Thailand-IRRI Collaborative Five-Year Work Plan

2023-2027

Rice Department
The Government of Thailand
&
International Rice Research Institute
The Philippines

IRRI-THAILAND PARTNERSHIP

The International Rice Research Institute (IRRI) has been an important strategic partner of the Government of Thailand through the Ministry of the Agriculture and Cooperatives (MOAC) under the Rice Department over the past five decades, contributing to rice production growth, food security, and rural livelihood improvement through rice Research & Development (R&D). Underpinned by this partnership as well as Thailand's success in developing its agricultural sector, rice production has increased astoundingly to about 25 million tons as of 2022, transforming the country from food deficit to food self-sufficiency and one of the leading rice exporting nations today. Transformations in rice-based farming systems have also laid a key foundation for the country's recent economic development and growth.

There have been many landmark achievements through the IRRI-Thailand Partnership, with the conservation of genetic rice resources, advancements in Thailand's breeding programs, strengthening of rice seed systems, and capacity development of Thai scientists, extension workers and policymakers being major highlights. The IRRI Genebank currently conserves over 6321 rice available accessions originated from Thailand, while IRRI Genebank has provided more than 7000 samples or around 4600 distinct accessions to Thailand since 1976. IRRI, directly or indirectly, has also contributed to the development of more than 80% of the 1,229 high yielding inbred and hybrid rice varieties developed and released in Thailand until 2021. A recent low-cost appraisal based on leading varieties that comprise 57% of production area looked at the return to IRRI's investment in varietal improvement in Thailand over the period 1990 to 2018. The Net Present Value (NPV) of IRRI's contributions to changes in varietal improvement for the period of 1990 to 2018 ranged from USD 2.33-4.50 billion.

Since 1963, more than 940 Thai scholars have completed academic degrees, short-term training courses and on-the-job training at IRRI headquarters in the Philippines. In addition to these areas, the IRRI-Thailand partnership has also been central to improving climate resilience, agronomic practices, farm mechanization and post-harvest technologies, and diversification and intensification of rice-based agri-food systems in Thailand.

Looking forward, the IRRI-TRD partnership remains critical to Thailand's food security, economic transformation and achievement of the UN Sustainable Development Goals (SDGs). Rice is economically and culturally important to Thailand. Ceremonies invoking rain and bountiful harvest are commonly performed by rice farmers before planting seasons. Between 1960 and 1980, Thailand invested significantly in agricultural development, particularly in irrigation systems, road networks, marketing

facilities and agricultural research and extension. The increase in rice cropping intensity and in the adoption of modern rice varieties regenerated growth in production. The country is the biggest producer of the coveted, high-quality and aromatic Jasmine rice.

Today, rice is still Thailand's most important agricultural commodity and the staple food of around 70.2 million of its people. Despite of the effects of COVID-19 pandemic on agriculture, particularly on rice production, Thailand is not likely to experience rice shortages, as domestic consumer demand accounts for just 50% of total production; even though the production decreased during 2019-2020, which was caused by unfavorable conditions heavy rain, drought, and pests and diseases. Moreover, farmers have faced increased input costs (e.g., fertilizers, pesticides). The country accounts for over 4.56 million hectares of arable land. Thailand's rice exports in the first six months of 2022 rose by more than 56% to 3.50 million tons. Furthermore, industry experts say the country's rice export for this year will reach between 7 million and 7.5 million tons making the country the second biggest rice exporter.

TRD places a strategic importance on strengthening the role of the agricultural sector with regards to rice-based farming systems as one of its crucial components in generating jobs, ensuring food security, reducing poverty and developing rural areas. This is evident based on the 2021 collaborated work plan outlining the research themes on Rice Genetic Improvement and Sustainable Rice Production.

With the critical importance of rice R&D to Thailand, IRRI places the highest priority on its partnership with the Thai Rice Department and contributing to national policy goals. Therefore, the IRRI-Thailand partnership focuses on a mission of increasing nutrition security through improvement in productivity and diversity, contributing to ending poverty, and improving livelihoods among those who depend on rice-based agri-food systems. In doing so, the partnership aims to protect the health and prosperity of rice farmers and consumers, ensure the environmental sustainability of rice farming, and build rice farmers' resilience to climate change. Therefore, to enable IRRI's continued engagement and support to improve the rice-based agri-food system in Thailand through rice science innovation, IRRI and the Thai Rice Department partners have jointly prepared this new Five-year Work Plan (2023-2027).

The Thailand-IRRI Work Plan is focused on building on the high-level framework of the Thai Rice Department through the following components (i) Excellence in rice science and further utilization; (ii) Enhancing production efficiency and problem solving; (iii) Climate change; (iv) Food security and site-specific production; (v) Responding to the need of markets and consumers ; and (vi) Strengthening rice farmers and their organization.

To implement the Work Plan, IRRI will continue its hands-on engagement in Thailand through close collaboration with The Ministry of Agriculture and Cooperatives (MOAC) and its dependent departments, such as, Department of Agricultural Extension, Department of Agriculture, Department of Fisheries, Rice Department, Agricultural Universities and other government institutions; non-government organizations (NGO); the private sector; and other CGIAR institutions.

Aligned to the mission and objectives of the Work Plan, IRRI, TRD and other partners will support the development of the rice-based agri-food systems in Thailand through the development and implementation of the following program components:

COMPONENT 1: Excellence in Rice Science and Further Utilization

BACKGROUND:

The Thai Rice Department has considerable expertise in upstream rice science including physiology (photosynthesis and root biology), pathology, and genetics. Under the IRRI Thai-Rice Department collaborative project, the IRRI scientists working with Thai counterparts within similar disciplines have been improving the understanding of rice response to varying environmental conditions. Collaboration between the Thai Rice Department and IRRI can help expand those results to include bioinformatics analysis to target candidate genes, and functional validation through genome editing and phenotypic characterization at IRRI. This work will be done within the context of the Trait Development Pipeline to better link upstream research with breeding.

OBJECTIVES:

The Thai Rice Department aims to improve rice for a range of parameters, including high yield, high milling quality, short duration, lodging resistance, good eating and cooking quality, KDML 105 fragrance, head rice recovery, and biotic and abiotic stress. With the aim of moving forward with Trait Development of important loci identified by the Thai Rice Department, the Thai Rice Department will collaborate with IRRI for genetic validation. This includes:

1. Capacity building for genetic validation. Topics include speed breeding, breeding pipelines, genome editing, bioinformatics pipeline, and biometrics pipeline.
2. Genetic validation through generation and phenotyping of transgenics/genome edited lines at IRRI.

ACTIVITIES:

1. Training Programmes (Short-Term course)
2. Validation of selected loci identified by the Thai Rice Dept: Transgenic Research/CrisPR at IRRI
3. Validation of selected loci identified by the Thai Rice Dept: phenotyping of genetically modified lines at IRRI
4. Proposal Development

PARTNERS:

1. Rice Department
2. IRRI

FUNDING / RESOURCE MOBILIZATION:

Proposed budget funding - $ 300,000 (USD)

COMPONENT 2: Enhancing Production Efficiency and Problem Solving

BACKGROUND:

Thailand's rice production has faced labor shortages and climate change issues such as unanticipated droughts and floods, causing unstable yields and a high risk of crop losses. Although rice production in Thailand has recently developed and is more advanced than most of the neighboring countries in Southeast Asia, it still has several constraints leading to low farming efficiency, high carbon footprint, and high postharvest losses. Low farming efficiency (high energy and labor cost and agronomic input use) in Thailand's rice production is mainly caused by poor land consolidation, lack of precision land leveling, crop establishment, and crop care. These inefficient practices and poor water and rice straw management cause a high carbon footprint. Lastly, despite combine harvesting being almost fully adopted in Thailand, there are significant losses from unoptimized wet paddy logistics that seriously affect the quality of rice. Postharvest losses are estimated to be higher than 10% in Thailand, equating to over 2 million tons (Mt) per year. The barriers to scaling and context-specific needs of national and international value chains (market access, private actors, service providers, etc.) need to be evaluated.

On the other hand, there are solutions developed by the Thai Rice Research Institute, IRRI and other partners to address the said problems. For example, laser land leveling has been introduced in the country under the Thai Rice Department's Thai Rice NAMA project and CORIGAP but still needs to be further scaled; precision mechanized direct seeding recently deployed by IRRI in SEA; sustainable rice straw management options have been piloted by IRRI and the related knowledge was also provided under the said projects; and best postharvest management practices have been investigated by Thai institutions to address the said issues. The further collaborations between TRD and IRRI to leverage the said solutions integrated with the new developments of precision farming and digital arts such as drones, GIS, EasyHarvest, etc. would help to address the said problems and increase farming efficiency, productivity, and sustainability of rice production in Thailand.

OBJECTIVES:

1. To developing and deploy efficient rice establishment methods
2. To enhance the use resource-efficient (weed, water and nutrient) management practices
3. To improve mechanization and postharvest management.
4. Capacity development of partners
    - Farming practices for climate change adaptation and mitigation
    - Farming efficiency in terms of productivity, cost-benefits, labor, etc.

ACTIVITIES:

1. Developing and deploying efficient rice establishment methods
    1.1 Mapping and development of scale-appropriate crop establishment options, including mechanized direct seeding transplanting, drone-seeding, integrated with digital tools
    1.2 Developing business models to support promotion/scaling out of laser land leveling technology
    1.3 Leverage and integrate digital tools to increase farming efficiency and the problems of labor shortage and climate change.
    1.4 Development of region-specific crop calendars for reducing/mitigating climate risks, based on climate risk maps

2. Improving resource-efficient (weed, water and nutrient) management practices.
    2.1 Improving Thai digital tools on nutrient and water management
    2.2 Development of best practices for weed, water, nutrient management (e.g. for DSR)
    2.3 Development of ecologically-based weed management for organic rice culture

3. Improving mechanization and postharvest management.
    3.1 Pilot and further develop smart mechanization and postharvest management apps
    3.2 Develop rice straw-based bio-circular economy for optimized logistics, mechanization for rice straw collection and composting, and organic farming.
    3.3 Develop value adding products of rice straw: biochar, bioenergy, biosilica; mushroom, livestock, etc.

4. Capacity development of partner to stakeholders focusing on the solutions indicated in 1-3
    4.1. ToTs and field-demonstrations
    4.2. Establish e-learning modules
    4.3. Cross-country knowledge exchange (workshop and study tours)

PARTNERS

- Government partners, e.g. Royal Irrigation Department, Land Development Department, Department of Agricultural Extension (DOAE), Department of Agriculture (DOA), Geo-Informatics and Space Technology Development Agency (GISTDA)
- Private sector, e.g. KUBOTA Corporation, YANMAR, TOPCON (Japan),

KASET PATTANA, BAYER and Companies.
- International research and development, e.g. Hokkaido University., King Mongkut's University of Technology Thonburi (KMUTT)NARO (Japan), GIZ, SARMAP, IWMI
- Rice exporters
- Farmer community (Rice Seed Community, Mega Farms, etc.)

FUNDING /RESOURCE MOBILIZATION:

Proposed budget funding $ 800,000 - $ 1, 200,000 (USD)

COMPONENT 3: Responding to the Need of Markets and Consumers

BACKGROUND:

Thailand is aiming to implement a twenty-year national strategy based on the philosophy "Sufficiency Economy". Some of the goals that this collaboration will support are listed below. Adopting the plans and guidelines for the product development will allow to achieve a good quality of life and receive increased income by using eco-friendly technology and innovation for farmers.

IRRI is currently leading the CGIAR Initiative on Market Intelligence, which brings together strategic information on future crops, market segments and trait priorities aligned to the needs and preferences of farmers, agri-business and consumers. Market intelligence is needed in order to render Thai rice value chains more responsive to consumer demand (e.g., for safe and sustainably-produced food). Sustainability of the rice sector can be increased from seed to plate by investing in market intelligence for breeding and rice value chain upgrading. New market segments and game changers (e.g., low GI rice) that can drive rice value chains in the future need to be identified and analyzed.

- Thailand to become a developed country incl. "security, prosperity, and sustainability"
- Value added of agricultural products and processed agricultural products increases. GAP in the agriculture sector grows 4.5% per year. Net income per farmer household is not less than 537,000 baht /household in 2027.
- Strategies and Policy Guidelines of MOAC: Development of guidelines to drive sustainable agriculture, Agriculture 4.0, Safety-Security-Sustainability (3S), modern agriculture commerce, and The King's Philosophy

OBJECTIVES:

- Analyze rice market segments in Thailand and collect market intelligence to support breeding pipelines
- Study impact of low GI rice (RD43) on reducing sugar level in consumers' health, rice with health benefits/target consumers with specific health conditions
- To support export diversification, such as developing rice varieties that are medium amylose and slender, long
- To prolong the shelf life of grains through better storage and treatment

ACTIVITIES:

1. Analyze rice market segments in Thailand and collect market intelligence to

support breeding pipelines
    - Identify impact opportunities in rice market segments
    - Develop target product profiles for rice breeding pipelines
    - Develop pipeline investment cases for new rice breeding products and pipelines
    - Monitor and assess economic impact of new rice breeding products

2. Study impact of low GI rice (such as RD43) on reducing sugar level in consumers' health, (Softness declines, how far can we go reducing GI before impact) (address farmers' income issue and health concerns)
    - Impact assessment for the whole country in terms of overall nutrition (chronic, malnutrition, diabetes)
    - Compare RD43 to KDML105 and other varieties
    - Learning and training capacity for glycemic index measurement
    - Rice with health benefits (colored rice).
    - Development of pipeline investment cases based on market segment and target product profile for new and future varieties (product segment, pipeline investment case)

2. Export diversification, such as developing rice varieties that are medium amylose and slender, long (address farmers' income issue)
    - New germplasm for breeding for medium amylose and slender rice (long, elongated rice).
    - Market research
    - Low varietal turnover in export portfolio. For example, KDML105 vs RD15.
    - Development of pipeline investment cases based on market segment and target product profile for new and future varieties (product segment, pipeline investment case)

3. Grain storage. Alternative methods of fumigation. Use chemical-free methods to prolong shelf life of grains for organic rice and food safety purposes.
    - Training and demonstrations of hermetic storage for both small-scale (<5 tonnes/batch) and industrial scale (100-300 tonnes/batch);
    - Testing and verification of the drying-combined-hermetic storage technology for seed production in farmer groups
    - Training and learning (e.g. at IRRI)

PARTNERS:

- International Organizations: IRRI and CGIAR Initiative on Market Intelligence
- Government Sector: Thailand's Rice Department
- Private Sector: Rice exporters, Rice Millers, Consumer organizations
- University Partners: Health Science Centers/Institutes (Thailand or abroad), Kasetsart University (Prof. Orachos Napasintuwong)

FUNDING /RESOURCE MOBILIZATION:

Proposed budget funding $ 500,000 (USD) minimum per annum

COMPONENT 4: Food Security and Site-Specific Production

BACKGROUND:

Rice, being a major staple food, plays a critical role in food security in the region and in the world through exports and livelihoods of the rural population. Thailand remains to be among the world's largest rice producers and ties with Vietnam as the second largest exporter of rice.

The intensification of rice production in Thailand brought along new challenges. Shifts in crop management practices could be observed, such as increased fertilizer use to produce higher yields and intensive use of pesticides to manage insects and other pests, weeds and diseases. Intensive pesticide use poses health risks to farmers and other agricultural workers and environmental contamination including effects of wildlife and food safety. In recent years, consumer demand for safe and sustainably farmed food has increased. It is imperative for Thailand to develop and promote efficient and environmentally sound crop management practices to produce safe rice and to protect the rice ecosystem. More site-specific crop management is part of the required change.

OBJECTIVES:

1. To optimize rice-based cropping system for sustainable intensification
2. To improve crop health management
3. To safeguard livelihoods (e.g. through crop insurance schemes)
4. Capacity development

ACTIVITIES:

Objective 1

1.1 Accessing decomposition yield crops gap
1.2 Mapping area for abiotic stresses (flood, drought, etc.) jointly with component 3
1.3 Crop modeling and foresight, and designing of more sustainable cropping systems
1.4 Piloting of improved cropping system

Objective 2

2.1 Establishing and determining pest monitoring system and surveillance, incl. early warning system and pest management advisory
2.2 Developing site-specific IPM for key pests

Objective 3
3.1 Develop model for yield loss estimation
3.2 Develop crop insurance scheme
3.3 Validation of the model insurance scheme

Objective 4
4.1 Cross learning
4.2 Training courses

PARTNERS

- International organizations: e.g., IRRI, INGOs, Centre for Agriculture and Bioscience International (CABI), Asian Food & Agriculture Cooperation Initiative (AFACI)
- Government sectors: e.g. Department of Agriculture (DOA), Department of Agricultural Extension (DOAE), Royal Irrigation Department (RID), National Center for Genetic Engineering and Biotechnology (BIOTEC)
- Private sectors: e.g., pesticide companies, Geo-information & space technology development agency (GISTDA)
- University sectors e.g., Kasetsart University (KU), Chiang Mai University (CMU), Mae Fah Luang University (MFU)

FUNDING /RESOURCE MOBILIZATION:

Proposed budget funding $ 500,000 - $ 1,000,000 (USD) per annum

COMPONENT 5: Climate Change

BACKGROUND

Rice farming in Thailand is increasingly impacted by climate change. Farmers experience longer dry spells and higher temperatures. At the same time, rice production is water-intensive but periods without sufficient fresh water for irrigation occur more and more frequent. At the same time, rice farming is a significant contributor to greenhouse gas (GHG) emissions, mainly through methane (CH4) generated in flooded paddy fields.

The Thai Rice Research and Development bureau has conducted fundamental research with regards to climate change adaptation and mitigation and developed and adapted technologies and practices for climate-resilient and low-emission rice farming. Research areas include risk reduction of rice cultivation in disaster areas such as drought-, flood- and salinity-prone areas, adaptation of varieties to the impacts of climate change and farmers' adaptation technologies as well as options for low-carbon rice cultivation and utilization of by-products from rice production (e.g., straw, rice husk, bran, broken rice).

While many basic technologies exist, they are not yet adopted at scale. Furthermore, many research gaps still exist and modern technologies open up new research areas to be investigated for climate change adaptation and mitigation.

OBJECTIVES:

1) To get a better understanding of the impacts of climate change in different regions in Thailand
2) To develop and outscale technologies and practices to adapt rice farming in Thailand to increasing climatic stresses
3) To support Thailand's NDC targets for the rice sectors (i.e. 2 Mt CO2e reduction)

ACTIVITIES:

1. Use risk maps (drought, flood) to adapt the rice cropping calendar in high-risk areas
2. Explore the use of remote sensing and modeling approaches for identifying and managing biotic and abiotic stresses
3. Analyze the effect of climate change on pests (e.g. new species or virulence)
4. Develop adaptation strategies (incl. new cropping systems) for rice-based farming under climate change
5. Develop short duration rice varieties with high drought- and flood-tolerance

6. Support the outscaling of GHG mitigation technologies, e.g. AWD, DSR and sustainable rice straw management
7. Compare the combined effect of different irrigation and residue management practices on GHG emissions and soil health
8. Develop a system for Monitoring, Reporting and Verification of GHG emissions from Thai rice production for targeting of mitigation efforts and tracking of NDC progress

PARTNERS:

- Government Sector: e.g. Department of Agriculture (DOA), Department of Agricultural Extension (DOAE), Royal Irrigation Department (RID), Office of Natural Resources and Environmental Policy and Planning (ONEP), Geo-information & space technology development agency (GISTDA)
- University Partners: e.g. Kasetsart University (KU), Chiang Mai University (CMU), *King* Mongkut's University of Technology Thonburi (KMUTT)
- Private Sector: e.g. Bank of Agriculture & Agricultural Cooperative (BAAC), LDD, PTT, Thailand Greenhouse Gas Management Organization (TGO),

FUNDING /RESOURCE MOBILIZATION:

Proposed budget funding $ 800,000 - $ 1, 500,000 (USD) per annum

COMPONENT 6: Strengthening Rice Farmers and their Organizations

BACKGROUND:

Thailand's rice farmers face a variety of challenges. An aging farming population is confronted with increasing pressures such as climate change, productivity decline, rice market volatility, and socio-economic problems that not only impact on the country's future as a major rice exporter but are also relevant for national food security.

The proposed objectives and activities were formulated with the vision in mind that farmers get more control over parts of the value chain by strengthening their technological skills, financial literacy, and association as a group that is better equipped for negotiating with other actors of the value chain than a single individual. All this also requires that young farmers have to increasingly be in the focus of capacity building measures.

Thus, the major components of the research program include technological capacity building (higher seed quality), improving financial and economic literacy of farmers and studying its impacts on income generation (income improvement), and analyzing the rice value chain and markets in view of the necessary structural transformation of the rice sector that could increase income opportunities for smallholders as well as young farmers and help adapt to future challenges for the sector (socio-economic transformation/resilience of rice sector).

OBJECTIVES:

1. Upgrade quality of seeds
2. Increase farmers' income
3. Increase farmers equity by addressing current socio-economic problems and increasing income opportunities for youth and disadvantaged and marginalized groups.

ACTIVITIES:

1. Upgrade quality of seeds
    - Analysis of incentive mechanisms for producing good quality seeds by Community Rice Seed Center (CRSC)
    - Training for farmers and study of impact of the training on the quality of seeds

2. Increase farmers' income
    - Increase farmers' financial literacy and capacity building on bargaining situations
    - Innovate business models for farmers, such as vertical integration

- Strengthening bargaining power of farmers, especially for smallholder farmers through farmer associations or groups, and directly linking farmers. Fostering direct marketing of their rice and introducing value-added services. The current increase/demand of geographically indicated (GI) rice is another way smallholders could benefit. Certification, e.g. for SRP, GAP++, and TAS is another line.
- Study of impact of the financial literature education

3. Increase farmers equity by addressing current socio-economic problems and increasing income opportunities for youth and disadvantaged and marginalized groups.
    - Systemic analysis on the current market structure and macro structural changes (young vs old farmers, income, land consolidation, exits, local infrastructure development to attract younger generations).
    - Research on structural transformation in the rice sector.
    - Innovate and identify alternative income channels (e.g., agri-tourism)

PARTNERS:

- International Partnership: e.g. IRRI, INGOs
- Government Sector: e.g. Department of Agricultural Extension (DOAE), Department of Agriculture (DOA), Ministry of Agriculture and Cooperatives, Office of Agricultural Economics (OAE), Bank of Agriculture and Agricultural Cooperative(BAAC), Tourism Authority of Thailand, and other local government offices
- Private Sector: e.g. Bank of Thailand (BoT)
- University Partners: e.g. Kasetsart University (KU)

FUNDING /RESOURCE MOBILIZATION:

Proposed budget funding $ 400,000 - $ 1,000,000(USD) per annum

IN WITNESS WHEREOF, the authorized representatives of International Rice Research Institute and Rice Department, Government of Thailand, have signed this document at the places and on the dates indicated below.

For the
International Rice Research Institute (IRRI)

Jongsoo Shin
IRRI Asia Director
For
Ajay Kohli
Deputy Director General for Research
Date: May 25, 2023
Place: Bangkok, Rice department

For the
Rice Department - Ministry of the Agriculture and Cooperatives (MOAC)

Dr. Chitnucha Buddhaboon
Deputy Director General
For
Mr. Natthakit Khongthip
Director General
Date: 25 May 2023
Place: Rice Department