coconut (USD19,669), mangosteen (USD4,497), rice-irrigated (USD3,330), cassava (USD1,890), longan (USD1,753), and rice-rainfed (USD729). **Annex 9** provides information on the disaggregated value of sales by the farmer's land size, age, and sex for the target commodities.

Figures 6 and 7 show the total weighted annual sales of farms and average sales per farm for RAIN's target commodities.

Figure 6. Total weighted value of annual sales across all farms, RAIN Baseline Evaluation 2023

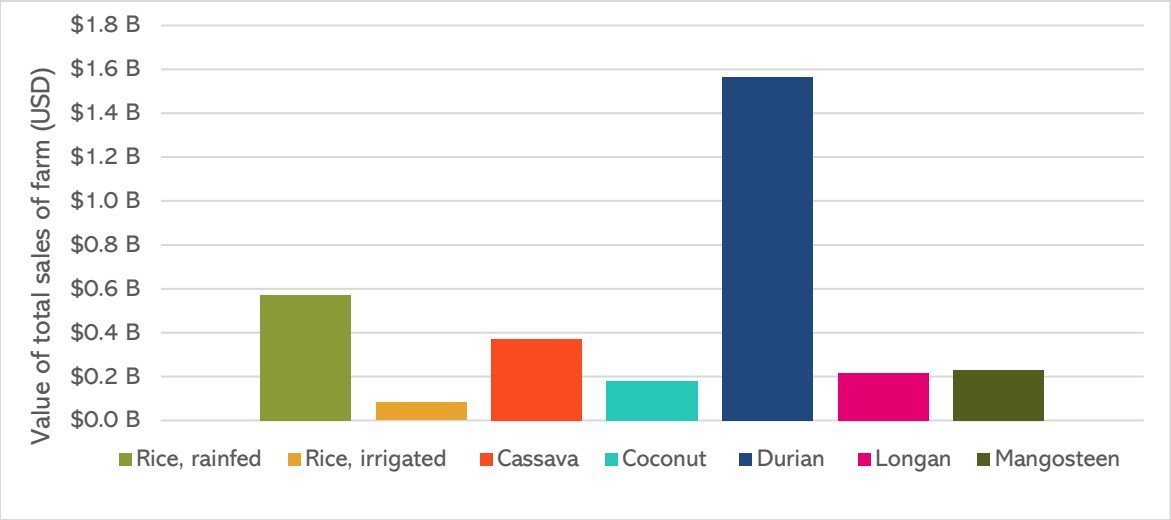
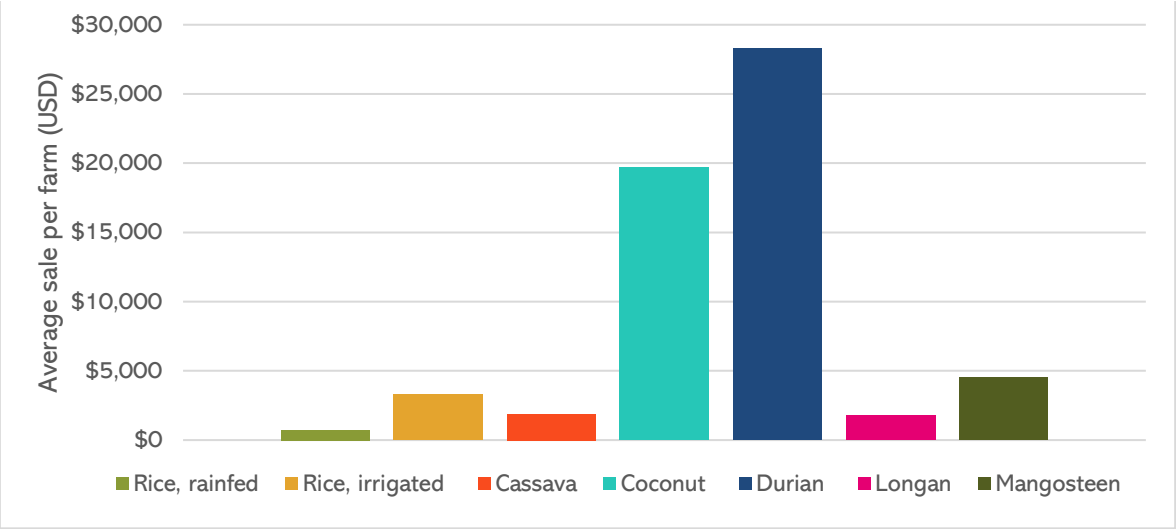


Figure 7. Average annual sales per farm, RAIN Baseline Evaluation 2023



FFPr Standard Indicator 19 (SI-19). Volume of commodities sold by farms and firms receiving USDA assistance

The volume of commodities (in mt) sold by farms is presented in **Table 25 and 26.** The total weighted volume of sales across cassava farmers was the highest, that is, 4,459,835 mt, which corresponds to 22.9 mt sold per farm, on average. Cassava farmers reported selling

their product as 99 percent fresh cassava and 1 percent dried cassava. On the other hand, the total weighted volume of sales across coconut farmers was 316,358 mt, but the corresponding sales per farm (34.9 mt) was the highest among all target commodities.

Table 25. Unweighted value and volume of commodities sold by farmers across commodities, RAIN Baseline Evaluation 2023

Commodity	Unweighted (sampled farmers)				
	Value of annual sales of farms (USD)	Average value of sales per farm (USD)	Volume of commodities sold by farm (mt)	Average volume of sales per farm (mt)	Number of Participants (n)*
Rice, rainfed (wet rice)	544,091	697	1,613	2.1	781
Rice, irrigated (wet rice)	2,388,768	3,202	10,409	14.0	746
Cassava (fresh)*	1,657,156	2,144	19,592	25.3	773
Coconut (green)	13,425,527	21,654	28,575	46.1	620
Durian	17,823,973	29,707	5,353	8.9	600
Longan	1,070,445	1,729	2,069	3.3	619
Mangosteen	3,179,433	5,264	2,397	4.0	604

Key: mt=metric ton; Cassava* 99% fresh and 1% dried

Table 26. Weighted value and volume of commodities sold by farmers across commodities, RAIN Baseline Evaluation 2023

Commodity	Weighted (extrapolated to farmer population)				
	Value of annual sales of farms (USD)	Average value of sales per farm (USD)	Volume of commodities sold by farms (mt)	Average volume of sales per farm (mt)	Number of Participants
Rice, rainfed (wet rice)	572,722,075	729	1,765,925	2.2	786,013
Rice, irrigated (wet rice)	81,810,108	3,330	656,616	26.7	24,564
Cassava (fresh)*	368,641,668	1,890	4,459,835	22.9	195,083
Coconut (green)	178,164,945	19,670	316,358	34.9	9,058
Durian	1,565,709,904	28,295	472,430	8.5	55,336
Longan	215,963,487	1,753	418,970	3.4	123,206
Mangosteen	229,730,923	4,497	176,891	3.5	51,080

Key: mt=metric ton; Cassava* 99% fresh and 1% dried

Among the smallholder farmers, the average volume of sales per farm ranges from 2.0 mt for rice (rainfed) to 657,960 mt for coconut. See **Annex 9** for total unweighted and weighted volume of sales by landholding, sex, and age across the target commodities.

QUALITATIVE FINDINGS

In this section, we present findings from KII and KSI interviews that complement the quantitative survey findings, add more depth, and provide more comprehensive understanding of the data. In addition, insightful contextual information from farmers and stakeholders is presented in the form of quotations where appropriate. To the extent

possible, the sections that follow align with the topics (farmers' characteristics, production, finance service, and sales and trade) covered under the quantitative findings.

3.5 KII AND KSI CHARACTERISTICS AND EXPERIENCES

The evaluation team conducted 41 key informant interviews and 24 key stakeholder interviews. Key informant interviews were conducted with 41 farmers—seven interviews each were conducted with rice (irrigated), rice (rainfed), and cassava farmers, and five KII interviews were conducted for each of the horticulture commodities. The mean age of the KII farmers was 55.1 years. Twenty-five farmers were male and 16 were female. More than half of farmers were smallholder farmers (53 percent). KSI interviews were conducted for 24 individuals, which included two researchers, one entrepreneur, nine extension officers, three crop collectors and nine input suppliers.

Farmers reported extreme weather events, including extreme heat, excessive rainfall, drought and floods that effects cultivation and production of target commodities. Observations from the qualitative interviews corroborate farmers' reports of experiencing climate shocks affecting crop production in the past 3 years. Rice (irrigated farmers) reported climate events, specifically rising temperatures (higher than usual), drought/floods and irregular rainfall. They reported that climate events have remained the same, but the intensity has increased by up to 50 percent in the past three years. About 28 percent of cassava farmers reported experiencing soil erosion, followed by 22 percent of rice (irrigation) and the same percent of longan farmers. Approximately 7 percent of coconut farmers also experienced soil erosion.

Mangosteen farmers reported drought, warmer than usual temperatures, irregular rain, and strong winds that affect 10 percent of their crop. The skin of the mangosteen becomes rubbery if it is ripped from the trees because of strong winds. Durian farmers shared similar shocks (irregular rain and drought). Longan farmers also reported that excessive rains have caused flooding, which resulted in challenges related to applying fertilizers, mold hindering the bloom, fruits falling, and damaging roots of the trees. Longan farmers also reported an increase in the severity of drought and strong winds.

Farmers reported extreme weather events, including extreme heat, excessive rainfall, drought and floods that effects cultivation and production of target commodities. All rice (irrigated) farmers in the qualitative interviews experienced shocks and stressors caused by pests and plant diseases in the past 3 years. Rice (rainfed) farmers also mentioned borers, which are reduced after using contraceptive spray, fungicides, and worm killers. Coconut farmers reported problems with crop production because of beetles. *"The presence of beetles has been a problem, which can damage my farms at a severe level. They will excavate through the trees (especially young coconut trees) and make them die. I use chemical pesticides to remove them. If he does not do so, the coconut trees will die."* Longan farmers reported bugs and firebugs, and invasion of bats that impacts longan production. They use bat-repelling systems that use high-frequency waves.

Although some agricultural extension officers/district agriculture officers provide support for treatment of "*Trichoderma Fungus*" and other conditions, they agree on the need to support

knowledge transfer and specific to the crops and cultivating season. However, they report limitations such as the number of officers in their department, access to resources (tools and equipment) by these officers, and age of the farmer—that is, most farmers are old and not interested in adjusting to new technology. In addition, there are some limitations in taking the equipment to the farmers' area, spending time to convince farmers for training, and taking appointments for training time.

3.6 PRODUCTION

Farmers expressed desire for higher productions. To improve production, farmers used both inorganic and organic fertilizers and other improved practices. Half of the rainfed farmers mentioned used biological fertilizer, animal manure, and mix farming[11] to increase land areas and production, while others did not have any plans to change the total land area under rice production. Some farmers reported a decrease in crop yield because of irregular rainfall or flash flooding. "*Water has been logged in the area for a long time, causing the rice plants to rot and die resulting in less production.*" Cassava farmers reported that curly leaf disease and rotten roots due to flooding have resulted in decreased productivity. Leaf curling in cassava plant is a symptom of Cassava Mosaic Disease which results in lower yields. While other farmers reported no change in crop yield, only one farmer reported a 10 percent to 20 percent increase in rice yields over the past 3 years.

Durian and longan farmers mentioned it takes at least 5 years for the plants to produce fruits. Mangosteen farmers reported they anticipate higher yield in the next 2 years as the trees are growing older. Farmers reported hot weather and less rainfall as some reasons for decreased mangosteen production. Coconut farmers reported an annual production of 7,000 to 12,000 coconuts/ha.

Regardless of the high or low yields in the past 3 years, most farmers shared their desire to grow more crops because 1) they did not have a good yield (*"We want to grow more corn. Because we didn't get a good yield from the rice. So, we thought of growing something else. But we can only think, not yet started,"* or 2) they want extra income (*"We would like to grow a small vegetable garden to earn the extra income during our soil break before a new round of planting rice"*), or 3) they have a desire to scale up and diversify because of increased rice yield ("*We want to grow other crops, including annual crops such as bananas and durian along with rice paddies").*

Improved Management Practices

An array of management practices is used by farmers to improve production. These include traditional practices related to soil preparation, water management, use of fertilizers, parachute rice farming, use of improved seeds and non-traditional practices and techniques, including mechanized harvesting, use of drones and weather forecast apps.

[11] Mixed farming involves both the growing of crops and the raising of livestock

Besides using irrigated water for rice farming, farmers reported using drones for spraying pesticides, rice transplanters/parachute rice farming as opposed to transplanting to reduce back pain, guidelines for soil preparation (to learn about the content of acid or salt in the soil), and bio-fertilizers to make soil fertile and produce nontoxic rice but also reported that rice yields are better with chemical fertilizer and rice seed varieties. Rainfed rice farmers prepare and plow the soil to make the soil fertile. They use **drones to spray chemicals** and **water management** systems to reserve water, but sometimes excessive water/flooding leads to an overflow of water into the rice field. They also reported pumping water from canals, using chemical fertilizers to increase rice growth, and using a combine harvester or other **mechanized harvesting** to reduce time and cost, which also increases postharvest losses.

Cassava farmers apply green manure fertilizers, which are less expensive than **chemical fertilizers** such as bat guano. *"It's better, as we invented and modified the compost ourselves by using Jatropha, which is equivalent to the fertilizer formula 15-15-15 also watch on YouTube."* They reported spraying weed killers and herbicides to reduce labor cost; however, noted that it also leads to soil deterioration. Farmers reported using canals for irrigation of cassava, but they also noted that ants can bite water hoses or canals, which can harm the crop because of the pollution/salt water. *"…ants bite the water hoses. Sometimes the water is left open, causing further water costs and flooding, making the rotting of the roots."* Despite their crop having curly leaf disease and rotten roots, cassava farmers were optimistic of increased yield in the coming year because they practice **weed management** and use chicken manure, compost, cow dung, liquid fertilizers, and drip irrigation systems. These agricultural interventions and practices have resulted in increased cassava production by farmers in the past 3 years.

Mangosteen farmers expressed concerns about soil deterioration. To increase production, they reported sweeping and gathering leaves and burning it to produce smoke to **repel insects** and using fertilizers/irrigation. Mangosteen farmers use efficient water management systems, as too much water will not produce fruits. They use **timed sprinkler irrigation**, which is easy to use and irrigates the field evenly while saving water. They also reported that they have knowledge from the "*academic institutions*" that the next 2 years will be dry, and mangosteen may not bloom. Therefore, they must prepare to find a natural water source.

Durian farmers also prepare soil to increase soil fertility, use sprinkle water systems to water up to 50–60 trees at a time, monitor **weather forecasts** specifically for rain and windstorms for better planning, use chemical fertilizer to make the soil, stems, and roots of the durian tree healthy, and use bio-fertilizer to protect soil from becoming too acidic or alkaline. Durian farmers mentioned the use of select varieties, such as *Monthon*.

Longan farmers use water management as one of the improved management practices. They use a sprinkle water system to disperse/irrigate the entire orchard at a time, piping water systems, which is thought to take less time than a sprinkle water system. They also use **canal and boat irrigation** to reduce time. Longan farmers also apply foliar fertilizers that reach directly to the flower and use **site-specific nutrients** and green manure for long-

term crop management. Longan farmers also mentioned that they found information from Google and marketing companies for fertilizer.

Quantitative survey's findings also show a high percentage of farmers use at least one or more improved management practices and technologies. Although the baseline evaluation was not designed to unravel the high use of agricultural practices and technology, some patterns do emerge. These are as follows:

- ***Participation in farmer groups***. The sampling frame is composed of the farmer group (*Plang Yai*) supported by the government of Thailand. Some farmers mentioned that agricultural government officers visit their village and disseminate information about soil fertility, crops, and water management. In other words, farmers are aware of practices and technologies for improved crop production.

  In addition to being members of the *Plang Yai* group, farmers also report membership in different farm provincial and district groups, including the Land Development Department, Large Plots of Longan, Chanthaburi District Agriculture Cooperatives, and Smallholder Agriculture. These groups keep them abreast of agriculture updates and practices. For example, rice (rainfed) farmers reported receiving free rice varieties and training from district agriculture offices, cooperatives, and municipalities in crop management, water management, spraying and application of insecticide, land preparation, weather, harvest, and crop selection, which were extremely useful practices and technologies to increase yield. *"I used to attend the training program "Smart Famer" and took my own rice to the contest…I like the method of sowing rice seeds, how many kilograms of 1 hectare of rice is used, 0.025 - 0.030 tons. could be seen that the rice was growing and yielded well. If there is another training like this, I will go again."*

- ***Training.*** Like other crop farmers, longan farmers received training on the use of composting (longan leaves mixed with manure) to reduce costs, manure compost for land preparation, recommendation for spraying, fertilizer formulas, site-specific nutrient management, soil fertility adjustment, organic fertilizer, or a combination of methods. Stakeholders also mentioned that "*training is provided according to the SRP (Sustainable Rice Platform) rice cultivation process such as planning and planting calendar, soil examination to be able to choose the right amount of fertilizer and formula. The selection and purchase of seed that meets the standards for improving the land area for efficient water use and reduction of greenhouse gases, management of rice straw and stubble harvested without burning to increase the nutrients in the soil increase soil quality and reduce air pollution. Cultivation of crops after the rice fields to nourish the soil and breaks the cycle of plant disease*."

  Stakeholders from various groups such as rice departments, banks, private companies, Digital Economy Promotion Agency (DEPA), BIOTEC, and the National Science and Technology Development Agency (NSTDA) provide specific technology trainings, including inspection of plots, demonstrations on how to use technology, ICT, and strip tests.

Agriculture officers also provide accessibility support, study tours for farmers, seminars for farmers through public relation boards and community leaders, and visits to farmers' fields.

"Visiting and studying with the model plots or learning from the model farmers who have been successful."

Farmers receive training such as making compost liquid fertilizer using banana shoots to reduce cost. Agriculture offices, buyers, academic institutions, biotechnology companies, and other stakeholders support multiple commodities targeted by the RAIN project and some not targeted by the project (mango, guava, dragon fruit, rose apple, jujube, and vegetables). Specifically, rice departments and academic institutions focus primarily on rice, biotechnology companies focus on cassava, and agriculture extension officers provide support based on the district *("…as for Nong Suea district, we have coconuts, rice, cassava, mangosteen, longan, and a few durians, but the focus is rice and coconut."*).

Though farmers receive support from district agriculture offices, government projects are implemented in areas/regions that lack individual support/training for farmers. Some farmers reported they received training at DOAE for spraying chemicals but did not follow the instructions because of the cost associated with spraying chemicals. Further, new/young coconut farmers have heard of some practices such as the use of tailor-made fertilizers to reduce cost, but they need advice on how to use these practices.

Adoption of Climate Mitigation Methods

Farmers use land and crop management practices and improved technologies to mitigate climate impact. Most farmers reported using weather forecasting on television (helps with planning but is not always accurate) and weather forecasting applications have helped them plan for when to water the crops, apply fertilizers, and so on. Sometimes information about the use of weather apps and information comes from store owners who also cultivate crops. They provide farmers with information regarding provision of services and technology according to a company's policy, for example, use of chemicals according to guidelines for good organic farming.

Some farmers reported that they have adopted climate mitigation methods, such as reducing area for production and irrigating with canal water while others have no mitigation/coping strategies to adopt other than pumping water from canals or from an underground well. Because of increased flooding in recent years, durian farmers create soil mounds around the root of the tree to prevent water from reaching the trunk. Farmers grow home plants like the "*Ashoka trees"* to reduce the severity of the wind, and they also grow high grass around the growing plant to protect it from sunlight and extreme temperatures.

Agriculture Inputs and Technology - Access, Demand, and Affordability

There is a high demand for inputs (improved seed varieties, fertilizers) and services (training, test kits). However, accessibility (poor road conditions to transport) and affordability (cost and financial debt) stifle the use of input and

technology by farmers. In the stakeholder interviews, the marketing officer reported that the demand for chemical fertilizer, drugs, and licensed seeds requires them to have a license. However, the biggest limitation reported was transportation to deliver inputs (especially fertilizer) because the roads are in poor condition, the farmer is usually distant from the store, and the storage place/warehouse infrastructure is not conducive to stocking fertilizer (it needs a cover to save it from rain and sunshine). Some stakeholders (store representatives) mentioned that there are more agriculture stores to supply inputs than the demand. Other limitations specified by store representatives included higher gas prices, regulation or certification needs, shelf life of products (opened coconuts), and preference of farmers for some stores that carry multiple products, including drones, spray tanks, and so on.

The store representative mentioned that on the farmer's side are capital funds and willingness to try new products. *"We introduce new products all the time; for example, there is a new machine called "radar ship," but farmers will consider if it is worth the investment or not."* A fertilizer provider mentioned a product shortage because of the Russia-Ukraine conflict. *"…also, perhaps with the effect from Ukraine war, it raised the cost of the product like the fertilizer cost… most of our fertilizer is imported from Russia."*

Farmers use improved inputs and technology, but it comes at a high cost to them. Rice (rainfed) farmers reported wages for labor, fertilizers, rice varieties, and gasoline (for tractors or rental/harvesting machines) as the main cost for the inputs. The farmers reported the use of chemical fertilizers and more bio-fertilizers for an increase in production.

The rice (irrigated) farmers were interested in tractors, drones, harvesters, and rice transplanters but also reported that the main cost components/input costs included increased wages for labor and increased prices of fertilizers. For example, over the past 3 years, the price of fertilizers has increased from 450–700 baht to more than 1,000 baht. The average cost of wages is approximately 300 baht per day. In fact, the rice transplanter is cheaper to rent compared to the cost of manual labor. It is also easy to operate and reduces the dependency on manual labor. Farmers mentioned that it is important to choose the best rice variety every 3 years for higher quality rice, which in turn results in good prices.

Cassava farmers also reported that using the same varieties of cassava leads to lower productivity and lower quality yield beyond 12 months. However, improved cassava varieties are expensive and hard to find. Like other farmers, cassava farmers also reported high costs of labor and costs related to spraying fertilizers and chemicals for maintenance.

Mangosteen, durian, and longan farmers reported increased input costs associated with fertilizer (increased from 550 to 1,400 baht) and pesticide costs, labor costs, and electricity for spraying fertilizers and chemicals for maintenance.

"In order to maintain or reduce the production cost of Durian, I strive to change the usage time of sprinkler (from morning to evening) to reduce electricity cost. Temperature in the evening is lower than morning or daytime and less energy/electricity required to operate sprinkler in the evening."

3.7 SALES AND TRADE

Agriculture-Related Financing

A high proportion of farmers take loans because of increased costs associated with pre- and post-production of the target crops. Higher costs of production limit their desire to expand/grow more crops. About two-thirds of all farmers who take loans are rice (rainfed) farmers, followed by cassava and longan farmers. More than 71 percent of farmers in the qualitative research reported taking loans for agriculture, specifically for buying fertilizers. The loans taken in the amounts between 20,000 baht to 100,000 baht (USD571 to USD2,858) by these farmers were in the form of an annual contract reserved for members of the farmer group. Survey data showed that the average debt per farmer was held by rice (rainfed) farmers, who reported taking loans in the amount of more than 100,000 baht (USD2,858) from the BAAC). The value of the loan reported aligns with survey data that found the average debt per rainfed farmer to be USD3,182.

Durian farmers pay interest on an annual (compound) basis. Some pay in monthly installments of up to 2,500 baht/month (USD70 per month). Longan farmers also reported taking loans from BAAC (to buy additional lands for the orchard), village funds, and district cooperatives with approximately 5 percent interest per year. Cassava farmers reported taking loans for up to 100,000 baht (USD2,858) with a high interest rate—that is, 9 percent per year. A representative from one of the banks mentioned that there is high demand for loans by farmers but sometimes farmers do not qualify for loans.

Stakeholders' representatives from banks provide knowledge of career development and financial management, and those from DEPA mentioned *"supporting budget, innovative coupon budget, digital coupons worth up to 10,000 baht before VAT."* However, one of the biggest challenges observed by farmers are the costs associated with agriculture inputs, both production and postproduction—including labor wages, fertilizers, chemicals, crop varieties, increases in cost of gasoline, and cost of rental machines.

In-depth interviews also revealed that farmers would like to increase production of their respective commodities and grow other crops, too. However, cost is the biggest impediment, as noted by a longan farmer. *"Longan is the main crop of Lamphun Province. If in any year it has a lot of harvests, it will generate a lot of income for us. I still don't want to plant anything more as it increases the cost more."* Further, most farmers do not have access to buyers in the area except for middlemen. This situation, along with the certification requirements (e.g., GAP, Fairtrade, etc.), prevents them from negotiating sale prices and/or export to countries like China (specifically durian and coconuts) for higher prices.

Farmers reported benefits and drawbacks of using middlemen as the buyer. They maintain the same buyers or change the buyers for higher prices.

The primary buyers for rice are middlemen and agriculture cooperatives who generally pick up the harvest at the farm. Farmers are not obligated to enter into a contract with a buyer to sell their harvest. They can sell it to any buyer who offers a competitive price. Some farmers prefer to sell their harvest directly to a rice mill because farmers can get a higher price for

their rice than a middlemen would offer as the middleman also sells their harvest to the mill. Some farmers prefer to sell their harvest to a middleman if that person offers a better price than a rice mill as it saves them time and costs of taking the harvest to the rice mill and waiting in the line for a long time to sell their rice.

In addition to picking up the harvest, the middleman is reported to cut down the coconuts, too. Most longan farmers sell their produce to the middleman. However, when possible, they change the middleman to get a better sale price. On the other hand, mangosteen farmers tend to have the same buyers (middleman, warehouse agents, or roadside shops) because they feel new buyers may not give them a better price. Some warehouse agents attract farmers by setting up tents in their area during harvest.

Farmers reported selling durian to the middleman. However, some reported looking for new middlemen or buyers to get higher prices. About 50 percent of farmers reported selling durian to customers in China in the past 3 years. Farmers reported Chinese people like durian very much and buyers purchase durian in large quantities. Some farmers export up to 90 percent of their harvest to China.

Cassava farmers reported selling the harvest to the same buyers because the flour factories are far from their areas. Some sell at the farm gate while others take the cassava to the warehouse.

Challenges Associated with Selling Crops

Most farmers reported that certification such as Global Agricultural Practices (GAP) and Fairtrade help sell crops at a better price, including expansion to markets in China. GAP certification also helps farmers export their produce to other countries. "*By having GAP, farmers can export their products to other countries. Since 90% of his product is exported, GAP is an important certificate for him."*

Durian Grades A, AB, B, C are exported to China, while Grade D is sold in Thailand. Examples include Marco and Lotus. Below-standard durians are sold to local sellers, including roadside shops and vendors. Grade refers to grading or sorting durian by size, which is also used to sort durian for destination—export/other countries or domestic. One farmer noted that "*the taste, sweetness, and beauty are major factors for farmers to stand out* ," which relates to incredibly high aesthetic standards for fruits/horticulture crops. *"I think the price of durian will have the biggest impact on us because, if the production in our farmland increases, the costs are rising, but the price in the durian market dropped due to an oversupply of durian in the market. We won't get anything, not making a profit or possibly losing. If we could export to China, it would be better."*

Cassava farmers also mentioned that Fairtrade certification helps in getting a better price than they would get from the middlemen or other buyers, but the price from Fairtrade sales has remained the same for many years. The helplessness of the farmers is echoed in the statement below. *"When the price changes (goes down) once a day, this itself is affecting a lot but when it changes 2–3 times a day, it's too much to handle and we are just farmers, we can't do anything about it."*

4. CONCLUSION

Quantitative survey data for the RAIN baseline evaluation was collected through a population-based survey, and a purposive sample of qualitative data was collected through KIIs and KSIs.

This section includes key conclusions for the six nonzero baseline outcome indicators followed by substantiative explanation supporting the findings.

Production/Yield

Crop yield estimates from the baseline evaluation are comparable to the estimates from the Thailand's Department of Agriculture Extension (DOAE). The total weighted yield for irrigated rice was 5.0 mt/ha, which is slightly double the production for rice (rainfed). Cassava and coconut production was 13.3 mt/ha and 30.8 mt/ha, respectively. The total yield for other horticulture crops (longan, mangosteen, and durian), which were mostly cultivated by smallholder famers, ranged from 3.8 to 6.7 mt/ha.

To measure the quality and validity of quantitative survey data, we compared these results to Thailand's Department of Agriculture Extension (DOAE) estimates as a benchmark. Except for rice (irrigated), the yield for all crop commodities in the target population is lower than the DOAE estimates. It should be noted that the direction of bias—that is, the tendency to over- or under-predict true yields—is nonclassical in which bias is correlated with plot size. The plot size information for the quantitative survey was obtained from the recall of land size by farmers, most of whom were smallholder farmers. Lower or less than optimum crop yields are usually associated with lower than normal (or higher than normal) rainfall conditions. The baseline survey data revealed that flooding or too much rain has affected production for some crops, especially rice and cassava.

Use of Improved Management Practices and Technologies

A high percentage of farmers apply at least one of the improved agriculture practices or management techniques. A high percentage of farmers apply at least one of the improved agriculture practices or management techniques. Approximately 94 percent of farmers used at least one promoted improved management practice or technology. The percentage of hectares under USDA improved management practice or technology categories, specifically, NRM (94 percent), climate mitigation (96 percent), and CRM (94 percent) is high. More than a million farmers (1,049,257) have applied improved management practices or technologies in the target area. Variations exist by commodity, age, and sex of the farmer, and size of the farm.

Unpacking the results showed that the use of specific agriculture management practice technologies ranges from 4 percent to 100 percent. Farmers cultivating high-value crops such as coconut and durian use more of these technologies than low-value crop farmers. Farmers are highly knowledgeable about improved agricultural practices, especially traditional practices such as land preparation, use of fertilizers, and soil conservation—they are practiced by all farmers across commodities. Only one-third of all farmers use practices or technologies related to crop genetics, irrigation, value-added processing, and agriculture

water management (non-irrigation). However, a lower use of these practices/technologies does not signal lack of knowledge but rather lack of input, capital, and required certification to sell/export the crops at a fair price.

For the few CSi that were under consideration at the time of the baseline survey, their use ranges from 0.01 percent to 96.3 percent (straw management/bailing among rice farmers), suggesting opportunities for improving the use CSi technologies, specifically the use of ICTs (Ricebot, Munbot, drones, satellite imagery, Kasettrack and mobile apps). Similarly, fertigation is not commonly used by farmers for the target commodities. Over three-fourths of farmers either have access to or use weather information/early warning systems, which seems higher especially since the use of ICT's is very low.

Sales and Trade

The farm-level results revealed that the average value of annual sales per farm is highest for durian, followed by coconut, and lowest for rainfed rice. The farm-level results revealed that the average value of annual sales per farm is highest for durian, followed by coconut, and lowest for rainfed rice. This is not surprising given commercial production and export of durians to China. The volume of the commodity sold per farm (in mt) is highest for coconut, followed by rice (irrigated), and both crops are staples in Thailand and are largely exported as well.

The baseline evaluation questions related to RAIN's relevance, coherence, effectiveness, efficiency, impact, and sustainability are presented as follows:

Relevance

The design of RAIN is well aligned with USDA's FFPr objectives and Thailand's 20-year Agriculture Development Plan (2017–2026). The design of RAIN is well aligned with USDA's FFPr objectives of improving productivity and expanding trade through partnering with eligible organizations such as KU, NSTDA, BAAC National Savings Fund (NSF), the Digital Economy Promotion Agency, the Ministry of Agriculture and Cooperatives (MOAC), Young Smart Farmers, Royal Irrigation department (RID), the Ministry of Natural Resources and Environment (MNRE), the USAID Horticulture Innovation Lab, and the Ministry of Agriculture. The project objectives also align with Thailand's 20-year Agriculture Development Plan (2017–2026), which aims to increase competitiveness in the agriculture sector through technology and innovation.

Most farmers shared their desire to grow more crops for different reasons: (1) they did not have a good yield; (2) they want extra income; and (3) they have a desire to scale up and diversify to have a larger crop yield.

Coherence

There is potential for interventions related to CSi as farmers are interested in new technologies. Stakeholders' interventions include promoting the lead farmer model and improve coordination with agencies and business to promote improved agriculture practices. RAIN EQs are not explicitly measuring coherence. However, there is potential for interventions related to CSi as farmers are interested in new technologies

including solar cells to save electricity and drones to save labor cost, protect crops from animals such as squirrels, and spray chemicals and pesticides for tree crops so the chemicals do not reach the underside of the leaves. In fact, farmers expressed interest in the marketplace for farmers (a digital platform that connects farmers and consumers to buy and sell products) and other social media platforms, such as Facebook.

An academician mentioned that research institutions and universities are testing models such as the lead farmer model to reward or promote farmers. They select individuals as models or lead farmers, who are first trained on specific technologies, and the lead farmers in turn disseminate information to groups of farmers in their community. Rice farmers are provided temporary income insurance and get compensated if the yield from Sustainable Rice Platform (SRP) cultivation is lower than traditional cultivation. In fact, agriculture officers help follow up and advise on preparation before and during cultivation. Farmers are also helped through coordination of technical agencies such as the Rice Department and the Land Development Department, which help to coordinate the procurement of production factors such as fertilizers and seeds, coordinating with baling business operators in managing the leftover rice straw from the harvest and helping supply the market.

Effectiveness

The effectiveness of RAIN can be realized through interventions related to climate mitigation, value-added crop production, technology, capital funds, and disease and pest management. The effectiveness of RAIN can be realized through interventions related to climate mitigation, value-added crop production, technology, capital funds, and disease and pest management. Farmers expressed their desire to learn how to dry longans to reduce waste and increase sales/profit, use fertilizers specific to their crops and land, get near real-time weather information, and decrease time and labor and increase production at harvest time. Store owners mentioned that providing future trends information regarding production helps farmers adapt and adopt technologies and innovations.

Although some stakeholders mentioned websites that provide knowledge about testing kits and platforms such as “Techhunt” for registered inputs, farmers are required to contact the company or platform to order. However, many farmers gain knowledge about which tools and chemicals to use through word-of-mouth recommendations. In short, face-to-face communication, providing technology information during field trips, visiting fields with pre-appointment, and introducing technology to their field in a specific farmer group can potentially be effective.

Efficiency

The rate of return of interventions and technologies is paramount to farmers. It must have guaranteed benefits and reduced risk. Although efficiency of the project cannot be assessed at baseline, farmers generally consider the cost of production to ensure adequate returns to a new technology. For successful adoption of technologies and innovations, RAIN could consider the following observations from farmers and stakeholders.

Stakeholders reported that interventions and technologies across all target commodities should be affordable, easily accessible, and easy to use, and should save time and carry

less risk. Therefore, as RAIN identifies climate-smart innovations, the stakeholder-reported findings should serve as the criteria for selection of a CSi. The rate of return from these technologies should be promising. It must reduce the workload and result in better output (quality and quantity) with less money spent. For example, there is potential to create efficiencies for increased production by site-specific nutrient management. However, the tests and systems must provide real-time or near real-time benefits to maximize yield for the existing production cycle.

Impact

Except for some older farmers, most others are open to adoption of improved agricultural techniques and technology. Except for some older farmers, most others are open to adoption of improved agricultural techniques and technology. Farmers use improved agricultural practices for various reasons, which include, but are not limited to, use of good-quality varieties, biofertilizers, fertilizers to make soil more fertile and increase productivity; spraying/drone spraying to manage pest and diseases and reduce costs associated with time and labor, and water management/sprinkle system/pump canals to save water, protect crops from flooding, and so on. In short, farmers have a high knowledge of improved agricultural practices but lack input, capital, and required certification to sell/export the crops at a fair price.

Sustainability

Transfer of knowledge and user-friendly technologies that address soil and climate conditions, diseases, and pests are key to sustainability. Transfer of knowledge and user-friendly technologies that address soil and climate conditions, diseases, and pests are key to sustainability. According to stakeholders, these technologies must have apparent/direct benefits to the farmers, such as higher quality, increased productivity, reduced cost, and increased profits. These are also important criteria for the selection of a CSi.

A store owner mentioned that communication and trust are key to innovation/technology promotion and sustainability. Introduction to technologies or products should be free of cost to the farmers. If the product works, then farmers will be interested and more likely to use the product. Further, sustainable technologies should not have adverse health effects on the farmer and should be effective in reducing time and labor. The major factor that would encourage farmers to continue to use services and technology is via capital funds to support access and their continued ability to use those services. If new services or technology have a low price that the farmer can easily afford, are beneficial, and are worth their money, then it would surely encourage the farmers to continue using them.

5. RECOMMENDATIONS

This section presents specific, actionable recommendations for Winrock's management and RAIN in the areas of (1) target setting for outcome indicators; and (2) design/implementation of the project.

Target Setting Recommendations

Recommendation #1: Revise RAIN's indicator targets incorporating the values established in the baseline evaluation.

A key component of this evaluation was to establish baseline values for six standard outcome indicators and their respective disaggregates. Using this newly available data, RAIN's annual and life of project indicator values should be reviewed and revised. Below, we highlight a handful of salient areas for revision; however, RAIN should systematically compare additional indicator-related averages to ensure targets accurately reflect the on-the-ground reality of the project's target population.

1a. Refine RAIN's indicator targets using the actual average hectares under each target commodity from the baseline.

The average land area under each of RAIN's target commodities from the proposal versus the baseline report are as follows:

Table 27. Estimated hectares under each commodity from the proposal vs. the RAIN baseline evaluation, 2023

Commodity	Proposal Values Average hectares under target commodity per farm	RAIN Baseline Values Average hectares under target commodity per farm
Rice rainfed	1.6	1.7
Rice irrigated	1.6	1.8
Cassava	1.6	2.1
Durian	1.6	1.6
Mangosteen	1.6	1.3
Coconut	1.6	0.8
Longan	1.6	1.1

As highlighted above, the actual average number of hectares under each of RAIN's target commodities per farm captured in the baseline study differs from the figures initially established at the proposal stage. The difference in hectarage has implications across a number of FFPr Standard Indicator (SI) targets, especially value and volume of sales (SI-18 and SI-19) and the project's two hectares-related indicators (SI-2 and SI-3). These indicator targets should be revised (as needed) using the actual hectares under each target commodity established through the RAIN baseline.

1b. Review RAIN's yield (and associated value and volume of sales) targets using data from the baseline evaluation.

The average yield for RAIN's target commodities from the proposal versus the baseline evaluation are as follows:

Table 28. Estimated yield for RAIN commodities from the proposal and baseline evaluation, 2023

Commodity	Proposal Values Yield of target commodity	RAIN Baseline Values Yield of target commodity (weighted)
Rice (mt/ha)	2.9	2.4 (rain fed); 5.0 (irrigated)
Cassava (mt/ha)	21.5	13.3
Durian (mt/ha)	5.0	6.7
Mangosteen (mt/ha)	7.7	3.8
Coconut (mt/ha)	6.9	30.8
Longan (mt/ha)	4.8	4.6

Similar to the estimated values for hectares under each target commodity, yield of RAIN's target commodities captured in the baseline study differed to various degrees when compared with figures from the proposal stage. This difference in yield has implications across a number of the project's FFPr Standard Indicator (SI) targets, especially value and volume of sales (SI-18 and SI-19). These indicator targets should be revised using the yield figures established through the RAIN baseline.

Recommendation #2: Review the number of CSi and number of farmers applying CSi that will be promoted through RAIN.

RAIN proposed to track 30 CSi progression through the Five S (five-stage process): Source, Support, Scale, Sell, and Share for 30,000 farmers applying at least one CSi.

2a. Review RAIN's custom indicator targets relevant to CSi.

Beginning year 1, RAIN aims to have at least 1,000 farmers apply at least one of the 30 CSi. However, at the time of the baseline evaluation, there were only a few potential CSi in the first stage (source) of the Five S process and application rates ranged from 0.2 percent to 96.3 percent (straw management/bailing for rice). RAIN should consider whether 1,000 farmers is a realistic target for each promoted CSi, which could have implications on the targets for SI-2, SI-3, and SI-4.

In addition to refining the indicators, RAIN should adhere to the selection criteria for CSi—that is, it must be affordable, easily accessible, and easy to use and should save time and carry less risk. Identification of CSi should consider least adopted improved practices and technologies by farmers such as water management, irrigation, crop genetics, value-added processing. This will enable higher use of improved management practices and technologies by farmers while combating major challenges experienced by the farmers, including erratic rainfall, flooding, drought, access to improved markets, etc.

Project-Specific Recommendations

Aligned with the FFPr learning agenda, we propose the following project-specific recommendations:

Recommendation #3: Support inputs and certification for expansion of markets and increased production. For increased trade, RAIN aims to expand and validate technologies and CSi. This is expected to be achieved by expanding markets and adopting improved agriculture techniques and technology. Farmers and stakeholders reported multiple challenges, including good-quality inputs such as improved seeds, market linkages, and quality/standard certifications.

RAIN should provide inputs and services, including sources to access improved seeds, which are likely to improve quality and quantity of crop yields. This will help farmers get the required certifications (GAP and Fairtrade) for higher exports and sales.

3a. Inputs for higher production. Baseline data showed that farmers need guarantees that a given technology will yield desirable results (e.g., rice seeds given to them must germinate). Technological interventions should be relevant, specific, and suitable to the crops cultivated (e.g., drones for rice cultivation), repair and maintenance services should be available for the technology (e.g., weather forecast app to provide information at least 7 days in advance so that they can fertilize injection of plant hormones), and brands must be trusted or offer guarantees.

To gain farmers trust in the use/adoption of CSi, RAIN should ensure that technological and other CSi interventions are highly relevant to the target crop and tested to ensure the desired outcome.

3b. Quality and standard global certifications. Farmers reported benefits and drawbacks of using middlemen as the buyer. Most farmers reported that a certification such as Global Agricultural Practices (GAP) helps sell crops at a better price. GAP certification also helps farmers export their produce to other countries. Durian Grades A, AB, B, C are exported to China, while Grade D is sold in Thailand. Examples include Marco and Lotus. Below-standard durians are sold to local sellers, including roadside shops and vendors. Grade refers to grading or sorting durian by size, which is also used to sort durian for destination—export/other countries or domestic.

The CSi must be able to support and facilitate linkages between producers and traders for a more equitable distribution of power within the supply chain, encouraging and matching farmers to suitable markets for higher sales.

3c. Market linkages. There is a decrease in selling price reported for some commodities, particularly for rice. Along with the falling market prices, farmers rely mostly on middlemen as buyers because they are more apt at negotiating prices with the mill or warehouse. Further, most farmers do not have access to buyers in the area except for middlemen. This reliance on middlemen, along with the certification requirements (e.g., GAP, Fairtrade, etc.), prevents them from negotiating sale prices and/or export to countries like China (specifically durian and coconuts) for higher prices. These findings coupled with the “special study 1” findings should be used by RAIN to validate the effectiveness of CSi bundles.

ANNEXES

ANNEX 1. BIBLIOGRAPHY

Ahmed F, Mia S, and Wiboonpongse A, "Micro Finance Institutions, Programmes and Initiatives in Thailand: A Review," *International Journal of Economic Research* 14, no. 15, part 4 (2017).

Anupunt P, "Mangosteen Production and Marketing in Thailand," Department of Agricultural Extension, Ministry of Agriculture and Cooperatives, Bangkok, Thailand. Available at: http://itfnet.org/Download/tfnetsymposium2015/6-Thailand.pdf.

Arthey T, Srisompun O, and Zimmer Y, "Cassava Production and Processing in Thailand: A Value Chain Analysis Commissioned by FAO," Agri Benchmark, February 2018.

Choo WK, "Longan Production in Asia," Food and Agriculture Organization of the United Nations, Regional Office for Asia and the Pacific, Bangkok, Thailand, December 2000.

"The Durian: Botany, Horticulture, and Utilization," *Horticulture Reviews* 47, no. 11 (2019).

International Trade Administration, *Thailand Country Commercial Guide* (Washington, DC: International Trade Administration, July 2022), https://www.trade.gov/country-commercial-guides/thailand-agriculture.

Jeenkerdsup B, "The Opportunities and Key Success of the Competitive Ability of Thai Aromatic Coconut Exporter Business," *Association of Private Higher Education Institutions of Thailand* 8, no. 2 (July–December 2019).

Langford K, "Are Women and Men Equal in Agriculture in Thailand?" *World Agroforestry* (blog), March 30, 2016, https://www.worldagroforestry.org/blog/2016/03/30/are-women-and-men-equal-in-agriculture-in-thailand.

Neufeldt H et al., "Scaling Up Climate-Smart Agriculture: Lessons Learned from South Asia and Pathways for Success" (ICRAF Working Paper No. 209, World Agroforestry Centre, Nairobi, 2015), http://dx.doi.org/10.5716/WP15720.PDF.

Paull RE and Saichol K, "Coconut: Postharvest Quality-Maintenance Guidelines," Fruit, Nut, and Beverage Crops, College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa, March 2015.

Yakam S, Jierwiriyapant P, Nilsamranchit S, and Pothisuwan R, "Market Conduct of Fresh Longan in Chiang Mai and Lamphun Provinces," *Journal of Agricultural Research and Extension* 29, no. 3 (2012): 41–50.

Thailand Production, International Production Assessment Division, FAS, USDA, 2024. Available at https://ipad.fas.usda.gov/countrysummary/default.aspx?id=TH&crop=Rice.

United Nations Development Programme, "Thailand Focuses on Climate-Smart Agriculture to Transform Its Climate Action, September 30, 2022, https://www.adaptation-

undp.org/scala-thailand-focuses-on-climate-smart-agriculture-to-transform-its- climate-action.

U.S. Department of Agriculture, *Food for Progress Report, Fiscal Year 2020*, https://www.fas.usda.gov/sites/default/files/2021-07/Food for Progress Report FY2020.pdf.

Commodity Intelligence Report, “Thailand Rice: Recent Dry Conditions after a Promising Start; Optimism Still Remains for the Crop Season,” October 2021, USDA.

ANNEX 2. RAIN INDICATOR TABLE WITH TARGET VALUES

No.	Indicator	Unit	Type	BL	Year 1	Year 2	Year 3	Year 4	Year 5	LOP
SI-1	Yield of targeted agricultural commodities among program participants with USDA assistance		Outcome							
	Rice	mt/ha		TBD	2.95	3.10	3.25	3.40	3.40	3.40
	Cassava	mt/ha		TBD	21.59	22.67	23.75	24.83	24.83	24.83
	Coconut	mt/ha		TBD	6.91	7.25	7.60	7.94	7.94	7.94
	Durian	mt/ha		TBD	5.05	5.30	5.55	5.81	5.81	5.81
	Longan	mt/ha		TBD	4.79	5.03	5.27	5.51	5.51	5.51
	Mangosteen	mt/ha		TBD	7.74	8.13	8.52	8.90	8.90	8.90
SI-2	Number of hectares under improved management practices or technologies that promote improved climate risk reduction and/or natural resources management with USDA assistance	ha	Outcome	TBD	600	4,200	5,040	6,480	2,400	24,000
SI-3	Number of hectares under improved management practices or technologies with USDA assistance	ha	Outcome	TBD	600	4,200	5,040	6,480	2,400	24,000
SI-4	Number of individuals in the agriculture system who have applied improved management practices or technologies with USDA assistance	individuals	Outcome	TBD	1,500	7,500	9,000	9,000	3,000	30,000
SI-5	Number of individuals accessing agriculture-related financing as a result of USDA assistance	individuals	Output	0	600	3,000	3,600	3,600	1,200	12,000
SI-6	Number of individuals participating in group-based savings, micro-finance or lending programs with USDA assistance	individuals	Output	0	1,200	6,000	7,200	7,200	2,400	24,000
SI-7	Number of loans disbursed as a result of USDA assistance	loans	Output	0	150	750	900	900	300	3,000
SI-8	Value of agriculture-related financing accessed as a result of USDA assistance	USD	Output	0	67,500	337,500	405,000	405,000	135,000	1,350,000
SI-9	Number of technologies, practices, and approaches under various phases of research, development,	Technologies practices approaches	Output	0	6	26	35	32	13	30

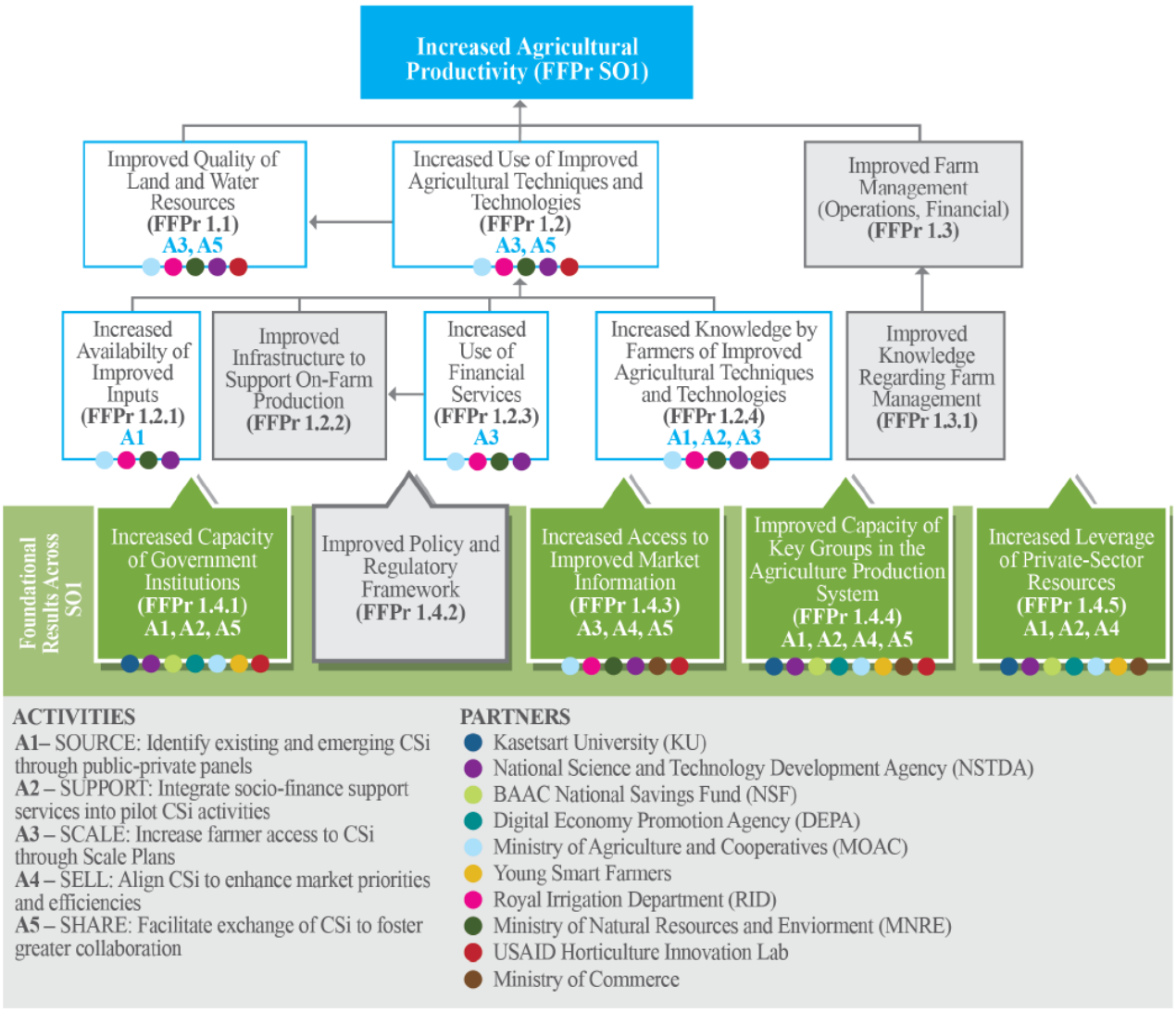
No.	Indicator	Unit	Type	BL	Year 1	Year 2	Year 3	Year 4	Year 5	LOP
	and uptake as a result of USDA assistance									
SI-13	Number of public-private partnerships formed as a result of USDA assistance	partnerships	Output	0	5	10	15	15	0	45
SI-14	Value of new USG commitments and new public and private sector investment leveraged by USDA to support food security and nutrition	USD	Outcome	0	152,214	304,427	380,534	456,641	228,321	1,522,137
SI-18	Value of annual sales of farms and firms receiving USDA assistance	USD	Outcome	TBD	555,255	3,904,877	4,887,560	6,414,772	2,359,175	18,121,638
	Rice	mt/ha		TBD	TBD	TBD	TBD	TBD	TBD	TBD
	Cassava	mt/ha		TBD	TBD	TBD	TBD	TBD	TBD	TBD
	Coconut	mt/ha		TBD	TBD	TBD	TBD	TBD	TBD	TBD
	Durian	mt/ha		TBD	TBD	TBD	TBD	TBD	TBD	TBD
	Longan	mt/ha		TBD	TBD	TBD	TBD	TBD	TBD	TBD
	Mangosteen	mt/ha		TBD	TBD	TBD	TBD	TBD	TBD	TBD
SI-19	Volume of commodities sold by farms and firms receiving USDA assistance	mt	Outcome	TBD	1,772	13,025	16,375	22,010	8,152	61,334
	Rice	mt/ha		TBD	TBD	TBD	TBD	TBD	TBD	TBD
	Cassava	mt/ha		TBD	TBD	TBD	TBD	TBD	TBD	TBD
	Coconut	mt/ha		TBD	TBD	TBD	TBD	TBD	TBD	TBD
	Durian	mt/ha		TBD	TBD	TBD	TBD	TBD	TBD	TBD
	Longan	mt/ha		TBD	TBD	TBD	TBD	TBD	TBD	TBD
	Mangosteen	mt/ha		TBD	TBD	TBD	TBD	TBD	TBD	TBD
SI-21	Number of individuals who have received short-term agricultural sector productivity or food security training as a result of USDA assistance	individuals	Output	0	10	100	200	200	150	200
SI-22	Number of individuals participating in USDA food security programs	individuals	Output	0	1,510	7,590	9,100	9,000	3,000	30,200
SI-23	Number of individuals benefiting indirectly from USDA-funded interventions	individuals	Output	0	4,350	21,750	26,100	26,100	8,700	87,000

No.	Indicator	Unit	Type	BL	Year 1	Year 2	Year 3	Year 4	Year 5	LOP
CI-1	Projected greenhouse gas emissions reduced or avoided from CSi as a result of USDA assistance	tCO_2	Outcome	0	1,755	13,267	19,655	26,534	15,443	76,654
CI-2	Layers of production information accessed as a result of Csi	layer	Output	0	0	2	7	8	7	24
CI-3	Number of improved inputs accessed as a result of CSi	inputs	Output	0	0	2	14	15	14	45
CI-4	Number of organizations strengthened as a result of USDA assistance	organizations	Outcome	0	0	10	45	50	45	150
CI-5	Number of government institutions supported to scale Csi	institutions	Output	0	1	2	3	3	1	10
CI-6	Layers of market information accessed as a result of Csi	layer	Output	0	0	3	15	17	15	51
GND R-2	Percentage of female participants in USG-assisted programs designed to increase access to productive economic resources	percent	Output	0	25	35	40	40	40	40
YOU TH-3	Percentage of participants in USG-assisted programs designed to increase access to productive economic resources who are youth (15-29)	percent	Output	0	25	35	40	40	40	40

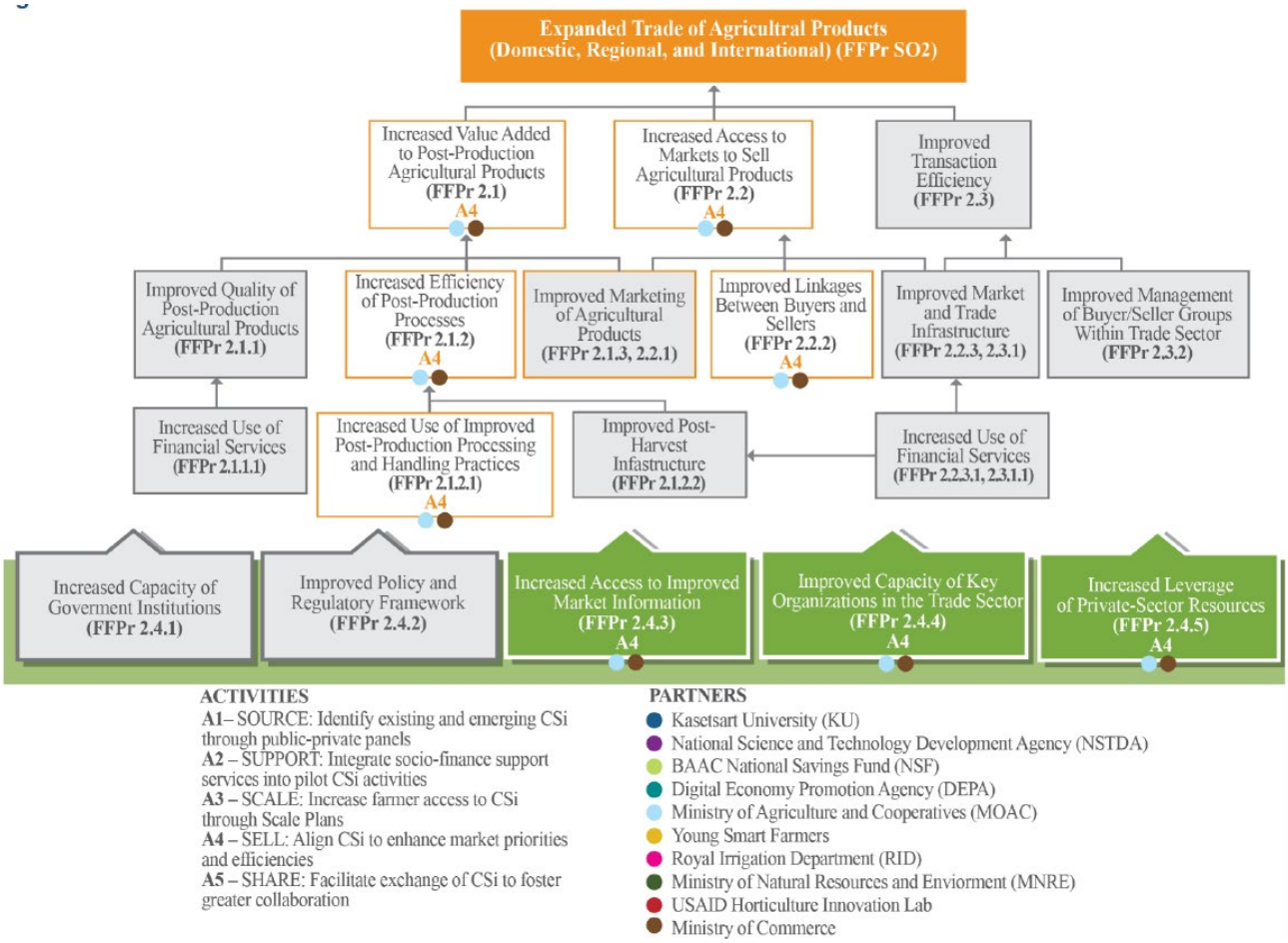
Key: BL=Baseline; LOP =Life of Project

ANNEX 3. RAIN'S RESULTS FRAMEWORK

RAIN Strategic Objective 1 Results Framework



RAIN Strategic Objective 2 Results Framework



ANNEX 4. BASELINE EVALUATION SCOPE OF WORK

Regional Agriculture Innovation Network (RAIN) Abbreviated Scope of Work

Bangkok, Thailand

Introduction

The Regional Agriculture Innovation Network (RAIN) project is a five-year, $16 million project funded by the Food for Progress (FFPr) Program of the United State Department of Agriculture (USDA) and implemented in partnership with Michigan State University (MSU). Winrock International (Winrock) will implement RAIN in Chiang Rai, Chiang Mai, Lamphun, Nakhon Ratchasima, Chairyaphum, Khon Kaen, Chantaburi, and Nakkon Si Thammarat provinces of Thailand. RAIN participants will include smallholder farmers as well as other agriculture-focused entities, organizations, and persons, including Royal Thai Government (RTG) representatives, research entities, academic university staff, trade association management, agricultural businesses and entrepreneurs, service providers, extension agents, data and technology businesses, and financial providers. RAIN will identify emerging climate smart innovations (CSi), train and promote CSi to farmers, and ensure sustainability by building capacity of support services for and facilitating market access to CSi. RAIN will work in six value chains: rice (irrigated and rainfed), cassava, coconut, durian, longan, and mangosteen.
Winrock International (WI) is seeking a local or international firm with a presence or local partner in Thailand to conduct a baseline evaluation to establish the baseline for project monitoring and evaluation (M&E) efforts.

Methodology

Baseline will employ mixed methods to collect the required information to fulfil its objectives listed above. The following data collection modes will be used.

- A household (beneficiary-based) survey of a sample of farmers will be taken. This will include complex statistical samples (as indicated in the sampling section below) from the intervention group as well as the control group to support a quasi-experimental study design. Data collected from this survey will establish baseline values for intervention and control groups on impact indicators. It will also establish baseline values for outcome performance indicators for the intervention group.
- Surveys of consumers and entrepreneurs will be taken to present a picture of the current status of technology, financial services, and data use. A convenience sample in select provinces will be used for this survey.
- Key informant interviews of stakeholders—such as government officials, private sector managers, CSi panel members, bankers supporting financial programs, etc.—will be utilized to help review and refine program targets and to identify anticipated challenges that may occur during implementation.
- Focus group discussions will be used to gather the views of groups of demographically- similar beneficiaries—in terms of gender, age, location, income, and project involvement— to help review and refine program targets and to identify anticipated challenges that may occur during implementation.

- Secondary data will be collected to verify and/or acquire data for indicators that are unavailable or outdated.

Collected data will include demographic and district information; gendered household type; beneficiary use of identified CSi, financial services, and data; direct-beneficiary profile information; agricultural capacity; production, volume, and values of cassava, rice, and high- value horticultural products; total yield and percent of yield lost during production, post- production, and processing; number and value of loans accessed; and local extension and information sources and services delivery, as well as any other information required for the indicators. RAIN will provide performance indicator reference sheets upon award.

Sample and Setting

The program will be implemented in eight provinces across four regions in Thailand. There are three crops that are included in the program: rice, cassava, and horticulture (durian). Rice is grown two ways: through irrigation and rainfed. For evaluation purposes, we are categorizing rice as two separate commodities (based on their watering modality) because the content of the intervention may have different impact on the different watering modalities. The program, however, treats them as a single commodity. Different commodities are grown in different provinces: Rice, irrigated: Northern region (Chiang Rai province); Rice, rainfed: Northeastern region (Nakhon Ratchasima, Chaiyaphun, and Khon Kaen provinces); Cassava: Northeastern region (Nakhon Ratchasima, Chaiyaphun, and Khon Kaen provinces); and Horticulture: Northern region (Chiang Mai, Chiang Rai, Lamphun provinces), Eastern region (Chantaburi province), and Southern region (Nakhon Si Thammarat province). The program intervention will be provided to 10,000 farmers per category: 1,000 irrigated rice; 9,000 rainfed rice; 10,000 cassava; and 10,000 horticulture farmers (2,500).

For the beneficiary-based survey (BBS), a statistical sample shall be drawn based on provinces and commodities. For cassava, initial sample size of approximately 370 participants will be needed. For rice, initial sample size of approximately 278 participants will be needed for irrigated and 369 for rainfed methods. For horticulture, an initial sample size of 334 will be needed for each item type for a total 1336 for 4 items. The representative sample will have a Confidence Level of 95 percent, Margin of Error of 5 percent, and Power of 0.8. Since irrigated rice is only grown in one province, a simple random sample will suffice. However, for commodities that are grown across multiple provinces, a stratified and/or clustered sample may be needed where a probability proportional to size can be drawn based on the initial sample sizes listed above. Note, where clustered samples are used, the sample sizes may increase due to design effects of clustering. Approximately 10 percent shall be added to the program participant sample to account for possible non-response. Comparative sample sizes will be needed for the control group; however, given the high potential for non-response, a 25 percent larger sample shall be drawn.

Sampling design will use the propensity scoring method. Control group members will be selected based on their location and other demographic characteristics, so that each member of the treatment group (program participants) has a comparable counterpart with similar characteristics in the control group. For example, location selection will ensure that the geo-climatic characteristics of the control group are similar to treatment group. It will also be isolated enough that the intervention will not reach/contaminate it. Location selection will also ensure that political conditions and technological infrastructure of the control group are comparable to treatment groups. Demographic characteristics—such as gender, race/ethnicity or other factors that may affect their ability to the use of services provided by the program—will also be taken into consideration.

Interview and Focus Groups will include purposive sampling. Whenever possible, at least five representatives of each stakeholder type (farmer beneficiaries, government partners, local private partners, CSi innovators, finance partners, data partners, other value chain partners, etc.) will be interviewed for both methods. Whenever applicable, beneficiaries by all disaggregating variables—including commodity, gender, and regions—will be included. For example, irrigated rice is only grown in the northern region. Therefore, at least five male farmers and five female farmers will be interviewed or included in focus group discussions. Horticulture, however, is done in three regions. Therefore, at least five male farmers and five females from each of the three regions will be interviewed or included in focus groups.

Roles and Responsibilities

The offeror is responsible for some or all the following activities:

- Collect data with an inclusive perspective including collection of socio- demographic data and disaggregation by gender, age, and disability. The evaluation firm is responsible for creating and enabling environment for female and male, youth and adult participation.
- Review project documents (other project data, baseline and mid-term data, monitoring data, etc.).
- Develop a **detailed evaluation plan** including evaluation study design, sampling protocols, data collection tools, data analysis plans, quality assurance plan etc.) and timeline for the execution of the evaluation tasks (preferably a Gantt chart with work breakdown structure), and a final report structure outline.
- Translate into Thai and pilot all **survey questionnaires and tools**.
- Hire a field team (supervisors and data collectors), preferably recruiting experienced staff with similar research exercises in country.
- Prepare a **field manual** for training, then train data collectors.
- Arrange all fieldwork logistics.
- Oversee data collection and any required data entry or transcription, using appropriate quality control measures and supervision
- Consolidate beneficiary-based outcomes survey data into a database, exportable into a RAIN-prescribed MS Excel template. Ensure anonymity of data, human

subject research concerns (Do No Harm - dignity, right, safety, and privacy concerns), and confidentiality.

- Present initial findings and recommendations (drawn from their own conclusion, free from organizational or political pressure) to RAIN MEL team and senior management team, and subsequently to USDA for feedback.
- Prepare a **draft report** using the USDA provided outline
- Prepare a **revised report** that incorporates the feedback provided by RAIN and USDA,
- Submit a final report in English to Winrock.
- Submit **information and data** to RAIN. Data and information deliverables include any knowledge, information, data (structured and unstructured), or analyses collected/ developed under this assignment.
- Submit to RAIN all the documents related to the study (filled questionnaires, electronic versions of the collected data, transcripts, coded qualitative (interview/focus group) data, training manual, fieldwork logs, etc.).
- Hold weekly status calls with RAIN team.
- Prepare a **research brief** on any identified ethical issues and how they were addressed.
- Prepare a **2-3-page stand-alone brief** describing the evaluation design, key findings and other relevant considerations that will serve to inform any interested stakeholders of the final evaluation and should be written in language easy to understand by non-evaluators and with appropriate graphics and tables.Presentation of key findings to Winrock RAIN team.
- Virtual presentation of the evaluation for USDA stakeholders. The RAIN MEL team is responsible for all of the following activities:
- Provide access to the research materials cited above (Monitoring and Evaluation Plan, PMP, other projects' baseline and mid-term surveys, reports and protocols, project monitoring database, etc.) and will ensure that the contractor receives timely feedback on evaluation study design, all data collection tools, translation, sampling strategy and other methodological components.
- Inform partners and stakeholders about the Baseline Evaluation.
- Provide a complete list of:
- Standard and customized Indicators (SI & CI indicators)
- Implementing partners and government partners
- The RAIN MEL team is supported by a designated member of Winrock International's Analytics, Gender, Inclusion, Learning, and Evaluation (AGILE) team. The AGILE point of contact is responsible for all of the following activities:
- Lead solicitation, procurement, negotiations, and award of the baseline study contract.
- Provide existing resources and research materials in addition to those listed above, as necessary.
- Review deliveriables.

ANNEX 5. CONFLICT OF INTEREST FORM

Conflict of Interest Statement

Supporting Greater Performance

On behalf of **Capacity Building Service Group (CBSG),** I certify, to the best of my knowledge and belief as of the date indicated below, that any of us in CBSG either;

1. Have no actual or potential conflict of interest, personal or organizational, that could diminish our capacity to perform an impartial and objective of the RAIN baseline evaluation, or that might otherwise result in an unfair advantage or personal gain or,

2. Have fully disclosed all such conflicts to Winrock International and will comply fully with any instructions to mitigate, avoid, or neutralize conflict(s). We understand that we will also be under a continuing obligation to disclose, and act as instructed concerning, such conflicts discovered at any time prior to the completion of the evaluation.

Name: **Joyanta Roy**	**Signature:**
Title: Chairman/President and CEO	**Date: January 23, 2024**

Capacity Building Service Group CBSG

ANNEX 6. BASELINE EVALUATION MATRIX

Key Evaluation Question	Sub-Evaluation Questions	Key Performance Indicators	Data Collection Methods/Analytical Tools
Relevance			
EQ 5. How relevant were program activities for the beneficiaries? Was RAIN's design and delivery aligned with USDA and U.S. Government development goals, objectives, and strategies? And to what extent does the project satisfy/consider the geography and ecological importance?	What are the USDA and U.S. Government development goals, objectives, and strategies? Did RAIN's design and delivery promote and facilitate the USDA and U.S. Government development goals, objectives, and strategies? To what extent are smallholder farmers selected?	USDA and USG development goals, objectives, and strategies Project strategies and inputs that directly or indirectly promote and facilitate USDA and U.S. Government developmental goals, objectives, and strategies	Desk review of - USDA's Monitoring and Evaluation Policy - RAIN program documents - Other internal documentation and reporting - Other external resources and reporting Primary data collection. Literature review–available market information of the 7 value chain products.
Was RAIN's approach aligned with the Government of Thailand's agriculture and/or development investment strategy?	What is Thailand's strategy for agriculture development? To what extent did the project facilitate/add to the existing strategy for the 7 value chain products?	Thailand's agriculture investment and development strategy Perceptions of government officials regarding the intervention facilitating the existing strategies on the 7 value chain commodities	
Coherence			
To what extent do stakeholders of RAIN project promote, optimize coordinated efforts, and contribute to innovation?	Did academic experts, private sector actors, and industry stakeholders serving on panels promote and prioritize coordination and harmonization with existing development work when reviewing data on CSi in order to draw conclusions and recommendations for innovations?	Number of innovations recommended and supported by stakeholders	Review project documents and project activity records. Conduct qualitative interviews with key stakeholders.
Effectiveness			
EQ 4. To what extent did the use of improved agricultural techniques and technologies	Yield targeted for the 7commodities among the beneficiaries with RAIN project support in terms of productivity	Increase in yield of the commodities - produced by the 7 targeted commodities as a result of USDA assistance	Confirm that the project has achieved output targets as reported from routine monitoring systems:

Key Evaluation Question	Sub-Evaluation Questions	Key Performance Indicators	Data Collection Methods/Analytical Tools
increase through increased use of financial services promoted by RAIN?		Number of short-term agricultural sector productivity or food security trainings conducted for agro-dealers and/or other input suppliers, farmers, or government institutions	- Validating the accuracy of output results reported to date through a review of internal documentation and databases - Identifying any additional data that may be necessary and coordinating with project staff to obtain reliable source documents - Conducting qualitative interviews with stakeholders - Designing a quantitative survey of direct beneficiaries and sampling methodology that complements/supplements the data and findings from routine evaluations–with a focus on the project's outcome indicators, which primarily highlight results achieved among the project's 30,000 direct beneficiaries - Mobilizing the requisite tools, staff, and other resources to carry out the quantitative survey—with support from RAIN project staff - Conducting qualitative interviews with key stakeholders
	Were farmers able to receive financial services as support from the project?	Percentage of farmers who received financial services as a result of USDA assistance, average amount of loans received by farmers as a result of USDA assistance Value of loans provided as a result of USDA assistance	
	Did the production of targeted commodities in kg per hectare in the targeted areas increase?	Percent increase in yield of targeted commodities in kg or ton per hectare in the targeted areas	
	Did the farmers apply new techniques or technologies as a result of USDA assistance?	Percentage of farmers who have applied new techniques or technologies as a result of USDA assistance	
	How were the policy and regulatory framework improved?	Number of policies, regulations, and/or administrative procedures in each of the following stages of development as a result of USDA assistance Perceptions of government officials regarding the development of policy and regulatory framework.	

Key Evaluation Question	Sub-Evaluation Questions	Key Performance Indicators	Data Collection Methods/Analytical Tools
	How much did the produce/volume of commodities sold by farmers improve because of the project? What was the role of postharvest handling for the same?	Volume of commodities (kg or metric tons) sold by project beneficiaries Perceptions of farmers regarding the role of postharvest handling to improve the amount sold	
	How was the project able to help farmers improve their marketing and branding? How did the project facilitate improved linkages between sellers and buyers?	Number of events to improve linkages between buyers and sellers Perceptions of buyers and sellers regarding improvement in market access	
Efficiency			
EQ 7. How did adopted innovations lead to improvements/efficiencies? How were they effective? *EQ 8. What were characteristics/ factors in sourced innovations that were successfully adopted? What were characteristics/factors of sourced innovations that were not adopted?*	What was the RoI (return on investment) of USDA's funding in terms of increased economic activity? What was the RoI of USDA's funding in terms of farmer incomes?	Total cumulative value of incremental sales/total value of project budget Total cumulative increase in farmer profits/total value of project budget Perceptions of farmers and stakeholders of the challenges in adopting improved practices Reasons for not continuing the improved practices (for farmers who dropped the practices)	Technical analysis and visual modeling of validated project data in relation to the total project budget (i.e., USDA investment).
	Which specific interventions of targeted commodities delivered compelling results while requiring minimal resources in terms of cost or time (i.e., value	Number of trainings conducted in each district for the intervention farmers, percentage of farmers who attended, percentage of farmers who dropped out,	Desk review of project-sponsored technical reports and research studies: - Interviews with project staff and sector stakeholders

Key Evaluation Question	Sub-Evaluation Questions	Key Performance Indicators	Data Collection Methods/Analytical Tools
	for money)? Which training/combination of trainings was the most cost-effective as per coverage?	percentage of farmers who adopted technology/resources in the field	- Technical analysis of project investments (based on internal accounting data)
Impact			
EQ 1. To what extent did trade expand through the increased adoption of improved agricultural techniques and technology? *EQ 2. To what extent did agricultural productivity increase through increased farmer capacity resulting from the increased use of improved agricultural techniques and technologies?* *EQ 4. To what extent did use of improved agricultural techniques and technologies increase through increased use of financial services promoted by RAIN?*	What were farmers' perceptions regarding the improved agricultural practices? What were the reasons behind farmers' choosing their method of agriculture? Did the project-supported producer organizations successfully receive short-term agricultural sector productivity?	Farmers' perceptions regarding the improved production practices Number of trainings received by the producer organizations Views of members of producer organizations on service provision Farmers' and stakeholders' perceptions of major challenges and risks of farming related to water, inputs, climate, market, and so on Number of events to improve linkages between buyers and sellers Perceptions of buyers and sellers regarding improvement in market access	Quantitative counterfactual survey: - Stakeholder interviews with farmer group leaders and private sector partners throughout the value chain - Technical analysis and reporting
	In what ways were farmers more/less likely to adopt improved agricultural practices, access finance/credit, or engage in bulk sales? What were the reasons behind farmers' choices of their methods		

Key Evaluation Question	Sub-Evaluation Questions	Key Performance Indicators	Data Collection Methods/Analytical Tools
	of agriculture?		
Sustainability			
EQ 6. How will the program activities be sustained by various stakeholders? Is there any evidence of sustainability?	Do last-mile service providers (e.g., input retailers) perceive an increase in demand for the high-quality inputs and modern production technologies promoted by RAIN? Why? Or why not?	Perceptions of last-mile service providers regarding technologies promoted by the project Suggested technologies	On-site semi-structured interviews with financial institutions and service providers engaged by the project KII with Government Agriculture Extension officers
	Whether the project could engage the private sector to support farmers—trade and output marketing—this is an important issue. Any best practices the project yielded—are they sustainable and have remained relevant?	Views and evidence of financial institutions making loans to smallholder farmers for production of the 7 targeted commodities Perception of Agriculture Extension officers regarding providing services and knowledge to farmers about improved technologies	
	Are any of the program-induced changes to be sustained? Did the program impact trade improvement, production, and income of farmers?		

ANNEX 7. SAMPLING DESIGN AND PROTOCOLS

Sampling Design

Background

This sampling design document details the sampling design and procedures of the Thailand RAIN Baseline Survey. The document outlines the target population, sampling frame, sampling stages, sample allocation, and selection procedure. The target population for the Thailand RAIN Baseline Survey are potential farmer beneficiaries of the RAIN project who cultivate seven value chain crops: rice (irrigated and rainfed), cassava, durian, longan, mangosteen, and coconut. The targeted areas are 11 provinces, specifically, the Northern region (Chiang Mai, Chiang Rai, and Lamphun); Northeastern region (Chaiyaphum, Khon Kaen, and Nakhon Ratchasima); Central-Eastern (Chanthaburi, Samut Sakhon, and Ratchaburi); and Southern region (Chumphon and Nakhon Si Thammarat).

Sampling Frame

The evaluation team did not have access to an updated list of all farmers of the target crops. We used a stratified, multistage cluster sample design to obtain a representative random sample for the Thailand RAIN Baseline Survey. We used a list of villages in all the target areas. The list included data about provinces, districts, sub-districts, and the location of each village. The list also included total population by male and female within each village. Although the list did not include data about the number of farmers per village, it included such data by sub-district, where the number of farmers by crops was provided for each sub-district. See **Table A1** for distribution of districts, sub-districts, and villages by provinces, and see **Table A2** for distribution of farmers by provinces and crops.

Table A 1. Number of districts, sub-districts, and villages by province

Province	Districts	Sub-districts	Villages
Chanthaburi	10	69	821
Nakhon Ratchasima	32	280	4035
Chaiyaphum	16	124	1752
Khon Kaen	26	198	2532
Chiang Mai	24	186	2241
Lamphun	8	51	622
Chiang Rai	18	123	1936
Ratchaburi	10	94	1089
Samut Sakhon	3	23	312
Nakhon Si Thammarat	20	116	1620
Chumphon	8	68	800
All	175	1,332	17,760

Table A 2. Distribution of farmers by provinces and crops

Province	Rice Rainfed	Rice Irrigated	Cassava	Coconut	Durian	Longan	Mango-steen	Total
Chanthaburi			527		29,969		20,375	50,871
Nakhon Ratchasima	231,110	61,140**	93,786					386,036
Chaiyaphum	260,515	10,123**	57,340					327,978
Khon Kaen	294,388	24,818**	43,957					363,163
Chiang Mai						65,654		65,654
Lamphun						57,552		57,552
Chiang Rai	203,773	24,564						228,337
Ratchaburi				9,058				9,058
Samut Sakhon						515*		515
Nakhon Si Thammarat							30,705	30,705
Chumphon					25,367			25,367
Grand Total	989,786	120,645	195,610	9,058	55,336	123,721	51,080	1,545,236

** Because the number of farmers is very low, we excluded Samut Sakhon from the sampling for Longan.*
***Although these provinces have farmers who cultivate rice-irrigated, we dropped those provinces from sampling for rice-irrigated as the RAIN project does not target those provinces for this commodity.*

Sampling Stages

The sample for the Thailand RAIN Baseline Survey is a stratified, multistage cluster sample design. The sample is stratified by crops. Within each stratum (i.e., crop), (1) a list of sub-districts where the crop is cultivated is compiled, (2) a sample of sub-districts is selected as primary sampling units (PSUs), (3) from each selected PSU, a sample of villages is selected as secondary sampling units (SSUs), and (4) from each selected village, a sample of farmer households is selected, and farmers are interviewed.

First Stage: Selection of sub-districts

In the first stage, sub-districts were selected by probability proportional to size (PPS) selection. We used the number of farmers per sub-district as the size for the PPS selection. Before the sample selection, to achieve an implicit stratification by different administrative levels, we sorted the list of sub-districts by provinces, district codes and sub-district codes. For each crop, five sub-districts were selected as primary sampling units (PSUs).

Second Stage: Selection of villages

In the second stage, four or five villages were randomly selected from each selected sub-district. Those villages were assigned as the “original selection” where interviewers should start. A total of 155 villages were selected. Another two villages were selected within each selected sub-district as “reserve.” A total of 70 villages were selected as reserves. The reserve villages are reserved for village replacement in scenarios that will be discussed later. See **Table A 2** for the allocation of selected villages by crops and provinces.

Third Stage: Selection of farmers

In the last stage, 35 farmers will be selected from each village. See **Table A 3** for the allocation of farmers by crop. The selection method to use depends on the availability of a list of farmers in the village. Systematic sampling is recommended when there is a list of all farmers residing in the selected village. Rapid Asia field teams will contact the village headman or village chief known as “phu yai ban” of the muban/mooban (village) to get a list

of farmers in the sampled village. The selection can be done at the office or in the field. When any selected farmer is not present or refuses to participate, the team should NOT replace the farmer with other nonselected farmers.

When a list of farmers is not available, compact segment sampling can be used. Under this method, the village will be divided into equal-size segments, and one segment will be selected at random for data collection. All farmers residing in the selected segment should be recruited for the survey even if more or fewer than the planned number (e.g., more or fewer than 35 farmers). If the selected segment had fewer than 20 farmers, the team should complete another segment in addition to make up for the reduction in number of selected farmers. For example, if the selected segment number 2 had 15 farmers, all will be selected for interview (and as expected some of them might not complete the interview), and then the team should move to the adjacent segment number 3 and interview all farmers as well (e.g., if segment 3 has 30 farmers, the team will select up to 45 farmers from this village, 15 from segment 2 and 30 from segment 3).

The selection steps for both systematic and compact sampling are explained in a separate protocol document.

We expect 10 percent of selected farmers not to be interviewed for different reasons (e.g., they were not present during the visit, or refused to cooperate). We also expect to find villages with a small number of farmers (e.g., fewer than 35 farmers). To make up for sample reduction because of those scenarios, if a team interviewed fewer than 20 farmers from any given village, the team should proceed to one of the reserve villages and select an additional sample as illustrated above. We have a total of 70 reserve villages (about two villages in each sub-district).

Table A 3. Number of selected sub-districts, villages, and farmers by crop

Province	Villages	Sub-district	Villages per sub-district	Number of farmers	Expected number of farmers interviewed*
Rice, rainfed	25	5	5	875	788
Rice, irrigated	25	5	5	875	788
Cassava	25	5	5	875	788
Coconut	20	5	4	700	630
Durian	20	5	4	700	630
Longan	20	5	4	700	630
Mangosteen	20	5	4	700	630
Total	155	35	31	5,425	4,884

** Assuming a 90% completion rate due to noncontact, refusals, and villages with fewer than 35 farmers.*

Table A 4. Number of selected original and reserve villages by province and crop

	Rice Rainfed	Rice Irrigated	Cassava	Coconut	Durian	Longan	Mangosteen	Total
Original selection	25	25	25	20	20	20	20	155
Chanthaburi					12		8	20
Nakhon Ratchasima	5		10					15
Chaiyaphum	10		10					20
Khon Kaen	10		5					15
Chiang Mai						12		12
Lamphun						8		8
Chiang Rai		25						25
Ratchaburi				20				20
Nakhon Si Thammarat							12	12
Chumphon					8			8
Reserve	10	10	10	10	10	10	10	70
Chanthaburi					6		4	10
Nakhon Ratchasima	2		4					6
Chaiyaphum	4		4					8
Khon Kaen	4		2					6
Chiang Mai						6		6
Lamphun						4		4
Chiang Rai		10						10
Ratchaburi				10				10
Nakhon Si Thammarat							6	6
Chumphon					4			4
Grand Total	35	35	35	30	30	30	30	225

Sampling Protocol

This sampling protocol document details the steps undertaken to select eligible farmers from sampled villages for the Thailand RAIN Baseline Survey. The target population for the Thailand RAIN Baseline Survey are farmers who cultivate rice (irrigated and rainfed), cassava, mangosteen, longan, durian, and coconut in 11 provinces, specifically, the Northern region (Chiang Rai, Chiang Mai, and Lamphun); Northeastern region (Chaiyaphum, Khon Kaen, and Nakhon Ratchasima); Central-Eastern region (Chanthaburi, Samut Sakhon, and Ratchaburi); and Southern region (Chumphon and Nakhon Si Thammarat).

Selection of Farmers

A fixed number of farmers (typically 35 farmers) should be selected across all sample villages. The selection method to use depends on the availability of a list of farmers in the village. If there is a list, it is recommended to do a systematic selection of farmers. When lists are not available, compact segment sampling can be used.

Option 1. Systematic Sampling (a list of farmers is available from)

Systematic sampling is recommended when there is a list of all farmers residing in the selected village. Rapid Asia field teams will contact the village headman or village chief known as "*phu yai ban*" of the *muban/mooban* (village) to get a list of farmers in the sampled village. The selection can be done at the office or in the field.

A systematic sample of *m* farmers can be selected as follows:

1. Create a farmer ID that starts from 1 (e.g., for a list of 175 farmers, the ID is between 1 and 175).
2. Calculate a Selection Interval *K* by dividing the total number of farmers by the number of farmers to be selected (e.g., 175/35 = 5).
3. Select one random number from the selection interval (e.g., one random number from 1, 2, 3, 4, or 5); this will be the first farmer *S* in the sample (e.g., *S* = 4).
4. Add the Selection Interval as follows to select the subsequent farmers:

2nd farmer: S + K	(e.g., 4 + 5 = 9)
3rd farmer: S + 2K	(e.g., 4 + 10 = 14)
……	
35th farmer: S + 34K	(e.g., 4 + 170 = 174)

These steps are illustrated in **Table A 5**.

Table A 5.Systematic selection of farmers from total number of farmers in a cluster

No.	Name	No.	Name	No.	Name	No.	Name	No.	Name	No.	Name	No.	Name
1	*A-wut*	26	*Phanumas*	51	*Phassakorn*	76	*Nam*	101	*Fai*	126	*Tanakorn*	151	*Fah*
2	*Channarong*	27	*Orraya*	52	*Phueng*	77	*Satja*	102	*Taeng*	127	*Suppanat*	152	*Ram*
3	*Khemkhaeng*	28	*Ratana*	53	*Ratchanan*	78	*Nutcha*	103	*Patcharee*	128	*Ton*	153	*Arthit*
*4	*Kiet*	29	*Ploy*	54	*Teerata*	79	*Niran*	104	*Panya*	129	*Thanachart*	154	*Piyawat*
5	*Somchai*	30	*Sarut*	55	*Nam thip*	80	*Sup*	105	*James*	130	*Vanida*	155	*Busarakham*
6	*Somsak*	31	*Orn-a-nong*	56	*Sirichai*	81	*On-in*	106	*Taeng*	131	*Virote*	156	*Mali*
7	*Arthit*	32	*Sarawut*	57	*Chayaphon*	82	*Nong Yao*	107	*Puenthai*	132	*Phailin*	157	*Rune*
8	*Malee*	33	*Borwornsit*	58	*Tayada*	83	*Piyabutr*	108	*Piyapon*	133	*Paitoon*	158	*Khlahan*
9	*Anong*	34	*Chaiya*	59	*Pensri*	84	*Kittichai*	109	*Ying*	134	*Fang*	159	*Tawin*
10	*Pornthip*	35	*May*	60	*Tipprapha*	85	*Narawit*	110	*Krit*	135	*Sroy*	160	*Duangkamol*
11	*Praew*	36	*Nan*	61	*Pen-Chan*	86	*Yathida*	111	*Sakda*	136	*Sirinat*	161	*Fern*
12	*Aison*	37	*Nin*	62	*Kasaem*	87	*Suteera*	112	*Nithirot*	137	*Kla*	162	*Tipkamol*
13	*Boribun*	38	*Tassanee*	63	*Natcha*	88	*Pensri*	113	*Sunan*	138	*Malai*	163	*Kwang*
14	*Badin*	39	*Tanawat*	64	*Kasaemchai*	89	*Alisa*	114	*Kittipong*	139	*Thuanthong*	164	*Som*
15	*Orachon*	40	*Lertpong*	65	*Sudarat*	90	*Anurat*	115	*Jasmine*	140	*Thuangrat*	165	*Kohsoom*
16	*Khlahan*	41	*Phailin*	66	*Montra*	91	*Yadthip*	116	*Jira*	141	*Kanya*	166	*Theeraphop*
17	*Taska-orn*	42	*Nattapong*	67	*Suganya*	92	*Samorn*	117	*Saksit*	142	*Jack*	167	*Atid*
18	*Saengdao*	43	*Aom*	68	*Waen*	93	*Rapeepong*	118	*Nick*	143	*Sujira*	168	*Sanouk*
19	*Mongkut*	44	*Kantee*	69	*Chatchai*	94	*Yanisa*	119	*Thinnakorn*	144	*Decha*	169	*Suteera*
20	*Ruangrit*	45	*New*	70	*Ruangsak*	95	*Watcharapong*	120	*Kritsana*	145	*Waen*	170	*Karawek*
21	*Niran*	46	*Gan*	71	*Solada*	96	*Saengdau*	121	*Jennarong*	146	*Benz*	171	*Sarut*
22	*Lawan*	47	*Lek*	72	*Panupong*	97	*Rungnapa*	122	*Phaibun*	147	*Som*	172	*Akara*
23	*Ngam-Chit*	48	*Suda*	73	*Prisana*	98	*Sirawit*	123	*Sukanya*	148	*Kulap*	173	*Somchai*
24	*Pakpao*	49	*Phet*	74	*Werawat*	99	*Tangmo*	124	*Arunprapa*	149	*Kittisak*	174	*Aat*
25	*Waan*	50	*Kanokwan*	75	*Sunee*	100	*Nattawut*	125	*Nakul*	150	*June*	175	*Montra*

**First farmer selected*

When *K* or *S* are non-integer numbers (i.e., numbers with decimals, like 4.26), they should be kept as they are, step 4 should be implemented, and then the selected numbers should be rounded up as in the following example where we select 35 farmers from a list of 178 farmers:

1. Create an ID from 1 to 178
2. K = 178/35 = 5.08
3. Select a random number between 0.00 and 5.08 (e.g., *S* = 2.23).
4. Add the Selection Interval as follows:

   2nd farmer: S + K (e.g., 2.23 + 5.08 = 7.31)

   3rd farmer: S + 2K (e.g., 2.23 + 10.16 = 12.39)

   ……

   35th farmer: S + 34K (e.g., 2.23 + 172.72 = 174.95)

5. Round the numbers up to find the ID of the select farmers:

   1st farmer ID: 5.08 ≈ 6

   2nd farmer ID: 7.31 ≈ 8

   3rd farmer ID: 12.39 ≈ 13

   ……

   35th farmer ID: 174.95 ≈ 175

Note that to select a non-integer random number *S*, you can multiply the selection interval by a random number between 0 and 1. You can do this by using the numbers from your hand- or phone-watch. For example, if the time is 9:23 a.m., you can assign the random number as 0.923. Then you can find the first selection number as 5.08 * 0.923 = 4.6888. The ID of the selected farmer will be 4.6888 ≈ 5.

When any selected farmer is not present or refuses to participate, the team should **NOT** replace the farmer with other nonselected farmers. Rapid Asia will use Listing Form I, Systematic Sampling for Option 1.

Option 2. Compact Segment Sampling (a list of farmers is not available)

When a list of farmers is not available, compact segment sampling can be used. Under this method, the selection can be done at the office or in the field. The selection of farmers can be done as follows:

1. Teams (or anyone sent from Rapid Asia to conduct sensitization ahead of the team's arrival) might request a community leader to make a rough map of the community and to estimate the number of farmers (e.g., 175).
2. Divide the total number of farmers by the number of farmers to be selected (e.g.,175/35 = 5).
3. Split the community into equal-size segments based on the previous calculation (5 segments of 35 farmers in each).
4. Randomly select one of those segments and survey **all eligible farmers** in the selected segment. The random selection of segment can be done using the *random*

lottery method as follows: Write down the segment numbers on slips of papers (one slip for each segment, e.g., five slips numbered as 1 to 5 for 5 segments)

- Fold the slips so that numbers are not distinguishable unless unfolded.
- Place all slips in a container (e.g., box, hat, jar, …, etc.).
- Pick one slip as the selected segment.

All farmers residing in the selected segment should be recruited for the survey even if more or fewer than the planned number (e.g., more or fewer than 35 farmers). If the selected segment had fewer than 20 farmers, the team should complete another segment in addition to make up for the reduction in the number of selected farmers. For example, if the selected segment number 2 had 15 farmers, all will be selected for interview (and as expected some of them might not complete the interview), and then the team should move to the adjacent segment number 3 and interview all farmers as well (e.g., if segment 3 has 30 farmers, the team will select up to 45 farmers from this village, 15 from segment 2, and 30 from segment 3).

Rapid Asia will use Listing Form II and III to record the results of segment and farmers selection for Option 2.

Nonresponse and Reserve Villages

We expect 10 percent of selected farmers not to be interviewed for different reasons (e.g., they were not present during the visit, or refused to cooperate). We also expect to find villages with a small number of farmers, e.g., fewer than 35 farmers. To make up for sample reduction because of those scenarios, if a team interviewed fewer than 20 farmers from any given village, they should proceed to one of the reserve villages and select an additional sample as illustrated above. We have a total of 70 reserve villages (about two villages in each sub-district).

ANNEX 8. DATA ANALYSIS PLAN FOR THE QUANTITATIVE SURVEY

Data Management and File Organization

The data analyst will set up a clear file folder structure that enables consistent management of data, documents, and other files. After receiving the original data for analysis, the analyst will create folder/channels to store the original data files, processed (analytic) data files, syntax, results, and temporary folders to manage data and other files. Files are commonly organized by type: do-files, raw data, cleaned data, and survey instruments. In addition, the data analyst will preserve the original data, and for analysis, use de-identified data—that is, data files with personal identifying information (PII) removed.

Stata syntax will include sufficient documentation and bookmarks to organize the syntax into sections to make the order of data manipulation clear, such as recoding, generating, or calculating new variables.

Data Cleaning

Data cleaning is an important step in any data analysis task. Before doing any kind of analysis, it is important to first clean the data, regardless of whether it is primary data collected from the field or data from a secondary source. Cleaning data can be time-consuming, but the effort invested at the beginning is an important step to maintain the quality of the data and can save time and energy down the line.

During data cleaning, the analyst will examine the distribution of every variable in the data, check for outliers, both plausible and implausible values, missing values–system missing versus user-defined, and check for duplicates in unique IDs. In addition, the analyst will identify skip patterns in the questionnaire and review frequencies accordingly.

Handling Outliers and Missing Data

The analyst will document outliers by creating a log file. The data analyst will double-check outliers carefully and troubleshoot to resolve any issues identified. In particular, examine the outliers one by one for plausibility before replacing them with values.

Incorporating Complex Survey Design for Analysis

The sample design for the survey followed a multistage stratified cluster sampling design. To ensure proper account for sampling weights, cluster sampling, and stratification, the analyst will perform analyses in Stata using survey commands “svy”.

Table A 6.Baseline survey indicators and analytical requirements

No.	Indicator	Disaggregate Levels	Unit of Measure	Indicator Requirement
1	Yield of targeted agricultural commodities among program participants with USDA assistance	First level: Commodity Second level: Farm size Third level: Sex and Age	Total production (TP)/Units of production (UP)	Crop yield
2	Number of hectares under improved management practices or technologies that promote improved climate risk reduction and/or natural resources management with USDA assistance	None	Hectares	- Natural resource or ecosystem management - Climate adaptation - Soil-related fertility and conservation (for climate mitigation-zero tillage, organic soils, and nitrogen fertilizer) - Irrigation
3	Number of hectares under improved management practices or technologies with USDA assistance	First level: Type of hectare Second level: Sex, Age Management practice or technology type, and Commodity	Hectares	Plot area in hectares
4	Number of individuals in the agriculture system who have applied improved management practices or technologies with USDA assistance	First level: Value chain actor type Second level: Sex, Age, Management practice or technology type, and Commodity	Number	- Crop genetics: (varieties of seed) improved open pollinated or hybrid or mostly modern/improved or about half traditional/half improved - Cultural practices: plant in rows or some in rows and some randomly broadcast - Natural resource or ecosystem management: soil based organic or foliar feeds organic or weed control mulching or terracing or soil bands/trenches - Pest and disease management: chemical pest control or herbicide or mulching - Soil-related fertility and conservation: terracing or mulching or soil/bands/trenches - Irrigation: permanent hose/drip irrigation or pumps - Agriculture water management (non-irrigation): terracing or mulching or soil/bands/trenches - Climate adaptation: improved open pollinated or hybrid or

No.	Indicator	Disaggregate Levels	Unit of Measure	Indicator Requirement
				permanent hose/drip irrigation or pumps - Marketing and distribution: bought from ag dealer with cash or bought from ag dealer with voucher or stalks harvested and sold to others or husks sold/traded with others as animal feed - Post-harvest handling and storage: solar dryers or mechanized dryers or hermetic bag or stored in warehouses Value-added processing: shelling by machine - Other: land prep with motorized tiller or tractor or harvested with a machine only or some by hand, some with a machine
5	Number of individuals accessing agriculture-related financing as a result of USDA assistance	First level: Type of financing accessed Second level: Type of debt Size of recipient Sex and Age	Number	- Type of debt: cash and in-kind (accessing credit from banks, microfinance institutions or commercial banks, and provision of services, inputs, goods up front). - Nondebt financing: equity, convertible debt, equity like investments, leasing by bank or leasing companies
6	Number of individuals taking part in group-based savings, microfinance, or lending programs with USDA assistance	First level: Product type (savings and credit) Sex, Age, and Duration		-Group-based savings programs - Mobile savings - Village savings - Lending associations
7	Number of loans disbursed as a result of USDA assistance	None	Number	- Number of cash loans from financial institutions - Value of in-kind lending
8	Value of agriculture-related financing accessed as a result of USDA assistance	First level: Type of financing accessed Second level: Type of debt, Size of recipient, Sex, Age	USD	- Value of loans in Baht (converted to USD during data analysis). - Type of debt: cash and in-kind (accessing credit from banks, microfinance institutions or commercial banks, and provision of services, inputs, goods up front). - Nondebt financing: equity, convertible debt, equity like investments, leasing by bank or leasing companies.
18	Value of annual sales of farms and firms receiving USDA assistance	First level: Type of product or service Second level: Type of	USD	- Raw products sold by farmers - Inputs: seeds and planting material.

No.	Indicator	Disaggregate Levels	Unit of Measure	Indicator Requirement
		producer/firm Third level: Sex and Age		- Inputs: other non-durable inputs, such as fertilizer and pesticides. - Inputs: durable equipment and machinery, including land preparation equipment, irrigation equipment, and other equipment or machinery. - Processed products/value-added products (post-harvest). - Post-harvest storage and processing equipment, including PICS bags and processing machinery Services: - Business services, including financial, entrepreneurial, legal, and other enterprise/producer strengthening services - Information services: SMS, Radio, TV, print, etc. - Production support services: other services that are sold to farmers, including extension services, rental of equipment, land preparation, warehousing, post-harvest processing
19	Volume of commodities sold by farms and firms receiving USDA assistance	First level: Commodity Second level: Type of producer Third level: Sex and Age	Metric tons	- Gross volume of product sold, including the volume of farm-gate sales

Table A 7. Improved management practices and technologies and RAIN baseline survey variables

Disaggregates	USDA PIRS Definition	Description relevant to RAIN	Corresponding RAIN variables						
			Rice, rainfed	Rice, irrigation	Cassava	Mango-steen	Durian	Longan	Coconut
Climate Mitigation	Technologies selected because they minimize emission intensities relative to other alternatives (while preventing leakage of emissions elsewhere). Examples include low- or no-till practices; restoration of organic soils and degraded lands; efficient nitrogen fertilizer use; practices that promote methane reduction; agroforestry; introduction/expansion of perennials; practices that promote greater resource use efficiency (e.g., drip irrigation).	Land preparation with zero tillage, reduced tillage, Use of drip, sprinkler, or furrow irrigation	216 (b,c), 237 (1)	216 (b,c), 227 (a, b, c) 237 (1)	316 (b,c) 327 (a, b, c), 336	425 (a,b, c),	525 (a, b, c) 532(1)	623 (a, b,c) 630(1)	724 (a, b,c) 732 (1)
Climate Mitigation	- same as above -	Use of fertigation	233 (1)	233 (1)	332 (1)	428 (1)	528 (1)	626 (1)	728(1)
Climate Mitigation	- same as above -	Use of organic fertilizer, green manure, animal manure, biochar, or soil test-recommended fertilizer blends	234 (a), 235 (1), 236, 237, 244 (1)	234 (a), 235, 236, 237, 244 (1)	333 (a, c), 334, 344(1)	429 (a, c), 430 (1), 443 (1); 427 (1): 432 (1)	529 (a), 530 (1), 541 (1)	627 (a, c) 628 (1) 638 (1)	729 (a, c) 730 (1) 739(1)

Disaggregates	USDA PIRS Definition	Description relevant to RAIN	Corresponding RAIN variables						
			Rice, rainfed	Rice, irrigation	Cassava	Mango-steen	Durian	Longan	Coconut
Climate Mitigation	- same as above -	Straw management (straw bailing)/combined harvester; Rice husk management, rice packaging;	256 (1), 257 (1)	256 (1), 257 (1)	x	x	x	x	x
Climate adaptation/climate risk management	Technologies promoted with the explicit objective of reducing risk and minimizing the severity of climate change. Examples include drought and flood resistant varieties; short-duration varieties; adjustment of sowing time; diversification, use of perennial varieties; agroforestry.	Use of weather forecast, early warning system, Ricebot, Crop health/farm health using drone and satellite imagery, Kasettrack, Munbot, smart farm management mobile app, crop management mobile app	254, 253 (a1, b1, c1, x1), 254 (1), 255 (1)	254, 253 (a1, b1, c1, x1), 254(1), 255 (1)	354 (a1, b1, c1, x1), 355 (1), 356 (1)	451 (1), 452 (1), 453 (1), 454 (1)	550 (a1, b1, x1), 551 (1), 552 (1)	648 (a1, b1, x1), 649 (1), 650 (1)	751 (a1, x1), 752 (1), 753 (1)
Crop Genetics	Improved/certified seed that could be higher-yielding or higher in nutritional content (e.g., through bio-fortification, such as vitamin A-rich sweet potatoes or rice, or high-protein maize), and/or more resilient to climate impacts (e.g., drought tolerant maize or stress tolerant rice); improved germplasm.	Improved pollinated varieties of seed	220 (b), 222 (1)	220 (b), 222 (1)	321 (b), 322 (1), 323 (1)	421 (b),	521 (b)	619 (b)	720 (b)
Cultural Practices	Context specific agronomic practices that do not fit in other categories, e.g., seedling production and transplantation; cultivation practices such as planting	Use of organic fertilizer, green manure, animal manure, biochar, or soil test-recommended fertilizer blends	234 (a), 235 (1), 236, 237, 244 (1)	234 (a), 235 (1), 236, 237, 244 (1)	333 (a, c), 334, 340 (1), 344(1)	429 (a, c), 430 (1), 443 (1)	529 (a), 530 (1), 541 (1)	627 (a, c) 628 (1) 638 (1)	729 (a, c) 730 (1) 739(1)

Disaggregates	USDA PIRS Definition	Description relevant to RAIN	Corresponding RAIN variables						
			Rice, rainfed	Rice, irrigation	Cassava	Mango-steen	Durian	Longan	Coconut
	density, crop rotation, and mounding.								
Cultural Practices	- same as above -	Crop rotation, inter-cropping	229 (c1, d1), 251 (b)	229 (c1, d1), 251 (b)	328 (c1, d1), 351 (b)	450 (b)	548 (b)	644 (b)	747 (b)
Cultural Practices	- same as above -	Bee keeping	x	x	x	x	x	x	749 (1)
Cultural Practices	- same as above -	pruning, inflorescence thinning	x	x	x	x	x	645 (3)	748 (1)
Cultural Practices	- same as above -	Land selection, land leveling, laser land leveling, and preparation	216 (e, f)	216 (e, f)	316 (e, f)	x	x	x	x

Disaggregates	USDA PIRS Definition	Description relevant to RAIN	Corresponding RAIN variables						
			Rice, rainfed	Rice, irrigation	Cassava	Mango-steen	Durian	Longan	Coconut
Natural Resource Management (NRM)	biodiversity conservation; strengthening of ecosystem services, including stream bank management or restoration or re/afforestation; woodlot management.	Land preparation with zero tillage, reduced tillage Use of bio-fertilizer (Biochar) or organic fertilizer Use of organic fertilizer, green manure, animal manure, biochar, or soil test-recommended fertilizer blends Use of drip, sprinkler, or furrow irrigation Use of crop residue/straw management through incorporation into soil, left for grazing, production of biochar	216 (b,c), 237 (1), 234 (a), 235 (1), 236, 237, 244 (1), 259 (b, c, d),	216 (b,c), 227 (a, b, c) 237 (1), 234 (a), 235, 236, 237, 244 (1), 259 (b, c, d)	316 (b,c) 327 (a, b, c), 336, 333 (a, c), 334, 344(1), 349 (1), 357 (b, c, d)	425 (a,b, c), 432 (1), 429 (a, c), 430 (1), 443 (1), 455 (b,c,d)	525 (a, b, c) 532(1), 529 (a), 530 (1), 541 (1), 553 (b, c, d)	623 (a, b,c) 630(1), 627 (a, c) 628 (1), 638 (1), 651 (b, c, d)	724 (a, b,c) 732 (1), 729 (a, c) 730 (1) 739(1)
Disease Management	Integrated Pest Management; improved fungicides; appropriate application of fungicides; improved and environmentally sustainable use of cultural, physical, biological, and chemical insecticides and pesticides; crop rotation; aflatoxin prevention and control during production.	Use of bio-fertilizer or organic fertilizer, and biochar	234 (a), 235 (1), 236 (1), 237 (1), 244 (1)	234 (a), 235 (1), 236 (1), 237 (1), 244 (1)	333 (a, c), 334 (1), 344(1)	429 (b,c), 430(1), 432 (1)	529 (a), 530 (1), 541 (1)	627 (a, c), 628 (1), 638 (1)	729 (a, c) 730 (1) 739(1)
Disease Management	- same as above -	Use of pesticide, herbicide, biologicals, other agro-chemicals, and IPM	246 (1), 249 (1)	249 (1)	346 (1); 349 (1)	445(1)	543 (1)	640(1)	741(1); 742(a, b, c, d, e)

Disaggregates	USDA PIRS Definition	Description relevant to RAIN	Corresponding RAIN variables						
			Rice, rainfed	Rice, irrigation	Cassava	Mango-steen	Durian	Longan	Coconut
Disease Management	- same as above -	Use of herbicide, intercropping, crop rotation	229 (c1 d1), 251 (a, b)	229 (c1 d1); 251 (a, b)	328 (c1 d1), 351 (a, b)	426 (c1); 450 (a, b)	526 (c1); 548 (a, b)	624 (c1); 644 (a. b)	726 (c1);747 (a, b)
Disease Management	- same as above -	Pesticide spray using drones	247 (1)	247 (1)	347 (1)	446 (1)	544 (1)	641 (1)	743(1)
Pest Management	Integrated Pest Management; improved fungicides; appropriate application of fungicides; improved and environmentally sustainable use of cultural, physical, biological, and chemical insecticides and pesticides; crop rotation; aflatoxin prevention and control during production.	Use of bio-fertilizer or organic fertilizer, and biochar	234 (a), 235 (1), 236 (1), 237 (1), 244 (1)	234 (a), 235 (1), 236 (1), 237 (1), 244 (1)	333 (a, c), 334 (1), 344(1)	429 (b,c), 430(1), 432 (1)	529 (a), 530 (1), 541 (1)	627 (a, c), 628 (1), 638 (1)	729 (a, c) 730 (1) 739(1)
Pest Management	- same as above -	Use of pesticide, herbicide, biologicals, other agro-chemicals, and IPM	246 (1), 249 (1)	246 (1), 249 (1)	346 (1), 349 (1)	445(1), 448(1)	543 (1), 546 (1)	640(1) 643 (1)	741(1), 742 (1a, b1, c1, d1, e1, x1), 745
Pest Management	- same as above -	Use of herbicide	251 (a)	251 (a)	351 (a)	450 (a)	548 (a)	644 (a)	747 (a)

Disaggregates	USDA PIRS Definition	Description relevant to RAIN	Corresponding RAIN variables						
			Rice, rainfed	Rice, irrigation	Cassava	Mango-steen	Durian	Longan	Coconut
Pest Management	- same as above -	Crop rotation, inter-cropping	229 (d1), 251 (b)	229 (d1), 251 (b)	328 (d1), 351 (b)	450 (b)	548 (b)	644 (b)	747 (b)
Post-harvest Handling & Storage	Improved transportation; decay and insect control; temperature and humidity control; improved quality control technologies and practices; sorting and grading, sanitary handling practices.	Storage of commodities	263 (b, c)	263 (b, c)	x	x	x		x
Post-harvest Handling & Storage	- same as above -	Straw management (straw bailing)/combined harvester 259 (b, c, d, e, f)	256 (1), 257 (1), r259_b, r259_c, r259_d, r259_e, r259_f r259_g	256 (1), 257 (1), r259_b, r259_c, r259_d, r259_e, r259_f r259_g	x	x	x	x	x
Post-harvest Handling & Storage	- same as above -	Drying facility at the farm	261(f,g, h)	261(f,g, h)	358 (1)	x	x	652 (1)	x

Disaggregates	USDA PIRS Definition	Description relevant to RAIN	Corresponding RAIN variables						
			Rice, rainfed	Rice, irrigation	Cassava	Mango-steen	Durian	Longan	Coconut
Post-harvest Handling & Storage	- same as above -	Rice husk management rice packaging	(265 b c)	(265 b c)	x	x	x	x	x
Post-harvest Handling & Storage	- same as above -	Residue waste and by-product management, biochar production	265 (a b,c)	265 (abc)	357 (c,b, d, e, f)	455 (b, c, d, e, f)	553 (b, c, d, e, f)	651 (b,c, d, e, f, g)	754 (a, b, c)
Post-harvest Handling & Storage	- same as above -	Grading, sorting	x	x	x	456(1)	554(1)	655 (1)	755 (1)
Post-harvest Handling & Storage	- same as above -	Sulphur dioxide fumigation	x	x	x	x	x	653 (1); 654 (1)	x
Soil-related fertility and conservation	Integrated Soil Fertility Management; soil management practices that increase biotic activity and soil organic matter levels, such as soil amendments that increase fertilizer-use efficiency (e.g., soil organic matter, mulching); improved fertilizer; improved fertilizer use practices; inoculant; erosion control.	Use of fertigation, organic fertilizer, green manure, animal manure, biochar, biologicals, and fertilizer blends	233 (1), 234 (a, b), 235 (1), 236 (1), 237, 244 (1)	233 (1), 234 (a, b), 235 (1), 236 (1), 237, 244 (1)	332(1), 333 (a,b,c,d), 334 (1), 344(1), 349 (1)	427 (1), 428(1), 429 (a,b,c, d), 430(1), 432 (1); 443 (1)	528 (1), 529 (a,b), 530 (1), 541 (1)	626 (1), 627 (a,b,c,d) , 628 (1), 634 (1), 638 (1)	728 (1), 729 (a, b, c, d) 730 (1) 739(1)

Disaggregates	USDA PIRS Definition	Description relevant to RAIN	Corresponding RAIN variables						
			Rice, rainfed	Rice, irrigation	Cassava	Mango-steen	Durian	Longan	Coconut
Soil-related fertility and conservation	- same as above -	Crop rotation and inter-cropping	229 (d1), 251 (b)	251 (b)	328 (d1), 351 (b)	450 (b)	548 (b)	644 (b)	747 (b)
		Use of herbicide	251 (a)	251 (a)	351 (a)	450 (a)	548 (a)	644 (a)	747 (a)
Soil-related fertility and conservation	- same as above -	Use of zero till, reduced tillage, conventional tilling, land leveling, and laser land leveling	216 (b,c, d, e, f)	216 (b,c, d, e, f)	316 (b,c, d, e, f)	x	x	x	x
Irrigation	Drip, surface, and sprinkler irrigation; irrigation schemes.	Use of drip, sprinkler, or furrow irrigation	x	227 (a, b, c)	316 (b,c) 327 (a, b, c)	425 (a,b, c)	525 (a, b, c)	623 (a, b,c)	724 (a, b,c)
Irrigation	- same as above -	Use of alternate wetting and drying (AWD)	228 (1)	228(1)	x	x	x	x	x
Water Management/Agriculture water management - non-irrigation-based	Water harvesting; sustainable water use practices; practices that improve water quality	Land leveling, laser land leveling, and water harvesting	216 (e, f), 225 (a, c, d, e)	216 (e, f), 225 (a, c, d, e)	316 (e, f), 325 (a, c, d, e)	423 (a, c, d, e)	523 (a, c, d, e)	621 (a, c, d, e),	722 (a, c, d, e), 725 91)

Disaggregates	USDA PIRS Definition	Description relevant to RAIN	Corresponding RAIN variables						
			Rice, rainfed	Rice, irrigation	Cassava	Mango-steen	Durian	Longan	Coconut
Marketing and distribution	Contract farming technologies and practices; improved input purchase technologies and practices; improved commodity sale technologies and practices; improved market information system technologies and practices	Grown for local/domestic market, local company, intermediary or broker (middleman), private trader, off taker, cooperative, supermarket, international or export company or export trade.	214 (c,d,e,f,g,h ,i)	214 (c,d,d,f,g, h,i)	314 (c, d, e, f, g, h, I, j)	418 (c, d, e, f, g, h, i), 411 (d1, e1)	518 (c, d, e, f, g, h, i), 511 (d1, e1)	609 (d1, e1), 616 (c, d, e, f, g, h, i)	717 (d, e, f, g, h, I, j), 710 (d1, e1)
Value-Added Processing	Improved packaging practices and materials including biodegradable packaging; food and chemical safety technologies and practices; improved preservation technologies and practices.	Improved packaging, use of 2- or 3-layer woven bags or hermetic 3-layer bags (PICS), Processing of cassava into cassava pellets, flour/starch or chips	x	x	311 (c, d, e)	415 (c, d, e)	515 (c,d,e)	613 (c, d, e)	714 (e, f, g)
Other	Improved mechanical and physical land preparation; non-market- and non-climate-related information technology; improved record keeping; improved budgeting and financial management; Improved capacity to repair agricultural equipment; improved quality of agricultural products or technology.	GAP, SRP, Organic and Fairtrade procedures and Certification	266 (a1, b1, c1, d1)	266 (a1, b1, c1, d1)	360(a1, b1, c, d1)	458 (a1, b1, c1)	556 (a1, b1, c1)	657 (a1, b1, c1)	757 (a1, b1, c1)

ANNEX 9. RAIN BASELINE INDICATOR ESTIMATES

Table A 8. Demographic characteristics of farmers in the target provinces, RAIN Baseline Evaluation, 2023

Characteristic	Rice, Rainfed	Rice, irrigated	Cassava	Coconut	Durian	Longan	Mangosteen	Number of Participants*
	(Percent)							
Farm size								
Smallholder farmers	97.3	97.3	92.2	97.7	97.3	98.2	97.2	4,584
Non-smallholder farmers	2.7	2.7	7.8	2.3	2.7	1.8	2.8	159
Average farm size (ha)	1.8	1.8	2.4	1.7	1.4	0.9	1.2	4,743
Average area under the target crop (ha)	1.7	1.8	2.1	1.6	1.3	0.8	1.1	4,743
Sex								
Female	47.8	56.4	52.0	68.1	60.3	59.5	53.3	2,073
Male	52.2	43.6	48.0	31.9	39.7	40.6	46.7	2,670
Age								
15-29	0.8	0.5	2.3	1.1	4.5	1.8	3.0	91
30+	99.2	99.5	97.7	98.9	95.5	98.2	97.0	4,652
Education								
Preschool	0.1	1.9	0.4	3.6	0.3	1.8	0.3	55
Elementary (Prathom)	80.8	80.4	73.4	40.0	58.7	77.7	55.6	3,215
Secondary (Matthayom)	16.1	16.2	24.8	38.9	31.8	17.8	35.9	1,198
Higher	2.9	1.5	1.4	17.6	9.2	2.8	8.1	275
Religion								
Buddhism	99.7	100.0	99.9	99.8	100.0	97.7	100.0	4,725
Islam	0.3	0.0	0.1	0.2	0.0	0.2	0.0	5
Christianity	0.0	0.0	0.0	0.0	0.0	2.1	0.0	13
Farming Experience								
Less than 5 years	2.8	2.1	3.2	2.7	2.5	3.6	2.2	130
5-10 years	8.1	5.6	14.9	45.5	26.3	16.2	22.4	895
More than 10+ years	89.1	92.2	81.9	51.8	71.2	80.3	75.5	3,718
Total Number	781	746	773	620	600	619	604	4,743

**Results are not statistically reliable if n<10*

Table A 9. Percent of farmers reporting making decision regarding production of target commodities, RAIN Baseline Evaluation, 2023

Commodity	Weighted (extrapolated to farmer population)					
	Land Preparation	Input Selection	Adoption and use of new technologies	Pest/Disease Management	Harvesting	Marketing
Rice, rainfed						
Male-head of household	27.9	20.1	18.8	26.7	16.8	14.1
Female-head of household	7.1	8.0	7.9	6.0	7.4	11.1
Jointly by male & female head of household	68.2	75.1	74.7	68.2	77.1	75.5
Other household member	6.0	6.2	6.6	5.0	5.5	5.0
Other non-household member	0.6	0.0	0.4	0.0	0.0	0.0
Rice, irrigated						
Male-head of household	30.0	27.3	22.9	28.8	21.8	16.7
Female-head of household	5.7	4.0	5.8	4.4	6.2	7.7
Jointly by male & female head of household	66.2	69.9	72.0	67.9	73.8	76.6
Other household member	2.1	2.9	3.6	2.2	2.6	2.5
Other non-household member	0.0	0.0	0.3	0.0	0.0	0.3
Cassava						
Male-head of household	27.9	21.7	21.5	25.6	19.5	14.4
Female-head of household	5.1	5.4	5.3	4.9	6.4	7.0
Jointly by male & female head of household	67.7	73.6	73.6	70.5	74.7	77.9
Other household member	4.5	4.2	3.2	2.9	4.2	3.7
Other non-household member	1.0	0.1	0.1	0.6	1.5	0.1
Coconut						
Male-head of household	56.2	51.1	42.3	47.8	47.5	42.0
Female-head of household	9.3	9.2	8.7	8.9	9.0	10.2
Jointly by male & female head of household	34.6	39.8	48.7	43.7	43.7	45.9
Other household member	3.2	6.7	16.6	28.7	22.3	13.0
Other non-household member	0.2	0.1	9.5	22.1	30.6	4.6
Durian						
Male-head of household	38.0	28.8	26.6	34.4	28.6	22.7
Female-head of household	9.2	8.7	6.6	5.8	7.7	9.3
Jointly by male & female head of household	60.4	69.2	69.3	63.4	67.9	72.1
Other household member	10.4	9.8	9.2	7.4	7.2	8.6
Other non-household member	0.1	0.0	0.4	0.0	0.4	0.3
Longan						
Male-head of household	37.8	33.1	29.1	31.1	27.8	25.8
Female-head of household	4.8	5.2	4.8	4.6	5.1	5.7

Commodity	Weighted (extrapolated to farmer population)					
	Land Preparation	Input Selection	Adoption and use of new technologies	Pest/Disease Management	Harvesting	Marketing
Jointly by male & female head of household	60.0	64.5	67.2	66.4	68.8	70.9
Other household member	6.0	5.7	6.2	4.9	5.9	5.3
Other non-household member	0.0	0.0	0.0	0.1	0.2	0.1
Mangosteen						
Male-head of household	38.4	26.9	27.5	37.3	29.0	25.0
Female-head of household	9.5	8.4	8.0	5.9	7.8	7.9
Jointly by male & female head of household	58.4	69.5	68.4	59.6	66.8	70.4
Other household member	7.3	7.2	9.1	7.5	7.7	8.3
Other non-household member	0.0	0.0	0.0	0.1	0.3	0.0

Table A 10. Crop yields disaggregated by landholding size, sex, and age of the farmer, RAIN Baseline Evaluation, 2023

Commodity	Unweighted (sampled farmers)					Weighted (extrapolated to farmer population)				
	Total Production (mt)	Unit of Production (ha)	Yield (mt/ha)	Total production per farm	Number of farmers*	Total Production (mt)	Unit of Production (ha)	Yield (mt/ha)	Total production per farm	Number of farmers
Rice, rainfed	3,164	1,348	2.3	4.1	781	3,262,672	1,343,100	2.4	4.2	786,013
Smallholder farmers	2,793	1,189	2.3	3.7	760	2,877,397	1,178,074	2.4	3.8	762,917
Sex: Female	1,390	622	2.2	3.8	362	1,450,307	624,072	2.3	4.0	360,907
Sex: Male	1,403	567	2.5	3.5	398	1,427,090	554,002	2.6	3.5	402,010
Age: 15-29	22	9	2.4	3.7	6	20,929	6,865	3.0	4.2	5,001
Age: 30+	2,770	1,180	2.3	3.7	754	2,856,468	1,171,208	2.4	3.8	757,916
Non-smallholder farmers	371	159	2.3	17.7	21	385,275	165,027	2.3	16.7	23,096
Sex: Female	225	80	2.8	20.4	11	216,805	78,426	2.8	16.3	13,314
Sex: Male	146	79	1.8	14.6	10	168,469	86,600	1.9	17.2	9,782
Age: 15-29	-	-	-	-	0	-	-	-	-	-
Age: 30+	371	159	2.3	17.7	21	385,275	165,027	2.3	16.7	23,096
Rice, irrigated (wet rice)	12,582	2,529	5.0	16.9	746	422,744	84,735	5.0	17.2	24,564
Smallholder farmers	11,255	1,203	9.4	15.5	726	380,105	40,333	9.4	15.9	23,939
Sex: Female	4,752	504	9.4	11.6	410	174,902	18,342	9.5	13.3	13,136
Sex: Male	6,503	700	9.3	20.6	316	205,203	21,991	9.3	19.0	10,803
Age: 15-29	63	6	11.3	21.0	3	2,183	215	10.2	17.2	127
Age: 30+	11,192	1,198	9.3	15.5	723	377,922	40,118	9.4	15.9	23,812
Non-smallholder farmers	1,327	141	9.4	66.3	20	42,639	4,439	9.6	68.2	625
Sex: Female	523	60	8.7	47.6	11	18,481	1,901	9.7	54.7	338
Sex: Male	803	82	9.8	89.3	9	24,159	2,538	9.5	84.5	286
Age: 15-29	64	6	10.0	64.0	1	1,422	142	10.0	64.6	22
Age: 30+	1,263	135	9.3	66.4	19	41,217	4,297	9.6	68.4	603
Cassava (fresh)	23,500	1,653	14.2	30.4	773	5,389,049	404,012	13.3	27.6	195,083
Smallholder farmers	17,020	1,230	13.8	23.9	713	4,144,536	316,171	13.1	22.8	181,939
Sex: Female	7,712	589	13.1	21.3	362	1,860,677	150,038	12.4	19.9	93,729
Sex: Male	9,308	641	14.5	23.4	398	2,283,859	166,134	13.7	25.9	88,210
Age: 15-29	424	33	12.7	70.7	6	87,955	7,125	12.3	25.7	3,416
Age: 30+	16,596	1,197	13.9	22.0	754	4,056,581	309,046	13.1	22.7	178,523
Non-smallholder farmers	6,481	423	15.3	108.0	60	1,244,513	87,841	14.2	94.7	13,144
Sex: Female	2,246	171	13.1	70.2	32	501,416	41,809	12.0	84.1	5,961
Sex: Male	4,235	252	16.8	151.2	28	743,098	46,032	16.1	103.5	7,183
Age: 15-29	227	12	18.4	113.5	2	46,401	2,518	18.4	113.4	409
Age: 30+	6,254	411	15.2	107.8	58	1,198,112	85,322	14.0	94.1	12,735

Commodity	Unweighted (sampled farmers)					Weighted (extrapolated to farmer population)				
	Total Production (mt)	Unit of Production (ha)	Yield (mt/ha)	Total production per farm	Number of farmers*	Total Production (mt)	Unit of Production (ha)	Yield (mt/ha)	Total production per farm	Number of farmers
Coconut (green)	29,168	974	29.9	47.0	620	320,580	10,392	30.8	35.4	9,058
Smallholder farmers	26,454	876	30.2	43.7	606	307,476	9,918	31.0	34.2	8,994
Sex: Female	8,548	280	30.5	20.7	412	84,204	2,649	31.8	13.1	6,429
Sex: Male	17,906	596	30.1	92.3	194	223,272	7,269	30.7	87.1	2,564
Age: 15-29	214	8	28.5	30.6	7	1,526	54	28.0	30.5	50
Age: 30+	26,240	868	30.2	43.8	599	305,949	9,864	31.0	34.2	8,944
Non-smallholder farmers	2,714	99	27.5	193.9	14	13,045	474	27.5	203.8	64
Sex: Female	817	32	25.5	81.7	10	3,913	154	25.3	83.3	47
Sex: Male	1,897	67	28.5	474.2	4	9,186	320	28.8	540.4	17
Age: 15-29	-	-	-	-	0	-	-	-	-	-
Age: 30+	2,714	99	27.5	193.9	14	13,104	474	27.6	204.8	64
Durian	5,502	807	6.8	9.2	600	485,223	72,848	6.7	8.8	55,336
Smallholder farmers	4,908	675	7.3	8.4	584	437,385	61,423	7.1	8.1	54,039
Sex: Female	1,778	261	6.8	5.1	349	162,505	23,926	6.8	5.1	31,960
Sex: Male	3,130	413	7.6	13.3	235	274,880	37,497	7.3	12.4	22,079
Age: 15-29	160	42	3.8	6.2	26	15,133	3,896	3.9	6.3	2,411
Age: 30+	4,748	633	7.5	8.5	558	422,252	57,526	7.3	8.2	51,629
Non-smallholder farmers	594	132	4.5	37.1	16	47,838	11,425	4.2	36.9	1,297
Sex: Female	53	35	1.5	4.1	13	4,084	2,637	1.5	3.8	1,084
Sex: Male	541	97	5.6	180.3	3	43,754	8,789	5.0	205.4	213
Age: 15-29	22	3	8.1	22.0	1	918	113	8.1	21.9	42
Age: 30+	572	130	4.4	38.1	15	46,920	11,312	4.1	37.4	1,255
Longan	2,287	504	4.5	3.7	619	460,601	100,982	4.6	3.7	123,206
Smallholder farmers	2,118	436	4.9	3.5	608	421,618	87,278	4.8	3.5	120,855
Sex: Female	742	168	4.4	2.1	360	144,144	33,857	4.3	2.0	71,900
Sex: Male	1,376	268	5.1	5.5	248	277,473	53,421	5.2	5.7	48,955
Age: 15-29	49	4	11.9	4.5	11	11,519	904	12.7	5.0	2,299
Age: 30+	2,069	432	4.8	3.5	597	410,098	86,374	4.7	3.5	118,556
Non-smallholder farmers	169	69	2.4	15.3	11	38,984	13,704	2.8	16.6	2,351
Sex: Female	14	35	0.4	1.8	8	2,573	6,499	0.4	1.4	1,799
Sex: Male	155	34	4.6	51.5	3	36,411	7,205	5.1	65.8	553
Age: 15-29	-	-	-	-	0	-	-	-	-	-
Age: 30+	169	69	2.4	15.3	11	38,984	13,704	2.8	16.6	2,351
Mangosteen	2,489	679	3.7	4.1	604	184,669	48,472	3.8	3.6	51,080
Smallholder farmers	2,180	490	4.4	3.7	587	175,765	41,142	4.3	3.5	50,178

Commodity	Unweighted (sampled farmers)					Weighted (extrapolated to farmer population)				
	Total Production (mt)	Unit of Production (ha)	Yield (mt/ha)	Total production per farm	Number of farmers*	Total Production (mt)	Unit of Production (ha)	Yield (mt/ha)	Total production per farm	Number of farmers
Sex: Female	976	216	4.5	3.1	312	75,699	17,980	4.2	2.8	27,259
Sex: Male	1,204	274	4.4	4.4	275	100,066	23,162	4.3	4.4	22,918
Age: 15-29	67	13	5.1	3.7	18	4,167	787	5.3	2.5	1,635
Age: 30+	2,113	477	4.4	3.7	569	171,598	40,355	4.3	3.5	48,542
Non-smallholder farmers	309	189	1.6	18.2	17	8,904	7,330	1.2	9.9	902
Sex: Female	76	72	1.0	7.6	10	2,321	2,828	0.8	4.2	556
Sex: Male	234	116	2.0	33.4	7	6,583	4,502	1.5	19.0	346
Age: 15-29	-	-	-	-	0	-	-	-	-	-
Age: 30+	309	189	1.6	18.2	17	8,904	7,330	1.2	9.9	902

**Results are not statistically reliable if n<10*
Key: mt=metric ton; ha=hectare

Table A 11. Number of individuals accessing agriculture-related financing from among the total number of farmers, RAIN Baseline Evaluation, 2023

Disaggregates	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
	Number of Farmers accessing ag-related financing	Total number of farmers*	Percent of the total farmers accessing ag-related financing from the total number of farmers	Number of Farmers	Total Number of Farmers	Percent of the total farmers accessing ag-related financing from the total number of farmers
Total						
Farmers	1,591	4,743	33.5	481,679	1,244,340	38.7
Sex: Female	714	2,073	34.4	250,908	615,920	40.7
Sex: Male	877	2,670	32.8	230,771	628,420	36.7
Age: 15-29	21	91	23.1	4,623	15,411	30.0
Age: 30+	1,570	4,652	33.7	477,056	1,228,929	38.8
Rice, rainfed (wet rice)						
Farmers	308	781	39.4	328,181	786,013	41.8
Sex: Female	170	408	41.7	176,642	411,792	42.9
Sex: Male	138	373	37.0	151,540	374,221	40.5
Age: 15-29	1	6	16.7	1,468	5,001	29.4
Age: 30+	307	775	39.6	326,713	781,012	41.8
Rice, irrigated (wet rice)						
Farmers	223	746	29.9	7,557	24,564	30.8
Sex: Female	103	325	31.7	3,500	11,089	31.6
Sex: Male	120	421	28.5	4,057	13,475	30.1
Age: 15-29	1	4	25.0	22	150	14.7
Age: 30+	222	742	29.9	7,535	24,414	30.9
Cassava (fresh)						
Farmers	306	773	39.6	76,837	195,083	39.4
Sex: Female	162	371	43.7	43,956	102,223	43.0
Sex: Male	144	402	35.8	32,881	99,690	33.0
Age: 15-29	7	18	38.9	2,262	3,825	59.1
Age: 30+	299	755	39.6	74,575	191,258	39.0
Coconut (green)						
Farmers	201	620	32.4	2,366	9,058	26.1
Sex: Female	66	198	33.3	725	2,582	28.1
Sex: Male	135	422	32.0	1,642	6,476	25.4
Age: 15-29	3	7	42.9	14	50	28.0

Disaggregates	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
	Number of Farmers accessing ag-related financing	Total number of farmers*	Percent of the total farmers accessing ag-related financing from the total number of farmers	Number of Farmers	Total Number of Farmers	Percent of the total farmers accessing ag-related financing from the total number of farmers
Age: 30+	198	613	32.3	2,352	9,008	26.1
Durian						
Farmers	202	600	33.7	18,341	55,336	33.1
Sex: Female	78	238	32.8	7,293	22,292	32.7
Sex: Male	124	362	34.3	11,048	33,044	33.4
Age: 15-29	6	27	22.2	455	2,453	18.5
Age: 30+	196	573	34.2	17,886	52,883	33.8
Longan						
Farmers	165	619	26.7	32,530	123,206	26.4
Sex: Female	61	251	24.3	12,246	49,508	24.7
Sex: Male	104	368	28.3	20,285	73,698	27.5
Age: 15-29	2	11	18.2	389	2,299	16.9
Age: 30+	163	608	26.8	32,142	120,907	26.6
Mangosteen						
Farmers	186	604	30.8	15,866	51,080	31.1
Sex: Female	74	282	26.2	6,546	23,264	28.1
Sex: Male	112	322	34.8	9,319	27,816	33.5
Age: 15-29	1	18	5.6	13	1,635	0.8
Age: 30+	185	586	31.6	15,852	49,445	32.1

**Results are not statistically reliable if n<10*

Table A 12. Number of individuals accessing agriculture-related financing from among the individuals who accessed any loans in the past 12 months, RAIN Baseline Evaluation, 2023

Disaggregates	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
	Number of Farmers accessing ag-related financing	Total Number of Farmers accessing any financing, n*	Percent of the total farmers accessing ag-related financing from among those who accessed financing	Number of Farmers	Total Number of Farmers	Percent of the total farmers accessing ag-related financing from among those who accessed financing
Type of financing accessed: Debt	1,591	1,611	98.8	482,183	485,065	99.4
Individuals/microenterprises	1,591	1,611	98.8	482,183	485,065	99.4
Cash	1,539	1,550	99.3	451,527	452,745	99.7
In-kind	65	74	87.8	32,551	34,214	95.1
Sex: Female	714	723	98.8	251,122	252,939	99.3
Sex: Male	877	888	98.8	231,062	232,126	99.5
Age: 15-29	21	21	100.0	4,623	4,623	100.0
Age: 30+	1,570	1,590	98.7	477,561	480,442	99.4
Type of financing accessed: Non-debt	150	182	82.4	33,861	37,496	90.3
Individuals/microenterprises	150	182	82.4	33,861	37,496	90.3
Cash	145	174	83.3	32,801	35,918	91.3
In-kind	6	9	66.7	1,646	2,164	76.1
Sex: Female	61	68	89.7	15,735	16,519	95.3
Sex: Male	89	114	78.1	18,127	20,976	86.4
Age: 15-29	4	4	100.0	339	339	100.0
Age: 30+	146	178	82.0	33,522	37,157	90.2
Rice, rainfed (wet rice)						
Type of financing accessed: Debt	308	309	99.7	328,181	328,362	99.9
Individuals/microenterprises	308	309	99.7	328,181	328,362	99.9
Cash	297	298	99.7	304,768	304,948	99.9
In-kind	14	14	100.0	23,621	23,621	100.0
Sex: Female	170	171	99.4	176,642	176,822	99.9
Sex: Male	138	138	100.0	151,540	151,540	100.0
Age: 15-29	1	1	100.0	1,468	1,468	100.0
Age: 30+	307	308	99.7	326,713	326,894	99.9
Type of financing accessed: Non-debt	21	22	95.5	16,945	18,436	91.9

Disaggregates	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
	Number of Farmers accessing ag-related financing	Total Number of Farmers accessing any financing, n*	Percent of the total farmers accessing ag-related financing from among those who accessed financing	Number of Farmers	Total Number of Farmers	Percent of the total farmers accessing ag-related financing from among those who accessed financing
Individuals/microenterprises	21	22	95.5	16,945	18,436	91.9
Cash	20	21	95.2	16,518	18,009	91.7
In-kind	2	2	100.0	1,012	1,012	100.0
Sex: Female	11	11	100.0	8,181	8,181	100.0
Sex: Male	10	11	90.9	8,764	10,255	85.5
Age: 15-29	-	-	-	-	-	-
Age: 30+	21	22	95.5	16,945	18,435	91.9
Rice, irrigated (wet rice)						
Type of financing accessed: Debt	223	227	98.2	7,557	7,695	98.2
Individuals/microenterprises	223	227	98.2	7,557	7,695	98.2
Cash	215	217	99.1	7,193	7,250	99.2
In-kind	9	11	81.8	376	457	82.3
Sex: Female	103	104	99.0	3,500	3,511	99.7
Sex: Male	120	123	97.6	4,057	4,184	97.0
Age: 15-29	1	1	100.0	22	22	100.0
Age: 30+	222	226	98.2	7,535	7,673	98.2
Type of financing accessed: Non-debt	9	13	69.2	371	523	70.9
Individuals/microenterprises	9	13	69.2	371	523	70.9
Cash	9	11	81.8	371	460	80.7
In-kind	-	2	-	-	63	-
Sex: Female	6	7	85.7	239	279	85.7
Sex: Male	3	6	50.0	132	244	54.1
Age: 15-29	-	-	-	-	-	-
Age: 30+	9	13	69.2	371	523	70.9
Cassava (fresh)						
Type of financing accessed: Debt	306	312	98.1	76,837	79,083	97.2
Individuals/microenterprises	306	312	98.1	76,837	79,083	97.2
Cash	294	295	99.7	72,981	73,890	98.8
In-kind	14	19	73.7	4,583	5,920	77.4

Disaggregates	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
	Number of Farmers accessing ag-related financing	Total Number of Farmers accessing any financing, n*	Percent of the total farmers accessing ag-related financing from among those who accessed financing	Number of Farmers	Total Number of Farmers	Percent of the total farmers accessing ag-related financing from among those who accessed financing
Sex: Female	162	166	97.6	43,956	45,669	96.2
Sex: Male	144	146	98.6	32,881	33,414	98.4
Age: 15-29	7	7	100.0	2,262	2,262	100.0
Age: 30+	299	305	98.0	74,575	76,821	97.1
Type of financing accessed: Non-debt	30	33	90.9	8,160	8,752	93.2
Individuals/microenterprises	30	33	90.9	8,160	8,752	93.2
Cash	27	29	93.1	7,568	7,705	98.2
In-kind	3	4	75.0	592	1,047	56.5
Sex: Female	13	15	86.7	4,333	4,869	89.0
Sex: Male	17	18	94.4	3,827	3,883	98.6
Age: 15-29	2	2	100.0	137	137	100.0
Age: 30+	28	31	90.3	8,023	8,615	93.1
Coconut (green)						
Type of financing accessed: Debt	201	204	98.5	2,366	2,378	99.5
Individuals/microenterprises	201	204	98.5	,366	2,378	99.5
Cash	201	204	98.5	2,366	2,378	99.5
In-kind	-	-	-	-	-	-
Sex: Female	66	67	98.5	725	729	99.5
Sex: Male	135	137	98.5	1,642	1,649	99.6
Age: 15-29	3	3	100.0	14	14	100.0
Age: 30+	198	233	85.0	2,352	2,364	99.5
Type of financing accessed: Non-debt	19	32	59.4	453	656	69.1
Individuals/microenterprises	19	32	59.4	453	656	69.1
Cash	19	32	59.4	453	656	69.1
In-kind	-	-	-	-	-	-
Sex: Female	4	6	66.7	118	169	69.8
Sex: Male	15	26	57.7	335	486	68.9
Age: 15-29	-	-	-	-	-	-
Age: 30+	19	32	59.4	453	656	69.1

Disaggregates	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
	Number of Farmers accessing ag-related financing	Total Number of Farmers accessing any financing, n*	Percent of the total farmers accessing ag-related financing from among those who accessed financing	Number of Farmers	Total Number of Farmers	Percent of the total farmers accessing ag-related financing from among those who accessed financing
Durian						
Type of financing accessed: Debt	202	204	99.0	18,341	18,519	99.0
Individuals/microenterprises	202	204	99.0	18,341	18,519	99.0
Cash	197	198	99.5	17,770	17,853	99.5
In-kind	9	10	90.0	980	1,075	91.2
Sex: Female	78	79	98.7	7,293	7,388	98.7
Sex: Male	124	125	99.2	11,048	11,131	99.3
Age: 15-29	2	6	33.3	455	455	100.0
Age: 30+	196	198	99.0	17,886	18,064	99.0
Type of financing accessed: Non-debt	26	31	83.9	2,473	2,881	85.8
Individuals/microenterprises	26	31	83.9	2,473	2,881	85.8
Cash	25	30	83.3	2,431	2,839	85.6
In-kind	1	1	100.0	42	42	100.0
Sex: Female	11	13	84.6	913	1,070	85.3
Sex: Male	15	18	83.3	1,559	1,811	86.1
Age: 15-29	1	1	100.0	89	89	100.0
Age: 30+	25	30	83.3	2,384	2,792	85.4
Longan						
Type of financing accessed: Debt	165	168	98.2	32,530	33,136	98.2
Individuals/microenterprises	165	168	98.2	32,530	33,136	98.2
Cash	156	158	98.7	30,517	30,973	98.5
In-kind	11	12	91.7	2,428	2,578	94.2
Sex: Female	61	61	100.0	12,246	12,246	100.0
Sex: Male	104	107	97.2	20,285	20,890	97.1
Age: 15-29	2	2	100.0	389	389	100.0
Age: 30+	163	166	98.2	32,142	32,747	98.2
Type of financing accessed: Non-debt	12	16	75.0	2,147	2,887	74.4
Individuals/microenterprises	12	16	75.0	2,174	2,887	75.3
Cash	12	16	75.0	2,147	2,887	74.4

Disaggregates	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
	Number of Farmers accessing ag-related financing	Total Number of Farmers accessing any financing, n*	Percent of the total farmers accessing ag-related financing from among those who accessed financing	Number of Farmers	Total Number of Farmers	Percent of the total farmers accessing ag-related financing from among those who accessed financing
In-kind	-	-	-	-	-	-
Sex: Female	6	6	100.0	1,009	1,009	100.0
Sex: Male	6	10	60.0	1,138	1,878	60.6
Age: 15-29	-	-	-	-	-	-
Age: 30+	12	16	75.0	2,147	2,887	74.4
Mangosteen						
Type of financing accessed: Debt	186	187	99.5	15,866	15,892	99.8
Individuals/microenterprises	186	187	99.5	15,866	15,892	99.8
Cash	179	180	99.4	15,427	15,453	99.8
In-kind	8	8	100.0	563	563	100.0
Sex: Female	74	75	98.7	6,546	6,573	99.6
Sex: Male	112	112	100.0	9,319	9,319	100.0
Age: 15-29	1	1	100.0	13	13	100.0
Age: 30+	185	186	99.5	15,852	15,879	99.8
Type of financing accessed: Non-debt	33	35	94.3	3,222	3,361	95.9
Individuals/microenterprises	33	35	94.3	3,222	3,361	95.9
Cash	33	35	94.3	3,222	3,361	95.9
In-kind	-	-	-	-	-	-
Sex: Female	10	10	100.0	941	941	100.0
Sex: Male	23	25	92.0	2,281	2,420	94.3
Age: 15-29	1	1	100.0	113	113	100.0
Age: 30+	32	34	94.1	3,109	3,248	95.7

**Results are not statistically reliable if n<10*

Table A 13 Number of individuals who accessed loans from group-based savings, micro-finance or lending programs by age and sex. RAIN Baseline Evaluation, 2023

Disaggregates	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
	Number of farmers who accessed loans from SMLP, n*	Total number of farmers	Percent of the total farmers accessing SMLP	Number of farmers who accessed loans from SMLP	Total number of farmers	Percent of the total farmers accessing SMLP
Total	378	4,743	8.0	132,459	1,244,340	10.6
Sex: Female	187	2,073	9.0	69,296	615,920	11.3
Sex: Male	191	2,670	7.2	63,163	628,420	10.1
Age: 15-29	1	91	1.1	22	15,411	0.1
Age: 30+	377	4,652	8.1	132,437	1,228,929	10.8
Rice, rainfed (wet rice)	80	781	10.2	86,081	786,013	11.0
Sex: Female	44	408	10.8	44,963	411,792	10.9
Sex: Male	36	373	9.7	41,118	374,221	11.0
Age: 15-29	-	6	0.0	-	5,001	0.0
Age: 30+	80	775	10.3	86,081	781,012	11.0
Rice, irrigated (wet rice)	55	746	7.4	1,656	24,564	6.7
Sex: Female	23	325	7.1	675	11,089	6.1
Sex: Male	32	421	7.6	981	13,475	7.3
Age: 15-29	1	4	25.0	22	150	14.7
Age: 30+	54	742	7.3	1,634	24,414	6.7
Cassava (fresh)	77	773	10.0	22,856	195,083	11.7
Sex: Female	46	371	12.4	13,533	102,223	13.2
Sex: Male	31	402	7.7	9,323	99,690	9.4
Age: 15-29	-	18	0.0	-	3,825	0.0
Age: 30+	77	755	10.2	22,856	191,258	12.0
Coconut (green)	6	620	1.0	3,334	9,058	36.8
Sex: Female	1	198	0.5	10	2,582	0.4
Sex: Male	5	422	1.2	187	6,476	2.9
Age: 15-29	-	7	0.0	-	50	0.0
Age: 30+	6	613	1.0	197	9,008	2.2
Durian	41	600	6.8	4,084	55,336	7.4
Sex: Female	19	238	8.0	1,765	22,292	7.9
Sex: Male	22	362	6.1	2,320	33,044	7.0
Age: 15-29	-	27	0.0	-	2,453	0.0

Disaggregates	Unweighted (sampled farmers)			Weighted (extrapolated to farmer population)		
	Number of farmers who accessed loans from SMLP, n*	Total number of farmers	Percent of the total farmers accessing SMLP	Number of farmers who accessed loans from SMLP	Total number of farmers	Percent of the total farmers accessing SMLP
Age: 30+	41	573	7.2	4,084	52,883	7.7
Longan	65	619	10.5	13,277	123,206	10.8
Sex: Female	29	251	11.6	5,996	49,508	12.1
Sex: Male	36	368	9.8	7,280	73,698	9.9
Age: 15-29	-	11	0.0	-	2,299	0.0
Age: 30+	65	608	10.7	13,277	120,907	11.0
Mangosteen	50	604	8.3	4,165	51,080	8.2
Sex: Female	24	282	8.5	2,293	23,264	9.9
Sex: Male	26	322	8.1	1,872	27,816	6.7
Age: 15-29	-	18	0.0	-	1,635	0.0
Age: 30+	50	586	8.5	4,165	49,445	8.4

**Results are not statistically reliable if n<10; Key: SMLP=Savings, Microfinance, Lending Programs*

Table A 14. Total value of sales across commodities disaggregated by landholding size, sex, and age of the farmer, RAIN Baseline Evaluation 2023

Commodity	Unweighted (sampled farmers)					Weighted (extrapolated to farmer population)				
	Value of annual sales of farms (USD)	Average value of sales per farm (USD)	Volume of commodities sold by farm (mt)	Average volume of sales per farm (mt)	Number of farmers (n)*	Value of annual sales of farms (USD)	Average value of sales per farm (USD)	Volume of commodities sold by farm (mt)	Average volume of sales per farm (mt)	Number of farmers
Rice, rainfed (wet rice)										
Smallholder farmers	462,371	608	1,403	1.8	760	483,280,837	633	1,499,022	2.0	762,917
Sex: Female	221,571	612	669	1.8	362	237,461,133	658	737,603	2.0	360,907
Sex: Male	240,800	605	734	1.8	398	245,819,688	611	761,419	1.9	402,010
Age: 15-29	5,436	906	15	2.4	6	5,181,266	1,036	13,561	2.7	5,001
Age: 30+	456,935	606	1,388	1.8	754	478,099,571	631	1,485,462	2.0	757,916
Non-smallholder farmers	81,720	3,891	210	10.0	21	89,441,238	3,873	266,903	11.6	23,096
Sex: Female	49,763	4,524	106	9.6	11	50,834,866	3,818	138,562	10.4	13,314
Sex: Male	31,957	3,196	104	10.4	10	38,606,372	3,947	128,340	13.1	9,782
Age: 15-29	-	-	-	-	0	-	-	-	-	-
Age: 30+	81,720	3,891	210	10.0	21	89,441,238	3,873	266,903	11.6	23,096
Rice, irrigated (wet rice)										
Smallholder farmers	2,101,240	2,894	9,225	12.7	726	72,237,559	3,018	308,797	12.9	23,939
Sex: Female	882,580	2,153	3,853	9.4	410	33,666,544	2,563	139,932	10.7	13,136
Sex: Male	1,218,660	3,857	5,372	17.0	316	38,571,015	3,570	168,865	15.6	10,803
Age: 15-29	11,319	3,773	50	16.5	3	415,046	3,268	1,815	14.3	127
Age: 30+	2,089,921	2,891	9,176	12.7	723	71,822,505	3,016	306,981	12.9	23,812
Non-smallholder farmers	287,528	14,376	1,183	59.2	20	9,572,550	15,319	347,819	556.6	625
Sex: Female	119,803	10,891	450	40.9	11	4,404,160	13,030	156,711	463.6	338
Sex: Male	167,725	18,636	734	81.5	9	5,168,387	18,071	191,108	668.2	286
Age: 15-29	14,177	14,177	62	62.0	1	314,984	14,317	3,193	145.1	22
Age: 30+	273,351	14,387	1,121	59.0	19	9,257,565	15,353	344,627	571.5	603
Cassava (fresh)										
Smallholder farmers	1,232,634	1,729	14,193	19.9	713	288,891,325	1,588	3,415,970	18.8	181,939
Sex: Female	548,198	1,514	6,359	17.6	362	128,296,510	1,369	1,515,062	16.2	93,729
Sex: Male	684,437	1,720	7,833	19.7	398	160,594,815	1,821	1,900,908	21.5	88,210
Age: 15-29	31,464	5,244	362	60.3	6	6,031,425	1,766	70,975	20.8	3,416
Age: 30+	1,201,170	1,593	13,831	18.3	754	282,859,883	1,584	3,344,995	18.7	178,523
Non-smallholder farmers	424,522	7,075	5,399	90.0	60	79,750,343	6,067	1,043,865	79.4	13,144
Sex: Female	148,134	4,629	1,925	60.2	32	33,494,388	5,619	442,467	74.2	5,961
Sex: Male	276,388	9,871	3,474	124.1	28	46,255,955	6,440	601,399	83.7	7,183

Commodity	Unweighted (sampled farmers)					Weighted (extrapolated to farmer population)				
	Value of annual sales of farms (USD)	Average value of sales per farm (USD)	Volume of commodities sold by farm (mt)	Average volume of sales per farm (mt)	Number of farmers (n)*	Value of annual sales of farms (USD)	Average value of sales per farm (USD)	Volume of commodities sold by farm (mt)	Average volume of sales per farm (mt)	Number of farmers
Age: 15-29	16,292	8,146	190	95.0	2	3,330,297	8,143	38,838	95.0	409
Age: 30+	408,230	7,038	5,209	89.8	58	76,420,052	6,001	1,005,027	78.9	12,735
Coconut (green)										
Smallholder farmers	2,445,979	4,036	25,886	42.7	606	169,138,902	18,806	303,343	33.7	8,994
Sex: Female	2,448,243	5,942	8,308	20.2	412	46,254,954	7,195	81,776	12.7	6,429
Sex: Male	2,444,911	12,603	17,578	90.6	194	122,883,948	47,927	221,568	86.4	2,564
Age: 15-29	1,742,354	248,908	213	30.5	7	754,827	15,097	1,513	30.3	50
Age: 30+	2,454,216	4,097	25,673	42.9	599	168,384,082	18,826	301,830	33.7	8,944
Non-smallholder farmers	10,979,548	784,253	2,689	192.1	14	9,026,043	141,032	13,015	203.4	64
Sex: Female	11,676,156	1,167,616	817	81.7	10	2,789,530	59,352	3,917	83.3	47
Sex: Male	10,700,904	2,675,226	1,872	468.0	4	6,236,513	366,854	9,097	535.1	17
Age: 15-29	-	-	-	-	0	-	-	-	-	-
Age: 30+	10,979,548	784,253	2,689	192.1	14	9,026,043	141,032	13,015	203.4	64
Durian										
Smallholder farmers	15,824,581	27,097	4,766	8.2	584	1,405,556,753	26,010	425,105	7.9	54,039
Sex: Female	5,597,835	16,040	1,706	4.9	349	509,427,637	15,940	156,325	4.9	31,960
Sex: Male	10,226,743	43,518	3,060	13.0	235	896,129,117	40,587	268,779	12.2	22,079
Age: 15-29	526,537	20,251	156	6.0	26	49,343,405	20,466	14,760	6.1	2,411
Age: 30+	15,298,042	27,416	4,610	8.3	558	1,356,213,337	26,268	410,344	7.9	51,629
Non-smallholder farmers	1,999,392	124,962	587	36.7	16	160,153,150	123,515	47,325	36.5	1,297
Sex: Female	158,761	12,212	52	4.0	13	12,007,584	11,077	3,999	3.7	1,084
Sex: Male	1,840,631	613,544	535	178.5	3	148,145,575	695,519	43,327	203.4	213
Age: 15-29	68,599	68,599	22	21.7	1	2,861,833	68,139	904	21.5	42
Age: 30+	1,930,793	128,720	566	37.7	15	157,291,306	125,332	46,421	37.0	1,255
Longan										
Smallholder farmers	996,138	1,638	1,905	3.1	608	198,851,159	1,645	380,894	3.2	120,855
Sex: Female	350,811	974	669	1.9	360	68,616,721	954	130,722	1.8	71,900
Sex: Male	645,327	2,602	1,235	5.0	248	130,234,438	2,660	250,172	5.1	48,955
Age: 15-29	16,312	1,483	46	4.2	11	3,677,060	1,599	10,766	4.7	2,299
Age: 30+	979,826	1,641	1,859	3.1	597	195,174,099	1,646	370,128	3.1	118,556
Non-smallholder farmers	74,307	6,755	164	15.0	11	17,112,328	7,278	38,076	16.2	2,351

Commodity	Unweighted (sampled farmers)					Weighted (extrapolated to farmer population)				
	Value of annual sales of farms (USD)	Average value of sales per farm (USD)	Volume of commodities sold by farm (mt)	Average volume of sales per farm (mt)	Number of farmers (n)*	Value of annual sales of farms (USD)	Average value of sales per farm (USD)	Volume of commodities sold by farm (mt)	Average volume of sales per farm (mt)	Number of farmers
Sex: Female	7,446	931	13	1.6	8	1,370,225	762	2,321	1.3	1,799
Sex: Male	66,861	22,287	152	50.6	3	15,742,102	28,467	35,755	64.7	553
Age: 15-29	-	-	-	-	0	-	-	-	-	-
Age: 30+	74,307	6,755	164	15.0	11	17,112,328	7,279	38,076	16.2	2,351
Mangosteen										
Smallholder farmers	2,719,462	4,633	2,091	3.6	587	216,056,067	4,306	168,240	3.4	50,178
Sex: Female	1,231,434	3,947	939	3.0	312	93,343,560	3,424	72,775	2.7	27,259
Sex: Male	1,488,029	5,411	1,151	4.2	275	122,712,507	5,354	95,465	4.2	22,918
Age: 15-29	70,847	3,936	64	3.6	18	5,003,960	3,061	3,920	2.4	1,635
Age: 30+	2,648,615	4,655	2,026	3.6	569	211,052,099	4,348	164,320	3.4	48,542
Non-smallholder farmers	459,970	27,057	306	18.0	17	13,674,856	15,160	8,651	9.6	902
Sex: Female	90,907	9,091	74	7.4	10	2,109,134	3,793	2,250	4.0	556
Sex: Male	369,064	52,723	232	33.1	7	11,565,722	33,427	6,401	18.5	346
Age: 15-29	-	-	-	-	0	-	-	-	-	-
Age: 30+	459,970	27,057	306	18.0	17	13,674,856	15,161	8,651	9.6	902

**Results are not statistically reliable if n<10*
Key: mt=metric ton; ha=hectare

Table A 15. Unweighted value of agriculture-related financing accessed by farmers across commodities, RAIN Baseline Evaluation 2023

Disaggregates	Unweighted (sampled farmers)				
	Value of agriculture-related financing (USD)	Value of agriculture-related financing (Thai Baht)	Ag financing per farmer (USD)	Ag financing per farmer (Thai Baht)	Total number of farmers (n)*
Total					
Type of financing accessed: Debt					
Cash	6,147,375	215,071,009	3,994	139,747	1,539
In-kind	189,905	6,644,000	2,922	102,215	65
Sex: Female	2,586,276	90,483,001	3,622	126,727	714
Sex: Male	3,751,004	131,232,008	4,277	149,637	877
Age: 15-29	102,041	3,570,000	4,859	170,000	21
Age: 30+	6,235,239	218,145,009	3,971	138,946	1,570
Type of financing accessed: Non-debt					
Cash	237,605	8,312,800	1,639	57,330	145
In-kind	4,898	171,350	816	28,558	6
Sex: Female	91,989	3,218,300	1,508	52,759	61
Sex: Male	150,514	5,265,850	1,691	59,167	89
Age: 15-29	5,431	190,000	1,358	47,500	4
Age: 30+	237,072	8,294,150	1,624	56,809	146
Rice, rainfed (wet rice)					
Type of financing accessed: Debt					
Cash	973,423	34,056,000	3,278	114,667	297
In-kind	78,432	2,744,000	5,602	196,000	14
Sex: Female	617,993	21,621,000	3,635	127,182	170
Sex: Male	433,861	15,179,000	3,144	109,993	138
Age: 15-29	1,429	50,000	1,429	50,000	1
Age: 30+	1,050,425	36,750,000	3,422	119,707	307
Type of financing accessed: Non-debt					
Cash	19,579	685,000	979	34,250	20
In-kind	1,401	49,000	700	24,500	2
Sex: Female	10,976	384,000	998	34,909	11
Sex: Male	10,004	350,000	1,000	35,000	10
Age: 15-29	-	-	-	-	-
Age: 30+	20,980	734,000	999	34,952	21
Rice, irrigated (wet rice)					
Type of financing accessed: Debt					

Disaggregates	Unweighted (sampled farmers)				
	Value of agriculture-related financing (USD)	Value of agriculture-related financing (Thai Baht)	Ag financing per farmer (USD)	Ag financing per farmer (Thai Baht)	Total number of farmers (n)*
Cash	820,904	28,720,001	3,818	133,581	215
In-kind	15,235	533,000	1,693	59,222	9
Sex: Female	317,443	11,106,001	3,082	107,825	103
Sex: Male	518,696	18,147,000	4,322	151,225	120
Age: 15-29	5,717	200,000	5,717	200,000	1
Age: 30+	830,422	29,053,001	3,741	130,869	222
Type of financing accessed: Non-debt					
Cash	10,298	360,300	1,144	40,033	9
In-kind	-	-	-	-	-
Sex: Female	8,012	280,300	1,335	46,717	6
Sex: Male	2,287	80,000	762	26,667	3
Age: 15-29	-	-	-	-	-
Age: 30+	10,298	360,300	1,144	40,033	9
Cassava (fresh)					
Type of financing accessed: Debt					
Cash	1,190,854	41,663,000	4,051	141,711	294
In-kind	32,928	1,152,000	2,352	82,286	14
Sex: Female	642,289	22,471,000	3,965	138,710	162
Sex: Male	581,493	20,344,000	4,038	141,278	144
Age: 15-29	45,733	1,600,000	6,533	228,571	7
Age: 30+	1,178,048	41,215,000	3,940	137,843	299
Type of financing accessed: Non-debt					
Cash	32,442	1,135,000	1,202	42,037	27
In-kind	-	-	-	-	3
Sex: Female	7,174	251,000	552	19,308	13
Sex: Male	25,906	906,350	1,524	53,315	17
Age: 15-29	857	30,000	429	15,000	2
Age: 30+	32,223	1,127,350	1,151	40,263	28
Coconut (green)					
Type of financing accessed: Debt					
Cash	444,380	15,547,000	2,211	77,348	201
In-kind	-	-	-	-	-
Sex: Female	167,639	5,865,000	2,540	88,864	66
Sex: Male	276,741	9,682,000	2,050	71,719	135

Disaggregates	Unweighted (sampled farmers)				
	Value of agriculture-related financing (USD)	Value of agriculture-related financing (Thai Baht)	Ag financing per farmer (USD)	Ag financing per farmer (Thai Baht)	Total number of farmers (n)*
Age: 15-29	6,288	220,000	2,096	73,333	3
Age: 30+	438,092	15,327,000	2,213	77,409	198
Type of financing accessed: Non-debt					
Cash	8,646	302,500	455	15,921	19
In-kind	-	-	-	-	-
Sex: Female	2,087	73,000	522	18,250	4
Sex: Male	6,560	229,500	437	15,300	15
Age: 15-29	-	-	-	-	-
Age: 30+	8,646	302,500	455	15,921	19
Durian					
Type of financing accessed: Debt					
Cash	1,198,056	41,915,000	6,082	212,766	197
In-kind	34,014	1,190,000	3,779	132,222	9
Sex: Female	309,411	10,825,000	3,967	138,782	78
Sex: Male	922,659	32,280,000	7,441	260,323	124
Age: 15-29	28,297	990,000	14,149	495,000	2
Age: 30+	1,203,773	42,115,000	6,142	214,872	196
Type of financing accessed: Non-debt					
Cash	84,320	2,950,000	3,373	118,000	25
In-kind	-	-	-	-	1
Sex: Female	38,015	1,330,000	3,456	120,909	11
Sex: Male	49,163	1,720,000	3,278	114,667	15
Age: 15-29	2,287	80,000	2,287	80,000	1
Age: 30+	84,892	2,970,000	3,396	118,800	25
Longan					
Type of financing accessed: Debt					
Cash	620,251	21,700,000	3,976	139,103	156
In-kind	15,006	525,000	1,364	47,727	11
Sex: Female	227,949	7,975,000	3,737	130,738	61
Sex: Male	407,308	14,250,000	3,916	137,019	104
Age: 15-29	6,002	210,000	3,001	105,000	2
Age: 30+	629,255	22,015,000	3,860	135,061	163
Type of financing accessed: Non-debt					
Cash	20,008	700,000	1,667	58,333	12

Disaggregates	Unweighted (sampled farmers)				
	Value of agriculture-related financing (USD)	Value of agriculture-related financing (Thai Baht)	Ag financing per farmer (USD)	Ag financing per farmer (Thai Baht)	Total number of farmers (n)*
In-kind	-	-	-	-	-
Sex: Female	9,432	330,000	1,572	55,000	6
Sex: Male	10,576	370,000	1,763	61,667	6
Age: 15-29	-	-	-	-	-
Age: 30+	20,008	700,000	1,667	58,333	12
Mangosteen					
Type of financing accessed: Debt					
Cash	835,481	29,230,000	4,667	163,296	179
In-kind	14,292	500,000	1,786	62,500	8
Sex: Female	283,829	9,930,000	3,836	134,189	74
Sex: Male	565,943	19,800,000	5,053	176,786	112
Age: 15-29	8,575	300,000	8,575	300,000	1
Age: 30+	841,198	29,430,000	4,547	159,081	185
Type of financing accessed: Non-debt					
Cash	61,739	2,160,000	1,871	65,455	33
In-kind	-	-	-	-	-
Sex: Female	16,292	570,000	1,629	57,000	10
Sex: Male	45,447	1,590,000	1,976	69,130	23
Age: 15-29	2,287	80,000	2,287	80,000	1
Age: 30+	59,453	2,080,000	1,858	65,000	32

**Results are not statistically reliable if n<10*
1 Baht = 0.028583 USD (used conversion rate an average of 2022-2023)

Table A 16. Weighted value of agriculture-related financing accessed by farmers across commodities, RAIN Baseline Evaluation 2023

Disaggregates	Weighted (extrapolated to farmer population)				
	Value of agriculture-related financing (USD)	Value of agriculture-related financing (Thai Baht)	Ag financing per farmer (USD)	Ag financing per farmer (Thai Baht)	Total number of farmers, (n)*
Total					
Type of financing accessed: Debt					
Cash	1,589,164,410	55,598,237,075	3,520	123,134	451,527
In-kind	115,124,827	4,027,737,718	3,537	123,736	32,551
Sex: Female	868,373,891	30,380,781,962	3,458	120,980	251,122
Sex: Male	835,915,347	29,245,192,831	3,618	126,569	231,062
Age: 15-29	14,715,562	514,836,162	3,183	111,364	4,623
Age: 30+	1,689,573,676	59,111,138,632	3,538	123,777	477,561
Type of financing accessed: Non-debt					
Cash	41,723,039	1,459,715,185	1,272	44,502	32,801
In-kind	979,921	34,283,338	595	20,828	1,646
Sex: Female	17,544,853	613,821,259	1,115	39,010	15,735
Sex: Male	25,158,107	880,177,263	1,388	48,556	18,127
Age: 15-29	513,019	17,948,392	1,513	52,945	339
Age: 30+	42,189,941	1,476,050,130	1,259	44,032	33,522
Rice, rainfed (wet rice)					
Type of financing accessed: Debt					
Cash	969,642,370	33,923,743,826	3,182	111,310	304,768
In-kind	95,242,675	3,332,144,091	4,032	141,067	23,621
Sex: Female	587,656,318	20,559,644,467	3,327	116,392	176,642
Sex: Male	477,228,727	16,696,243,450	3,149	110,177	151,540
Age: 15-29	2,097,825	73,394,143	1,429	49,996	1,468
Age: 30+	1,062,787,220	37,182,493,774	3,253	113,808	326,713
Type of financing accessed: Non-debt					
Cash	15,437,038	540,077,607	935	32,696	16,518
In-kind	733,877	25,675,292	725	25,371	1,012
Sex: Female	8,335,975	291,641,008	1,019	35,649	8,181
Sex: Male	7,834,940	274,111,891	894	31,277	8,764
Age: 15-29	-	-	-	-	-
Age: 30+	8,335,975	291,641,008	492	17,211	16,945
Rice, irrigated (wet rice)					
Type of financing accessed: Debt					

Disaggregates	Weighted (extrapolated to farmer population)				
	Value of agriculture-related financing (USD)	Value of agriculture-related financing (Thai Baht)	Ag financing per farmer (USD)	Ag financing per farmer (Thai Baht)	Total number of farmers, (n)*
Cash	27,879,167	975,375,833	3,876	135,601	7,193
In-kind	504,256	17,641,831	1,341	46,920	376
Sex: Female	11,217,593	392,456,797	3,205	112,131	3,500
Sex: Male	17,165,831	600,560,867	4,231	148,031	4,057
Age: 15-29	127,009	4,443,531	5,773	201,979	22
Age: 30+	28,256,414	988,574,133	3,750	131,198	7,535
Type of financing accessed: Non-debt					
Cash	612,704	21,435,960	1,651	57,779	371
In-kind	-	-	-	-	-
Sex: Female	506,026	17,703,724	2,117	74,074	239
Sex: Male	106,678	3,732,236	808	28,275	132
Age: 15-29	-	-	-	-	-
Age: 30+	612,704	21,435,960	1,651	57,779	371
Cassava (fresh)					
Type of financing accessed: Debt					
Cash	275,168,364	9,626,993,820	3,770	131,911	72,981
In-kind	10,738,312	375,688,758	2,343	81,974	4,583
Sex: Female	162,389,862	5,681,344,232	3,694	129,251	43,956
Sex: Male	123,516,814	4,321,338,346	3,756	131,424	32,881
Age: 15-29	8,858,657	309,927,464	3,916	137,015	2,262
Age: 30+	277,048,019	9,692,755,115	3,715	129,973	74,575
Type of financing accessed: Non-debt	-				
Cash	6,911,445	241,802,650	913	31,951	7,568
In-kind	-	-	-	-	592
Sex: Female	2,310,892	80,848,482	533	18,659	4,333
Sex: Male	4,727,354	165,390,398	1,235	43,217	3,827
Age: 15-29	51,278	1,794,009	374	13,095	137
Age: 30+	6,986,968	244,444,870	871	30,468	8,023
Coconut (green)					
Type of financing accessed: Debt					
Cash	3,690,149	129,102,945	1,560	54,566	2,366
In-kind	-	-	-	-	-
Sex: Female	1,410,177	49,336,223	1,945	68,050	725
Sex: Male	2,279,972	79,766,722	1,389	48,579	1,642

Disaggregates	Weighted (extrapolated to farmer population)				
	Value of agriculture-related financing (USD)	Value of agriculture-related financing (Thai Baht)	Ag financing per farmer (USD)	Ag financing per farmer (Thai Baht)	Total number of farmers, (n)*
Age: 15-29	28,188	986,167	2,013	70,440	14
Age: 30+	3,661,962	128,116,778	1,557	54,471	2,352
Type of financing accessed: Non-debt					
Cash	174,164	6,093,285	384	13,451	453
In-kind	-	-	-	-	-
Sex: Female	73,627	2,575,904	624	21,830	118
Sex: Male	100,537	3,517,381	300	10,500	335
Age: 15-29	-	-	-	-	-
Age: 30+	174,164	6,093,285	384	13,451	453
Durian					
Type of financing accessed: Debt					
Cash	108,853,145	3,808,317,691	6,126	214,312	17,770
In-kind	3,715,694	129,996,635	3,792	132,650	980
Sex: Female	29,097,714	1,018,007,706	3,990	139,587	7,293
Sex: Male	83,471,124	2,920,306,619	7,555	264,329	11,048
Age: 15-29	2,329,178	81,488,224	5,119	179,095	455
Age: 30+	110,239,660	3,856,826,101	6,163	215,634	17,886
Type of financing accessed: Non-debt					
Cash	8,781,696	307,234,935	3,612	126,382	2,431
In-kind	-	-	-	-	42
Sex: Female	3,108,726	108,761,368	3,405	119,125	913
Sex: Male	5,792,213	202,645,384	3,715	129,984	1,559
Age: 15-29	203,192	7,108,846	2,283	79,875	89
Age: 30+	8,697,747	304,297,905	3,648	127,642	2,384
Longan					
Type of financing accessed: Debt					
Cash	121,665,499	4,256,568,563	3,987	139,482	30,517
In-kind	3,715,611	129,993,726	1,530	53,539	2,428
Sex: Female	48,145,547	1,684,411,958	3,932	137,548	12,246
Sex: Male	77,235,563	2,702,150,330	3,808	133,209	20,285
Age: 15-29	1,159,782	40,575,927	2,981	104,308	389
Age: 30+	124,221,328	4,345,986,362	3,865	135,212	32,142
Type of financing accessed: Non-debt					
Cash	3,820,183	133,652,290	1,779	62,251	2,147

Disaggregates	Weighted (extrapolated to farmer population)				
	Value of agriculture-related financing (USD)	Value of agriculture-related financing (Thai Baht)	Ag financing per farmer (USD)	Ag financing per farmer (Thai Baht)	Total number of farmers, (n)*
In-kind	-	-	-	-	-
Sex: Female	1,677,897	58,702,624	1,663	58,179	1,009
Sex: Male	2,142,286	74,949,666	1,883	65,861	1,138
Age: 15-29	-	-	-	-	-
Age: 30+	3,820,183	133,652,290	1,779	62,251	2,147
Mangosteen					
Type of financing accessed: Debt					
Cash	79,476,925	2,780,566,246	5,152	180,240	15,427
In-kind	1,208,280	42,272,678	2,146	75,085	563
Sex: Female	27,742,282	970,586,772	4,238	148,272	6,546
Sex: Male	52,942,923	1,852,252,152	5,681	198,761	9,319
Age: 15-29	114,924	4,020,707	8,840	309,285	13
Age: 30+	80,570,281	2,818,818,217	5,083	177,821	15,852
Type of financing accessed: Non-debt					
Cash	5,934,098	207,609,364	1,842	64,435	3,222
In-kind	-	-	-	-	-
Sex: Female	1,531,710	53,588,150	1,628	56,948	941
Sex: Male	4,402,388	154,021,214	1,930	67,524	2,281
Age: 15-29	258,549	9,045,537	2,288	80,049	113
Age: 30+	5,675,550	198,563,827	1,826	63,867	3,109

1 Baht = 0.028583 USD (used conversion rate an average of 2022-2023)

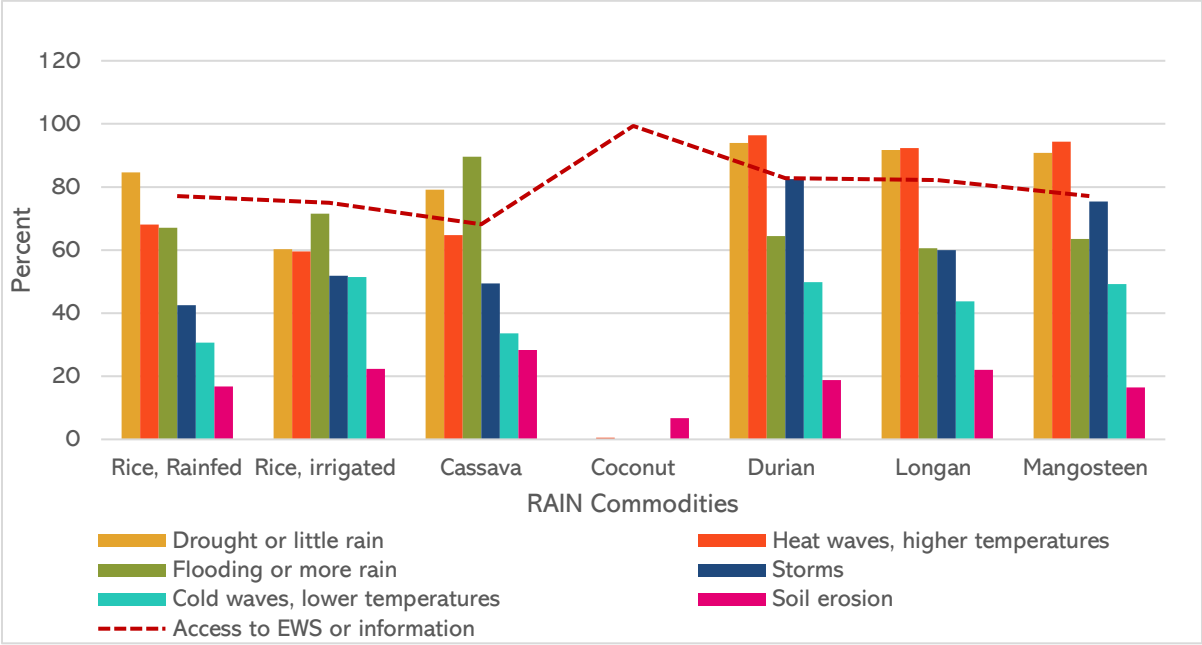
ANNEX 10. ADDITIONAL FINDINGS

This section presents the association between select variables—specifically, use of climate shocks and use of early warning systems (EWS), and amount of loans accessed by farmers and average sales of commodities.

Climate shocks and use of Early Warning Systems

There is an association between climatic shocks and stressors experienced by farmers and the use of agricultural practices and technologies (**Figure A 1**). The farming population in the sampled provinces has experienced high shocks and stressors related to various factors including inability to access or afford inputs or sell crops at a fair price, ill effects on crops of disease and pests, and unfavorable climate events (too much rain and drought, higher/lower than usual temperatures, hail, etc.). In fact, farmers perceive unpredictable weather and the associated severity of pests and diseases as the biggest threat to farming.

Figure A 1. Climate shocks and stressors experienced by farmers and access to early warning system, RAIN Baseline Evaluation 2023



The survey asked farmers if they have access to any EWS or information about extreme climatic events. Although cultivation and production methods differ for coconut compared with other crop commodities, the results show that more than 99 percent of coconut farmers who reported having access to EWS or information about climatic events also reported no shocks or stressors related to climatic events. The inverse relationship between access to EWS and climate information and shocks and stressors experienced by farmers exists for all crop commodities.

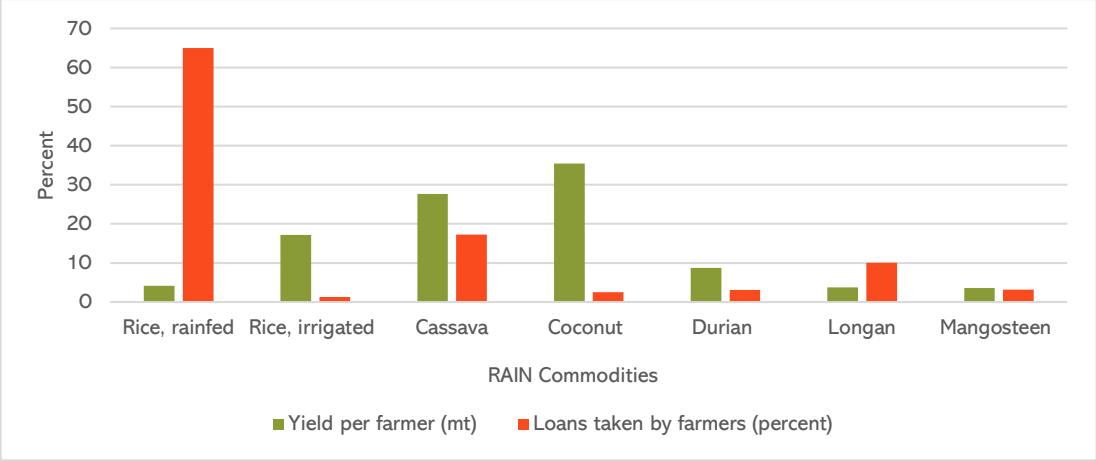
Studies have found that the coping strategies of smallholder farmers are associated with farmers' use of a wide range of agricultural technologies and strategies, including soil and

water conservation technologies and on-farm diversification.[12] These are several factors that affect farmers' adaptation decisions, including farmers' awareness and knowledge of climatic trends.

Average Sales of Commodities and the Amount of Loans/Debt

There is an inverse relationship between average **sales** of the commodities and the amount of **loans/debt** taken by the farmers. The average sales are lowest for rice (rainfed), cassava, and longan farmers, and farmers for these commodities also have higher debt than farmers who cultivate other crops. Similarly, the baseline survey data showed an inverse relationship between the crop yield/yield per farmer and the percent of farmers who take loans. For example, yield per farmer is lowest for rainfed rice while the percentage of farmers taking loans is highest. Conversely, yield per farmer is high for coconut while the percentage of farmers taking loans for coconut farming is low (**Figure A 2**).

Figure A 2. Yield per farmer and loans taken by farmers for the select crops, RAIN Baseline Evaluation 2023



According to the researchers at Puey Ungphakorn Institute for Economic Research (PIER),[13] more than 90 percent of Thai farmers are indebted at an average of 450,000 baht or USD12,862. Farmers are trapped in a vicious cycle of debt, which starts with households' unavoidable financial challenges, including insufficiency, instability, and illiquidity. This results in more reliance on credit as a tool to resolve the financial challenges, and problems in rural financial markets (information asymmetry, enforcement problems, and contract design problems), which further creates over-borrowing beyond households' repayment capacity and traps households in a debt trap.

[12] D.N. Mubiru et al., "Climate Trend, Risks and Coping Strategies in Smallholder Farming Systems in Uganda," *Climate Risk Management* 22 (2018): 4–21, https://doi.org/10.1016/j.crm.2018.08.004.

[13] S. Chantarat et al., "Financial Lives and the Vicious Cycle of Debt among Thai Agricultural Households," Discussion paper no. 204, March 2023, https://www.pier.or.th/files/dp/pier_dp_204.pdf.

ANNEX 11. DATA COLLECTION INSTRUMENTS

Qualitative Questions and Study Guide

Key Informant Interview (KII) with Farmers

Respondent's name			
Location	**Province**	**District**	**Sub-district /Village**
Date			
Time			
Moderator			
DECLARATION			
I confirm that the moderator guide meets and was carried out under the Rapid Asia Co., Ltd.'s guidelines (based on ESOMAR) and instructions supplied to me for this study. I understand that the information given to me during the interview must be kept confidential.			
Signed by moderator: _____			

Criteria for recruitment

- Agricultural household that is currently farming [CROP].
- Household decision makers (age 18 years and above).
- Have participated and provided consent to participate in the survey.

Introduction [5 minutes]

Thank you for agreeing to this follow-up interview.

I will record our discussion so I can concentrate on what you are saying. The interview will take up to 30 minutes to an hour. There are no right or wrong answers, so please give us your honest opinion. The recording will only be used for internal processing purposes. The recording will not be shared with anybody except our study team members. Please be assured that anything you say is confidential and your participation is completely voluntary, and you can end this interview at any time.

Do you have further questions about this interview? PROVIDE CLARIFICATIONS AS NEEDED. Do you understand and give your consent to be interviewed? IF YES, CONTINUE. START RECORDING

Production

1. Earlier you told us you have [LAND AREA] rai of your farm to produce [CROP]?
   a) Has the total land area under your [CROP] production increased, decreased, or remained the same in the last 3 years? Why?
   b) Do you plan to increase or decrease the total land area for production of [CROP] in the next 12 months? If so, why?

2. Earlier you mentioned that the total production of your [CROP] is [PRODUCTION AMOUNT] Kgs/Tonnes/Units over the last year/harvest.

a) Has the total production of [CROP] increased or decreased in the last 3 years? Why?
b) Do you anticipate your total production for [CROP] will increase or decrease in the next year or two? Why?
c) What steps are you taking to increase the total production of [CROP]?

3. What are your major production costs for [CROP]? (e.g., labor, inputs, machine/tool purchase or rental, etc.)
   a) Have these production costs increased or decreased in the last 3 years? Why?
   b) Do you anticipate these production costs will increase or decrease in the next 12 months? Why?
   c) What steps have/are you taken/taking to reduce or maintain production costs for [CROP]?

4. Has your crop been affected by any of the following in the past 3 years?
   SELECT ALL THAT APPLY IN TABLE, THEN ASK FOR EACH SHOCK TYPE:

   a) Has [SHOCK TYPE] been happening more or less in frequency in the past 3 years?
   b) Has the severity—that is, the financial impact (i.e., crop loss, infrastructure damage, land damage, etc.) increased or decreased in the past 3 years?
   c) What actions have you taken to protect [CROP] from these shocks?

No.	Shock Type	**Frequency** 1. Increase 2. Decrease 3. unchanged	**Severity** 1. Increase 2. Decrease 3. unchanged	**Mitigation measures taken:** What are you doing to reduce the frequency and/or severity of the shock?
1	Erratic rain	1 2 3	1 2 3	
2	Drought	1 2 3	1 2 3	
3	Flooding	1 2 3	1 2 3	
4	Extreme temperature	1 2 3	1 2 3	
5	Storms	1 2 3	1 2 3	
6	Pest & disease outbreak	1 2 3	1 2 3	

5. What do you see as the biggest threats to farming [CROP] in the next 3 years?
   a) Reduced Yield
   b) Increased Costs
   c) Climate Shocks
   d) Lower Market Price
   e) Other

6. What do you see as the greatest opportunity for farming [CROP] in the next 3 years?
   a) Higher Yield
   b) Better Quality
   c) Expanded Market
   d) Higher Price
   e) Increased Profit
   f) Other

Innovation

7. What training or technical assistance have you received or are currently using for CROP? IF NONE GO TO Q9
   a) Input selection
   b) Land preparation
   c) Weather
   d) Spraying
   e) Harvesting
   f) Transportation
   g) Other support services. Please specify.

8. Who provides this/these service(s) (record all service providers)?
   a) Was it useful?
   b) What do you like most about the service(s) received?
   c) Will you use the service(s) again next year? Why or why not?

9. Earlier you told us that you used [PRACTICE 1, PRACTICE 2, and PRACICE 3.PRACTICE X] for your crop in the last 3 years. Which of these practices do you use most commonly used for [CROP].
   REFER TO THE POST SURVEY FORM AND CONFIRM WITH FARMER.
   ASK FOR EACH PRACTICE OR TECHNOLOGY IN TURN:

9a. What about [PRACTICE/TECHNOLOGY 1]:
   a) What are the major advantages of using [PRACTICE/TECHNOLOGY]?
   b) What are the major disadvantages of using [PRACTICE/TECHNOLOGY]?
   c) Did you receive any support to adopt [PRACTICE/TECHNOLOGY]? Y N
   d) IF YES: Please tell me about the support you received.
   e) Who provided the support? How was it provided? How long did you receive it?

9b. What about [PRACTICE/TECHNOLOGY 2]:
   a) What are the major advantages of using [PRACTICE/TECHNOLOGY]?
   b) What are the major disadvantages of using [PRACTICE/TECHNOLOGY]?
   c) Did you receive any support to adopt [PRACTICE/TECHNOLOGY]? Y N
   d) IF YES: Please tell me about the support you received.
   e) Who provided the support? How was it provided?

9c. What about [PRACTICE/TECHNOLOGY 3]:
   a) What are the major advantages of using [PRACTICE/TECHNOLOGY]?
   b) What are the major disadvantages of using [PRACTICE/TECHNOLOGY]?
   c) Did you receive any support to adopt [PRACTICE/TECHNOLOGY]? Y N
   d) IF YES: Please tell me about the support you received.
   e) Who provided the support? How was it provided?

10. Are there any particular new practices or technologies that you would like to adopt for your crop farming business? Please select up to three most useful technologies or practices that you would be interested in adopting or applying.

NOTE: SHOW THE POST SURVEY FORM AGAIN AND SELECT UP TO THREE. IF THE FARMER DOES NOT SELECT ANY, GO TO Q11.

10a. You are interested in [PRACTICE/TECHNOLOGY 1]:

a) Why do you want to use [PRACTICE/TECHNOLOGY 1] and what results do you expect?
b) Why have you not used [PRACTICE/TECHNOLOGY 1] before?
c) What support will you need to use [PRACTICE/TECHNOLOGY 1]?

10b. You are interested in [PRACTICE/TECHNOLOGY 2]:

a) Why do you want to use [PRACTICE/TECHNOLOGY 2] and what results do you expect?
b) Why have you not used [PRACTICE/TECHNOLOGY 2] before?
c) What support will you need to use [PRACTICE/TECHNOLOGY 2]?

10c. You are interested in (PRACTICE/TECHNOLOGY 3):

a) Why do you want to use [PRACTICE/TECHNOLOGY 3] and what results do you expect?
b) Why have you not used [PRACTICE/TECHNOLOGY 3] before?
c) What support will you need to use [PRACTICE/TECHNOLOGY 3]?

10d. Is there a new practice/technology you have heard of that you do <u>not</u> want to apply or adopt when farming [CROP]? Why?

Finance & Sales

CHECK POST SURVEY FORM, IF THE FARMER DOES NOT HAVE ANY LOANS GO TO

11. Earlier you mentioned that you accessed loans or input credit for your [CROP] from [PROVIDER]
    a) What were loan terms?
        i. Probe: Length of loan period
        ii. interest rate obtained
        iii. re-payment terms
    b) Have you paid back the loan/credit in full?

12. Do you plan to access any additional loans/credits in the next year? Y N
13. Which buyers/customers did you sell [CROP] to most recently? Why?
14. Are these the same buyers/customers over the past three years? Y N
15. Will you sell to the same buyers/customers over the next 12 months? Why?
16. Which new buyers/customers would you like to sell to in the next 12 months? Why?

Key Stakeholders Interview (KSI)

Respondent Name				
Location	**Region**	**Province**	**Sub-district**	**Village**
Date				
Time				
Moderator				

DECLARATION
I confirm that the moderator guide meets and was carried out under the Rapid Asia Co., Ltd.'s guidelines (based on ESOMAR) and instructions supplied to me for this study. I understand that the information given to me during the interview must be kept confidential.
Signed by moderator: _____

KSI Target Audience:
Value chain actors who are delivering services or technologies to farmers: Input Suppliers, Crop Collectors, Researchers, Entrepreneurs, Group Leaders, Extension Officers.

Introduction (5 minutes):

Thank you for spending the time to speak with me today. I would like to introduce myself - I am **(NAME)** from Rapid Asia Co., Ltd. We really appreciate your time. We are currently undertaking a study to increase productivity, profitability, and trade opportunities in the Thai agricultural sector, simultaneously reducing greenhouse gas emissions and natural resource depletion. As part of the study, it will be very helpful to hear about your experiences and insights regarding the agricultural technologies adopted and practices applied for rice cultivation. We also welcome your suggestions on services, inputs and barriers impacting rice production**.** Similar interviews are taking place with farmers cultivating other commodities in other regions of Thailand.

I will record our discussion so I can concentrate on what you are saying. The interview will take up to 30 minutes. There are no right or wrong answers, so please give us your honest opinion. The recording will only be used for internal processing purposes. The recording will not be shared with anybody except our study team members. Please be assured that anything you say is confidential and your participation is completely voluntary, and you can end this interview at any time.

Do you have further questions about this interview? PROVIDE CLARIFICATIONS, AS NEEDED. Do you understand and give your consent to be interviewed? IF YES, CONTINUE. START RECORDING

WARM-UP QUESTIONS (5 min):

FOR MODERATOR: Warm-up questions should be very brief and should not consume much time. Just for participants to feel comfortable speaking.

Let's start. Please briefly introduce yourselves including:

- Name;
- Age;
- Gender;
- Education (total # of years);
- Position in the organization;
- Years of experience

How do you bring technology, innovations, and improved practices to the farmer?

1. Which of the following commodities do you support? (Please select all applicable)
    a. Rice, Cassava, Durian, Longan, Mangosteen, Coconut

2. Please list the services and/or technologies that you provide to farmer(s) for each of the commodities selected above?
    a. How much demand is there for the services or technologies?
    b. What limitations do you currently face in providing each service or technology?

3. When you first introduce a new service or technology to a farmer, how do you present this service or technology to the farmer? *(Probe for the format used to present the service/tech., demonstration type provided, value proposition to the farmer, etc.)*
    a. What is the key messaging you provide to explain the service or technology?
    b. What additional information do you provide?

4. How do you assist a farmer to apply/use a new service or technology?
    a. What training is provided to the farmer?
    b. Beyond training, what other type(s) of support is provided to the farmer?

5. What are factors that contribute to successful use of a new service or technology by the farmer?
    a. What challenges do you most frequently encounter?
    b. How do you overcome these challenges?
    c. How do you determine if the new service or technology is successful?
    d. How do you determine if a farmer is satisfied with the new service or technology?

6. In your opinion, what are the major factors that encourage farmers to continue using a new service or technology?

7. What are opportunities for new services or technologies that could be beneficial to farmers producing X commodity or commodities?

Quantitative Baseline Survey Questionnaire

The baseline survey questionnaire with a separate module for each target commodity is presented below.

THAILAND REGIONAL AGRICUTLURE INNOVATION NETWORK (RAIN)
BASELINE SURVEY QUESTIONNAIRE

IDENTIFICATION, ELIGIBILITY AND CONSENT

01 BENEFICIARY IDENTIFICATION NUMBER . . . . . | | | | | | | | | | | | | | |

02 CLUSTER NUMBER . . . . . | | | | | | | | | | | | | | |

03 VILLAGE NAME AND CODE [MUBAN] _____ | | | | | | | | | | | | | | |

04 SUB-DISTRICT [TAMBON] _____ | | | | | | | | | | | | | | |

05 DISTRICT [AMPHOE] _____ | | | | | | | | | | | | | | |

06 PROVINCE [CHANGWAT] _____ | | | | | | | | | | | | | | |

07 GPS COORDINATES OF HOUSEHOLD

07a LATITUDE . . . . . | | | | | | | ° | | | ` | | | "

07b LONGITUDE . . . . . | | | | | | | ° | | | ` | | | "

07 INTERVIEWER VISITS

TIME STAMP

DAY				
MONTH				
YEAR	2	0	2	3
INT. NO.				

TOTAL NUMBER OF VISITS | |

RESULT* | |

*RESULT CODES:
- 01 COMPLETED
- 02 FARMER ABSENT/AWAY FOR EXTENDED PERIOD OF TIME
- 03 POSTPONED/UNAVAILABLE
- 04 REFUSED
- 05 PARTIAL COMPLETE

08 INFORMED CONSENT

OBTAIN THE INFORMED CONSENT OF THE FARMER.

Hello. My name is _____ from Rapid Asia. We are conducting a survey on behalf of Winrock International to improve that is implementing the Regional Agriculture Innovation Network (RAIN) project funded by the United States Department of Agriculture. This project aims to increase agriculture production through climate smart innovations. We are conducting this survey to learn about agriculture practices, technology use, and agriculture production for select crops such as rice, cassava, mangosteen, longan, coconut, durian.

The interview will take around 30-45 minutes. Your participation is voluntary. If you agree to participate, you can choose to stop at any time. Private information like your name will not be shared with anyone and will be removed after analysis. Data collected will be aggregated in a report, but no information will be shared that can link you to the study. Do you have any questions?

If you have any questions or concerns regarding the survey or the interview, we welcome you to contact Mr. Toru Hisada at 662-231-8181.

9a. Are you willing to participate in the interview? ☐ YES=1 ☐ NO=2

INTERVIEWER _____ NAME | | | | | NUMBER

IF THE FARMER AGREES TO PARTICIPATE IN THE BASELINE EVALUATION, READ THE FOLLOWING CONSENT

Thank you for agreeing to participate in the interview. For the RAIN project, Winrock International will select farmers to provide climate smart innovation services, financial services, and trainings to improve crop production. To provide these services, can we contact you in the future to see if you would be interested in participating in the RAIN project and/or a follow-up interview.

If you have any questions or concerns regarding future participation or interview, we welcome you to contact Mr. Supol Singhapoom at 087-592-6319.

9b. Can Winrock recontact you in the future to participate in the RAIN project? ☐ YES=1 ☐ NO=2

IF THE FARMER AGREES TO PARTICIPATE IN FUTURE ACTIVITIES, ASK FOR THE CONTACT INFORMATION, OTHERWISE PROCEED TO Q.10

9c. Thank you for agreeing to participate in future activities. Could you please provide your address and phone number that can be used to contact you in the future?

ADDRESS: _____

_____

PHONE NO. _____

09 FARMER IDENTIFICATION - DEMOGRAPHIC INFORMATION

QUESTIONS	CODING CATEGORIES
10 CONFIRM NAME OF THE FARMER	11 ENTER SEX OF THE FARMER ☐☐ (01=MALE, 02 = FEMALE)
12 What is your age?	☐☐ (IN YEARS)
13 What is the highest level and grade you completed? [USE CODES BELOW FOR LEVEL AND GRADE] **LEVEL** PRESCHOOL, ENTER 0 ELEMENTARY/PRATHOM, ENTER 1 SECONDARY/MATTHAYOM, ENTER 2 HIGHER, ENTER 4 **GRADE** LESS THAN ONE YEAR COMPLETED, ENTER 0 PRATHOM, ENTER 1-6 MATTHAYOM, ENTER 1-6	☐ ☐☐ LEVEL GRADE
14 What language do you speak? CIRCLE LANGUAGE	THAI . . . . . 1 CHINESE . . . . . 2 BURMESI . . . . . 3 KHMER . . . . . 4 MALAY . . . . . 5 ENGLISH . . . . . 6 OTHER . . . . . 7 (SPECIFY)_____
15 What is your religion?	BUDDHISM . . . . . 1 ISLAM . . . . . 2 CHRISTIANITY . . . . . 3 OTHER . . . . . 7 (SPECIFY)_____
16 CONFIRM COMMODITY CULTIVATED BY [NAME] In the past 12 months did you cultivate the following crops: a) Rice? b) Cassava? c) Mangosteen? d) Longan? e) Durian? f) Coconut? g) Any other? IF YES, which crop did you cultivate in the past 12 months?	A RICE ☐☐ B CASSAVA ☐☐ C MANGOSTEEN ☐☐ D LONGAN ☐☐ E DURIAN ☐☐ F COCONUT ☐☐ G ANY OTHER ☐☐ (01=YES, 02=NO) → IF YES OR '01' FOR ANY CROPS (A—H), PROCEED TO THE NEXT MODULE (1A) → IF NO OR '02' FOR ANY CROPS (A—H), THANK RESPONDENT AND END INTERVIEW _____ (SPECIFY)

MODULE 1A. HOUSEHOLD SIZE, LAND AREA, SHOCKS AND STRESSORS

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES
100	Including yourself, how many people usually live in this household?	ENTER NUMBER OF HH MEMBERS . . . . . [ ][ ]
101	CHECK 100, IF ONLY THE FARMER LIVES IN THE HOUSEHOLD (ENTERED '01') THEN SKIP TO 103, OTHERWISE CONTINUE.	
102	How many people in your household were responsible for cultivating [CROP] in the past one year?	ENTER NUMBER OF HH MEMBERS RESPONSIBLE FOR CULTIVATING [CROP] . . . . . [ ][ ]
103	How many years of farming experience do you have?	YEARS . . . . . [ ][ ]
104	How many rai of total agricultural land does your household farm (include land that is owned, rented and leased)? USING THE FARM DIAGRAM, ASK FOR THE SIZE OF THE TOTAL LAND FARMED BY THE HOUSEHOLD	UNIT RAI . . . . . [ ][ ][ ][ ]
105	What is the **total** land area (in rai) that your household cultivates [CROP] on your farm? USING THE FARM DIAGRAM, ASK FOR THE AREA OF THE PLOT(S) USED FOR CULTIVATION OF [CROP]. INCLUDE ALL PLOTS REGARDLESS OF WHETHER THEY ARE CONTINGUOUS OR NOT.	UNIT RAI . . . . . [ ][ ][ ][ ]
106	Next I will ask you some questions about type of shocks and stressors or difficult times that farmers face as a result of climate or weather related problems.	
107	Thinking about the past 3 years, did your household face shocks, stressors or difficult times as a result of having too much rain or flooding?	YES . . . . . 1 NO 2
108	In the past 3 years, did your household face shocks and stressors or difficult times as a result of having too little rain or drought?	YES . . . . . 1 NO 2
109	In the past 3 years, did your household face shocks and stressors or difficult times as a result of too much heat, heat waves or higher than usual temperatures?	YES . . . . . 1 NO 2
110	In the past 3 years, did your household face shocks and stressors or difficult times as a result of too much cold, cold waves or lower than usual temperatures?	YES . . . . . 1 NO 2
111	In the past 3 years, did your household face shocks and stressors or difficult times as a result of storms?	YES . . . . . 1 NO 2
112	In the past 3 years, did your household face shocks and stressors or difficult times as a result of erosion of your soil?	YES . . . . . 1 NO 2
113	In the past 3 years, did your household face shocks and stressors or difficult times as a result of not being able to access or afford inputs for your crops?	YES . . . . . 1 NO 2
114	In the past 3 years, did your household face shocks and stressors or difficult times as a result of disease affecting your crops?	YES . . . . . 1 NO 2
115	In the past 3 years, did your household face shocks and stressors or difficult times as a result of pests affecting your crops?	YES . . . . . 1 NO 2
116	In the past 3 years, did your household face shocks and stressors or difficult times as a result of not being able to sell the crops your household produces for a fair price?	YES . . . . . 1 NO 2

MODULE 2. RICE

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	
	CHECK FARMER ROSTER ITEM 16 TO CONFIRM IF THE FARMER IS ELIGIBLE TO RESPOND TO MODULE 2 - RICE. ADMINISTER THIS QUESTIONNAIRE TO THE ELIGIBLE FARMER.		
200	Now, I will ask you about common agricultural practices and/or technology farmers use to cultivate rice. These questions refer to the past 12 months, therefore, think of the practices and/or technologies you have used in the past 12 months starting from today, that is from [MONTH] 2022 to [MONTH] 2023.		
VARIETIES AND HARVEST - YIELD LOSS AND SALES			
201	In the past 12 months, what type of rice did you cultivate? SELECT ALL THAT APPLY	KDML 105 . . . . . A RD15 . . . . . B RD 6 . . . . . C PATUMTHANI 1 . . . . . D OTHER (SPECIFY) _____ X	
202	Now, tell me the times when you harvested rice in the past 12 months. Please provide the month for start of the harvest and end of the harvest starting with the most recent harvest. INTERVIEWER: ADD CORRESPONDING YEAR '23' FOR 2023 AND '22' FOR 2022 FOR START OF EACH HARVEST **CODES FOR MONTHS:** JANUARY ..... 01 JULY ..... 07 FEBRUARY ..... 02 AUGUST ..... 08 MARCH ..... 03 SEPTEMBER ..... 09 APRIL ..... 04 OCTOBER ..... 10 MAY ..... 05 NOVEMBER ..... 11 JUNE ..... 06 DECEMBER 12	START MONTH / END MONTH / YEAR LAST HARVEST [ ][ ] [ ][ ] [ ][ ] SECOND TO LAST HARVEST [ ][ ] [ ][ ] [ ][ ] THIRD TO LAST HARVEST [ ][ ] [ ][ ] [ ][ ] DON'T KNOW . . . . . Y	
203	How much wet rice did you harvest in the past 12 months, starting with the most recent harvest? Please provide the wet rice production volume (as harvested in kgs or metric tons) for the total land area harvested. INTERVIEWER: SHOW THE FARM AREA MAP TO THE FARMER.	LAST HARVEST [ ][ ][ ] . [ ] SECOND TO LAST HARVEST [ ][ ][ ] . [ ] THIRD TO LAST HARVEST [ ][ ][ ] . [ ] CIRCLE UNIT KG . . . . . 1 TON . . . . . 2 DON'T KNOW . . . . . Y	
204	Did you experience any production loss for rice?	YES . . . . . 1 NO 2	→ 207
205	How much of the harvested rice was lost during production?	AMOUNT [ ][ ][ ] . [ ] CIRCLE UNIT KG . . . . . 1 TON . . . . . 2 DON'T KNOW . . . . . Y	
206	What were the reasons for production loss for your rice?	DROUGHT . . . . . A FLOODS . . . . . B OTHER EXTREME NATURAL EVENTS C	

	QUESTIONS AND FILTERS	CODING CATEGORIES	
	SELECT ALL THAT APPLY	PEST . . . . . D DISEASE . . . . . E UNPREDICTED WEATHER PATTERN F OTHER (SPECIFY) _____ X DON'T KNOW . . . . . Y	
207	Did you grow rice crop: To provide food for the household? To be sold or traded in the market? Both for food and for the market?	GROWN FOR FOOD ONLY . . . . . 1 GROWN FOR MARKET ONLY . . . . . 2 GROWN FOR BOTH FOOD & MARKE . . . . . 3 OTHER (SPECIFY) _____ 6	→ 209
208	How much of the harvested rice was consumed by your household? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	[ ][ ][ ] . [ ] KG . . . . . 1 TON . . . . . 2 QUANTITY UNIT	
209	Did you sell any of the rice from the past 12 months?	YES . . . . . 1 NO 2	→ 215
210	How much of the total harvested rice did you sell in the past 12 months? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	[ ][ ][ ] . [ ] KG . . . . . 1 TON . . . . . 2 QUANTITY UNIT	
211	Farmers sell their harvested rice in different forms such as wet rice or dry rice (with or without husk). How did you sell your [CROP]? SELECT ALL THAT APPLY	WET RICE . . . . . A DRY RICE WITH HUSK . . . . . B DR DRY RICE WITH HUSK . . . . . C OTHER (SPECIFY) _____ X	
212	How much money did you receive after selling the rice this past 12 months? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	AMOUNT IN THAI BAHT [ ][ ][ ][ ]	
213	Did you experience any loss in profit of rice in the past 12 months?	YES . . . . . 1 NO 2	
214	Where did sell rice and who was the main buyer of your harvested rice in the past 12 months? INTERVIEWER: FARM-GATE SALES ARE WHEREBY FARMERS SELL PRODUCE DIRECTLY TO THE CONSUMER SELECT ALL THAT APPLY	RELATIVE/FRIEND . . . . . A AT THE FARM GATE . . . . . B LOCAL MARKET/TO A LOCAL BUYER . . . . . C LOCAL COMPANY . . . . . D TO AN INTERMEDIARY OR A BROKE . . . . . E TO A PRIVATE TRADER/OFFTAKER . . . . . F TO A COOPERATIVE OR AN AG COOPERATIV . . . . . G TO A SUPERMARKET . . . . . H TO AN EXPORT COMPAN . . . . . I TO THE MIDDLEMAN DEPOT OR THE COLLECTOR HUB SUCH AS LHONG . . . . . J OTHER (SPECIFY) _____ X	
215	Why did you not sell your rice in the past 12 months?	ONGOING HARVEST . . . . . A DELAYED HARVEST . . . . . B DELAYED PROCESING (DRYING, MILLING) . . . . . C LAND ONERSHIP ISSUES . . . . . D SATURATED MARKET . . . . . E OTHER (SPECIFY) _____ X	

	QUESTIONS AND FILTERS	CODING CATEGORIES	
LAND PREPARATION			
216	What kind of land preparation did you use for the rice you planted in the past 12 months? SELECT ALL THAT APPLY	NONE . . . . . A ZERO TILLAGE/NO PLOUGHING . . . . . B REDUCED TILLAGE . . . . . C USE OF TILLING/PLOUGHING . . . . . D LAND LEVELING . . . . . E LASER LAND LEVELING . . . . . F OTHER (SPECIFY) _____ X	
217	CHECK 216: DID RESPONDENT USE ZERO TILLAGE METHODS TO PREPARE THE LAND?	YES . . . . . 1 NO 2	→ 219
218	What kind of zero tillage system did you use on the land where you planted paddy rice? SELECT ALL THAT APPLY	SLASH AND PLANT . . . . . A BURN AND PLANT . . . . . B HERBICIDE AND PLAN . . . . . C OTHER (SPECIFY) _____ X	
PLANTING			
219	What was your main source of rice seed you used in the past 12 months?	OWN SAVED SEED, SEED FROM FRIEND/ RELATIVE (NOT PURCHASED . . . . . 01 BOUGHT FROM FRIEND/RELATI . . . . . 02 BOUGHT IN MARKET (NON-AG DEALER . . . . . 03 BOUGHT FROM AG GROU . . . . . 04 BOUGHT FROM AG DEALER WITH CAS . . . . . 05 BOUGHT FROM AG DEALER WITH VOUCH . . . . . 06 BOUGHT FROM AG DEALER WITH CRE . . . . . 07 AID DISTRIBUTION . . . . . 08 OTHER (SPECIFY) _____ 96	
220	What type(s) of rice seed did you plant in the past 12 months? SELECT ALL THAT APPLY	OWN SAVED SEEDS . . . . . A IMPROVED VARIETIES . . . . . B DON'T KNOW . . . . . Y	→ 223
221	CHECK 220: DID RESPONDENT SELECT MORE THAN ONE TYPE OF SEED?	YES . . . . . 1 NO 2	→ 223
222	Would you say that most of the rice seed you planted was traditional, local seed, or was it modern, improved seed?	MOSTLY MODERN/IMPROVED SEED . . . . . 1 ABOUT HALF TRADITIONAL/HALF IMPROVED . . . 2 DON'T KNOW 8	
223	How did you sow rice seed in the past 12 months? a) Direct seedling b) Transplanting seedling? c) Broadcasting with dried seed? d) Broadcasting with seedling? Any other technique? IF YES: How did you sow rice seed?	YES NO A) DIRECT SEEDIN . . . . . 1 2 B) TRANSPLANTING SEEDLINGS . . . . . 1 2 C) BROADCASTING WITH DRIED SEED . . . . . 1 2 D) BROADCASTING WITH SEEDLIN . . . . . 1 2 X) OTHER (SPECIFY) _____ 1 2	
IRRIGATION SYSTEM AND WATER MANAGEMENT			
224	Besides rainfall, did you use any additional irrigation methods for the paddy rice?	YES . . . . . 1 NO 2	→ 216
225	What source of water did you use for planting rice? SELECT ALL THAT APPLY	NATURAL SOURCE (CANAL, RESERVOIR) . . . . . A IRRIGATION SOURCE (IRRIGATION CANAL . . . . . B RAIN . . . . . C OWN POND . . . . . D COMMUNITY POND . . . . . E OTHER (SPECIFY) _____ X	

	QUESTIONS AND FILTERS	CODING CATEGORIES	
226	How do you gather water from the source for your paddy rice? SELECT ALL THAT APPLY	ELECTRIC PUMI . . . . . A SOLAR PUMP . . . . . B DISEL PUMP . . . . . C WATER TRUCK . . . . . D GRAVITY . . . . . E OTHER (SPECIFY) _____ X	
227	Still thinking about the past 12 months, what type of irrigation did you use on your paddy rice? SELECT ALL THAT APPLY	DRIP IRRIGATION . . . . . A SPRINKLE/NOZZLE . . . . . B FURROW/SURFACE IRRIGATIOI . . . . . C OTHER (SPECIFY) _____ X	
228	Did you practice alternate wetting and drying in the past 12 months for your paddy rice?	YES . . . . . 1 NO 2	
SOIL AND NUTRIENT MANAGEMENT			
229	In the past 12 months, did you use any of the following practices to improve soil fertility for your paddy rice? a) Composting? b) Mulching (soil covering)? c) Intercropping? d) Crop rotation? Any other?	YES NO A) COMPOSTING . . . . . 1 2 B) MULCHING (SOIL COVERING) . . . . . 1 2 C) INTERCROPPIN(. . . . . 1 2 D) CROP ROTATIOI . . . . . 1 2 X) OTHER (SPECIFY) _____ 1 2	
230	CHECK 229: DID RESPONDENT SELECT '1' OR 'YES' FOR 'D) CROP ROTATION?	YES . . . . . 1 NO 2	→ 232
231	Over the past planting season, what type of crop(s) did you use for crop rotation with your paddy rice? SELECT ALL THAT APPLY	LEGUME . . . . . A CASH CROP . . . . . B NON-CASH CROP . . . . . C OTHER (SPECIFY) _____ X	
232	Did you apply fertilizer to the paddy rice in the past 12 months?	YES . . . . . 1 NO 2	→ 240
233	Did you use fertigation for your paddy rice in the 12 months?	YES . . . . . 1 NO 2	
234	What type of fertilizer did you use? SELECT ALL THAT APPLY	SOIL BASED ORGANIC . . . . . A SOIL BASED NON-ORGANIC OR CHEMICA . . . . . B OTHER (SPECIFY) _____ X	→ 239
235	Did you apply green manure fertilizer to your rice fields in the past 12 months? Green manure are plants sow to cover bare soil to prevent growth of weeds and their roots inhibit soil erosion. Some examples inlcude, legumes such as clover, beans, peas, cowpea; grasses such as ryegrass, oats, rapeseed, winter wheat, winter rye; and lablab.	YES . . . . . 1 NO 2	
236	Did you apply animal manure to your rice fields in the past 12 months?	YES . . . . . 1 NO 2	
237	Did you apply biochar as a type of fertilizer to your paddy rice?	YES . . . . . 1 NO 2	
238	How many tons of bio fertilizer (organic matters) did you use in the past season for your paddy rice?	TONS ☐☐.☐	

	QUESTIONS AND FILTERS	CODING CATEGORIES	
239	A sack of chemical fertilizers is 50 kilograms. How many sacks of chemical fertilizers did you use in the past season?	NUMBER OF SACKS ☐☐☐.☐	
240	Are you trained on how to use inorganic or chemical fertilizer for your paddy rice?	YES . . . . . 1 NO 2	
241	Have you tested the soil for fertility? Would you say in the past 12 months, more than a year ago, or never tested the soil for fertility?	YES, IN THE PAST 12 MONTHS 1 YES, MORE THAN A YEAR AGO 2 NO, NEVER TESTED SOIL FOR FERTILITY 3	→ 245
242	How did you test the soil for fertility?	RAPID SOIL TEST 1 SENT TO THE PRIVATE LAB 2 SENT TO THE GOVERNMENT LAB 3	
243	Who conducted testing to measure soil fertility? SELECT ALL THAT APPLY	THAI GOVERNMENT . . . . . A TRAINING CENTER B RESEARCH CENTER C OTHER (SPECIFY) _____ X	
244	Have you used tailor made fertilizer according to the soil testing results?	YES . . . . . 1 NO 2	
CROP MANAGEMENT			
245	Did you have any bird, insect, rodent, or disease attacks on your paddy rice in the past 12 months?	YES . . . . . 1 NO 2	
246	Did you use pesticides or insecticides to control insect or rodents your rice paddy?	YES . . . . . 1 NO 2	
247	In the past 12 months, did you use a drone to spray pesticides?	YES . . . . . 1 NO 2	
248	Have you been trained on how to apply pesticides for paddy rice?	YES . . . . . 1 NO 2	
249	Did you use any herbicides to control disease attacks on your paddy rice?	YES . . . . . 1 NO 2	
250	Have you ever received training on how to apply herbicides for your paddy rice?	YES . . . . . 1 NO 2	
251	In the past 12 months, how did you control the weeds among your paddy rice? SELECT ALL THAT APPLY	HERBICIDE . . . . . A INTERCROPPING . . . . . B MANUAL WEEDING . . . . . C OTHER (SPECIFY) _____ X	
252	In the past 12 months have you used any of Information and Communication Technologies (ICT) applications to manage production of your paddy rice?	YES . . . . . 1 NO 2	→ 254
253	In the past 12 months, did you use any of the following Information and Communication Technologies (ICT) applications to manage your paddy rice? a) Ricebot line group? b) Crop Health/farm health using drone & satellite imagery? c) Kasettrack? x) Any other crop management mobile application?	YES NO A) RICEBOT LINE GROUP 1 2 B) CROP HEALTH/ FARM MONITORING USING DRONE & SATELLITE IMAGERY 1 2 C) KASETTRACK 1 2 X) OTHER MOBILE APP (SPECIFY) _____ 1 2	
WEATHER & CLIMATE INFORMATION SYSTEM			

	QUESTIONS AND FILTERS	CODING CATEGORIES	
254	Do you have access to and use any weather information to inform your agricultural planning?	YES . . . . . 1 NO 2	
255	Do you have access to any early warning systems or information about extreme climate shocks?	YES . . . . . 1 NO 2	
HARVEST & POST-HARVEST HANDLING			
256	Did you use a combine harvester to harvest your paddy rice in the past 12 months?	YES . . . . . 1 NO 2	
257	In the past 12 months, did you use a straw bailing machine?	YES . . . . . 1 NO 2	
258	Did you thresh your paddy rice?	YES . . . . . 1 NO 2	→ 260
259	After threshing the rice, what was done with the straw? SELECT ALL THAT APPLY	BURNED . . . . . A INCORPORATED BACK INTO THE SOIL . . . . . B USED AS BEDDING FOR OWN LIVESTOCK . . C LEFT IN FIELD FOR GRAZING BY ANIMALS . . D FED TO OWN ANIMALS . . . . . E SOLD TO OTHERS . . . . . F USED FOR BAILING . . . . . G OTHER (SPECIFY) _____ X	
260	Did you dry any of your paddy rice harvest before sale or use?	YES . . . . . 1 NO 2	→ 262
261	What did you dry the paddy rice on? SELECT ALL THAT APPLY	BARE GROUND . . . . . A GROUND PLASTERED WITH COW DUNG . . . . . B LEFT TO DRY ON PLANT IN FIELD . . . . . C TARPAULINS . . . . . D DRYING YARD WITH CEMENTED GROUND . . E DRYING RACKS . . . . . F SOLAR DRYERS . . . . . G MECHANIZED DRYERS . . . . . H OTHER (SPECIFY) _____ X	
262	Did you store the paddy rice in bags or other containers after harvest for storage or transport? SELECT ALL THAT APPLY	YES, IN BUCKETS . . . . . A YES, IN DRUMS . . . . . B YES, IN BAGS . . . . . C NO . . . . . D	→ 264 → 264
263	What type of storage bag did you use for the paddy rice? SELECT ALL THAT APPLY	WOVEN BAG, SINGLE LAYER . . . . . A TWO- OR THREE-LAYERED WOVEN BAGS . . B HERMETIC THREE LAYERED BAGS OR PICS BAGS C	
264	In the past 12 months, did you use a community rice mini mill?	YES . . . . . 1 NO 2	→ 266
265	Did you do anything with the rice husk after milling? SELECT ALL THAT APPLY	YES, USED FOR ANIMAL FEED A YES, PRODUCED BIOCHAR B YES, SOLD THE HUSK C NO . . . . . D	
CERTIFICATION			
266	Is your farm certified according to standards such as follows: a) Global Agricultural Practice (GAP) b) Sustainable Rice Platform (SRP) c) Organic d) Fairtrade Any other? SELECT ALL THAT APPLY	YES NO A) GLOBAL AGRICULTURAL PRACTICES (GAP 1 2 B) SUSTAINABLE RICE PLATFORM . . . . . 1 2 C) ORGANIC . . . . . 1 2 D) FAIRTRADE . . . . . 1 2 X) OTHER (SPECIFY) _____ 1 2	

MODULE 3. CASSAVA

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
	CHECK FARMER ROSTER ITEM 16 TO CONFIRM IF THE FARMER IS ELIGIBLE TO RESPOND TO MODULE 3 - CASSAVA. ADMINISTER THIS QUESTIONNAIRE TO THE ELIGIBLE FARMER IN THE HOUSEHOLD.		
300	Now, I will ask you about common agricultural practices and/or technology farmers use to cultivate cassava. These questions refer to the past 12 months, therefore, think of the practices and/or technologies you have used in the past 12 months starting from today, that is from [MONTH] 2022 to [MONTH] 2023.		
VARIETIES AND HARVEST - YIELD LOSS AND SALES			
301	What varieties of cassava did you cultivate? SELECT ALL THAT APPLY	KASETSART 50 OR KU50 ..... A RAYONG 72 OR R 72 ..... B HB60 ..... C OTHER (SPECIFY) _____ X	
302	Now, tell me the times when you harvested cassava in the past 12 months. Please provide the month for start of the harvest and end of the harvest. INTERVIEWER: ADD CORRESPONDING YEAR '23' FOR 2023 AND '22' FOR 2022 FOR START OF THE LAST HARVEST **CODES FOR MONTHS:** JANUARY ..... 01 JULY ..... 07 FEBRUARY ..... 02 AUGUST ..... 08 MARCH ..... 03 SEPTEMBER ..... 09 APRIL ..... 04 OCTOBER ..... 10 MAY ..... 05 NOVEMBER ..... 11 JUNE ..... 06 DECEMBER 12	START MONTH END MONTH YEAR LAST HARVEST ☐☐ ☐☐ ☐☐ DON'T KNOW ..... Y	
303	How much fresh cassava did you harvest in the past 12 months? Please provide the fresh cassava production volume (as harvested in kgs or metric tons) for the total land area harvested. INTERVIEWER: SHOW THE FARM AREA MAP TO THE FARMER.	LAST HARVEST ☐☐☐.☐ CIRCLE UNIT KG ..... 1 TON ..... 2 DON'T KNOW ..... Y	
304	Did you experience any production loss for cassava?	YES ..... 1 NO 2	→ 307
305	How much of the harvested fresh cassava was lost during production?	AMOUNT ☐☐☐.☐ CIRCLE UNIT KG ..... 1 TON ..... 2 DON'T KNOW ..... Y	
306	What were the reasons for production loss for your fresh cassava? SELECT ALL THAT APPLY	DROUGHT ..... A FLOODS ..... B OTHER EXTREME NATURAL EVENTS ..... C PEST ..... D DISEASE ..... E UNPREDICTED WEATHER PATTERN F OTHER (SPECIFY) _____ X DON'T KNOW ..... Y	
307	Did you grow cassava crop: To provide food for the household? To be sold or traded in the market? Both for food and for the market?	GROWN FOR FOOD ONLY ..... 1 GROWN FOR MARKET ONLY ..... 2 GROWN FOR BOTH FOOD & MARKET ..... 3 OTHER (SPECIFY) _____ 6	→ 309
308	How much of the harvested cassava was consumed by your household? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	☐☐☐.☐ KG ..... 1 TON ..... 2 QUANTITY UNIT	
309	Did you sell any of the cassava from the past 12 months?	YES ..... 1 NO 2	→ 315

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
310	How much of the total harvested cassava did you sell in the past 12 months? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	☐☐☐.☐ QUANTITY KG ..... 1 TON ..... 2 UNIT	
311	Farmers sell their harvested cassava in different forms such as fresh cassava leaves or roots, dried cassava leaves or roots, cassava pellets, cassava flour or starch, cassava chips or crunchy, etc. How did you sell your cassava? SELECT ALL THAT APPLY	FRESH CASSAVA LEAVES/ROOTS A DRIED CASSAVA LEAVES/ROOTS B CASSVA PELLETS C CASSAVA FLOUR/STARCH D CASSAVA CHIPS/CRUNCHY E OTHER (SPECIFY) _____ X	
312	How much money did you receive after selling the cassava this past 12 months? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	AMOUNT IN THAI BAHT ☐☐☐☐	
313	Did you experience any loss in profit of cassava in the past 12 months?	YES ..... 1 NO 2	
314	Where did sell cassava and who was the main buyer of your cassava in the past 12 months? INTERVIEWER: FARM-GATE SALES ARE WHEREBY FARMERS SELL PRODUCE DIRECTLY TO THE CONSUMER SELECT ALL THAT APPLY	RELATIVE/FRIEND ..... A AT THE FARM GATE B LOCAL MARKET/TO A LOCAL BUYER C LOCAL COMPANY D TO AN INTERMEDIARY OR A BROKER E TO A PRIVATE TRADER/OFFTAKER F TO A COOPERATIVE OR AN AG COOPERATIVE G TO A SUPERMARKET H TO AN EXPORT COMPANY I TO THE MIDDLEMAN DEPOT OR THE COLLECTOR HUB SUCH AS LHONG J OTHER (SPECIFY) _____ X	
315	Why did you not sell your cassava in the past 12 months?	ONGOING HARVEST ..... A DELAYED HARVEST B DELAYED PROCESING (DRYING, MILLING) C LAND ONERSHIP ISSUES D SATURATED MARKET E OTHER (SPECIFY) _____ X	
LAND PREPARATION			
316	What kind of land preparation did you use for the cassava you planted in the past 12 months? SELECT ALL THAT APPLY	NONE . A ZERO TILLAGE/NO PLOUGHING B REDUCED TILLAGE C USE OF TILLING/PLOUGHING D LAND LEVELING E LASER LAND LEVELING F OTHER (SPECIFY) _____ X	
317	CHECK 316: DID RESPONDENT USE ZERO TILLAGE METHODS TO PREPARE THE LAND?	YES ..... 1 NO 2	→ 319
318	What kind of zero tillage system did you use on the land where you planted cassava? SELECT ALL THAT APPLY	SLASH AND PLANT ..... A BURN AND PLANT ..... B HERBICIDE AND PLANT ..... C OTHER (SPECIFY) _____ X	
PLANTING			
319	In the past 12 months, did you plant cassava seed or cassava stem? SELECT ALL THAT APPLY	SEED CASSAVA A CASSAVA CUTTINGS ..... B	
320	In the past 12 months, what was your main source of cassava seed/stem?	OWN SAVED SEED, SEED/STEM FROM FRIEND/ RELATIVE (NOT PURCHASED) ..... 01 BOUGHT FROM FRIEND/RELATIVE ..... 02 BOUGHT IN MARKET (NON-AG DEALER) ..... 03 BOUGHT FROM AG GROUP 04	

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
		BOUGHT FROM AG DEALER WITH CASH ..... 05 BOUGHT FROM AG DEALER WITH VOUCHER .. 06 BOUGHT FROM AG DEALER WITH CREDIT 07 AID DISTRIBUTION ..... 08 OTHER (SPECIFY) _____ 96	
321	What type of cassava seed/stem did you plant in the past 12 months? SELECT ALL THAT APPLY	UNIMPROVED LOCAL VARIETIES ..... A IMPROVED VARIETIES ..... B DON'T KNOW ..... Y	
322	Are varieties of cassava that you plant drought resistant?	YES ..... 1 NO 2	
323	Are varieties of cassava that you plant resistant to disease such as mosaic or witches' broom disease?	YES ..... 1 NO 2	
IRRIGATION AND WATER MANAGEMENT			
324	Besides rainfall, did you use any additional irrigation methods for cassava?	YES ..... 1 NO 2	→ 328
325	What type of irrigation did you use? SELECT ALL THAT APPLY	NATURAL SOURCE (CANAL, RESERVOIR) A IRRIGATION SOURCE (IRRIGATION CANAL) B RAIN C OWN POND D COMMUNITY POND E OTHER (SPECIFY) _____ X	
326	How do you gather water from the source for your cassava? SELECT ALL THAT APPLY	ELECTRIC PUMP A SOLAR PUMP B DISEL PUMP C WATER TRUCK D GRAVITY E OTHER (SPECIFY) _____ X	
327	Still thinking about the past 12 months, what type of irrigation did you use? SELECT ALL THAT APPLY	DRIP IRRIGATION A SPRINKLE/NOZZLE B FURROW/SURFACE IRRIGATION C OTHER (SPECIFY) _____ X	
SOIL AND NUTRIENT MANAGEMENT			
328	In the past 12 months, did you use any of the follow practices to improve soil fertility for your cassava? a) Composting? b) Mulching (soil covering)? c) Intercropping? d) Crop rotation? Any other?	YES NO A) COMPOSTING ..... 1 2 B) MULCHING (SOIL COVERING) ..... 1 2 C) INTERCROPPING .. 1 2 D) CROP ROTATION 1 2 X) OTHER (SPECIFY) _____ 1 2	
329	CHECK 328: DID RESPONDENT SELECT '1' OR 'YES' FOR 'D) CROP ROTATION?	YES ..... 1 NO 2	→ 331
330	Over the past two planting seasons, what type of crops did you use for crop rotation with your cassava? SELECT ALL THAT APPLY	LEGUME ..... A CASH CROP ..... B NON-CASH CROP C	
331	Did you apply fertilizer to cassava in the past 12 months?	YES ..... 1 NO 2	→ 334
332	Did you use fertigation for your cassava farm in the past 12 months?	YES ..... 1 NO 2	
333	What type of fertilizer did you use in the past 12 months? SELECT ALL THAT APPLY	SOIL BASED ORGANIC ..... A SOIL BASED NON-ORGANIC OR CHEMICAL B → 338 FOLIAR FEEDS ORGANIC ..... C FOLIAR FEEDS NON-ORGANIC OR CHEMICAL D → 338 OTHER (SPECIFY) _____ X	
334	Did you apply green manure to your cassava fields in the past 12 months? Green manure are plants sow to cover bare soil to prevent growth of weeds and		

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
	their roots inhibit soil erosion. Some examples inlcude, legumes such as clover, beans, peas, cowpea; grasses such as ryegrass, oats, rapeseed, winter wheat, winter rye; and lablab.	YES . . . . . 1 NO 2	
335	Did you apply animal manure to your cassava fields in the past 12 months?	YES . . . . . 1 NO 2	
336	Did you apply biochar as a type of fertilizer to your cassava?	YES . . . . . 1 NO 2	
337	How many tons of bio fertilizer (organic matters) did you used in the past season for your cassava?	TONS ☐☐ . ☐	
338	A sack of chemical fertilizers is 50 kilograms. How many sacks of chemical fertilizers did you use in the past season.	NUMBER OF SACKS ☐☐☐ . ☐	
339	Have you been trained in how to use inorganic (not organic) fertilizer for cassava?	YES . . . . . 1 NO 2	
340	Organic fertilizer includes things like manure or compost. Have you been trained in how to use organic fertilizer for cassava?	YES . . . . . 1 NO 2	
341	Have you tested the soil for fertility? Would you say in the past 12 months, more than a year ago, or never tested the soil for fertility?	YES, IN THE PAST 12 MONTHS 1 YES, MORE THAN A YEAR AGO 2 NO, NEVER TESTED SOIL FOR FERTILITY 3	→ 345
342	How did you test the soil for fertility?	RAPID SOIL TEST 1 SENT TO THE PRIVATE LAB 2 SENT TO THE GOVERNMENT LAB 3	
343	Who conducted testing to measure soil fertility? SELECT ALL THAT APPLY	THAI GOVERNMENT A TRAINING CENTER B RESEARCH CENTER C OTHER (SPECIFY) _____ X	
344	Have you used tailor made fertilizer according to the soil test results?	YES . . . . . 1 NO 2	
CROP MANAGEMENT			
345	Did you have any insect or rodent attacks or diseases for your cassava such as cassava mosaic and witches' broom in the past 12 months?	YES . . . . . 1 NO 2	
346	Did you use chemicals to control insect, rodent, or disease attacks on the cassava?	YES . . . . . 1 NO 2	
347	In the past 12 months, did you use a drone to spray pesticides?	YES . . . . . 1 NO 2	
348	Have you been trained on how to apply pesticides for cassava?	YES . . . . . 1 NO 2	
349	Biological controls include things like beneficial insects, beneficial fungi, or beneficial bacteria that are used to manage pests that may attack your crops. Did you use biologicals to control insect, rodent, or disease attacks on the cassava?	YES . . . . . 1 NO 2	
350	Have you been trained on how to apply biologicals for cassava?	YES . . . . . 1 NO 2	
351	How did you control the weeds among your cassava crops in the past 12 months? SELECT ALL THAT APPLY	HERBICIDE . . . . . A INTERCROPPING . . . . . B MANUAL WEEDING C	

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
352	Have you ever been trained on how to apply herbicides for cassava crops?	YES . . . . . 1 NO 2	
353	In the past 12 months have you used any of Information and Communication Technologies (ICT) applications to manage production of your cassava?	YES . . . . . 1 NO 2	→ 355
354	In the past 12 months, did you use any of the following Information and Communication Technologies (ICT) applications to manage your cassava? a) Munbot line group? b) Crop Health/farm health using drone & satellite imagery? c) Smart farm management mobile application? x) Any other crop management mobile application?	YES NO A) MUNBOT LINE GROUP 1 2 B) CROP HEALTH/ FARM MONITORING USING DRONE & SATELLITE IMAGERY 1 2 C) SMART FARM MANAGEMENT MOBILE APPLICATION 1 2 X) OTHER MOBILE APP (SPECIFY) _____ 1 2	
WEATHER & CLIMATE INFORMATION SYSTEM			
355	Do you have access to and use any weather information to inform your agricultural planning?	YES . . . . . 1 NO 2	
356	Do you have access to any early warning systems or information about extreme climate shocks?	YES . . . . . 1 NO 2	
HARVEST & POST-HARVEST HANDLING			
357	After you harvest cassava what do you do with the crop residue or waste? SELECT ALL THAT APPLY	BURN IT . . . . . A INCORPORATE BACK INTO THE SOIL B PRODUCE BIOCHAR FOR SOIL AMENDMENT C LEFT IN THE FIELD FOR GRAZING BY ANIMALS D FED TO OWN ANIMALS . . . . . E SOLD TO OTHEI . . . . . F OTHER (SPECIFY) _____ X	
358	Do you have a drying facility at the farm?	YES . . . . . 1 NO 2	
359	Do you transport your cassava to the point of sales location by your own vehicle?	YES . . . . . 1 NO 2	
CERTIFICATION			
360	Is your farm certified according to standards such as: a) Global Agricultural Practice (GAP) c) Organic d) Fairtrade b) Other Sustainability standards x) Any other? SELECT ALL THAT APPLY	YES NO A) GLOBAL AGRICULTURAL PRACTICES ((1 2 B) ORGANIC . . . . . 1 2 C) FAIRTRADE . . 1 2 D) SUSTAINABLE STANDARDS . . 1 2 X) OTHER (SPECIFY) _____ 1 2	

MODULE 4. MANGOSTEEN

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
	CHECK FARMER ROSTER ITEM 16 TO CONFIRM IF THE FARMER IS ELIGIBLE TO RESPOND TO MODULE 4 - MANGOSTEEN. ADMINISTER THIS QUESTIONNAIRE TO THE ELIGIBLE FARMER.		
400	Now, I will ask you about common agricultural practices and/or technology farmers use to cultivate mangosteen. These questions refer to the past 12 months, therefore, think of the practices and/or technologies you have used in the past 12 months starting from today, that is from [MONTH] 2022 to [MONTH] 2023.		
VARIETIES AND HARVEST - YIELD LOSS AND SALES			
401	How many mangosteen trees in total do you have?	NUMBER OF TREES	
402	How many of your mangosteen trees produced fruit in the past one year?	NUMBER OF PRODUCING TREES	
403	How many varieties of mangosteen did you cultivate in the past 12 months?	VARIETIES CULTIVATED . . . . . DON'T KNOW 98	
404	Now, tell me the times when you harvested mangosteen in the past 12 months. Please provide the month for start of the harvest and end of the harvest starting with the most recent harvest. INTERVIEWER: ADD CORRESPONDING YEAR '23' FOR 2023 AND '22' FOR 2022 FOR START OF EACH HARVEST **CODES FOR MONTHS:** JANUARY ..... 01 FEBRUARY ..... 02 MARCH ..... 03 APRIL ..... 04 MAY ..... 05 JUNE ..... 06 JULY ..... 07 AUGUST ..... 08 SEPTEMBER ..... 09 OCTOBER ..... 10 NOVEMBER ..... 11 DECEMBER 12	START MONTH END MONTH YEAR LAST HARVEST DON'T KNOW . . . . . Y	
405	How much mangosteen did you harvest in the past 12 months? INTERVIEWER: SHOW THE FARM AREA MAP TO THE FARMER.	LAST HARVEST . CIRCLE UNIT KG . . . . . 1 TON . . . . . 2 DON'T KNOW . . . . . Y	
406	In the past 12 months, for how many days did you harvest your mangosteen?	DAYS DON'T KNOW . . . . . Y	
407	In the past 12 months, how much mangosteen did you pick every day for the total land area harvested? INTERVIEWER: SHOW THE FARM AREA MAP TO THE FARMER.	. CIRCLE UNIT KG . . . . . 1 TON . . . . . 2 DON'T KNOW . . . . . Y	
408	Did you experience any production loss for mangosteen?	YES . . . . . 1 NO 2	→ 411
409	How much of the harvested mangosteen was lost during production?	AMOUNT . CIRCLE UNIT KG . . . . . 1 TON . . . . . 2 DON'T KNOW . . . . . Y	
410	What were the reasons for production loss for your mangosteen? SELECT ALL THAT APPLY	DROUGHT . . . . . A FLOODS . . . . . B OTHER EXTREME NATURAL EVENTS . . . . . C PEST . . . . . D DISEASE . . . . . E UNPREDICTED WEATHER PATTERN F OTHER (SPECIFY) _____ X DON'T KNOW . . . . . Y	

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
411	Did you grow your mangosteen crop: a) For home consumption? b) To grow seedlings for sale? c) For processing and sale? d) For sale to the local or domestic market? e) For sale to the international or export market? Any other reason? IF YES: Why else did you grow your mangosteen crop?	YES NO A) GROWN FOR HOME CONSUMPTION 1 2 B) TO GROW SEEDLINGS FOR SAL . . 1 2 C) GROWN FOR PROCESSIN . . . . . 1 2 D) GROWN FOR LOCAL OR DOMESTIC MARKET . . . . . 1 2 E) GROWN FOR INTERNATIONAL OR EXPORT MARKET . . . . . 1 2 X) OTHER (SPECIFY) _____ 1 2	→ 413
412	How much of the harvested mangosteen was consumed by your household? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	[ ][ ][ ] . [ ] QUANTITY KG . . . . . 1 TON . . . . . 2 UNIT	
413	Did you sell any of the mangosteen from the past 12 months?	YES . . . . . 1 NO 2	→ 419
414	How much of the total harvested mangosteen did you sell in the past 12 months? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	[ ][ ][ ] . [ ] QUANTITY KG . . . . . 1 TON . . . . . 2 UNIT	
415	Farmers sell their harvested mangosteen in different forms such as young fruit, mature fruit, frozen, juice, paste, concentrate, sliced, dried, etc. How did you sell your [CROP]? SELECT ALL THAT APPLY	UNRIPENED/YOUNG FRUIT A RIPENED/MATURE FRUIT B FROZEN FRUIT C JUICE, PASTE, OR CONCENTRATE FROM FRUIT D SLICED AND DRIED E OTHER (SPECIFY) _____ X	
416	How much money did you receive after selling the mangosteen this past 12 months? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	AMOUNT IN THAI BAHT [ ][ ][ ][ ]	
417	Did you experience any loss in profit of mangosteen in the past 12 months?	YES . . . . . 1 NO 2	
418	Where did sell mangosteen and who was the main buyer of your harvested mangosteen in the past 12 months? INTERVIEWER: FARM-GATE SALES ARE WHEREBY FARMERS SELL PRODUCE DIRECTLY TO THE CONSUMER SELECT ALL THAT APPLY	RELATIVE/FRIEND . . . . . A AT THE FARM GATE B LOCAL MARKET/TO A LOCAL BUYER C LOCAL COMPANY D TO AN INTERMEDIARY OR A BROKER E TO A PRIVATE TRADER/OFFTAKER F TO A COOPERATIVE OR AN AG COOPERATIVE G TO A SUPERMARKET H TO AN EXPORT COMPANY I TO THE MIDDLEMAN DEPOT OR THE COLLECTOR HUB SUCH AS LHONG J OTHER (SPECIFY) _____ X	
419	Why did you not sell your mangosteen in the past 12 months?	ONGOING HARVEST . . . . . A DELAYED HARVEST B DELAYED PROCESING (DRYING, MILLING) C LAND ONERSHIP ISSUES D SATURATED MARKET E OTHER (SPECIFY) _____ X	
PLANTING			
420	What was your main source of mangosteen seedlings in the past 12 months?	BOUGHT FROM FRIEND/RELATIVE . . . . . 01 OWN NURSERY . . . . . 02 LOCAL NURSERY . . . . . 03 STRATIFIED SCHEME . . . . . 04 AG EXTENSION/GOVT INSTITUTION . . . . . 05 AID DISTRIBUTION 06	→ 424 → 424

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
		OTHER (SPECIFY) _____ 96 DON'T KNOW 98	
421	What type of mangosteen seedling did you plant in the past 12 months? SELECT ALL THAT APPLY	UNIMPROVED LOCAL VARIETIES ..... A IMPROVED/GRAFTED VARIETIES ..... B DON'T KNOW ..... Y	
IRRIGATION AND WATER MANAGEMENT			
422	Besides rainfall, did you use any additional irrigation methods for the mangosteen?	YES ..... 1 NO 2	→ 426
423	What type of irrigation did you use? SELECT ALL THAT APPLY	NATURAL SOURCE (CANAL, RESERVOIR) A IRRIGATION SOURCE (IRRIGATION CANAL) B RAIN C OWN POND D COMMUNITY POND E OTHER (SPECIFY) _____ X	
424	How do you get water from the source for your cassava? SELECT ALL THAT APPLY	ELECTRIC PUMP A SOLAR PUMP B DISEL PUMP C WATER TRUCK D GRAVITY E OTHER (SPECIFY) _____ X	
425	Still thinking about the past 12 months, what type of irrigation did you use? SELECT ALL THAT APPLY	DRIP IRRIGATION A SPRINKLE/NOZZLE B FURROW/SURFACE IRRIGATION C OTHER (SPECIFY) _____ X	
SOIL AND NUTRIENT MANAGEMENT			
426	In the past 12 months, did you use any of the follow practices to improve soil fertility for your mangosteen? a) Composting? b) Mulching (soil covering)? c) Intercropping? Any other?	YES NO A) COMPOSTING ..... 1 2 B) MULCHING (SOIL COVERING) ..... 1 2 C) INTERCROPPING .. 1 2 X) OTHER (SPECIFY) _____ 1 2	
427	Did you apply fertilizer to your mangosteen seedlings in the past 12 months?	YES ..... 1 NO 2	→ 430
428	Did you use fertigation for your mangosteen trees in the past 12 months?	YES ..... 1 NO 2	
429	What type of fertilizer did you use in the past 12 months? SELECT ALL THAT APPLY	SOIL BASED ORGANIC ..... A SOIL BASED NON-ORGANIC OR CHEMICAL B → 434 FOLIAR FEEDS ORGANIC ..... C FOLIAR FEEDS NON-ORGANIC OR CHEMICAL D → 434 OTHER (SPECIFY) _____ X	
430	Did you apply green manure to your mangosteen trees in the past 12 months? Green manure are plants sow to cover bare soil to prevent growth of weeds and their roots inhibit soil erosion. Some examples inlcude, legumes such as clover, beans, peas, cowpea; grasses such as ryegrass, oats, rapeseed, winter wheat, winter rye; and lablab.	YES ..... 1 NO 2	
431	Did you apply animal manure to your mangosteen trees in the past 12 months?	YES ..... 1 NO 2	
432	Did you apply biochar as a type of fertilizer to your mangosteen?	YES ..... 1 NO 2	
433	How many tons of bio fertilizer (organic matters) did you used in the past season for your mangosteen trees?	TONS ☐☐.☐	

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
434	A sack of chemical fertilizers is 50 kilograms. How many sacks of chemical fertilizers did you use in the past season.	NUMBER OF SACKS ☐☐☐.☐	
435	Have you been trained on how to use fertilizer for mangosteen trees?	YES . . . 1 NO . . . 2	
436	Do you prune your mangosteen trees?	YES . . . 1 NO . . . 2	→ 438
437	How often do you prune your mangosteen trees?	ONCE A YEAR . . . 1 ONCE EVERY TWO YEARS . . . 2 ONCE EVERY THREE YEARS . . . 3 LESS FREQUENTLY . . . 4	
438	Do you graft your mangosteen trees?	YES . . . 1 NO . . . 2	→ 440
439	How often do you graft your mangosteen trees?	ONCE A YEAR . . . 1 ONCE EVERY TWO YEARS . . . 2 ONCE EVERY THREE YEARS . . . 3 LESS FREQUENTLY . . . 4	
440	Have you tested the soil for fertility? Would you say in the past 12 months, more than a year ago, or never tested the soil for fertility?	YES, IN THE PAST 12 MONTHS 1 YES, MORE THAN A YEAR AGO 2 NO, NEVER TESTED SOIL FOR FERTILITY 3	→ 444
441	How did you test the soil for fertility?	RAPID SOIL TEST 1 SENT TO THE PRIVATE LAB 2 SENT TO THE GOVERNMENT LAB 3	
442	Who conducted testing to measure soil fertility? SELECT ALL THAT APPLY	THAI GOVERNMENT A TRAINING CENTER B RESEARCH CENTER C OTHER (SPECIFY) _____ X	
443	Have you used tailor made fertilizer according to the soil test results?	YES . . . 1 NO . . . 2	
CROP MANAGEMENT			
444	Did you have any bird, insect, rodent, or disease attacks on your mangosteen in the past 12 months?	YES . . . 1 NO . . . 2	
445	Did you use pesticides or insecticides to control insect or rodent for your mangosteen trees?	YES . . . 1 NO . . . 2	
446	In the past 12 months, did you use a drone to spray pesticides?	YES . . . 1 NO . . . 2	
447	Have you ever been trained on how to apply pesticides to your mangosteen trees?	YES . . . 1 NO . . . 2	
448	Did you use any herbicide to control disease attacks on your mangosteen trees?	YES . . . 1 NO . . . 2	
449	Have you been trained on when to use and how to apply herbicides for mangosteen trees?	YES . . . 1 NO . . . 2	
450	In the past 12 months, how did you control the weeds among your mangosteen trees? SELECT ALL THAT APPLY	HERBICIDE A INTERCROPPING B MANUAL WE . . . C OTHER (SPECIFY) _____ X	
451	In the past 12 months have you used any of Information and Communication Technologies (ICT) applications to manage production of your mangosteen trees?	YES . . . 1 NO . . . 2	→ 453
452	In the past 12 months did you use crop management mobile application to manage production of your mangosteen trees?	YES . . . 1 NO . . . 2	
WEATHER & CLIMATE INFORMATION SYSTEM			
453	Do you have access to and use any weather information to inform your	YES . . . 1	

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
	agricultural planning?	NO 2	
454	Do you have access to any early warning systems or information about extreme climate shocks?	YES . . . . . 1 NO 2	
HARVEST & POST-HARVEST HANDLING			
455	After you harvest mangosteen what do you do with the crop residue or waste? SELECT ALL THAT APPLY	BURN IT . . . . . A INCORPORATE BACK INTO THE SOIL B PRODUCE BIOCHAR FOR SOIL AMENDMENT C LEFT IN THE FIELD FOR GRAZING BY ANIMALS D FED TO OWN ANIMAL‘S . . . . . E SOLD TO OTHE . . . . . F OTHER (SPECIFY) X	
456	Do you grade your mangosteens?	YES . . . . . 1 NO 2	→ 458
457	How do you grade your mangosteens? SELECT ALL THAT APPLY	BY SHAPE A BY SIZE . . . . . B BY TEXTURE . . . . . C BY PHYSICAL APPEARANCE . . . . . D OTHER (SPECIFY) _____ X	
CERTIFICATION			
458	Is your farm certified according to standards such as follows: a) Global Agricultural Practice (GAP) b) Organic c) Fairtrade Any other? SELECT ALL THAT APPLY	YES NO A) GLOBAL AGRICULTURAL PRACTICES (GAP) 1 2 B) ORGANIC . . 1 2 C) FAIRTRADE . . 1 2 X) OTHER (SPECIFY) _____ 1 2	

MODULE 5. DURIAN

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
NO.	CHECK FARMER ROSTER ITEM 16 TO CONFIRM IF THE FARMER IS ELIGIBLE TO RESPOND TO MODULE 5 - DURIAN. ADMINISTER THIS QUESTIONNAIRE TO THE ELIGIBLE FARMER.		
AGRICULTURE PRACTICES AND TECHNOLOGIES			
500	Now, I will ask you about common agricultural practices and/or technology farmers use to cultivate durian. These questions refer to the past 12 months, therefore, think of the practices and/or technologies you have used in the past 12 months starting from today, that is from [MONTH] 2022 to [MONTH] 2023.		
NUMBER AND VARIETIES			
501	How many durian trees in total do you have?	NUMBER OF TREES	
502	How many of your durian trees produced fruit in the past one year?	NUMBER OF PRODUCING TREES	
503	In the past 12 months, what type or variety of durian did you cultivate? SELECT ALL THAT APPLY	EARLY MATURITY CHANEE . . . . . A MEDIUM MATURITY MONTHONG . . . . . B KAN YAO . . . . . C OTHER (SPECIFY) _____ 96 DON'T KNOW 98	
504	Now, tell me the times when you harvested durian in the past 12 months. Please provide the month for start of the harvest and end of the harvest starting with the most recent harvest. INTERVIEWER: ADD CORRESPONDING YEAR '23' FOR 2023 AND '22' FOR 2022 FOR START OF EACH HARVEST **CODES FOR MONTHS:** JANUARY ..... 01 FEBRUARY ..... 02 MARCH ..... 03 APRIL ..... 04 MAY ..... 05 JUNE ..... 06 JULY ..... 07 AUGUST ..... 08 SEPTEMBER ..... 09 OCTOBER ..... 10 NOVEMBER ..... 11 DECEMBER 12	START MONTH END MONTH YEAR LAST HARVEST DON'T KNOW . . . . . Y	
505	How much durian did you harvest in the past 12 months? INTERVIEWER: SHOW THE FARM AREA MAP TO THE FARMER.	LAST HARVEST . . CIRCLE UNIT KG . . . . . 1 TON . . . . . 2 DON'T KNOW . . . . . Y	
506	In the past 12 months, for how many days did you harvest your durian?	DAYS DON'T KNOW . . . . . Y	
507	In the past 12 months, how much durian did you pick every day for the total land area harvested? INTERVIEWER: SHOW THE FARM AREA MAP TO THE FARMER.	. . CIRCLE UNIT KG . . . . . 1 TON . . . . . 2 DON'T KNOW . . . . . Y	
508	Did you experience any production loss for durian?	YES . . . . . 1 NO . . . . . 2 → 511	
509	How much of the harvested durian was lost during production?	AMOUNT . . CIRCLE UNIT KG . . . . . 1 TON . . . . . 2 DON'T KNOW . . . . . Y	
510	What were the reasons for production loss for your durian? SELECT ALL THAT APPLY	DROUGHT . . . . . A FLOODS . . . . . B OTHER EXTREME NATURAL EVENTS . . . . . C PEST . . . . . D	

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
		DISEASE ..... E UNPREDICTED WEATHER PATTERN F OTHER (SPECIFY) _____ X DON'T KNOW ..... Y	
511	Did you grow your durian crop: a) For home consumption? b) To grow seedlings for sale? c) For processing and sale? d) For sale to the local or domestic market? e) For sale to the international or export market? Any other reason? IF YES: Why else did you grow your durian crop?	YES NO A) GROWN FOR HOME CONSUMPTION 1 2 B) TO GROW SEEDLINGS FOR SALE . . 1 2 C) GROWN FOR PROCESSIN . . . . . 1 2 D) GROWN FOR LOCAL OR DOMESTIC MARKET . . . . . 1 2 E) GROWN FOR INTERNATIONAL OR EXPORT MARKET . . . . . 1 2 X) OTHER (SPECIFY) _____ 1 2	→ 513
512	How much of the harvested durian was consumed by your household? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	[ ][ ][ ] . [ ] KG ..... 1 TON ..... 2 QUANTITY UNIT	
513	Did you sell any of the durian from the past 12 months?	YES ..... 1 NO 2	→ 519
514	How much of the total harvested durian did you sell in the past 12 months? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	[ ][ ][ ] . [ ] KG ..... 1 TON ..... 2 QUANTITY UNIT	
515	Farmers sell their harvested durian in different forms such as young fruit, mature fruit, frozen, juice, paste, concentrate, sliced, dried, etc. How did you sell your durian? SELECT ALL THAT APPLY	UNRIPENED/YOUNG FRUIT A RIPENED/MATURE FRUIT B FROZEN FRUIT C JUICE, PASTE, OR CONCENTRATE FROM FRUIT D SLICED AND DRIED E OTHER (SPECIFY) _____ X	
516	How much money did you receive after selling the durian this past 12 months? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	AMOUNT IN THAI BAHT [ ][ ][ ][ ]	
517	Did you experience any loss in profit of durian in the past 12 months?	YES ..... 1 NO 2	
518	Where did sell durian and who was the main buyer of your harvested durian in the past 12 months? INTERVIEWER: FARM-GATE SALES ARE WHEREBY FARMERS SELL PRODUCE DIRECTLY TO THE CONSUMER SELECT ALL THAT APPLY	RELATIVE/FRIEND ..... A AT THE FARM GATE B LOCAL MARKET/TO A LOCAL BUYER C LOCAL COMPANY D TO AN INTERMEDIARY OR A BROKER E TO A PRIVATE TRADER/OFFTAKER F TO A COOPERATIVE OR AN AG COOPERATIVE G TO A SUPERMARKET H TO AN EXPORT COMPANY I TO THE MIDDLEMAN DEPOT OR THE COLLECTOR HUB SUCH AS LHONG J OTHER (SPECIFY) _____ X	
519	Why did you not sell your durian in the past 12 months?	ONGOING HARVEST ..... A DELAYED HARVEST B DELAYED PROCESING (DRYING, MILLING) C LAND ONERSHIP ISSUES D SATURATED MARKET E OTHER (SPECIFY) _____ X	
PLANTING			

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
520	What was your main source of durian seedlings in the past 12 months?	BOUGHT FROM FRIEND/RELATIVE . . . . . 01 OWN NURSERY . . . . . 02 LOCAL NURSERY . . . . . 03 STRATIFIED SCHEME . . . . . 04 AG EXTENSION/GOVT INSTITUTION . . . . . 05 AID DISTRIBUTION . . . . . 06 NO SEEDLINGS SOURCED 07 OTHER (SPECIFY) _____ 96 DON'T KNOW 98	→ 522 → 522
521	What type of durian seedling did you plant in the past 12 months? SELECT ALL THAT APPLY	UNIMPROVED LOCAL VARIETIES . . . . . A IMPROVED/GRAFTED VARIETIES . . . . . B DON'T KNOW . . . . . Y	
IRRIGATION AND WATER MANAGEMENT			
522	Besides rainfall, did you use any additional irrigation methods for the durian?	YES . . . . . 1 NO 2	→ 526
523	What type of irrigation did you use for durian? SELECT ALL THAT APPLY	NATURAL SOURCE (CANAL, RESERVOIR) A IRRIGATION SOURCE (IRRIGATION CANAL) B RAIN C OWN POND D COMMUNITY POND E OTHER (SPECIFY) _____ X	
524	How do you gather water from the source for your durian? SELECT ALL THAT APPLY	ELECTRIC PUMP A SOLAR PUMP B DISEL PUMP C WATER TRUCK D GRAVITY E OTHER (SPECIFY) _____ X	
525	Still thinking about the past 12 months, what type of irrigation did you use? SELECT ALL THAT APPLY	DRIP IRRIGATION A SPRINKLE/NOZZLE B FURROW/SURFACE IRRIGATION C SNOZZLE D OTHER (SPECIFY) _____ X	
SOIL AND NUTRIENT MANAGEMENT			
526	In the past 12 months, did you use any of the follow practices to improve soil fertility for your durian? a) Composting? b) Mulching (soil covering)? c) Intercropping? Any other?	YES NO A) COMPOSTING . . . . . 1 2 B) MULCHING (SOIL COVERING) . . . . . 1 2 C) INTERCROPPING . . . . . 1 2 X) OTHER (SPECIFY) _____ 1 2	
527	Did you apply fertilizer to your durian seedlings in the past 12 months?	YES . . . . . 1 NO 2	→ 530
528	Did you use fertigation for your durian trees in the past 12 months?	YES . . . . . 1 NO 2	
529	What type of fertilizer did you use? SELECT ALL THAT APPLY	SOIL BASED ORGANIC . . . . . A SOIL BASED NON-ORGANIC OR CHEMICAL B OTHER (SPECIFY) _____ X	→ 534
530	Did you apply green manure to your durian trees in the past 12 months? Green manure are plants sow to cover bare soil to prevent growth of weeds and their roots inhibit soil erosion. Some examples inlcude, legumes such as clover, beans, peas, cowpea; grasses such as ryegrass, oats, rapeseed, winter wheat, winter rye; and lablab.	YES . . . . . 1 NO 2	
531	Did you apply animal manure to your durian trees in the past 12 months?	YES . . . . . 1 NO 2	
532	Did you apply biochar as a type of fertilizer to your durian?	YES . . . . . 1 NO 2	

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
533	How many tons of bio fertlizer (organic matters) did you used in the past season for your durian trees?	TONS ☐☐.☐	
534	A sack of chemical fertilizers is 50 kilograms. How many sacks of chemical fertilizers did you use in the past season.	NUMBER OF SACKS ☐☐☐.☐	
535	Have you been trained on how to use fertilizer for durian trees?	YES . . . . . 1 NO 2	
536	Do you graft your durian trees?	YES . . . . . 1 NO 2	→ 538
537	How often do you graft your durian trees?	ONCE A YEAR . . . . . 1 ONCE EVERY TWO YEARS . . . . . 2 ONCE EVERY THREE YEARS . . . . . 3 LESS FREQUENTLY 4	
538	Have you tested the soil for fertility? Would you say in the past 12 months, more than a year ago, or never tested the soil for fertility?	YES, IN THE PAST 12 MONTHS 1 YES, MORE THAN A YEAR AGO 2 NO, NEVER TESTED SOIL FOR FERTILITY 3	→ 542
539	How did you test the soil for fertility?	RAPID SOIL TEST 1 SENT TO THE PRIVATE LAB 2 SENT TO THE GOVERNMENT LAB 3	
540	Who conducted testing to measure soil fertility? SELECT ALL THAT APPLY	THAI GOVERNMENT A TRAINING CENTER B RESEARCH CENTER C OTHER (SPECIFY) _____ X	
541	Have you used tailor made fertilizer according to the soil test results?	YES . . . . . 1 NO 2	
CROP MANAGEMENT			
542	Did you have any insect, rodent, or disease attacks on your durian trees in the past 12 months?	YES . . . . . 1 NO 2	
543	Did you use pesticides or insecticides to control insect or rodent for your durian trees?	YES . . . . . 1 NO 2	
544	In the past 12 months, did you use a drone to spray pesticides?	YES . . . . . 1 NO 2	
545	Have you ever been trained on how to apply pesticides to your durian trees?	YES . . . . . 1 NO 2	
546	Did you use any herbicide to control disease attacks on your durian trees?	YES . . . . . 1 NO 2	
547	Have you been trained on when to use and how to apply herbicides for durian trees?	YES . . . . . 1 NO 2	
548	In the past 12 months, how did you control the weeds among your durian trees? SELECT ALL THAT APPLY	HERBICIDE A INTERCROPPING B MANUAL WEEDING C OTHER (SPECIFY) _____ X	
549	In the past 12 months have you used any of Information and Communication Technologies (ICT) applications to manage production of your durian?	YES . . . . . 1 NO 2	→ 551
550	In the past 12 months, did you use any of the following Information and Communication Technologies (ICT) applications to manage your durian? a) Kasettrack? b) Smart farm management mobile application?	YES NO A) KASETTRACK 1 2 B) SMART FARM MANAGEMENT MOBILE APPLICATION 1 2	

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
	x) Any other crop management mobile application?	X) OTHER MOBILE APP (SPECIFY) _____ 1 2	
WEATHER & CLIMATE INFORMATION SYSTEM			
551	Do you have access to and use any weather information to inform your agricultural planning?	YES . . . . . 1 NO 2	
552	Do you have access to any early warning systems or information about extreme climate shocks?	YES . . . . . 1 NO 2	
HARVEST & POST-HARVEST HANDLING			
553	After you harvest durian what do you do with the crop residue or waste? SELECT ALL THAT APPLY	BURN IT . . . . . A INCORPORATE BACK INTO THE SOIL B PRODUCE BIOCHAR FOR SOIL AMENDMENT C LEFT IN THE FIELD FOR GRAZING BY ANIMALS D FED TO OWN ANIMALS . . . . . E SOLD TO OTHER . . . . . F OTHER (SPECIFY) _____ X	
554	Do you grade your durians?	YES . . . . . 1 NO 2	→ 556
555	How do you grade your durians? SELECT ALL THAT APPLY	BY SHAPE A BY SIZE . . . . . B BY TEXTURE . . . . . C BY PHYSICAL APPEARANCE . . . . . D OTHER (SPECIFY) _____ X	
CERTIFICATION			
556	Is your farm certified according to standards such as follows: a) Global Agricultural Practice (GAP) b) Organic c) Fairtrade Any other? SELECT ALL THAT APPLY	YES NO A) GLOBAL AGRICULTURAL PRACTICES (GAP) 1 2 B) ORGANIC . . . . . 1 2 C) FAIRTRADE . . . . . 1 2 X) OTHER (SPECIFY) _____ 1 2	

MODULE 6. LONGAN

CHECK FARMER ROSTER ITEM 16 TO CONFIRM IF THE FARMER IS ELIGIBLE TO RESPOND TO MODULE 6 - LONGAN. ADMINISTER THIS QUESTIONNAIRE TO THE ELIGIBLE FARMER.

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
600	Now, I will ask you about common agricultural practices and/or technology farmers use to cultivate longan. These questions refer to the past 12 months, therefore, think of the practices and/or technologies you have used in the past 12 months starting from today, that is from [MONTH] 2022 to [MONTH] 2023.		
NUMBER AND VARIETIES			
601	How many longan trees in total do you have?	NUMBER OF TREES	
602	How many of your longan trees produced fruit in the past one year?	NUMBER OF PRODUCING TREES	
603	In the past 12 months, what type or variety of longan did you cultivate? SELECT ALL THAT APPLY	E-DOR . . . . . A PUONGTHONG . . . . . B OTHER (SPECIFY) _____ 96 DON'T KNOW 98	
604	Now, tell me the times when you harvested longan in the past 12 months. Please provide the month for start of the harvest and end of the harvest. INTERVIEWER: ADD CORRESPONDING YEAR '23' FOR 2023 AND '22' FOR 2022 FOR START OF EACH HARVEST **CODES FOR MONTHS:** JANUARY ..... 01 FEBRUARY ..... 02 MARCH ..... 03 APRIL ..... 04 MAY ..... 05 JUNE ..... 06 JULY ..... 07 AUGUST ..... 08 SEPTEMBER ..... 09 OCTOBER ..... 10 NOVEMBER ..... 11 DECEMBER 12	START MONTH END MONTH YEAR LAST HARVEST DON'T KNOW . . . . . Y	
605	How much longan did you harvest in the past 12 months? Please provide the longan production volume (as harvested in kgs or metric tons) for the total land area harvested. INTERVIEWER: SHOW THE FARM AREA MAP TO THE FARMER.	LAST HARVEST . . CIRCLE UNIT KG . 1 TON . . . . . 2 DON'T KNOW . . . . . Y	
606	Did you experience any production loss for longan ?	YES . . . . . 1 NO 2	→ 609
607	How much of the harvested longan was lost during production?	AMOUNT . . CIRCLE UNIT KG . . . . . 1 TON . . . . . 2 DON'T KNOW . . . . . Y	
608	What were the reasons for production loss for your longan? SELECT ALL THAT APPLY	DROUGHT . . . . . A FLOODS . . . . . B OTHER EXTREME NATURAL EVENTS . . . . . C PEST . . . . . D DISEASE . . . . . E UNPREDICTED WEATHER PATTERN F OTHER (SPECIFY) _____ X DON'T KNOW . . . . . Y	
609	Did you grow your longan crop: a) For home consumption? b) To grow seedlings for sale? c) For processing and sale? d) For sale to the local or domestic market? e) For sale to the international or export market? Any other reason?	YES NO A) GROWN FOR HOME CONSUMPTION 1 2 B) TO GROW SEEDLINGS FOR SALE . . 1 2 C) GROWN FOR PROCESSIN . . . . . 1 2 D) GROWN FOR LOCAL OR DOMESTIC MARKET . . . . . 1 2 E) GROWN FOR INTERNATIONAL OR EXPORT MARKET 1 2	→ 511

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
	IF YES: Why else did you grow your longan crop?	X) OTHER (SPECIFY) _____ 1 2	
610	How much of the harvested longan was consumed by your household? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	☐☐☐.☐ QUANTITY KG ..... 1 TON ..... 2 UNIT	
611	Did you sell any of the longan from the past 12 months?	YES ..... 1 NO 2	→ 617
612	How much of the total harvested longan did you sell in the past 12 months? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	☐☐☐.☐ QUANTITY KG ..... 1 TON ..... 2 UNIT	
613	Farmers sell their harvested longan in different forms such as young fruit, mature fruit, frozen, juice, paste, concentrate, sliced, dried, etc. How did you sell your longan? SELECT ALL THAT APPLY	UNRIPENED/YOUNG FRUIT A RIPENED/MATURE FRUIT B FROZEN FRUIT C JUICE, PASTE, OR CONCENTRATE FROM FRUIT D SLICED AND DRIED E OTHER (SPECIFY) _____ X	
614	How much money did you receive after selling the longan this past 12 months? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	AMOUNT IN THAI BAHT ☐☐☐☐	
615	Did you experience any loss in profit of longan in the past 12 months?	YES ..... 1 NO 2	
616	Where did sell longan and who was the main buyer of your harvested longan in the past 12 months? INTERVIEWER: FARM-GATE SALES ARE WHEREBY FARMERS SELL PRODUCE DIRECTLY TO THE CONSUMER SELECT ALL THAT APPLY	RELATIVE/FRIEND ..... A AT THE FARM GATE B LOCAL MARKET/TO A LOCAL BUYER C LOCAL COMPANY D TO AN INTERMEDIARY OR A BROKER E TO A PRIVATE TRADER/OFFTAKER F TO A COOPERATIVE OR AN AG COOPERATIVE G TO A SUPERMARKET H TO AN EXPORT COMPANY I TO THE MIDDLEMAN DEPOT OR THE COLLECTOR HUB SUCH AS LHONG J OTHER (SPECIFY) _____ X	
617	Why did you not sell your longan in the past 12 months?	ONGOING HARVEST ..... A DELAYED HARVEST B DELAYED PROCESING (DRYING, MILLING) C LAND ONERSHIP ISSUES D SATURATED MARKET E OTHER (SPECIFY) _____ X	
PLANTING			
618	What was your main source of longan seedlings in the past 12 months?	BOUGHT FROM FRIEND/RELATIVE ..... 01 OWN NURSERY ..... 02 LOCAL NURSERY ..... 03 STRATIFIED SCHEME ..... 04 AG EXTENSION/GOVT INSTITUTION ..... 05 AID DISTRIBUTION ..... 06 NO SEEDLINGS SOURCED 07 OTHER (SPECIFY) _____ 96 DON'T KNOW 98	→620 →620
619	What type of longan seedling did you plant in the past 12 months? SELECT ALL THAT APPLY	UNIMPROVED LOCAL VARIETIES ..... A IMPROVED/GRAFTED VARIETIES ..... B DON'T KNOW ..... Y	
IRRIGATION AND WATER MANAGEMENT			
620	Besides rainfall, did you use any additional irrigation methods for the longan?	YES ..... 1 NO 2	→ 624

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
621	What type of irrigation did you use? SELECT ALL THAT APPLY	NATURAL SOURCE (CANAL, RESERVOIR) A IRRIGATION SOURCE (IRRIGATION CANAL) B RAIN C OWN POND D COMMUNITY POND E OTHER (SPECIFY) _____ X	
622	How do you get water from the source for your longan? SELECT ALL THAT APPLY	ELECTRIC PUMP A SOLAR PUMP B DISEL PUMP C WATER TRUCK D GRAVITY E OTHER (SPECIFY) _____ X	
623	Still thinking about the past 12 months, what type of irrigation did you use? SELECT ALL THAT APPLY	DRIP IRRIGATION A SPRINKLE/NOZZLE B FURROW/SURFACE IRRIGATION C SNOZZLE D OTHER (SPECIFY) _____ X	
SOIL AND NUTRIENT MANAGEMENT			
624	In the past 12 months, did you use any of the follow practices to improve soil fertility for your longan? a) Composting? b) Mulching (soil covering)? c) Intercropping? Any other?	YES NO A) COMPOSTING . . . . . 1 2 B) MULCHING (SOIL COVERING) . . . . . 1 2 C) INTERCROPPING . . . . . 1 2 X) OTHER (SPECIFY) _____ 1 2	
625	Did you apply fertilizer to your longan seedlings in the past 12 months?	YES . . . . . 1 NO 2	→ 628
626	Did you use fertigation for your longan trees in the past 12 months?	YES . . . . . 1 NO 2	
627	What type of fertilizer did you use? SELECT ALL THAT APPLY	SOIL BASED ORGANIC . . . . . A SOIL BASED NON-ORGANIC OR CHEMICAL B → 632 FOLIAR FEEDS ORGANIC . . . . . C FOLIAR FEEDS NON-ORGANIC OR CHEMICAL D → 632 OTHER (SPECIFY) _____ X	
628	Did you apply green manure to your longan trees in the past 12 months? Green manure are plants sow to cover bare soil to prevent growth of weeds and their roots inhibit soil erosion. Some examples inlcude, legumes such as clover, beans, peas, cowpea; grasses such as ryegrass, oats, rapeseed, winter wheat, winter rye; and lablab.	YES . . . . . 1 NO 2	
629	Did you apply animal manure to your longan trees in the past 12 months?	YES . . . . . 1 NO 2	
630	Did you apply biochar as a type of fertilizer to your longan?	YES . . . . . 1 NO 2	
631	How many tons of bio fertilizer (organic matters) did you used in the past season for your longan trees?	TONS ☐☐.☐	
632	A sack of chemical fertilizers is 50 kilograms. How many sacks of chemical fertilizers did you use in the past season.	NUMBER OF SACKS ☐☐☐.☐	
633	Have you been trained on how to use fertilizer for longan trees?	YES . . . . . 1 NO 2	
634	Have you received training on micro-organism management and soil health?	YES . . . . . 1 NO 2	
635	Have you tested the soil for fertility? Would you say in the past 12 months, more than a year ago, or never tested the soil for fertility?	YES, IN THE PAST 12 MONTHS 1	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
		YES, MORE THAN A YEAR AGO 2 NO, NEVER TESTED SOIL FOR FERTILITY 3	→ 639
636	How did you test the soil for fertility?	RAPID SOIL TEST 1 SENT TO THE PRIVATE LAB 2 SENT TO THE GOVERNMENT LAB 3	
637	Who conducted testing to measure soil fertility? SELECT ALL THAT APPLY	THAI GOVERNMENT A TRAINING CENTER B RESEARCH CENTER C OTHER (SPECIFY) _____	
638	Have you used tailor made fertilizer according to the soil test results?	YES . . . . . 1 NO 2	
CROP MANAGEMENT			
639	Did you have any insect, rodent, or disease attacks on your longan trees in the past 12 months?	YES . . . . . 1 NO 2	
640	Did you use pesticides or insecticides to control insect or rodent for your longan trees?	YES . . . . . 1 NO 2	
641	In the past 12 months, did you use a drone to spray pesticides?	YES . . . . . 1 NO 2	
642	Have you ever been trained on how to apply pesticides to your longan trees?	YES . . . . . 1 NO 2	
643	Did you use any herbicide to control disease attacks on your longan trees?	YES . . . . . 1 NO 2	
644	How did you control the weeds among your longan trees in the past 12 months? SELECT ALL THAT APPLY	HERBICIDE A INTERCROPPING B MANUAL WE . . . . . C OTHER (SPECIFY) _____ X	
645	Have you been trained on when to use and how to apply herbicides for longan trees?	YES, APPLY POTASSIUM CHLORATE 1 YES, DO THINNING 2 YES, DO PRUNING 3 NO 4	
646	Do you do anything to promote off season production of longan?	YES . . . . . 1 NO 2	
647	In the past 12 months have you used any of Information and Communication Technologies (ICT) applications to manage production of your longan?	YES . . . . . 1 NO 2	→ 649
648	In the past 12 months, did you use any of the following Information and Communication Technologies (ICT) applications to manage your longan? a) Crop management mobile application b) Smart farm management mobile application? x) Any other crop management mobile application?	YES NO A) CROP MANAGEMENT MOBILE APPLICATIC 1 2 B) SMART FARM MANAGEMENT MOBILE APPLICATION 1 2 X) OTHER MOBILE APP (SPECIFY) _____ 1 2	
WEATHER & CLIMATE INFORMATION SYSTEM			
649	Do you have access to and use any weather information to inform your agricultural planning?	YES . . . . . 1 NO 2	
650	Do you have access to any early warning systems or information about extreme climate shocks?	YES . . . . . 1 NO 2	
HARVEST & POST-HARVEST HANDLING			
651	Do you do anything to manage residue, waste or byproducts from your longan production and harvest? SELECT ALL THAT APPLY	BURN IT . . . . . A INCORPORATE BACK INTO THE SOIL B PRODUCE BIOCHAR FOR SOIL AMENDMENT C LEFT IN THE FIELD FOR GRAZING BY ANIMALS D FED TO OWN ANIMALS . . . . . E SOLD TO OTHERS F DRY AND PROCESS IT G OTHER (SPECIFY) _____ X	
652	Do you have a drying facility at the farm?	YES . . . . . 1 NO 2	
653	Do you use sulphur dioxide for longan fumigation post-harvest?	YES 1	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
		NO 2	→ 655
654	Is the fumigation conducted in a closed fumigation house?	YES . . . . . 1 NO 2	
655	Do you grade your longans?	YES . . . . . 1 NO 2	→ 657
656	How do you grade your longans in the past 12 months? SELECT ALL THAT APPLY	BY SHAPE A BY SIZE . . . . . B BY TEXTURE . . . . . C BY PHYSICAL APPEARANCE . . . . . D OTHER (SPECIFY) _____ X	
CERTIFICATION			
657	Is your farm certified according to standards such as follows: a) Global Agricultural Practice (GAP) b) Organic c) Fairtrade Any other? SELECT ALL THAT APPLY	YES NO A) GLOBAL AGRICULTURAL PRACTICES (GAP) 1 2 B) ORGANIC . . . . . 1 2 C) FAIRTRADE . . . . . 1 2 X) OTHER (SPECIFY) _____ 1 2	

MODULE 7. COCONUT

CHECK FARMER ROSTER ITEM 16 TO CONFIRM IF THE FARMER IS ELIGIBLE TO RESPOND TO MODULE 7 - COCONUT. ADMINISTER THIS QUESTIONNAIRE TO THE ELIGIBLE FARMER.

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
700	Now, I will ask you about common agricultural practices and/or technology farmers use to cultivate coconut. These questions refer to the past 12 months, therefore, think of the practices and/or technologies you have used in the past 12 months starting from today, that is from [MONTH] 2022 to [MONTH] 2023.		
NUMBER AND VARIETIES			
701	How many coconut trees in total do you have?	NUMBER OF TREES . . . . . [ ][ ][ ]	
702	How many of your coconut trees produced fruit in the past 12 months?	NUMBER OF PRODUCING TREES [ ][ ][ ][ ][ ] DON'T KNOW 98	
703	In the past 12 months, what type or variety of coconut did you cultivate? SELECT ALL THAT APPLY	A) DAM NOEN . . . . . A B) BAN PAEW . . . . . B C) BANG Kia . . . . . C OTHER (SPECIFY) _____ X DON'T KNOW . . . . . Y	
704	How many coconuts did you harvest in the past 12 months? INTERVIEWER: SHOW THE FARM AREA MAP TO THE FARMER AND ASK FOR ANNUAL PRODUCTION FOR THE ENTIRE FARM AREA	[ ][ ][ ][ ][ ][ ] NUMBER OF COCONUTS DON'T KNOW 98	
705	On average, how many coconuts do you pick per tree in a single harvest?	NUMBER OF COCONUTS PER TREE [ ][ ][ ] DON'T KNOW 98	
706	How often did you harvest coconuts from your trees in the past 12 months?	ENTER FREQUENCY (DAYS) [ ][ ] OTHER (SPECIFY) _____ 98	
707	Did you experience any production loss for coconut?	YES . . . . . 1 NO . . . . . 2 → 710	
708	How much of the harvested coconut was lost during production?	AMOUNT [ ][ ][ ] . [ ] CIRCLE UNIT KG . . . . . 1 TON . . . . . 2 DON'T KNOW . . . . . Y	
709	What were the reasons for production loss for your coconut? SELECT ALL THAT APPLY	DROUGHT . . . . . A FLOODS . . . . . B OTHER EXTREME NATURAL EVENTS . . . . . C PEST . . . . . D DISEASE . . . . . E UNPREDICTED WEATHER PATTERN F OTHER (SPECIFY) _____ X DON'T KNOW . . . . . Y	
710	Did you grow your coconut crop: a) For home consumption? b) To grow seedlings for sale? c) For processing and sale?	YES NO A) GROWN FOR HOME CONSUMPTION 1 2 B) TO GROW SEEDLINGS FOR SALE . . 1 2 C) GROWN FOR PROCESSIN 1 2	

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
	d) For sale to the local or domestic market? e) For sale to the international or export market? Any other reason? IF YES: Why else did you grow your coconut crop?	D) GROWN FOR LOCAL OR DOMESTIC MARKET . . . . . 1 2 E) GROWN FOR INTERNATIONAL OR EXPORT MARKET . . . . . 1 2 X) OTHER (SPECIFY) _____ 1 2	→ 713
711	How much of the harvested coconut was consumed by your household? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	[ ][ ][ ] . [ ] QUANTITY KG . . . . . 1 TON . . . . . 2 UNIT	
712	Did you sell any of the coconut from the past 12 months?	YES . . . . . 1 NO 2	→ 718
713	How much of the total harvested coconut did you sell in the past 12 months? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	[ ][ ][ ] . [ ] QUANTITY KG . . . . . 1 TON . . . . . 2 UNIT	
714	Farmers sell their harvested coconut in different forms such as young fruit, mature fruit, with or without husk, as coconut milk, cream, oil, etc. How did you sell your coconut? SELECT ALL THAT APPLY	COCONUT WITH HUSK A COCONUT WITHOUT HUSK B GREEN/YOUNG COCONUT C BROWN/MATURE COCONUT D COCONUT MILK E COCONUT CREAM F COCONUT OIL G OTHER (SPECIFY) _____ X	
715	How much money did you receive after selling the coconut this past 12 months? PROBE TO ENSURE THE RESPONDENT INCLUDES ALL HARVEST IN THE PAST 12 MONTHS	AMOUNT IN THAI BAHT [ ][ ][ ][ ]	
716	Did you experience any loss in profit of coconut in the past 12 months?	YES . . . . . 1 NO 2	
717	Where did sell coconut and who was the main buyer of your harvested coconut in the past 12 months? INTERVIEWER: FARM-GATE SALES ARE WHEREBY FARMERS SELL PRODUCE DIRECTLY TO THE CONSUMER SELECT ALL THAT APPLY	RELATIVE/FRIEND . . . . . A AT THE FARM GATE B LOCAL MARKET/TO A LOCAL BUYER C LOCAL COMPANY D TO AN INTERMEDIARY OR A BROKER E TO A PRIVATE TRADER/OFFTAKER F TO A COOPERATIVE OR AN AG COOPERATIVE G TO A SUPERMARKET H TO AN EXPORT COMPANY I TO THE MIDDLEMAN DEPOT OR THE COLLECTOR HUB SUCH AS LHONG J OTHER (SPECIFY) _____ X	
718	Why did you not sell your coconut in the past 12 months?	ONGOING HARVEST . . . . . A DELAYED HARVEST B DELAYED PROCESING (DRYING, MILLING) C LAND ONERSHIP ISSUES D SATURATED MARKET E OTHER (SPECIFY) _____ X	
PLANTING			
719	What was your main source of coconut seedlings in the	BOUGHT FROM FRIEND/RELATIVE 01	→ 721

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
	past 12 months?	OWN NURSERY . . . . . 02 LOCAL NURSERY . . . . . 03 STRATIFIED SCHEME . . . . . 04 AG EXTENSION/GOVT INSTITUTION . . . . . 05 AID DISTRIBUTION . . . . . 06 NO SEEDLINGS SOURCED 07 OTHER (SPECIFY) _____ 96 DON'T KNOW 98	→ 721
720	What type of coconut seedling did you plant in the past 12 months? SELECT ALL THAT APPLY	UNIMPROVED LOCAL VARIETIES . . . . . A IMPROVED/GRAFTED VARIETIES . . . . . B DON'T KNOW . . . . . Y	
IRRIGATION AND WATER MANAGEMENT			
721	Besides rainfall, did you use any additional irrigation methods for coconut?	YES . . . . . 1 NO 2	→ 728
722	What type of irrigation did you use? SELECT ALL THAT APPLY	NATURAL SOURCE (CANAL, RESERVOIR) A IRRIGATION SOURCE (IRRIGATION CANAL) B RAIN C OWN POND D COMMUNITY POND E WATER SPRAYING F WATER TRUCK OR BIG GUN G OTHER (SPECIFY) _____ X	
723	How do you gather water from the source for your coconut? SELECT ALL THAT APPLY	ELECTRIC PUMP A SOLAR PUMP B DISEL PUMP C WATER TRUCK D GRAVITY E OTHER (SPECIFY) _____ X	
724	Still thinking about the past 12 months, what type of irrigation did you use? SELECT ALL THAT APPLY	DRIP IRRIGATION A SPRINKLE/NOZZLE B FURROW/SURFACE IRRIGATION C SNOZZLE D OTHER (SPECIFY) _____ X	
725	Do you practice irrigation canal closing when coconut trees reach maturity?	YES . . . . . 1 NO 2	
SOIL AND NUTRIENT MANAGEMENT			
726	In the past 12 months, did you use any of the follow practices to improve soil fertility for your coconut? a) Composting? b) Mulching (soil covering)? c) Intercropping? d) Cover cropping? Any other?	YES NO A) COMPOSTING . . . . . 1 2 B) MULCHING (SOIL COVERING) . . . . . 1 2 C) INTERCROPPING . . . . . 1 2 D) COVER-CROPPING . . . . . 1 2 X) OTHER (SPECIFY) _____ 1 2	
727	Did you apply fertilizer to your coconut seedlings in the past 12 months?	YES . . . . . 1 NO 2	→ 730
728	Did you use fertigation for your coconut farm in the past 12 months?	YES . . . . . 1 NO 2	
729	What type of fertilizer did you use? SELECT ALL THAT APPLY	SOIL BASED ORGANIC . . . . . A SOIL BASED NON-ORGANIC OR CHEMICAL B → 734 FOLIAR FEEDS ORGANIC . . . . . C FOLIAR FEEDS NON-ORGANIC OR CHEMICAL D → 734	

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
		OTHER (SPECIFY) _____ X	
730	Did you apply green manure to your coconut trees in the past 12 months? Green manure are plants sow to cover bare soil to prevent growth of weeds and their roots inhibit soil erosion. Some examples inlcude, legumes such as clover, beans, peas, cowpea; grasses such as ryegrass, oats, rapeseed, winter wheat, winter rye; and lablab.	YES . . . . . 1 NO 2	
731	Did you apply animal manure to your coconut trees in the past 12 months?	YES . . . . . 1 NO 2	
732	Did you apply biochar as a type of fertilizer to your coconut?	YES . . . . . 1 NO 2	
733	How many tons of bio fertilizer (organic matters) did you used in the past season for your coconut?	TONS ☐☐.☐	
734	A sack of chemical fertilizers is 50 kilograms. How many sacks of chemical fertilizers did you use in the past season.	NUMBER OF SACKS ☐☐☐.☐	
735	Have you been trained in how to use fertilizer for coconut trees?	YES . . . . . 1 NO 2	
736	Have you tested the soil for fertility? Would you say in the past 12 months, more than a year ago, or never tested the soil for fertility?	YES, IN THE PAST 12 MONTHS 1 YES, MORE THAN A YEAR AGO 2 NO, NEVER TESTED SOIL FOR FERTILITY 3 → 740	
737	How did you test the soil for fertility?	RAPID SOIL TEST 1 SENT TO THE PRIVATE LAB 2 SENT TO THE GOVERNMENT LAB 3	
738	Who conducted testing to measure soil fertility? SELECT ALL THAT APPLY	THAI GOVERNMENT A TRAINING CENTER B RESEARCH CENTER C OTHER (SPECIFY) _____ X	
739	Have you used tailor made fertilizer according to the soil test results?	YES . . . . . 1 NO 2	
CROP MANAGEMENT			
740	Did you have any insect, rodent, or disease attacks on your coconut trees in the past 12 months?	YES . . . . . 1 NO 2	
741	Did you use pesticides or insecticides to control insect or rodent for your coconut trees?	YES . . . . . 1 NO 2	
742	Do you practice any of the following integrated pest and disease management techniques? a) Bracon wasp? b) Green fungi or Green muscari? c) Ichris lure? d) Rhino lure? e) Rhinoceros Beetle? Any other?	YES NO A) BRACON WASP . . . . . 1 2 B) GREEN FUNGI OR GREEN MUSCARI 1 2 C) CHRIS LURE . . . . . 1 2 D) RHINO LURE . . . . . 1 2 E) RHINOCEROS BEETLE . . . . . 1 2 X) OTHER (SPECIFY) _____ 1 2	
743	In the past 12 months, did you use a drone to spray pesticides?	YES . . . . . 1 NO 2	

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
744	Have you ever been trained on how to apply pesticides to your coconut trees?	YES . . . . . 1 NO 2	
745	Did you use any herbicide to control disease attacks on your coconut trees?	YES . . . . . 1 NO 2	
746	Have you been trained on how to apply herbicides for coconut trees?	YES . . . . . 1 NO 2	
747	How did you control the weeds among your coconut trees in the past 12 months? SELECT ALL THAT APPLY	HERBICIDE A INTERCROPPING B MANUAL WEEDING C OTHER (SPECIFY) _____ X	
748	Do you practice inflorescence thinning for your coconut?	YES . . . . . 1 NO 2	
749	Do you practice bee keeping in order to increase yields?	YES . . . . . 1 NO 2	
750	In the past 12 months have you used any of Information and Communication Technologies (ICT) applications to manage production of your coconut?	YES . . . . . 1 NO 2	→ 752
751	In the past 12 months, did you use any of the following Information and Communication Technologies (ICT) applications to manage your coconut? a) Smart farm management mobile application? x) Any other crop management mobile application?	YES NO A) SMART FARM MANAGEMENT MOBILE APPLICATION 1 2 X) OTHER MOBILE APP (SPECIFY) _____ 1 2	
WEATHER & CLIMATE INFORMATION SYSTEM			
752	Do you have access to and use any weather information to inform your agricultural planning?	YES . . . . . 1 NO 2	
753	Do you have access to any early warning systems or information about extreme climate shocks?	YES . . . . . 1 NO 2	
HARVEST & POST-HARVEST HANDLING			
754	Do you practice any of the following techniques to manage waste or byproducts from your coconut production? a) Use fallen leaves for mulching? b) Use fallen leaves for compost? c) Produce biochar? SELECT ALL THAT APPLY	USE FALLEN LEAVES FOR MULCHING A USE FALLEN LEAVES FOR COMPOST B PRODUCE BIOCHAR C	
755	Do you grade your coconuts?	YES . . . . . 1 NO 2	→ 757
756	How do you grade your coconuts in the past 12 months? SELECT ALL THAT APPLY	BY SHAPE A BY SIZE . . . . . B BY TEXTURE . . . . . C BY PHYSICAL APPEARANCE . . . . . D OTHER (SPECIFY) _____ X	
CERTIFICATION			
757	Is your farm certified according to standards such as follows: a) Global Agricultural Practice (GAP) b) Organic	YES NO A) GLOBAL AGRICULTURAL PRACTICES (GAP) 1 2	

	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
	c) Fairtrade Any other? SELECT ALL THAT APPLY	B) ORGANIC . . . . . 1 2 C) FAIRTRADE . . . . . 1 2 X) OTHER (SPECIFY) _____ 1 2	