



# **IRRI–Cambodia Collaborative Work Plan**


**2020–2023**

**Ministry of Agriculture, Forestry and Fisheries  
The Royal Government of Cambodia**

**and**

**International Rice Research Institute  
Philippines**

In witness whereof, Minister of MAFF and the Director General of IRRI, have affixed their signatures.

**For the Ministry of Agriculture,  
Forestry and Fisheries, Cambodia** 



H.E. Veng Sakhon  
Minister  
Ministry of Agriculture, Forestry and Fisheries

Date:

**For the International Rice  
Research Institute** 



Dr. Matthew Morell  
Director General  
IRRI

Date:

## IRRI-CAMBODIA PARTNERSHIP

The International Rice Research Institute (IRRI) has been an important strategic partner of the Royal Government of Cambodia (RGC) since the two parties signed a first Memorandum of Understanding in 1986. This long-standing partnership has contributed to rice production growth, food security, and rural livelihood improvement through rice Research & Development (R&D). Underpinned by this partnership as well as RGC's success in developing its agricultural sector, rice production in Cambodia has increased spectacularly from 2.4 million tons in 1993 to 10.8 million tons in 2019, transforming the country from a food deficit to a net rice exporting nation 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-RGC partnership, with the conservation of rice genetic resources, advancements in Cambodian rice breeding programs, strengthening of rice seed systems, on-farm mechanization and capacity development of Cambodian scientists, extension workers and policymakers being major highlights. The IRRI Genebank currently conserves over 4,900 rice accessions from Cambodia. IRRI reintroduced 766 traditional Cambodian rice varieties to the country in the 1980s. IRRI has also either directly or indirectly contributed to the development of 14 inbred rice varieties developed and released in Cambodia. Since 1980, more than 250 Cambodian scholars and trainees have completed IRRI-supported academic degrees or attend short-term training courses at IRRI headquarters in the Philippines. In addition to these areas, the IRRI-RGC partnership has also been central to improving climate resilience, agronomic practices, and post-harvest technologies, and diversification and intensification of rice-based agri-food systems in Cambodia.

Looking forward, the IRRI-RGC partnership remains as critical as ever to Cambodia's food security, economic transformation and achievement of the UN Sustainable Development Goals (SDGs). Today, rice is the country's most important agricultural commodity and the staple food of 16 million Cambodians. It accounts for over 3.4 million hectares of arable land. Rice export has almost doubled from 387 thousand tons in 2014 to 626 thousand tons in 2018.

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RGC 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 in the country's key policy documents, such as the 4<sup>th</sup> phase Rectangular Strategy (2018-2023) and the Agricultural Strategic Development Plan (2019 - 2023). In particular, through these policies, RGC aims to increase agricultural productivity, quality and diversification as well as promoting the use of digital and smart technologies through investment in agricultural R&D.

Given the critical importance of rice R&D to Cambodia, IRRI places the highest priority on its partnership with RGC and contributing to national policy goals. Therefore, the IRRI-Cambodia partnership focuses on a mission of increasing food and nutrition security through improvement in productivity and diversity, contributing to end 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. The partnership's work promotes the empowerment of women and supports opportunities for youth in an equitable rice agri-food system.

Therefore, to enable IRRI's continued engagement and support to improve the rice-based agri-food system in Cambodia, IRRI and Cambodian National Agricultural Research and Extension System (NARES) partners have jointly prepared this new Four-year Work Plan (2020-2023).

Under this Work Plan, the IRRI-Cambodia partnership builds on our mission through the following key goals to: (i) Enhance the commercialization of rice sector through value chain assessment and strengthening; (ii) Enhance productivity and resiliency of the rice sector through germplasm conservation and utilization, crop improvement and seed system development; (iii) Enhance sustainable management of agricultural land through climate-smart production techniques, optimization of diversified land management options, and landscape monitoring, modeling and planning; and (iv) Promote agricultural modernization through on-farm mechanization, post-harvest and by-product management.

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To implement the Work Plan, IRRI will continue its hands-on engagement in Cambodia through close collaboration with NARES partners, such as the Cambodian Agricultural Research and Development Institute Council (CARDI), General Directorate of Agriculture (GDA), the Department of Agricultural Extension (DAE), Provincial Department of Agriculture, Forestry and Fisheries (PDAFF), 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, RGC and other partners will support the development of the rice-based agri-food systems in Cambodia through the development and implementation of the following projects:

1. Repositioning and strengthening Cambodian rice export in the global market
2. Rice value chain assessment
3. Rice policy development and evaluation
4. Germplasm conservation and utilization
5. Development of climate-smart and market-oriented varieties suitable for Cambodian ecosystems
6. Strengthening the national seed system
7. Climate-smart and sustainable soil, water and pest management
8. Optimization of diversified farming system
9. Landscape monitoring, modeling and planning
10. Post-harvest management and storage
11. By-product management and value addition
12. Field mechanization and business model for service provision

This Work Plan includes a list of potentially high impact R4D projects on the rice-based agri-food system, which have been prepared based on the RGC priorities, research and technology gaps, and IRRI's expertise. Annex I presents the list of projects. These projects align with RGC's agriculture development priorities outlined in policy papers, SDGs, IRRI's strategic plan, and the CGIAR Research Program on Rice Agri-Food System 2017-2021 (RICE CRP). IRRI and partner institutions in Cambodia will jointly implement the Work Plan under the existing collaborative mechanism and jointly seek funding support from potential investors.

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## **FOUR-YEAR WORK PLAN (2020-2023)**

BETWEEN

THE MINISTRY OF AGRICULTURE, FORESTRY AND FISHERIES (MAFF)  
THE ROYAL GOVERNMENT OF CAMBODIA

AND

INTERNATIONAL RICE RESEARCH INSTITUTE (IRRI)  
PHILIPPINES

UNDER THE EXISTING COLLABORATIVE PARTNERSHIP FOR SCIENTIFIC AND  
TECHNICAL COOPERATION IN RESEARCH AND TRAINING ON RICE AND RICE-  
BASED AGRI-FOOD SYSTEMS

In furtherance of the development of this partnership, the Ministry of Agriculture, Forestry and Fisheries, Cambodia and International Rice Research Institute, the Philippines (hereafter, MAFF and IRRI are collectively referred to as 'Parties') are hereby agreed to implement the proposed Four-year Work Plan (2020-2023) consisting of collaborative projects listed in **Annexure 1**, which have been developed through mutual agreement.

### **IMPLEMENTATION**

Details of the implementation of formal and donor-funded collaborative projects proposed in the Work Plan including money transfers will be covered by an umbrella Memorandum of Agreement (MoA) that will be signed by the designated officer(s) of the Ministry of Agriculture, Forestry and Fisheries and IRRI.

## **TECHNICAL COOPERATION**

The agreed collaboration will fall within the IRRI Strategic Plan 2017-2025. As per the Host Country Agreement signed between RGC and IRRI, the MAFF will arrange, subject to administrative approval of a competent authority, for attendance of Cambodian scientists at IRRI activities such as study, research, study tours, training, workshops, conferences and meetings, as required.

## **FINANCIAL ARRANGEMENTS**

This Work Plan does not commit to any financial support. To fund this Work Plan, IRRI and Cambodian NARES partners will jointly develop project proposals and seek funding from third parties, including, but not limited to the World Bank, Asian Development Bank, the Global Environment Facility and the United States Agency for International Development (USAID).

## **PUBLICATION AND INTELLECTUAL PROPERTY RIGHTS**

Results of the collaborative research will be jointly published in the public interest as mutually agreed upon.

All research materials and technologies developed through mutual collaboration will be transferred following Material Transfer Agreements (MTAs) and other appropriate rules/agreements, if any. The transfer of biological materials, including breeding materials and germplasm, will be subject to pertinent biosafety and bioprospecting laws and regulations.

IRRI seeks the support of MAFF for the exchange and distribution of germplasm and materials arising out of collaboration projects of the Work Plan and the other new initiatives amongst other ASEAN countries using Standard Material Transfer Agreement (SMTA) in line with CGIAR guidelines.

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At all times, IRRI shall follow appropriate quarantine requirements in Cambodia and other countries where germplasm is developed and shipped.

The implementation of the Work Plan will be subject to ratification by RGC and IRRI, whenever necessary, and would also be subject to legislation on intellectual property rights enacted by RGC, as well as IRRI's Intellectual Property Commercialization (IP&C) Policy and CGIAR Principles on the Management of Intellectual Assets (CGIAR IA Principles)

#### **AMENDMENTS**

MAFF and IRRI agree to add, modify, and delete items, if necessary, in the Work Plan on conditions mutually agreed upon.

#### **DATE OF EFFECT**

This Work Plan will come into force on signing and will remain valid until 26 April 2023, unless otherwise terminated, modified, or extended by mutual consent. Further, once signed and executed, the Work Plan will become the agreement of the Parties and unless expressly stated otherwise in writing written will supersede, modify and amend the provisions of this Work Plan.

Before the expiry of the validity of this Work Plan, representatives of MAFF and IRRI will meet at a mutually agreed place before April 2023 to review the entire collaborative work in progress and to prepare the next work plan.



## ANNEXURE 1

### A list of potential activities for IRRI-MAFF collaborative Four-Year Work Plan 2020–2024

The following 12 projects have been identified as priority areas for IRRI-MAFF collaboration on research-for-development (R4D) in the rice-based agri-food system in Cambodia for the next five years (2018-2023). IRRI and MAFF commit to jointly identifying potential investors, as well as to leverage their own existing resources, to fund and implement these projects. These potentially high-impact projects have been identified jointly considering existing technologies, associated gaps and alignment with RGC's priorities outlined in key policy documents such as the 4<sup>th</sup> phase Rectangular Strategy (2018-2023) and the Agricultural Strategic Development Plan (2019 - 2023); the United Nations Sustainable Development Goals; the IRRI Strategic Plan (2017-2025); and the RICE CRP (2017-2021).

The detail of the identified 12 research project themes identified under the Work Plan is presented below. The project themes are not listed in order of importance.

<b>Research theme 1. Economics and policy to advance Cambodian rice value chain</b>
<b>Background</b> Cambodian rice industry is rapidly transforming and increasingly facing emerging challenges along the value chain from production to consumption. The major problems include access to improved technologies and practices, access to quality input and output markets, large margin and variability in prices, low share of the farmer in retail price, food quality and safety, responding to market signals, value addition along the supply chain, and high transaction cost along the supply chain. External factors, such as expiring trade agreements, also pose some future risks on the sector. Analysis of the rice value chain is important to overcome bottlenecks and improve efficiency and competitiveness of Cambodian rice industry.
<b>Project 1.1. Repositioning and strengthening Cambodian rice export in the global market</b>
<b>Objectives</b> <ul style="list-style-type: none"><li>• Conduct studies on formal and informal export markets for Cambodian milled rice.</li><li>• Develop repositioning strategy for Cambodian export sector in international market.</li></ul>

- Develop capacities in conducting market studies and formulating strategy for export market positioning.
- Explore the new export market opportunities for Cambodia based on fore-sighting for policy decisions around a revised Cambodian export strategy.
- Assess the potential returns for farmers and the economy in better harnessing the potential of emerging market segments as a result of product differentiation.
- Analyze the impacts of EU tariffs on Cambodian rice export through various scenarios as the tariffs will remain in place up to 2021 or possibly beyond.

#### **Expected outputs and outcomes**

- Greater understanding of Cambodian formal and informal export markets that culminate in a series of strategic recommendations on how to reposition Cambodian rice export in the international market.
- Capacities in market studies developed through on-the-job training of NARES partners.
- Potential new markets for Cambodian rice export identified through trade policy simulation using the IRRI Global Rice Model.
- More in-depth understanding of the potential impact of product differentiation on returns for rice farmers and the economy based on computable general equilibrium (CGE) model.
- Impacts of EU tariffs on Cambodian rice export understood.

#### **Key Performance Indicators**

- Number of strategic recommendations on repositioning Cambodian rice export in international markets.
- Number of training events and trainees in market study methodologies.
- Number of rice-importing countries that could potentially buy Cambodian rice exports
- Publication on the impact of product differentiation on returns for rice farmers and other sectors of the economy
- Publication on the impacts of EU tariffs on Cambodian rice export

#### **Partners**

GDA, CARDI, PDAFF, Private sector partners, such as AmruRice and Cambodia Rice

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Federation (CRF), NGOs

### **Project 1.2. Rice value chain assessment**

#### **Objectives**

- Assess the country's rice value chain for strengths, opportunities, challenges and bottlenecks for strategy and policy development.
- Develop a restructuring strategy to strengthen Cambodian rice export sector's competitiveness in the international market.
- Assess the impacts of labeling and certification on consumers' purchase behavior and producers' farming practices.
- Optimize contract farming practices by conducting studies on contract terms and details as well as other factors that foster successful contract farming practices.
- Develop capacity for value chain studies among NARES partners.

#### **Potential outputs**

- Greater understanding of the current Cambodian rice value chain that culminates in a series of strategic recommendations to strengthen the chain.
- Impacts of labeling and certification on consumers' purchase behavior and producers' farming practices understood.
- Contract farming practices optimized.
- Capacities for value chain studies developed through on-the-job training among NARES partners.

#### **Key Performance Indicators**

- Number of strategic recommendations on strengthening Cambodian rice value chain.
- Publications on the impacts of labeling and certification on consumer's purchase behavior and producers' farming practices.
- Number of farming contracts being facilitated.
- Number of training events and trainees in market study methodologies.

#### **Partners**

GDA, CARDI, DAL, PDAPP, Private sector partners such as AmruRice and CRF, NGOs

### **Project 1.3. Policy development and evaluation**

#### **Objectives**

- Assess the impact of global trade agreements (e.g. termination of EU duty-free



access for Cambodian rice) on Cambodian rice value chain.

- Contribute to the development of policy roadmap to facilitate rice sector repositioning and restructuring.
- Develop and evaluate policy options to encourage adoption of sustainable agricultural practices which may cover sustainable pest, water, soil and by-product management, agricultural mechanization and seed systems.

#### **Potential outputs**

- The impact of global trade agreements (e.g. termination of EU duty-free access for Cambodian rice) on Cambodian rice value chain assessed.
- Agricultural policies reviewed, policy dialogues organized, and rice sector policies influenced.

#### **Key Performance Indicators**

- Publications on the impact of global trade agreements (e.g. termination of EU duty-free access for Cambodian rice) on Cambodian rice value chain.
- Numbers of agricultural policies being reviewed.
- Numbers of policy dialogues organized.
- Numbers of rice sector policies being influenced.

#### **Partners**

GDA, CARDI, PDAFF, DAL, Private sector partners such as AmruRice and CRF, NGOs

### **Research theme 2. Crop Improvement and Seed system**

#### **Background**

More than 85% of the rice in Cambodia is broadcast seeded. Farmers use high seed rates up to 250kg/ha to avoid germination risks and achieve adequate crop stands. Cambodian rice production system is also vulnerable to both drought and flood. Based on IRRI's survey in 2016, 49.7% of respondent farmers had experienced drought and 14% had experienced submergence flooding at least once between 2011 and 2016. The farmers also reported average yield losses of 48% and 51% associated with drought and submergence events, respectively.

Furthermore, droughts and floods impose a high risk on the livelihood of rice farmers. Drought and flood incidences reduce income and food consumption. The IRRI survey in 2016 showed that, during "stress" years, subsistence farmers were self-sufficient for only 8 months. Therefore, the prevailing abiotic stresses constitute a double threat to the



rice sector's overall market competitiveness and the livelihood of Cambodian farming communities. Incorporation of climate-smart traits into Cambodian varieties is one of the main mechanisms for climate adaptation in the country.

Moreover, premium varieties form one of Cambodia's main strengths in the export market. Phka Rumduol, a Cambodian variety, has been declared the best tasting rice in the world several times in the last five years. There is thus an opportunity to expand Cambodia's market share in the global market through this recognition of quality. Rice breeding programs clearly targeting development and testing of varieties suitable for Cambodia ecosystems and production systems is crucial to improving farmer livelihood in the country. Varieties allowing the use of low seed rates, improved yield and grain quality and resilience to biotic and abiotic stresses are key to successfully improving the overall rice sector in Cambodia.

### **Project 2.1. Germplasm conservation and utilization**

#### **Objectives**

- Increase capacity for in-country germplasm conservation
- Increase access to rice germplasm through cross-country exchange
- Enhance understanding of genetic diversity of rice in Cambodia
- Establish germplasm screening networks through public and private partnerships for multi-location testing and characterization of germplasm, pre-breeding lines, mutants and new varieties
- Enhance understanding of genetic diversity of rice in Cambodia.

#### **Potential outputs**

- Capacity for in-country gene bank management increased
- Access to rice germplasm and breeding lines increased
- Number of rice germplasm sequenced
- Rice germplasm sequenced and characterized

#### **Key Performance Indicators**

- Training events and trainees on genebank management
- Numbers of exchange on rice germplasm materials and breeding lines
- Number of rice germplasm sequenced
- Numbers of rice germplasm characterized

#### **Potential partners**

CARDI, GDA, Higher education organizations, such as the Royal University of

Agriculture, ITC, University of Battambang, Don Bosco vocational school and Preak Leap Agricultural School

**Project 2.2. Development of climate-smart, and market-oriented rice varieties suitable for Cambodian ecosystems**

**Objectives**

- Develop market-oriented and climate-responsive product concepts to guide rice breeding efforts for Cambodia.
- Improve existing high-quality Cambodian varieties such as Phka Rumduol to produce better agronomic performance, pest, disease and stress tolerance under direct seeded and alternate wetting and drying systems.
- Develop, test, and improve high-yielding direct seeded rice varieties with shorter maturity duration, tolerance to drought, prolonged flooding, and biotic stresses such as blast, bacterial leaf blight, and plant- and leafhoppers, preferred grain quality and high nutritive value.
- Take up trait development and deployment activities to enrich Cambodian rice germplasm with key genes and QTLs related to grain quality, biotic and abiotic stress tolerance.
- Capacity building on modern breeding technologies targeting government scientists and plant breeders, academia and graduate students.

**Potential outputs**

- Product profile on grain quality and ecosystems developed on the basis of market analysis.
- Improved Cambodian high-quality rice varieties making them more productive and more stable in the face of disease and stress pressure.
- Direct seeded rice varieties with tolerance to drought and prolonged flooding and resistance to major insects and diseases developed and released.
- Five popular varieties of Cambodia profiled for major disease and insect tolerance genes and augmented for missing genes. Trait development and deployment activities for grain quality traits taken up as needed.
- Government scientists, plant breeders, academia and students trained in modern breeding technologies.

**Key Performance Indicators**

- Product profile developed.
- Number of biotic/ abiotic stress tolerant direct seeded rice varieties released and

area covered

- Number of genes for major disease and insect tolerance traits added to the five selected varieties.
- Number of QTLs/ genes identified introgressed for grain quality traits in Cambodian rice germplasm.
- Training events and trainees in modern breeding technologies

#### **Potential partners**

CARDI, GDA, PDAFFs, Higher education organizations, such as the Royal University of Agriculture, ITC, University of Battambang, Don Bosco vocational school and Preak Leap Agricultural School, Private sector partners and NGOs

### **Project 2.3. Strengthening the national seed system**

#### **Objectives**

- Develop seed quality standards, seed certification standards for different classes of seeds of multiple crops, with emphasis on rice.
- Assess seed value chain to identify strengths, opportunities bottlenecks and challenges for formal seed system to be developed.
- Capacity development for Cambodian private sector to initiate commercial seed sector in the country.
- Capacity development on quality seed production for extension officers, PDAFF and GDA officers as well as small seed producers
- Capacity development on field and seed inspection targeting government officials implementing the seed certification schemes.

#### **Potential outputs**

- National seed quality and certification standards and procedures are in place for seeds of multiple crops, with emphasis on rice.
- Seed value chain assessment to inform business and policy development.
- Developed capacity of Cambodian private sector in initiating a commercial seed sector.
- Developed capacity for the implementation of seed certification schemes.
- Developed capacity for quality seed production among private and commercial seed producers.

#### **Key Performance Indicators**

- National seed quality and certification standards and certification procedures published.



- Publication on seed value chain assessment.
- Training events and number of trainees on field and laboratory seed inspection in the context of seed certification schemes.
- Training events and number of trainees on quality seed production targeting public and private sector agencies.

#### **Partners**

GDA, CARDI, PDAFF, Private sector partners, Agricultural Cooperatives

### **Research theme 3. Sustainable rice-based landscape management**

#### **Background**

Rapid response on extreme weather events can be facilitated by real-time landscape monitoring using remote sensing and crop modeling technologies. The same technologies can be used to develop insurance products that will further increase community resilience against extreme weather events.

Pre-harvest yield loss due to pests, weeds, rats and diseases in Cambodian rice production is estimated to be around 1.4 t/ha annually, corresponding to ~35% of national productivity. On the other hand, pesticide use is increasing dramatically in the country. In the 1990s, annual pesticide use on rice was estimated at 224,000 liters, applied by 22% of farmers in the wet season and 57% in the dry season (Jahn et al. 1997). Furthermore, some 38% of farmers used insecticides, 0.7% used herbicides, and 28% used rodenticides (Heong and Escalada 1997). Farmers most commonly used herbicides and insecticides, however in 2016 however, 100% of farmers surveyed applied some amount of pesticide on each season. Provinces with intensive rice cropping systems such as Prey Veng and Takeo in particular had higher insecticide use per season. Moreover, farmers often applied a mix of pesticides in one application, assuming this is more effective. This pesticide reliance is furthermore evident in the way very few farmers (3%) mentioned the use of non-pesticide methods for pest management. Development and dissemination of ecologically-based pest management techniques that reduce the overall use of pesticides will improve the sustainability of rice production in the country. In addition, IRRI has also tested the use of digital technologies to promote behavior change, knowledge sharing and information dissemination by and for pesticide suppliers, farmers and agriculture extension workers.

Low native soil fertility, high spatial and temporal variability affects rice yields in Cambodia (Dobermann and White, 1999; Seng et al., 2001). The site-specific nutrient



management (SSNM) approach was developed in Asia in the 1990's to calculate field-specific requirements for fertilizer N, P and K for cereal crops based on scientific principles (Dobermann et al., 2004). SSNM was shown to improve crop yields versus the farmer practice, which is often based on blanket recommendations and in some cases, overuse and, or, underuse of fertilizers. Furthermore, by rationalizing the use of fertilizer in rice production, SSNM contributes to the abatement of greenhouse gas emission in rice production. However, the SSNM approach is knowledge intensive and cannot be easily used by extension to disseminate nutrient management recommendations to farmers. Using the principles of SSNM, IRRI developed and released an ICT decision support tool, Rice Crop Manager (RCM; <https://phapps.irri.org/ph/rcm/>; <http://webapps.irri.org/in/od/rcm/>) in the Philippines and India to give field-specific fertilizer recommendations to individual smallholder farmers (Buresh et al., 2018; Sheetal et al. 2019). It is a web-based decision support tool that is used to calculate field-specific nutrient management recommendations using information provided by a farmer through an interview. The development of the SSNM recommendation and subsequent contextualization of RCM in Cambodia will help in increasing productivity and nutrient use efficiencies, while mitigating greenhouse gas emission. Similarly, IRRI has also developed an Internet of Things (IoT) based irrigation advisory service, AutoMon in the Philippines for improving water management at both the individual farmer and watershed scale.

The Tonle Sap lake is at the heart of the rice landscape in Cambodia. The lake also serves as a habitat for multiple species of birds, fish and reptiles, some with endangered species status. Multiple species of fish in the Tonle Sap contributes to the food and nutrition security of the Cambodian society. Agricultural run-off in the form of excess pesticides and fertilizer can further degrade the habitat quality of Tonle Sap and may threaten to reduce the diversity and abundance of organisms living in the lake.

### **Project 3.1. Climate-smart and sustainable soil, water and pest management**

#### **Objectives**

- Development, validation and dissemination of soil health management techniques that will minimize greenhouse gas emissions and soil pollution, while optimizing productivity in the different Cambodian agroecosystems.
- Validation and testing of climate-smart water management techniques (e.g. alternate wetting and drying, community water management) to improve the water productivity and reduce greenhouse gas emissions from rice-based production systems in Cambodia
- Development, validation and dissemination of the ecologically-based Integrated

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Pest Management (IPM) technique in rice production.

- Monitoring of invasive species in rice-based landscape.
- Measurement, analysis and reporting of economic, biodiversity, water- and soil health-related SRP indicators in SRP and control areas.
- Development, contextualization and validation of user-centered ICT tools for decision support systems on pest, water and fertilizer management in Cambodia.
- Capacity development on research techniques on ecologically-based pest management as well as sustainable water and soil health management targeting government researchers, academia and students.
- Capacity development on the application of ecologically-based pest management, climate smart water, soil health management and ICT tools for decision support systems targeting extension officers, GDA, PDAFF officers, agricultural cooperatives, farmers' groups and development partners.
- Promoting SRP as a national standard for paddy production by conducting training on SRP standards, practices and indicator data measurement and analysis targeting SRP national chapter members and SRP project implementers.

#### **Potential outputs**

- Integration of ecologically-based IPM, soil health management and water management techniques in the national rice best management practices (BMP).
- User-centered ICT tools on pest, water and fertilizer management are developed and contextualized and validated for Cambodia, ready for scaling.
- Field and landscape-scale environmental and economic indicators of SRP and farmers' practice are reported to the government and used for policy making.

#### **Key performance indicators**

- The national rice best management practices (BMP) published and disseminated, incorporating ecologically-based IPM, soil health management and water management techniques.
- Number of ICT tools piloted.
- SRP indicators reported.

#### **Partners**

GDA, CARDI, PDAFFs, Department of Extension, Higher education organizations, such as the Royal University of Agriculture, ITC, University of Battambang, Don Bosco vocational school and Preaek Leap Agricultural School, private sector partners, NGOs, Agricultural cooperatives



### **Project 3.2. Optimization of diversified farming systems**

#### **Objectives**

- Assessing suitability domains for diversified farming systems
- Development and validation of various crop rotation schemes (e.g. rice-mungbean, rice-maize, rice-vegetables) for different Cambodian agroecosystems.
- Optimization of field- and community-based rice-fish systems.
- Measurement, analysis and reporting of environmental and economic cost-benefit of diversified farming systems
- Development of scaling up strategies for diversified farming systems in Cambodia
- Capacity building on best management practices in diversified farming systems targeting extension officers, PDAFF and GDA officers.
- On-farm demonstrations on best management practices in diversified farming systems targeting agricultural cooperatives, farmers' groups and development partners.

#### **Potential outputs**

- Optimal options for crop rotation schemes are identified for the different Cambodian agroecosystems and integrated into national cropping BMP.
- Best practices for field- and community-based rice-fish systems documented.
- Scaling up strategy for diversified farming systems developed and implemented in some pilot provinces.

#### **Key performance indicators**

- Publications on optimal crop rotation schemes.
- Extension materials on best practices for rice-fish systems
- Scaling up strategies formulated and adopted at the provincial level.

#### **Partners**

GDA, CARDI, PDAFFs, Department of Extension, Higher education organizations, such as the Royal University of Agriculture, ITC, University of Battambang, Don Bosco vocational school and Preak Leap Agricultural School, private sector partners, NGOs, Agricultural cooperatives

### **Project 3.3. Landscape monitoring, modeling and planning**

#### **Objectives**

- Support institutionalization and cross-utilization of IRRI/sarmap technologies at MAFF.

- Develop new applications of IRRI/sarmap technologies for multiple crop monitoring, crop insurance and crop suitability mapping.
- Capacity enhancement on the operations of IRRI/sarmap technologies on landscape monitoring and yield modeling.
- Capacity building on new modules of the IRRI/sarmap technologies as they are developed.

#### **Potential outputs**

- Real time rice landscape monitoring is realized with the data used for rapid response to extreme weather events (e.g. flood, drought) and to support the development of insurance products.
- Methodologies developed for landscape monitoring for one or two additional crops (e.g. cassava, maize) and incorporated as new modules in the IRRI/sarmap technology package.
- Methodologies developed for crop suitability mapping.

#### **Key performance indicators**

- Flood and drought maps produced.
- Landscape monitoring methodologies for additional crops incorporated.
- Crop suitability mapping methodologies developed.

#### **Partners**

GDA, CARDI, Department of Planning and Statistics (MAFF), Higher education organizations such as the Royal University of Agriculture, ITC, University of Battambang, Don Bosco vocational school and Preaek Leap Agricultural School, private sector partners such as Forte, NGOs, Agricultural cooperatives

### **Research theme 4. Post-harvest management and Field mechanization**

#### **Background**

Mechanization and postharvest management play an important role in securing sustainable rice production. These good practices can improve energy efficiency, reduce the environmental footprint of rice, add value to rice production, and address the problem of labor shortage.

Rice production and mechanization in Cambodia has developed rapidly through the use of advanced machinery, such as combine harvesters. However, there are still challenges to adopt other advanced technologies, such as laser leveling, use of



mechanized seeding, and sustainable by-product management.

More than 85% of the rice crop in Cambodia is established by hand broadcast due to labor shortage. Paired with the generally low quality of rice seeds, farmers typically use a very high seed rate (150-250 kg/Ha). Introduction of mechanized options for land preparation and direct seeding can reduce seed rate and facilitate the use of high quality seeds.

Over 90% of harvest in Cambodia is done by combine harvesters. However, the operation of a typical combine harvester neglects best practices and at-harvest losses are relatively high. There is a scope for capacity development among operators of combine harvesters to reduce the losses.

Postharvest management and storage of rice in Cambodia are two other areas in need of improvement. Poor postharvest handling induces quality and quantity losses. Sub-optimal storage further erodes the quantity due to pest infestation and exposes the stored rice to potential mycotoxin contamination.

Finally, the rise of combine harvesting in Cambodia introduced a high amount of by-products in the form of straw in the fields and husk at millers over a short period of time. Farmers resort to straw burning to manage the straw in the fields due to the lack of labor to collect them and limited options for use. Introduction of mechanized options for by-product collection and validation of value addition/creation for these by-products will reduce the environmental impact of straw burning and potentially create new economic opportunities for rural populations.

#### **Project 4.1. Post-harvest management and storage**

##### **Objectives**

- Introduction, contextualization and testing of post-harvest technological options for cleaning, drying and storage (e.g. seed cleaner, flatbed dryer, 2-stage dryer, rice granary design, hermetic bag, etc.).
- Quantification of mycotoxin contamination risk associated with current drying and storage practices and development of techniques to mitigate risk.
- Quantification of postharvest losses associated with pests in storage development of mitigation techniques.
- Development of public-private collaboration and business models to mainstream the use of postharvest technologies (e.g. drying service provision, public-private partnership for storage, etc.).
- Capacity building in postharvest and storage technology development and

application.

### **Potential outputs**

- Validated technological options for post-harvest management and storage.
- Risk mitigation techniques for mycotoxin contamination and pest-related post-harvest losses.
- A network of public, private and public-private partnerships mainstreaming the use of postharvest technologies.

### **Key performance indicators**

- Publications and/or extension materials on technological options for post-harvest management and storage.
- Publications and/or extension materials on risk mitigation techniques for mycotoxin contamination and pest-related post-harvest losses.
- Public-private partnerships formed.

### **Partners**

GDA, CARDI, PDAFF, Department of Extension, Higher education organizations, such as the Royal University of Agriculture, ITC, University of Battambang, Don Bosco vocational school and Preaek Leap Agricultural School, private sector partners, NGOs, Agricultural cooperatives

## **Project 4.2. By-product management and value addition**

### **Objectives**

- Introduction, contextualization and testing of mechanized collection techniques and value addition/creation options for rice straw and husk.
- Quantification of the economic and environmental costs and benefits of different management regimes for straw and husks to inform business and policy development.
- Development of public-private partnerships and business models to mainstream sustainable management of rice straw and husk.
- Assessment on the nascent straw and husk value chain in Cambodia to identify strengths, potentials, challenges and bottlenecks and inform business and policy development.
- Capacity development on collection and value creation options for residual rice straw and husk, targeting agricultural cooperatives, farmers groups and agro-entrepreneurs.

**Potential outputs**

- Validated mechanized collection techniques and value addition/creation options for rice straw and husk.
- Quantified economic and environmental costs and benefits for various residue management options.
- Rice straw and husk value chain assessment results to inform business and policy.

**Key performance indicators**

- Publication and/or extension materials on validated mechanized collection techniques and value addition/creation options for rice straw and husk.
- Publication and/or extension materials on economic and environmental costs and benefits for various residue management options.
- Numbers of business and policies influenced.
- Training events and numbers of trainees on post-harvest management and value addition.

**Partners**

GDA, CARDI, PDAFF, Department of Extension, Higher education organizations, such as the Royal University of Agriculture, ITC, University of Battambang, Don Bosco vocational school and Preaek Leap Agricultural School, private sector partners, NGOs, Agricultural cooperatives

**Project 4.3. Field mechanization and business models for service provision****Objectives**

- Development and validation of mechanization options for field preparation (e.g. laser land leveling) and crop establishment with emphasis on direct seeded rice (DSR) systems.
- Development and validation of mechanization options for diversified farming systems.
- Explore public-private collaboration and develop business models for dissemination of field mechanization options.
- Contextualization and piloting of an ICT tool for harvest scheduling (e.g. EasyHarvest).
- Capacity building on the handling of field machineries to optimize results and reduce harvest loss (e.g. training of combine harvester operations) targeting machine operators.



- Engage youth in agriculture through development of agricultural engineering curriculum in higher education.

**Potential outputs**

- Validated field mechanization options for field preparation and crop establishment with an emphasis on DSR.
- Validated field mechanization options for crop establishment and harvesting of diversified farming systems.
- ICT tool for harvest scheduling is piloted in a few provinces.

**Key performance indicators**

- Publication and/or extension materials on validated field mechanization options for field preparation and crop establishment with emphasis on DSR.
- Publication and/or extension materials on validated field mechanization options for crop establishment and harvesting of diversified farming systems.
- Pilot assessment of ICT tool for harvest scheduling

**Partners**

GDA, CARDI, PDAPP, Department of Extension, Higher education organizations, such as the Royal University of Agriculture, ITC, University of Battambang, Don Bosco vocational school and Preaek Leap Agricultural School, private sector partners, NGOs, Agricultural cooperatives,

