2020

PhilRice R&D Highlights

Rice Farm Modernization and Mechanization Program

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PROGRAM

Rice Farm Modernization and Mechanization Program

Program Leader: Jasper G. Tallada

EXECUTIVE SUMMARY

The Rice Farm Modernization and Mechanization Program (RFMM) has a two-fold research for development (R4D) target. The program develops mechanization technologies for rice production and post-production operations: from land preparation, crop establishment, harvesting and threshing, drying to milling. With the availability of rice husks, there were efforts for complementary development of renewable biomass energy systems. RFMM also delves into the application of smart information technologies founded on electronic sensing and control and intelligent information systems and applications for decision support and to provide deeper industry insights.

The program implemented three projects: (1) Mechanization of rice and rice-based farming, (2) Post-production and renewable energy technologies for rice and rice- based farming, and (3) Modernized rice farming and strategy thru precision technology and intelligence information systems. Projects 1 and 2 divided the continuum of farming operations with Project 1 covering from land preparation until pre-harvesting. Project 2 focused on operations from harvesting to processing. Project 3 integrated farm modernization technologies including app and server software development, intelligent system, internet of things, robotics, and unmanned aerial vehicle or drone.

The program directly contributes to the following outcomes in the PhilRice Strategic Plan 2017-2022:

- Increased productivity, cost-effectiveness, and profitability of rice farming in a sustainable manner;
- Improved rice trade through efficient post production, better product quality, and reliable supply and distribution system;and
- Enhanced value, availability, and utilization of rice, diversified rice-based farming products, and by-products for better quality, safety, health, nutrition, and income

EXECUTUVE SUMMARY

Despite the difficulties imposed upon by the lockdown for several months and the limited movements caused by COVID-19, these three research for development (R4D) projects reinforced the achievement in 2020. Final prototypes of the three-row motorized weeder, multi-crop reduced till planter (MCRTP), gear transmission tractor, cutter-bar rice combine, and the pedal cum electric motor driven brown rice mill as reported last year, had stirred manufacturer interests. The boat tiller was pre-commercialized when one manufacturer signified interest in the machine's possible inclusion to the RCEF-Mechanization Program. Upgraded flatbed dryer with a temperature monitoring network within the dryer showed exemplary performance. A manufacturer's prototype of the concept-validated producer gas fed single cylinder non-retrofitted diesel engine was developed with materials and labor costs shouldered by the manufacturer. The rice-hull gasifier engine pump system that can continuously operate for at least 8h has now a gear-motor drive for the rice husk feeding system.

Intelligent executive information called RiceIntel is continuously populated with rice industry information particularly with datasets from ATI-BRS LAS and AgRiDOC. It also automatically gathers agricultural news from the internet. Downloads of mobile Android apps for rice varieties such as Binhing Palay, eDamuhan, and AgriDoc also increased. The unmanned aerial vehicle or UAV was also improved. A partnership with a private Harbest company to fine tune the application of herbicides (Herbadox and Command) was forged. The work on water quality monitors using IoT continued for real-time measurements of temperature, pH, dissolved oxygen, and electrical conductivity of the ponded water. Control of the drip irrigation and sluice-gate automation were also improved. The propulsion system of a robotic seeder was also developed.

PROJECT 1

Mechanization of rice and rice-based farming

Elmer G. Bautista

Mechanization plays an increasingly important role in enhancing agricultural production in Asia, particularly in rice production. Although farm mechanization is often not directly associated with yield increases, mechanizing crop production activities from land preparation to harvesting will enable early crop establishment, reduce less labor costs, and ease drudgery in different activities.

In implementing this project, about 36% women participated in the project implementation as part of the researcher's group. They had been involved in the planning and execution of activities under the project. Some of the project gains were shown to the rice farmers during this year's online Lakbay Palay.

In land preparation, in which difficulty on turning at headland or maneuverability is an issue, there is a need to develop a universal prime mover. The gear type transmission power tiller has great maneuverability with the use of clutch steering and several attachments/accessories can be attached for specific operations like tilling, ploughing, weeding, pumping, puddling, leveling, and transportation. It can also be used for transplanting, seeding, and harvesting. Multi-application of the gear transmission can reduce the cost of operation and improve the economics of use. In addition, a multi-crop reduced till planter was developed to resolve labor shortage and high cost during transplanting.

Physical/mechanical, cultural, biological, and chemical methods to control weeds are also being studied under this project.

Improvement and field testing of lightweight riding-type boat tiller for shallow and waist-deep mud conditions

Arnold S. Juliano, Jimson B. Bedonia, Joel A. Ramos, Elmer G. Bautista, Manuel Jose C. Regalado, Katherine C. Villota

The riding-type boat tiller was developed and currently being improved for shallow and waist-deep mud conditions of fields. Boat tiller for shallow fields that is equipped with 10hp reduction-type air-cooled diesel engine, was field tested. Based on data, the prototype shows promising potential for shallow field due to its fast performance and well-levelled result. The prototype has an average forward speed of 5km/h, average fuel consumption of 1.73Li/h, average actual field capacity of 0.45ha/h (3.6 ha/day), and average field efficiency of 75%. The prototype was set in ¾ of the power capacity of the engine. Through a series of tests, modifications and adjustments were made to achieve the desired performance of the machine. Pneumatic wheel was attached to the prototype to easily transport the machine to the field. Road tests showed that the prototype with pneumatic wheel has a speed of 10km/h using half of the engine power.

Riding-type boat tiller for shallow field was tested for endurance in 20ha, which results will be used for modifications.

Pilot-testing of multi-crop reduced till-planter for improving labor productivity, cost, and energy efficiencies for rice and rice-based crop in rainfed upland condition

Manuel Jose C. Regalado, Kristine S. Pascual, Marvelin L. Rafael, Alaissa T. Remocal

This study evaluated the performance of the multi-crop reduced till planter (MCRTP) on farmer's field in terms of energy efficiency, labor productivity, and cost effectiveness, and grain yields. Following field trials at PhilRice, MCRTP was pilot-tested in three regions under different biophysical conditions. Three field trials for corn seeding in Regions 1 (Pangasinan), 2 (Isabela), and 3 (Nueva Ecija) were established. Results showed that higher yields (330 - 5320kg/ha) were obtained using MCRTP compared with the Farmer's Practice in all regions. The MCRTP yielded more kilograms of corn per person-day by 4.1 - 48.4% at 153-239kg/day[1] compared with FP. This was due to higher yields with fewer labor-days per ha. The production cost of MCRTP was reduced by 31.9 - 82.5 % at PhP 2.51 - 4.42/

kg of corn. Overall energy ratio was 8.34 -14.76, which is higher than FP by 3% - 48%. MCRTP can be a better option to improve labor productivity, energy, and cost efficiency while having good yield in rainfed lowland corn cultivation. Economic analysis showed that owning and operating a multi-crop planter through custom hiring by farmers' associations is viable. SHowever, modifications are still needed to address problems on wide range of plant distance (12-35cm) and missing hills.

Development of gear transmission power tiller with pivot mechanism for multiple farm operations

Arnold S. Juliano, Joel A. Ramos, Joey P. Miano, Jimson B. Bedonia

The study aimed to develop a gear transmission power tiller with pivot mechanism for multiple farm operation made of locally-available spare parts. Using computer aided design (CAD), parts were detailed as guide for fabrication. The machine was fabricated by PhilRice shop technicians using the common tools, equipment, and locally-available materials. he prototype was field tested using land preparation. With rotavator attachment, the machine has a forward speed of 2.77km/h, fuel consumption of 1.97Li/h, actual field capacity of 0.12ha/h (0.96ha/day), and field efficiency of 70%. With harrow attachment, the machine has a forward speed of 3.4km/h, fuel consumption of 1.7Li/h, actual field capacity of 0.29ha/h (2.32ha/day), and field efficiency of 78%. With riding-type leveler attachment, the machine has a forward speed of 3.8km/h, fuel consumption of 1.8Li/h, actual field capacity of 0.48ha/h (3.84ha/day), and field efficiency of 75%.

Gear transmission power tiller with transplanter attachment was also evaluated. Data show that the machine has an average distance b/w hills of 16.05cm, average depth of planting of 5.53cm, average number of seedlings/hill of 7, percentage missing hills of 4.42%, theoretical field capacity of 0.18ha/h, actual field capacity of 0.14ha/h, and field efficiency of 77%.

Fabrication of the machine with rice transplanter attachment was completed. Functionality test was conducted to determine the workability of the machine parts. The machine with rice transplanter attachment is now ready for field testing.

PROJECT 1

Development and Pilot Testing of Local Mechanized Weeder for Straight Row Planted Rice Crop

Elmer G. Bautista, Arnold S. Juliano, Eugene S. Espique, Phoebe R. Castillo

Weeds are unwanted plants in fields and gardens, which compete with the main crop for nutrients, moisture, and sunlight resulting in decreased crop quality, high production costs, and reduced crop yield. Weeding is one of the most laborious operations in rice farming, and can easily be controlled by applying herbicides or e combining chemical, selective manual weeding, or using mechanical weeders. Mechanical weed control is very effective as it kills the weeds and keeps the soil surface loose ensuring soil aeration and water intake capacity. It also reduce labor in manual weeding. As existing mechanical weeders need improvement, PhilRice developed a gender-neutral mechanized weeding machine from locally-available materials. The machine uses a 4-stroke single cylinder gasoline engine similar to that of a grass-cutter. It comprises a handle, weeding rotator (wheel), mud guard, and skid. The improved prototype has weeding capacity of up to 1.5ha/day and efficiency of 77%.

PROJECT 2

Post-production and renewable energy technologies for rice and rice-based farming

Joel A. Ramos

This project aimed to develop interventions that reduce drudgery and cost input of farm operations, improve management of postharvest losses, and preserve quality of rice products. As food security is the ultimate goal of the Philippine government, an increased farm income must be ensured to sustain continuous food production. An increase in yield and a decrease in postharvest losses must be achieved to increase farm income.

One of the seven outcomes in the PhilRice Strategic Plan 2017-2022 is "Improved rice trade through efficient postproduction, better product quality, and reliable supply and distribution system." Postharvest losses are 16% of the total production, in which harvesting, drying, and milling account to 95%. The success indicator in achieving this outcome is to reduce postharvest losses down to 12%. Hence, by improving the management of harvest and postharvest operations, facilities, and equipment as the key components of this project, it is expected that it can contribute significantly to the target of reducing postharvest losses. Mechanical harvesting can reduce harvesting losses to 2%, one and half percent lower than manual harvesting method. Proper time of harvest with appropriate drying and storage technique will also reduce the total postharvest losses and improve the quality of rice in terms of milling recovery and head rice yield.

Improvement and pilot testing of rice combine harvester

Joel A. Ramos, Caesar Joventino M. Tado, Manuel Jose C. Regalado, Arnold S. Juliano, Elmer G. Bautista, Rodolfo S. De Gracia, Jr., Marco L. dela Cruz, Science Research Analyst

Increasing the level of mechanization isa key in modernizing the agriculture sector. PhilRice continuously improves its localized model of the cutter bar combine harvester and the rice stripper combine harvester to provide efficient and appropriate rice machines. For the stripper combine harvester, continuously variable transmission was coupled with the existing manual-type transmission to improve its drive. Fabrication of modified header- feeder conveyor assembly has started, the new design will fit with the existing prototype of cutter bar combine. For the cutter bar combine harvester, fabrication of first prototype units by manufacturers in Regions II and XI

was completed, likewise, initial field test runs were conducted. Pilot test units with updated transmission drive were expected to be ready for field test runs by dry season 2021.

Pilot testing and automation of rice hull gasifier engine-pump system (RHGEPS 1&2)

Joey P. Miano, Arnold S. Juliano, Joel A. Ramos, Jasper G. Tallada

Increasing cost of fuel is one of the agricultural challenges in the country, which affects farmers in the rainfed areas relying on pumping water for irrigation. Using rice hull biomass as a source of energy, PhilRice developed the rice hull gasifier engine-pump system (RHGEPS) that uses rice hull biomass as an alternative fuel source to run an engine to pump water from shallow tube well or open water. Through this technology, farmers can save as much as 30 – 40% from f fuel cost in irrigating their crops.

To assess the readiness of the technology for commercialization, the machine was pilot tested in rice fields with farmers operating the machine for one cropping season. Positive feedback was gathered; however, operation of the system needs more improvement such as reducing operation time and human intervention.

To achieve longer time of operation, the RHGEPS was converted to continuous type by incorporating a char discharging mechanism powered by the engine. The system operated continuously for eight hours with 6.27li/sec average water discharge. However, human intervention is highly needed to engage and disengage the discharging mechanism.The belt and pulley drive of the char discharging mechanism was replaced with 12v gear motor powered by battery. A programmable relay timer switch was installed to control the operating time of the motor that minimizes human intervention during operation. The system performed well during the preliminary test. However, optimization of the char discharging interval should be optimized for stable operation of the system.

With the limitations brought about by the pandemic, pilot test unit was installed at REMD field for endurance testing instead at PhilRice-Midsayap. The system operated for 30 hours in field with an average of 4.29li/sec water discharge at 7.6kg/hr rice hull consumption.

Design, Development, and Pilot testing of a non-retrofitted diesel engine co-fueled with producer gas from rice husk.

Alexis T. Belonio, Jasper G. Tallada, Joel A. Ramos, John Jeric A. Batanes, Jan 11 A. Dela Cruz

PhilRice has been working on alternative fuels to run internal combustion engines that farmers commonly use in their farms. One of these is the conversion of rice husk into combustible gas by partial combustion in fixed-bed and moving-bed reactors. The technology was proven to work well with spark ignition engine that provides power for stationary agricultural machines. However, the use of gasifier as an alternative is constrained with the use of gasoline engines since most of the farmers prefer diesel engines as prime mover for their farm machines.

REMD researchers began prototyping a non-retrofitted diesel engine co-fueled with producer gas from rice husk. Current iteration for the single cylinder model yielded breakthrough results in over-all performance. The gasifier system is powered by a 30cm diameter moving bed down draft reactor with an average of 7.4kg/hr rice husk consumption. The producer gas will pass through series of filtration starting from dry scrubbing made of metal tubes sprinkled by cool water; then, through a series of pre-cut PVC pipes inside a cylindrical tank, and ultimately to a box type fiber filter. The gas in ambient temperature is forced via a ring blower to the engine intake. Engine internal parts are not modified, only the intake to facilitate entrance of ambient air. Diesel fuel is still necessary to start and supplement the engine operation. Producer gas can now be introduced gradually via ball valves. On average, the producer gas can replace 65% of the diesel consumption at full load, whether the system is configured for electricity generation or water pumping application. The technology is undergoing a series of endurance tests, the system is still performing at operational specifications even up to 12 hours of straight operation through higher diesel replacement of 75% up to 90%.

Improvement of flatbed type mechanical dryer

Joel A. Ramos, Jasper G. Tallada, Marco L. dela Cruz

Paddy drying technologies are widely introduced in the country. The most popular one is the flatbed dryer, a fixed-bed batch type grain dryer, which is currently being updated at PhilRice CES. The study was conducted to develop a more efficient paddy drying system and reduce laborious operation through technology automation. It

is specifically aimed to design a furnace that has a provision of automatic feeding of rice hull while at the same time has auto unloading of char. The study also aimed to develop a system that monitors the condition of drying air temperature at the plenum and conduct paddy drying tests on the improved drying system. The design of rice hull indirect-fired furnace was conceptualized using CAD. It has a provision of auto-feeding of rice hull and auto-unloading of char. The main difference between the previous design (direct-fired) and the indirect-fired type furnace is the inclusion of heat exchanger. In 2020 wet season, drying test was continued using the direct-fired type furnace with one batch (2.5t/ha/batch) of freshly harvested *palay*. Results obtained an average rice hull consumption of 23kg/h, 1.28 percentage points per hour moisture reduction, and 43-degrees average heated-air temperature with 7-degrees temperature range.

Development of an Infrared heating system for shelf-stable brown rice

Manuel Jose C. Regalado, Joel A. Ramos, John Jeric A. Batanes

Brown rice is a high-quality, nutritious product. Despite the advantages of brown rice in improving the Filipino diet and increasing milling recovery, its production, sale, and consumption are limited. Constraints at the consumers' end are related to its high price, non-availability at times, poor eating quality, and lack of information about the product. Another downside is the short shelf life of brown rice that is attributed to rancidity caused by the breakdown of the bran oil into free fatty acids by hydrolytic and oxidative enzymes. This study aimed to extend the shelf-life of brown rice by stabilizing the bran through heat treatment using a pilot-scale infrared heating system (IRHS). The design throughput capacity is up to 50kg/h in a semi-continuous operation. The design features a horizontal configuration with a grain hopper and a loader that evenly dispense a thin layer of brown rice onto a food-grade conveyor belt, which moves the brown rice through a heating chamber consisting of a series of infrared ceramic heating panels situated above the belt. The prototype's hopper and conveyance system has been fabricated at the REMD shop. Various IRHS components were tested, including radiation leakage checks and material endurance trials.

Earlier, when microwave was still considered as the heating principle, two batches of NSIC Rc 160 brown rice were microwave-treated, stored using four different packaging materials, analyzed, and evaluated for their physico-chemical and cooking attributes after storage. Vacuum-sealed bags with microwave treated samples had the lowest moisture content after three months. All microwave treated brown rice samples stored using different packaging materials obtained larger values of water uptake ratio, weight increase and height increase and shorter cooking time. The sensory evaluation panel preferred the raw and cooked forms of microwave-treated brown rice stored in microwaveable plastic containers over other packaging materials.

Improvement and Endurance Testing of Portable Brown Rice Machine for Household Use

Phoebe R. Castillo, Arnold S. Juliano, Joel A. Ramos, Joey P. Miano, Maricar M. Rañeses, Silvestre C. Andales/Consultant

Brown rice is unpopular among Filipinos despite its health-promoting properties. It is likely consumed by health-conscious, high-income earners who can easily afford brown rice. For low-income earners, this type of rice is not accessible as it is relatively expensive and available only in supermarkets. If *palay* is processed in rural areas, then brown rice will be available and accessible to the locals. Hence, PhilRice developed a gender-neutral brown rice machine with simple design, easy to operate, and affordable that can provide the daily requirements of a family of five members. The prototype has a pair of 4" diameter rubber roll huller with the whole assembly mounted in a frame with seat and pedals, commonly found in bicycles, and with 0.5hp electric motor as alternative prime mover, which was considered particularly for senior citizens. Series of improvements was made after testing the machine prototype. For operator's comfort particularly during pedaling, a hand towel, cellphone, and water bottle holder were provided. The size of the hopper was reduced to a capacity that can only hold 1kg of paddy. The rice husk and brown rice discharge bucket were improved and increased its size to accommodate 1kg brown rice. The input roller was also improved by adding slats in order to increase feeding of paddy then decreasing time of operation. The outlet chute was also shortened to enable rice husks to slide easily towards the discharge bucket. Test results showed that the improved prototype has a capacity of 1.85kg/h with 76.66% of brown rice recovery when operated by male while 1.62kg/h with 78.07% of brown rice recovery when operated by female. When the prototype was powered by a motor, the average output capacity was 1.38kg/h with brown rice recovery of 76.41%.

Field validation of rice postharvest management protocol for reduced losses and improved rice quality

Manuel Jose C. Regalado, Joel A. Ramos, Tyrone C. Juganas, Maricar M. Rañeses, Juluis R. Waliwar

This study was conducted to validate recently developed rice postharvest management protocol, which covers from harvesting to commercial milling, and to integrate improved handlings. This study was conducted during dry and wet seasons in 2019 in a farmer's field at Villa Cuizon, Brgy. Bantug, Science of Muñoz,

Nueva Ecija. Harvested rice crops were milled and processed during 2020 DS after more than three months of storage.

Results from the 2019 wet season showed that five-day delay in harvesting using combine harvester yielded the lowest grain losses of 0.94%, which was significantly much lower than the five-day manually-harvested samples (4.02%). Drying the combine-harvested crops using a flatbed dryer and hermetically storing using PhilRice SACLOB kept physical grain losses at a minimum of 0.8-1.0%, which was significantly lower than sun-dried grains stored in ambient room (4.4-8.5%). SACLOB units maintained the optimum moisture content of 13-14% during the three-month storage period.

Milling five days late, samples harvested through combine harvester, flatbed-dried, and SACLOB-stored samples obtained the highest milling recovery of 72.29%. Meanwhile, five days late manually-harvested, sun-dried, and stored in ambient room samples had significantly lower milling recovery at 68.22%. Five days early harvested samples, whether manually or combine-harvested, had the lowest milling recovery values at 65.51% and 69.78%, respectively. Samples harvested on-time using combine harvester obtained the highest head rice percentage (73.81%) while the five days early-manually harvested samples had the lowest at 61.58%. During the wet season, combine-harvested and flatbed-dried samples obtained an average of 1.19% losses, which is below the optimum losses for combine harvested crops (1.5%).

During the wet season, harvesting five days late using a combine harvester, mechanical drying, and PhilRice SACLOB storage could significantly reduce total grain harvest and postharvest losses and improve milled rice quality.

PROJECT 3

Modernized rice farming through precision technology and intelligence information systems

Nehemiah L. Caballong

This project modernizes rice farming operations and provides strategic intelligence through electronics and intelligence information technology to different rice stakeholders, especially the men and women farmers. It is composed of five technology-specific studies, focusing on intelligence information systems (RiceIntel), mobile application tools (RApps), Internet of Things (RIoT), robotics (RoboRice), and drone technology (R-Drone). The RiceIntel's digital portal provides fast high-level information to PhilRice top management for executive planning and monitoring. It consolidates and organizes data from different internal and external databases. It provides information on rice situation and rice area per national, regional, and provincial level, PhilRice partner agencies, and research mappings among others, formatted in tables, histogram, line graphs, bar graphs, and vector overlays. New features and new datasets were added this year and the platform was made accessible to ManComm members at the IntraNet portal. On the study RApps, it developed three mobile application tools for specific rice farming operations. These are: AgRiDOC App, for rice farm operation management; eDamuhan App, for weed identification and management; and Binhing Palay App, for appropriate rice seed variety selection. Improvements and new functions were added this year. An increased number of users and accesses were recorded. Under RIoT, instrumentation and actuator devices are being developed for showcase at FutureRice Farm and rapid deployment for PhilRice operations. Some of the prototypes being developed since last year are for the following functions: automated drip irrigation, irrigation gate control, water quality monitoring, air quality monitoring, warehouse microclimate monitoring, insect monitoring, and rice paddy monitoring. On working with RoboRice, the electronics and wheel mechanism of the initial robotic drum seeder were improved. The R-Drone study explored and developed rice farming applications on the use of different drone technologies. The project partnered with Harbest corporation, an agricultural drone technology provider in conducting experiments to further test the use of drone sprayer in herbicide application which yielded promising results. All these endeavors contribute to exploring advanced science and technology as source of growth.

Intelligent information system for rice RDE planning (RiceIntel)

Nehemiah L. Caballong, Paul Austian A. Alday

This study aimed to contribute to the outcome 7 of the PhilRice strategic plan – strengthened institutional capability of PhilRice. This study has developed an intelligence information system that will be used by PhilRice's top management in planning and monitoring the institute's programs and interventions. The final output is an operational digital platform that provides fast high level rice situation information, relevant research data, ground partner directory, and others for target users. Information are in forms of tables, histogram, line graphs, bar graphs, maps, geographical points, and vector overlays. In 2020, new features were developed to enhance the RiceIntel dashboard. These are graphical chart download, data table view and download, map printing, user authorization and deployment to PhilRice Intranet, and year and/or semester selection for PSA and PRISM data display. Also, two new datasets were added – 236 ATI-BRS LAS and 507 AgRiDOC directory. Currently, there are 24 tabular datasets, 6 map layers, and the regional, provincial, and city/municipality boundary present in the dashboard.

Mobile application tools for rice farming (RApps)

Nehemiah L. Caballong, Paul Austian A. Alday, Dindo King M. Donayre, Edwin C. Martin, PhilRice-NCT Group

Based on the Rice-based Farming Household Survey (RBFHS) conducted by PhilRice Socioeconomic Division (SED) in 2016 - 2017, 95% of the respondent-household has at least one smartphone owned. This data imply the potential of smartphone technology as a significant medium for agricultural knowledge delivery. This study has developed three smartphone application tools that can be used by rice farming-households, extension workers, researchers, and other stakeholders in managing farm operations (AgRiDOC App), weed management (eDamuhan App), and seed variety selection (Binhing Palay App). In 2020, an increase in the number of active users and usage were recorded especially in Binhing Palay App.

Internet of Things (IoT) Technology for smart rice-based farms (RIoT)

Nehemiah L. Caballong, Jasper G. Tallada, Paul Austian A. Alday, Edwin M. Dicen III, Mighty Jemuel C. Sotto

An *Internet of Things* (IoT) system is a network of devices (sensors and actuators) connected to the Internet and can be controlled or monitored via a remote interface thru a mobile and web application software. This study aimed to develop IoT system models for rice farming. It will build the FutureRice Farm as a model of a modernized IoT-enabled farm in actual operation (FutureRIoT). For 2020, three IoT systems underwent version 2.0 development – the water quality monitoring system, automated drip irrigation system, and the water gate control system. The water quality monitoring system was added with dissolved oxygen, water level, and water temperature sensors. The automated drip irrigation system was improved and tested. The water gate control system now includes a manual close-open switch and a water level sensor that will be placed above a flume to measure the water inflow. Moreover, the seed warehouse microclimate monitoring system was improved to version 1.1, which now uses I2C LCD screens. Two microclimate monitoring devices were deployed at ISD servers.

Automated rice farming machines (RoboRice)

Jasper G. Tallada, Nehemiah L. Caballong, Mighty Jemuel C. Sotto

There is an imposing need for automation on farm machinery due to lack of manpower and manual farming inefficiency. Automation and innovation of existing farm machines can help lessen human intervention, improve productivity and efficiency, and reduce the efforts of aging farmers thus attracting younger generations to be engaged in rice farming activities. To innovate a rice drum seeder, stepper motors were used to control the wheels and the drums. This drum seeder can be remotely controlled by an RF controller. The initial prototype was developed and field tested in 2018 and was halted in 2019. For 2020, the propulsion component for a dry-seeded robotic seeder using two 350W, 24V geared DC motor for the left and right traction wheels through the RC60 sprocket chain power transmission was developed.

Applications of UAV systems in rice farming (R-Drone)

Nehemiah L. Caballong, Paul Austian A. Alday, Edwin M. Dicen III, Mighty Jemeul C. Sotto, Jasper G. Tallada, Dindo King M. Donayre, Edwin C. Martin, Oliver Manangkil, Wilhelmina Barroga, Perfecto Ramos, Jr

This study explores and develops rice farming applications on the use of different drone technology. The project partnered with Harbest Corporation, an agricultural drone technology provider, in conducting 2020 DS experiments to further test the use of drone sprayer in herbicide application. The project documented effectiveness in using drone sprayers for pre-emergence herbicide application compared to manual-knapsack sprayer and tested and compared the effectiveness of two herbicides (Herbadox and Command) in eliminating weeds using drone sprayer as applicator. Results suggest that drone sprayer is a considerable alternative to manual knapsack spraying method.