2018

NATIONAL RICE R&D HIGHLIGHTS

CLIMATE RESILIENCY FOR ENHANCED AGRICULTURAL TRADE AND EFFICIENCY FOR RICE PROGRAM

PHILRICE

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PROGRAM

CLIMATE RESILIENCY FOR ENHANCED AGRICULTURAL TRADE AND EFFICIENCY FOR RICE (CREATE-RICE)

Program lead: Ricardo F. Orge

EXECUTIVE SUMMARY

The CREATE-Rice Program operates within two underlying challenges of the Filipino rice farmers: climate change and rice trade liberalization. With climate change, rice production is becoming riskier than before, while trade liberalization may economically harm Filipino rice farmers.

This program implemented four projects geared towards developing technologies and farming system models that would help enhance the farmers' climate change resiliency and market competitiveness. Project 1 focused on the development of technologies that would help farmers manage climate change-related challenges such as typhoons, floods, droughts, saltwater intrusion (due to rise in seawater level), rise in temperature, and changing rainfall patterns. Studies show that resilience to climate change can best be achieved through diversification of income sources. As such, Project 2 worked on the development of diversified and integrated rice-based farming system models that are highly productive and climate-resilient. Backing up Project 2, Project 3 dealt on the development of value-adding technologies that would enhance the value of farm products and by-products, while also ensuring food and nutrition security of farming households. Project 4 focused on developing and evaluating package of technologies that could further reduce production cost and increase yield so local farmers can compete in the international market.

With seven studies implemented, Project 1 produced the first prototype of the long-range sprinkler irrigation system, which hopes to make irrigation in aerobic rice production more efficient and less laborious. The first prototype of a multi-purpose power tiller called *Makisig*, which could help farmers deal with extreme climate events such as droughts and floods was also developed. The bag drying system was subjected to test runs, which yielded design modifications for improved system performance. Two climate change adaptation technologies were also tested: the *capillarigation* system, a do-it-yourself type irrigation system and *kwebo*, a multi-purpose typhoon-resistant farm structure. Three on-farm trials had been established, in which 10 rice varieties were tested for their multi-tolerance against abiotic stresses. Field trial on water saving techniques on rice production with biochar under medium-textured soil was conducted at farmer's field.

Under Project 2, three farming system models were established and evaluated in terms of their net income-generating capability, namely: 1) 950m^2 highly intensified production system model, 2) 14.95m^2 triangular pyramid vegetable production model, and 3) crop + livestock production model occupying 1,700m^2. Enhancements of these models are still ongoing as their computed annual net incomes (P35.58/m^2, P42.59/m^2, and P41.73/m^2, respectively) were lower than the targeted annual net income of at least P50/m^2.

Under Project 3, rice-based food products, which could provide farming households opportunities for generating additional income were developed: gamma-aminobutyric acid (GABA) rice-based food products like the instant GABA rice congee (using NSIC Rc 160) and the ready-to-eat GABA rice adobo meal (using Rc 222), which were found to have high nutritional content and good eating quality and had earned high general acceptability scores. Instant am with improved cold-water solubility and rice-based complementary food (with 50% rice, 35% soybean, and 15% yellow sweet potato flours) for 9-23-month-old child with high nutrient and acceptable sensory attributes were also developed. Meanwhile, steam heating as a stabilization technique was found to be the most effective in reducing the lipase activity of rice bran, leading to its prolonged shelf-life. A multipurpose dryer attachment for the continuous-type rice hull carbonizer was also developed, which showed potential in drying and baking food products.

Among the package of technologies (POTs) tested under Project 4, the POT using the mechanical transplanter during crop establishment achieved the highest yield of 6.61t/ha with an input cost of P8.99/kg paddy yield during DS. The POT on using plastic drum seeder achieved a yield of 5.49t/ha at P8.14/kg input cost. Generally, the crops grown in WS were partially lodged, which contributed to the generally low yields in all POTs tested.

PROJECT 1:

MANAGING CLIMATE-RELATED STRESSES FOR A RESILIENT RICE AND RICE-BASED PRODUCTION SYSTEM

KS Pascual

In 2018, farmers in Zaragoza, Nueva Ecija and Santiago, Isabela tested two technologies that may help them cope with extreme climate events. One is the *kwebo* (typhoon-resistant multi-purpose farm structure) and the other is the *capillarigation* system (low cost, do-it-yourself type irrigation system) for smallholder farmers.

The first prototype of the long-range sprinkler irrigation system for rice (aerobic) and rice-based crops was also fabricated and ready for testing in 2019. Other technologies such as the paddy bag drying system for fast handling and drying of typhoon-affected palay and the multi-purpose mini-tractor (called *Makisig*) were further improved.

The conduct of multi-stress tests of rice breeding lines started in three abiotically-stressed sites, which were planted with 10 rice varieties, each representing tolerance to at least one abiotic stress. Field trial of water-saving techniques with rice hull biochar at farmer's field was conducted to further reduce the water requirement of rice. Results, however, showed that the addition of biochar in alternate wetting and drying (AWD) technique had no effect on the water productivity of rice in medium textured soils.

Development of a sprinkler irrigation system for rice and rice-based crops

AT Remocal, KS Pascual, RF Orge, DA Sawey, LV Leal

This study aimed to develop a sprinkler irrigation system for rice (aerobic cultivation) and rice-based crop so as to provide farmers an irrigation technology that would help them cope during periods wherein water supply is very limiting. Design criteria was established, which was used as guide in developing the system, fabrication, and evaluating the performance of the prototype, as well as design modification (if needed) so as to come up with a working prototype ready for pilot testing at farmers' fields. The system was designed to cover a service area of ¼ ha (2,500m^2) in one setting, making use of a typical engine-pump set commonly used by farmers in irrigating or flooding their crops. Fabrication of the first system prototype has been completed and ready for field testing in 2019. The prototype system is composed of a collapsible tripod with a commercially-available sprinkler head (32mm base diameter), a 50mm (2") centrifugal pump driven by a 6hp gasoline engine, and 50mm diameter layflat hose serving as conduit for water to flow from the pump to the sprinkler head.

Development of a Paddy Bag Drying System

DA Sawey, RF Orge, and LV Leal

This study aimed to come up with a working prototype of a climate-responsive rice postharvest handling and drying system for fast processing of high moisture content (MC) palay like those affected by typhoons or floods. It specifically aimed to improve the design of the system's grain handling and drying component and test and evaluate the system's performance on drying wet paddy grains. The design of the drying bags was modified while maintaining its 500kg-capacity. Result of test runs showed that the system performed its intended function of bulk handling the grains from the field to the drying shelter (~500m distance) and then drying the high MC grains (35.4%) to a final MC of 11.05% (±2.35%) after 12h of operation, consuming 310kg rice hull (25.8kg/h) and 108kg biochar (carbonized rice hull) as by-product. However, the system still needs further design refinements to attain a more uniform grain MC of the final product as well as series of tests to further evaluate its performance at full drying capacity of 4t.

Development of a multi-purpose mini-tractor for climate change adaptation

RF Orge, DA Sawey, and LV Leal

This study generally aimed to come up with a new generation of power tiller that can perform functions beyond the capability of the existing ones, particularly farming operations that address climate change. Specifically, it aimed to design and develop a riding-type small power tiller and attachments so that it can perform operations such as drilling shallow tubewells and digging canals that would help farmers respond better to extreme climate events. The first fabricated prototype, named *Makisig* 1 (*Makina para sa pabago-bagong Klima at Sari-saring Gawain sa bukid*), features two 200 mm-diameter screw wheels that serve as the prototype's traction mechanism. After going through laboratory test runs and making some design modifications on its transmission system to improve the transfer of power from the engine to the screw wheels, the prototype was tested in the field with dry soil to evaluate its mobility performance. While the machine can move on dry ground, there is still a need to further improve the design of its transmission system and the other components associated with it.

Establishment of Kwebo in Selected Farmers' Cooperative

KC Villota, LV Leal, DA Sawey, and RF Orge

This study aimed to demonstrate the construction of *kwebo*, a PhilRice-developed multi-purpose farm structure, in selected farmers' organizations and gather feedback regarding its method of construction and use. *Ugat-uhay* Farmers' Association in Zaragoza, Nueva Ecija and the Ambalatungan Vegetable Growers Organization in Santiago, Isabela were identified as farmers' organization-partners. Although the basic principle of construction and target cost per unit floor area is similar, the design

and function of the structure varies from each organization. *Ugat-uhay* Farmers' Association intends to use *kwebo* for growing mushroom while Ambalatungan Vegetable Growers Organization planned to use it as storage of farm inputs and products. Farmer-members of these organizations had been initially trained on the construction of the basic construction units (BCUs) so they can fabricate the required units needed in constructing the whole structure. Once completed, training on assembling the pre-fabricated BCUs will also be provided to the farmers. Both organizations had completed the required BCUs.

Pilot testing of the capillarigation system in selected farmers' cooperatives

DA Sawey, RF Orge, and LV Leal

This study aimed to pilot test the capillary irrigation (*capillarigation*) system, a do-it-yourself type irrigation system developed for smallholder farmers as a low-cost alternative technology for drip irrigating rice-based crops, especially during drought when it is already too risky to plant rice due to limited supply of water. The technology was pilot tested to *Ugat-uhay* Farmers Association of Zaragosa, Nueva Ecija and Ambalatungan Vegetable Growers Association of Santiago City, Isabela. Selected members of these organizations were trained on the fabrication of the system components, particularly the capillary wicks and the water distribution lines, through locally available materials. The system was planned to be established in the field after the training, however, it was not pursued due to the coming of the rainy season. Hence, in the later part of the year, the study focused on coming up with designs of vertical gardens integrating the use of the capillarigation system. With the vertical gardens, vegetable production is possible during rainy season when the ground is usually flooded or soaked in water. Two vertical garden designs (self-watering due to the integration of the capillarigation system) were developed and now being evaluated for performance.

Multi-stress tests of breeding lines in rainfed lowland

JM Niones, NV Desamero, MCJ Cabral, VC Lapitan, MAR Orbase, MJ Mercado, CU Seville, J Parina, Anielyn Y. AY Alibuyog, and BS Pungtilan

This study aimed to evaluate, identify, and select climate change resilient rice varieties with abiotic multi-stress tolerance in salinity, submergence, heat, and drought under multi-environment trials in rainfed lowland areas. Three on-farm sites were identified in 2018 DS for the conduct of 2018 WS multi-stress trial. These sites were experiencing cycle of abiotic stresses, drought, salinity, and submergence throughout the cropping season: Suso, Sta Maria, Ilocos Sur (drought-salinity); Ponong, Magarao, Camarines Sur (salinity-drought); and Camaba-og, Hinigaran, Negros Occidental (drought-salinity-submergence). Ten entries: NSIC Rc 222 and Rc 160 (irrigated lowland), N22 and IR52 (heat), PSB Rc14 and IR64 (drought), PSB Rc 68 and Rc 194 (submergence), IR29 and PSB Rc 90 (saline) were used as experimental materials. Establishment were carried out from July 11 to August 10, 2018 thru transplanted method (Sta. Maria, Hinigaran and PhilRice CES) and direct wet-seeded in Magarao. Data are still being consolidated.

Enhancing the water productivity of AWD through use of biochar and timing of irrigation

KS Pascual, AT Remocal, LS Caguiat, FS Grospe, and RT Cruz

This study aimed to enhance the water productivity of rice through biochar and improved irrigation timing. Two separate field experiments were conducted in farmer's field located in Cuyapo (site 1) and PhilRice in Science City of Muñoz (site 2), Nueva Ecija during 2018 DS. In site 1, two water management options <W> (continuously flooded-CF and safe alternate wetting and drying -AWD) and four biochar rates <B> (0, 2, 5, 10t/ha) were arranged in a strip-plot design in three replications. In site 2, field microclimate was evaluated using four treatments [CF, AWD, saturated soil condition (SC), safe AWD with night time irrigation (AWD+)]. Results in site 1 showed that W significantly ($p < 0.05$) affected the water use while the B and its interaction with W was not significant. AWD saved water by 49-55% and the irrigation interval (II) was three times lower than CF. In site 2, initial results of field's microclimate showed that CF and AWD+ were highest and lowest in soil temperatures with 1ºC and 0.7ºC difference, respectively. Meristem, air, and canopy temperatures were lower in AWD and AWD+ than CF and SSC. Water productivity of AWD and AWD+ were significantly ($p < 0.05$) higher than other treatments. The initial findings suggest that adding biochar in AWD had no effect on the water use of rice under medium textured soil. In terms of microclimate, further study is needed to understand more the underlying mechanism under water saving techniques that could help in adjusting the right timing of irrigation.

PROJECT 2:

PALAYAMANAN SMART: DEVELOPMENT FARMING SYSTEMS MODELS THAT ENHANCES CLIMATE-CHANGE RESILIENCY

RG Corales

The project aimed to develop highly productive climate-resilient farming system models with a target income of at least P50/m^2 and to assess their adaptability in climate-vulnerable rice-based communities in helping increase farm productivity and income. Three farming system models were established and evaluated: Highly Intensified Production Systems (HIPS), Triangular Pyramid Vegetable Production, and Rice + Livestock + Vegetable production models which yielded a computed annual net income of P35.58/m^2 , P42.59/m^2, and P41.73/m^2, respectively. Improvements are still needed as the three models have yet to pass the targeted annual net income. Four floating vegetable garden models were pilot tested in Barangay Matingkis, Science, City of Muñoz, Nueva Ecija in partnership with government agencies and civic organizations. Bamboo raft garden bed model, bamboo raft potted plant garden model, bamboo floating raft aquaponics models, and water hyacinth floating vegetable bed model were assessed.

Development of Highly Productive Climate –Resilient Farming Systems Models

RG Corales, JM Rivera, DA Gabriel, DA Sawey, RF Orge, and JT Sajor

This study aimed to develop highly profitable climate-resilient farming system models. Specifically, it aimed to develop crop production models that can generate an annual income of P50.00/m^2 and crop + livestock production models that can generate an annual income of P100.00/m^2. Three farming system models were evaluated: Highly Intensified Production Systems (HIPS), Triangular Pyramid Vegetable Production (TPVP), and Rice + Livestock + Vegetable production models, which were established at the PhilRice Central Experiment Station. Results showed that HIPS model generated an annual income of P33,808.63 equivalent to P35.58/m^2 from the production of special quality rice (SQR) and gabi on the sinks, vegetables planted on the raised beds, bunds, and trellis, and papaya planted along the bunds. The income generated by HIPS model was 28% higher than the average income generated from the Sorjan model from 2015 to 2017. The TPVP model planted with pechay and ampalaya, kangkong, pepper and cowpea, and ginger from July to November 2018 generated an income of P638.90 equivalent to P42.59/m^2. Rice + Livestock + Vegetable production model planted with rice, gabi, and vegetables and stocked with 500 ducks/ha generated an annual income of P70,943.20 equivalent to P41.73/m^2.

Piloting and Adaptability Assessment of Farming Systems Models in Climate-vulnerable Rice-based Communities

JM Rivera and RG Corales

The study pilot tested and assessed the adaptability of floating vegetable garden models in climate-vulnerable rice-based communities. Piloting and adaptability assessment of floating vegetable garden models were conducted in Small Water Reservoir Irrigation Project (SWRIP) in Matingkis, Science, City of Munoz, Nueva Ecija starting October 2018. The bamboo raft garden bed, bamboo raft potted plant garden, bamboo floating raft aquaponics, and water hyacinth floating vegetable bed were established and assessed by the Barangay Council, Senior Citizens Association, 4Ps Association, and Farmers Association. Project implementation was in collaboration with the City Agriculture Office, City Department of Tourism, and City Department of Social Welfare and Development of the Science City of Munoz, Nueva Ecija. The crops planted were *kangkong, okra,* cowpea, *pechay*, mustard, eggplant, pepper, and tomato. Water hyacinth vegetable garden model collapsed due to insufficient reinforcement. Some of the vegetables planted in the bamboo raft bed also died due to insufficient floater.

PROJECT 3:

DEVELOPMENT OF VALUE-ADDING TECHNOLOGIES

MV Romero

This project aimed to provide rice and rice-based farming household opportunities for generating additional income from their farms through the development of value-adding technologies. Studies implemented under this project include: 1) Upscale production of gamma-aminobutyric acid (GABA) rice and its potential as base ingredients for instant and ready-to-eat foods; 2) Rice-based complementary foods and beverage: Value-added products for enhanced nutrition and income among rice-based farm households; 3) Utilization of stabilized rice bran as food ingredients for functional food products; 4) Formulation, characterization, and efficacy testing of nanosilica structured biofertilizer for rice production; and 5) Development of carbonizer attachments for recovering heat as source of energy for processing Palayamanan products.

Results in Study 1 showed NSIC Rc 218 had the closest traits to Rc 160 in terms of sensory properties and general acceptability, among the five rice varieties screened for upscale production of GABA rice. Instant GABA rice congee (IGRC) using Rc 160 and ready-to-eat GABA rice *adobo* meal (RTE GRAM) using Rc 222 were also developed. These GABA rice-based food products were found to have high nutritional content, good eating quality, and high general acceptability scores.

In Study 2, instant am with improved cold-water solubility from 5.67 to 8.56% was developed. Rice-based complementary food for 9-23-month-old child with 50% rice, 35% soybean, and 15% yellow sweet potato flours with high nutrient and acceptable sensory attributes was also formulated. Study 3 focused on determining the best stabilization technique for rice bran. Steam heating was found to be the most effective technique in reducing the lipase activity; thereby, prolonging the shelf-life of rice bran. Study 4 synthesized and characterized amorphous nanosilica from rice hull ash. The best treatment in nitrogen, phosphorus, and potassium (NPK) content was observed in Fish Amino Acid (FAA) alone while the best treatment with the highest bacterial count was recorded from treatments with FAA, P, K, silica, and *L. plantarum*. The last study looked into the potential of the CtRH carbonizer in providing farmers opportunities for generating additional sources of income through the development of attachments that would recover and utilize the generated heat in, among others, processing value-added products. Hence, a multi-purpose dryer that functions both as dryer and oven was developed. A mushroom pasteurizer using steam was also developed. These value-adding technologies developed from rice, diversified rice-based farming products, and by-products contribute to the outcome on enhanced value, availability, and utilization of rice, diversified rice-based farming products, and by-products for better quality, safety, health, nutrition, and income.

Upscale Production of Gamma-aminobutyric Acid (GABA) Rice and Its Potential as Base Ingredients for Instant and Ready-to-eat Foods

RM Bulatao, MB Castillo, JPA Samin, and MV Romero

This study was conducted to screen five rice varieties and optimize different processes for the upscale production of GABA rice. The sensory properties and general acceptability of the developed GABA rice were evaluated by 15 trained laboratory panelists. Instant GABA rice congee (IGRC) and ready-to-eat GABA rice *adobo* meal (RTE GRAM) were also developed using Rc 160 and Rc 222, respectively. GABA rice and the developed products were further evaluated for their nutritional content, microbial load, sensory properties, and general acceptability. GABA rice produced from Rc 218 had comparable sensory properties and general acceptability with that produced from Rc 160. GABA rice produced from upscale production also had comparable sensory properties and general acceptability with the GABA rice from laboratory scale. GABA rice from Rc 160 and Rc 222 were found suitable for the production of IGRC and RTE GRAM, respectively, due to their high nutritional content, good eating quality, and high general acceptability scores.

Rice-Based Complementary Foods and Beverage: Value-Added Products for Enhanced Nutrition and Income Among Rice-Based Farm Households

RGA Ramos, EH Bandonill, AV Morales, ESA Labargan, PR Belgica, and MV Romero

Availability of nutritious foods from locally-grown materials can help meet the nutritional requirements of rice-based farm households. Combination of local agricultural crops and appropriate processing technique will improve the nutritional profile of foods and beverage. This study developed low-cost rice-based products from rice and nutrient-dense rice-based crops for infants and children.

Instant rice water ("am") was developed using different mesh size (unsieved, 100, and 120 mesh). The reconstituted "am" was evaluated in terms of sensory, functional, and microbial properties; and proximate composition. Sensory evaluation showed that 100-mesh reconstituted instant "am" was whiter and was slightly aromatic (pandan-like scent) than the control and did not differ in terms of suspended solids, viscosity, mouthfeel, and taste. Further validation selected the 120-mesh size for instant "am" preparation based on its highest cold-water solubility, water absorption index; and swelling power, whiter color, and comparable sensory characteristics with the control (traditionally prepared boiled "am"). Consumer sensory evaluation also showed comparable sensory qualities and overall acceptability between instant "am" and the control. Likewise, a nutrient-dense and acceptable rice-based complementary food (50% rice, 35% soybean, and 15% yellow sweet potato flours) was formulated. The complementary food contained 1.36% moisture, 17.64 % of protein, 6.77% fat, 1.38% total minerals, 73.12g carbohydrates, and 423.38 energy (kcal/ 100g) that meet the daily

recommendation for complementary food in terms of protein (≤5 g), carbohydrate (≥65g/100g), and energy (400-425 kcal/100g). The product received high consumer acceptance and purchase intention. The complementary food showed viscosity suited for 9-23-month old children based on its high water absorption index (3.66-4.67 g/g), water solubility index (0.24 – 0.39%), and swelling power (0.02 - 0.03%). The two rice-based products can now be packaged for transfer and upscale production.

Utilization of Stabilized Rice Bran as Food Ingredients for Functional Food Products

JPA Samin, RM Bulatao, MB Castillo, and MV Romero

This study focused mainly on the stabilization of rice bran and the development of food products from it. NSIC Rc 360 was used in the stabilization. Different parameters involving exposure time and temperature for oven-drying, infrared heating, steam heating, microwave heating, and gamma-irradiation were optimized as follows: oven drying for 30, 60, 90min at 125, 150, and 175°C; microwave for 1, 3 and 5min at low and medium settings; steam for 5, 15, 25, and 35min; infrared heating at 10, 20, and 30min at 150°C; and gamma irradiation of 1, 5, 10, and 15kGy. To indicate the effectiveness of the stabilization, free fatty acid content and lipase activity assay were determined before and after stabilization.

Little to no significant difference was observed in the free fatty acid (FFA) content of the rice bran samples before and after each treatment. Lipase activity, on the other hand, was observed to be reduced up to 30% and 96.5% for microwave treatment (medium, 3min) and steam heating (15, 25, and 35min). This signifies that steam heating of sample for at least 15min significantly lowered the activity of lipase; thereby, decreasing the rate of production of FFA. Further, analysis involving the one-month storage of the treatments is on-going to validate the results of the lipase activity.

Formulation, Characterization, and Efficacy Testing of Nanosilica Structured Biofertilizer for Rice Production

JJ Monserate (CLSU), RM Bulatao, MV Romero, and MM Sarong

This study was conducted to synthesize, formulate, and test nano biofertilizer on irrigated rice. Different treatments were prepared and evaluated for their chemical properties. Characterization of nanosilica (nSi) and nano calcium oxide (nCaO) through scanning electron microscope (SEM) micrographs showed that the synthesized nSi was less than 30 nm while x-ray diffraction (XRD) analysis showed a broad peak at 2Θ= 21°- 22° indicating that the synthesized silica nanoparticles were amorphous. XRD analysis confirmed the purity of nCao while SEM analysis showed that the shape of particles was semi hexagonal confirming its crystallinity. The treatment with Fish Amino Acid (FAA) alone proves to be the best treatment as it gave the highest numerical value of nitrogen, phosphorus, and potassium (NPK). The

incorporation of Ps and K of the plant samples and bacteria in combination worked together, showing values of NPK lower than the control (FAA). NPK of treatment with FAA and treatment with FAA and *L. plantarum* were not significantly different with each other. Hence, the best treatment in NPK content was with FAA alone while the best treatment with the highest bacterial count was with FAA, phosphorus, potassium, silica, and *L. plantarum*.

Development of Carbonizer Attachments for Recovering Heat as Source of Energy for Processing Palayamanan Products

LV Leal, DA Sawey, and RF Orge

This study looked into the potential of the CtRH carbonizer in providing farmers more income sources through development of attachments that would recover and utilize the generated heat in, among others, processing value-added products. A multi-purpose dryer attachment was developed and laboratory tested. Test results showed that the heat, as expressed by the temperature profiles of different sampling points within the dryer, is enough for the attachment to function as a dryer and as an oven, depending on the manner in which it is operated. In addition, an improved design of steam generator for the pasteurizer of mushroom fruiting bags was developed, which can potentially extend the function of the pasteurizer in other income-generating activities of the farmers.

PROJECT 4:

INNOVATIONS FOR ENHANCING AND SUSTAINING RICE PRODUCTIVITY, PROFITABILITY AND EFFICIENCY IN IRRIGATED AND RAINFED LOWLAND SYSTEMS

AS Juliano

The project aimed to determine the best package of yield-enhancing and cost-reducing technologies for irrigated areas that can help farmers become globally competitive. The project was composed of: 1) using the outputs from the 10-5 challenge, 2) using mechanical rice transplanter, 3) using plastic drum seeder, and 4) using multi-purpose seeder specific for rainfed lowland areas. These technologies are combination of new farming innovations and matured technologies promoted by PhilRice.

Conduct of studies were scheduled one month earlier than the scheduled station's target date of establishment (November 2017 for DS and May 2018 for WS). High-quality hybrid rice seeds were used for dry season and high-quality inbred seeds for wet season. The evaluation of technologies under the studies was based on yield and input cost per kilogram of palay produced for both irrigated and rainfed lowland farms.

Results showed that the mechanically transplanted-based package of technologies (POT) achieved the highest yield of 6.61t/ha with an input cost of P8.99/kg for DS and 5.20t/ha at P9.42/kg for WS (partially-lodged crops). Meanwhile, the manually transplanted study achieved a yield of 5.34t/ha at P10.18/kg for DS and 4.77t/ha yield at input cost of P10.39/kg) for wet season (partially-lodged crops). The plastic drum seeder-based POT achieved a yield of 5.49t/ha at P8.14 per kg palay for DS and the partially-lodged crop achieved yield of 4.42t/ha at input cost of P9.26/kg for WS. Labor cost was computed based on the 10% percentage share in the community. Computation of machine rental was based on the harvesting season's prevailing dry paddy price of P22.5/kg for DS and P26/kg for WS.

Results showed that mechanization can reduce the cost of rice production thru removing all machine rental and shifting to ownership of machines. In terms of yield, there is a need to focus on how it can be increased, as the input cost/kilogram of palay produced will depend on its value. High yield corresponds to low input cost/kg. Similarly, low yield will result in a higher input cost/kg. With these results, there is a need to look at the history of the experimental site and consider soil analysis and other techniques to determine the factors that can help increase the yield.

Development of Best Package of Technologies from the 10-5 Challenge Output

DP Dela Cruz and AS Juliano

Coping with the challenges in rice production is an unending process. Through Palayabangan challenge, rice technologies were tested and documented. The competition challenged rice industry players to show their technologies that can achieve high yield and at the same time reduce cost. Some farmers can already achieve yield of 10t/ha but seemingly, production cost is not considered. To assess the performance of these technologies, the study was conducted to test the replicability of these yield-enhancing and cost-reducing package of technologies and determine and develop new set of technologies for irrigated lowland areas that can achieve 10t/ha at P8kg for DS and 7t/ha at P7/kg for WS.

The study was conducted in two consecutive seasons at PhilRice - Central Experiment Station. Following a detailed crop production practices suitable for the cropping season, the yield and the production cost were computed to assess the result. 2018 DS results recorded a yield of 5.34t/ha at P10.18/ kg palay. For the wet season, 4.77t/ha at P10.39/kg was achieved.

Development of Best Package of Technologies for Mechanized Farming with Rice Transplanter as Major Intervention in Rice Production

DP Dela Cruz and AS Juliano

The study validated the best package of technologies on mechanized farming using rice transplanter in crop establishment. It was conducted in two seasons (one dry and one wet season) at PhilRice - Central Experiment Station following a detailed crop production practice suitable for the cropping season using a mechanical transplanter. The yield and input cost per kilogram were computed to assess the result. Dry season results recorded 6.61t/ha at P8.99/kg of palay while in the wet season, 5.2t/ha was produced at P9.42/kg. The target yield was greatly affected by the delayed schedule of crop establishment, low quality seeds, and other soil characteristics.

Mechanized Rice Farming with Plastic Drum Seeder in Rice Production

IP Pineda, JEO Abon,and AS Juliano

Drum seeder was developed to reduce seeding rate (as an answer to the high seeding rates in manually broadcasted seeds) and expenses on seeds. This study aimed to mechanize rice farming with plastic drum seeder as the major intervention in crop establishment to attain 10t/ha yield at P8/ kg palay for dry season and 5t/ha at P7/kg for wet season. The field trial was conducted at PhilRice-Central Experimental Station with crop management practices generally following the PalayCheck System for irrigated lowland rice. However, major intervention was made during land preparation (21 days duration) and crop establishment that is suitable for direct seeded rice.

Fertilizer applied was the recommended rate of 141-42-42 for DS and 97-28-28 for WS at three split applications. During crop establishment, plastic hoppers of the drum seeder were filled at 2/3 of its maximum capacity. After seeding, the field was saturated and left unirrigated until cracks became visible to allow the anchoring of roots into the soil and facilitate the control of golden apple snails. The replanting of missing hills was done 2-3 weeks after sowing.

Initial results showed a total production cost of P48,119.5/ha in the DS and P43, 248.16/ha in WS. Yield during DS (adjusted at 14% MC) was 5.49t/ha produced at P8.76/kg while harvest during wet season was 4.14t/ha at P10.45/kg. The low yield during wet season was due to inclement weather.

We are a government corporate entity (Classification E) under the Department of Agriculture. We were created through Executive Order 1061 on 5 November 1985 (as amended) to help develop high-yielding and cost-reducing technologies so farmers can produce enough rice for all Filipinos.

With a "Rice-Secure Philippines" vision, we want the Filipino rice farmers and the Philippine rice industry to be competitive through research for development in our central and seven branch stations, coordinating with a network that comprises 59 agencies strategically located nationwide.

We have the following certifications: ISO 9001:2008 (Quality Management), ISO 14001:2004 (Environmental Management), and OHSAS 18001:2007 (Occupational Health and Safety Assessment Series).

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