2019

PHILRICE R&D HIGHLIGHTS

RICE ENGINEERING AND MECHANIZATION DIVISION

Contents

DIVISION

Rice Engineering and Mechanization

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Executive Summary

The Rice Engineering and Mechanization Division (REMD) aims to help improve the national level of farm mechanization and modernize rice production and postharvest operations. The division develops agricultural and biosystems engineering technologies that will mechanize and modernize rice and rice-based production and postproduction operations to reduce cost of operations and postharvest losses, and optimize the use of land, water, and other farm resources. There are two projects under the division: (1) Development of REMD Farm Model for Modernization and Mechanization Goal, that aims to modernize and fully mechanize the 4-ha REMD Model Farm and (2) Division Operations and Services, which aims to support the implementation of research and delivery of services of the Institute. The division addresses the Institute's Strategic Plan outcomes on increased productivity, cost-effectiveness, and profitability of rice farming in a sustainable manner; improved rice trade through efficient postproduction, better quality, and reliable supply and distribution system; enhanced value, availability, and utilization of rice, diversified rice-based farming products, and by-products for better quality, safety, health, nutrition, and income; advanced rice science and technology as continuing sources of growth; and, enhanced partnerships and knowledge management for rice research for development.

The first project developed a modern rice farm model through land consolidation; appropriate mechanization; and establishment of improved irrigation and drainage facilities, access roads, and field ramps for machine entry/exit. The 4-ha REMD farm, with 32 small, unleveled, and non-uniform field plots, was consolidated, laser-leveled, and divided into larger 16 rectangular plots, each measuring one-fourth of a hectare. A single-lane gravel road (234-m long x 3-m wide) and eight units of 4-m concrete ramp were constructed, facilitating access and movement of machines and field operation. In addition, a 232m concrete irrigation ditch and 464m concrete drainage canal were constructed at the center and borders of the farm, respectively. Results of field experiments to assess crop productivity in laser-leveled and scraped field plots showed that yields were initially lower compared with those in non-leveled and non-scraped plots. The occurrence of crop lodging during grain filling stage in the leveled and scraped plots resulted in yield reduction. Moreover, harvesting

losses in these plots were higher because of the lodged crop. This would imply that soil amelioration measures need to be done in newly leveled and scraped plots to improve root anchorage, prevent crop lodging, and increase yield. Draft guidelines and a manual on how to develop a fully mechanized farm for irrigated lowland rice production are currently being improved.

Apart from research activities, REMD took initial steps in ensuring that technologies are promoted and customers are reached, especially during transitioning from research to extension. Other needs of researchers in the conduct of research activities which require engineering solution fall within the core competency of the division. Hence, the last project was formed to support the implementation of research and delivery of services of the Institute through provision of shop services on custom fabrication and related metal working activities; instrumentation services; establishment of agricultural engineering unit in the branch stations to strengthen their capability to promote engineering technologies as well as managing farm operation and equipment in the station; and, operationalization of agrometeorological stations at PhilRice-CES and branch stations.

PROJECT 1

Development of REMD Farm Model for Modernization and Mechanization Goal

MJC Regalado

Consolidation of small- and medium-sized farms is one of the eight new paradigms that the DA is espousing to usher the country to Agriculture 4.0. This brings about economies of scale, particularly for crops that require mechanization and massive use of technology. Congruently, this project aimed to develop a modern rice farm model through the application of land consolidation, appropriate mechanization, and establishment of improved irrigation and drainage facilities, access roads, and field ramps for machine entry and exit.

The 4-ha REMD farm with 32 small, unleveled and non-uniform field plots was consolidated and divided into larger 16 rectangular plots, each measuring one-fourth of a hectare. Twelve plots were leveled using a laser-guided leveler to a target elevation difference of ±2cm. A single-lane gravel road (234-m long x 3-m wide) and eight units of 4-m concrete ramp were constructed, facilitating access and movement of machines and field operation. A 232m concrete irrigation ditch and 464m concrete drainage canal were constructed at the center and borders of the farm, respectively. Both canals were equipped with 16 steel gates to facilitate irrigation and drainage within the 16 plots.

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Land Consolidation with Optimum Plot Sizing for Efficiency and Leveling Effects

EG Bautista, KC Villota, and MC Mariano

This study aimed to improve the 4-ha REMD farm in terms of plots size and levelness through application of land consolidation. Topographic survey was conducted to determine the elevation for dry leveling and formation of bigger plots. The area previously had 32 small, unleveled, and irregularly shaped plots. Application of land consolidation resulted in the formation of 16 rectangular plots having an area of about 2300m^2 per plot. Twelve of these plots were dry leveled with target leveling accuracy of ±2cm difference in elevation from using a laser-guided leveling equipment. Evaluation of machine performance as affected by plot size showed that efficiency tends to increase as the plot size increases.

Establishment of Efficient and Suitable Irrigation and Drainage Facilities at the REMD Model Farm for Mechanization

KS Pascual, LS Caguiat, AT Remocal, AS Juliano, and MJC Regalado

Increased rice productivity largely depends on efficient irrigation system complemented with a good drainage system. This study aimed to establish efficient irrigation and drainage facilities in the 4-ha model farm of the Philippine Rice Research Institute, Central Experiment Station, Muñoz, Nueva Ecija. Irrigation and drainage facilities were designed and constructed to improve delivery of water during irrigation and provide good drainage for mechanization. The design and layout of the irrigation and drainage facilities followed recommendations from the Philippine Agricultural Engineering Standards. A trapezoidal-irrigation-lined canal (232m) equipped with several gates per block was constructed strategically at the center of the model farm. Drainage system with 462-m lined canal, equipped with gates per plot, was constructed at both sides of the farm. Other facilities, such as drop box and shallow tube well, were established for supplementary irrigation. The improved irrigation and drainage systems are expected to provide efficient irrigation delivery during crop growth and facilitate mechanization at harvest due to good drainage.

Provision of Appropriate Machines and Access Roads for Mechanization

KC Villota, AS Juliano, and MC Mariano

This study aimed to improve farm accessibility of machines for operation, establish access road and field ramp, and identify the ideal location of these structures at the REMD farm at PhilRice CES. The design and layout were formulated through field inspection and based on existing standards. Two one-lane graveled roads were established in the farm. Eight units of the 4-meter concrete ramp were also constructed in the area. The ramp, which is situated between corners of two adjacent plots along the access road, serves as the entry and exit point of machines. The availability of these access structures obtained very good rating based from the operators' feedback on the easiness of passing to the access road and field ramp who deem them as easy and convenient to use. Operation is faster due to these structures according to comment of one respondent.

Evaluation of Fully Mechanized 4-ha REMD Model Farm in Rice Production

AS Juliano, KC Villota, MC Mariano, and IP Pineda

Even though the establishment of the REMD model farm is not yet completed, a trial experiment was carried out during the 2019 WS to assess its workability in rice production, specifically in yield, machine performance, and harvesting losses. Results showed that land preparation equipment (4-wheel tractor and power tiller) can be used in the model farm with promising outputs. Crop establishment technologies (manual transplanting, mechanical transplanting using a walk-behind transplanter, and direct seeding using plastic drum seeder) were used to plant NSIC Rc 160 at a seeding rate of 32kg/ha. Considering all interventions, the crop yielded lower than its expected yield in WS harvest owing to wind and rain occurrence during the flowering stage of the crop. Higher grain losses than the PAES standard were obtained due to lodged crop condition.

Crop growth were aided by the established irrigation canal, and the fertilizer rate and crop protection recommendation of PhilRice. This resulted to an average yield of 3.8t/ha for 2019 WS. Low yield was attained in the developed model farm due to strong wind and rains that occurred during the flowering stage of the crop, causing it to lodge. The incomplete leveling of the consolidated

plots and drainage system also contributed to the low yield. Harvesting losses reached an average of 5.35% grain losses. This is higher than the maximum PAES harvesting losses of 3.50% due to lodged crop condition during harvesting, with the combine harvester blower in full setting. Meanwhile, the guidelines for developing a fully-modernized and mechanized farm and the manual for mechanized rice farming was drafted and will be finalized after the REMD model farm is completed.

PROJECT 2

Division Operations and Services

JA Ramos

This project aimed to support the implementation of research and delivery of services of the Institute through the following components: (1) provision of shop services, which caters to service requests of customers in custom fabrication and related metal working activities; (2) establishment of agricultural engineering unit in the branch stations to strengthen the capability of the stations to promote engineering technologies while managing farm operation and equipment in the station; (3) instrumentation services to assist the researchers; and, (4) operationalization of agrometeorological stations to enhance the operation and maintenance of agrometeorological station at PhilRice-CES and its branch stations. These studies supported the Division's goal to commercialize PhilRice's research and development outputs, for smooth operation of machines in rice production and their the R and D activities.

Supporting RDE Through Shop Custom Service Provision

JA Ramos, PR Castillo, RS de Gracia, Jr., and AS Juliano

The study aimed to provide services such as custom fabrication, equipment repair and servicing, and metal working job that makes use of specialize equipment to researchers, offices, and private clients. Services provision comes in a first-come-first-served basis owing to the Division's limited resource. This study also catered to the increasing numbers of service requests over the years, as these become part of the regular operation of the Division. For 2019, the project accommodated 106 service requests from 33 customers.This gained a net income of P133,072.98. The services included fabrication and supply of equipment (stove, weeder, carbonizer, and dryer components), and custom fabrication and other shop services (bending, cutting, rolling). Feedback of customers showed high satisfaction on the services provided, and on-time service deliveries were rated s 100%. On the quality of produce, 38% gave excellent rating, 50% posted very satisfactory, and 12% said it was satisfactory.

Establishment of Agricultural and Biosystems Engineering (ABE) Unit in PhilRice Branch Stations

JEO Abon, AS Juliano, RMS Martin, PR Castillo, and ES Espique

The Division is the central provider of agricultural engineering (AE) services in the Institute. As it is based in Region 3 with limited staffing, the simultaneous regional demands on the provision of AE services covered by branch stations are unfavorably responded sometimes. Hence, Agricultural and Biosystems Engineering (ABE) units were established in the seven branch stations. Each unit is composed of agricultural engineer/s, technician/s, and operator/s. Assessment and evaluation of available farm machines and storage facility per station was conducted. A 3-day training (1-day lecture discussion and 2-day hands-on training), participated by 95 agricultural engineers/researchers, admin, technician/s, and operator/s from Midsayap, Agusan, and Negros were also done.

This training helped increase the knowledge on proper operation, maintenance, trouble shooting, storage, and safety of the agricultural machines of participants by 19.9% in Midsayap, 37.8% in Agusan, and 36.9% in Negros station.

Instrumentation Services

JG Tallada and DB Fenangad

Instrumentation plays a vital role in achieving the measurement requirements of research. Many of the instruments are too costly or does not fulfill the specific requirements of researches. The advent of open-source electronics technology such as Arduino and Raspberry Pi paved the easy development of instruments, especially now that sensors and control units or modules are constantly being brought to the marketplace to extend the capabilities of these microcontroller gadgets. This study aimed to provide instrumentation services by developing some basic instrument modules and custom monitoring system. Process of developing an instrumentation module includes: (1) drafting of hardware design; (2) assembly of the hardware/prototype (includes programming); (3) installation of the prototype; and, (4) field testing of the module. Two EC and pH monitoring systems were developed using Arduino and installed at Bicol and Cagayan. These were tested for one season and no problems were encountered during the testing of the monitoring system. A design of an automated water gate was drafted and a working prototype was fabricated. This was installed at the FutureRice Farm for field testing. With this design, automated water gates will be installed at the REMD Model Farm as part of its irrigation system.

Operationalization of Agrometeorological Stations at CES and Branch Stations

DB Fenangad, JG Tallada, JM Maloom, JV Galapon, GC Nuñez, L Dogeno, FPJ Tadle, and JC Villarina

Agro-meteorological (Agromet) Stations are set up in the different parts of the country to help in monitoring and gathering of weather data for agricultural researches. For accurate and reliable weather data to be achieved, several factors should be considered and several measures should be looked into. Maintenance, calibration, and efficient data management should be given importance to improve weather data collection and handling. This study aimed to enhance the operation and maintenance of existing PhilRice Agrometeorological Stations at CES and the branch stations. Activities conducted include updating the stations' metadata, periodic collection of weather data, and regular calibration, repair, and maintenance of weather instruments. Daily weather data were collected from the manual instruments and the AWS from January to October 2019. Calibration of weather instruments was also done at CES on November 14-15, 2019. Regular maintenance was continuously done at the Agromet station. As of November 2019, 34 weather data requests by students and researchers were delivered.

PROJECT 3

REMD Workshop Maintenance and Operation

JA Ramos

This project keeped the workshop facility ideal for the conduct of workshop-related activities to produce better quality R&D outputs of REMD. Specifically, it aimed to ensure that all equipment are maintained to good working condition, provide necessary consumable supplies for sustained operation of the equipment and facility, and establish a database from workshop operation. For 2019, P147,362.74 worth of consumable and maintenance supplies were procured by the project for continued operation. The project also provided services to 106 service requests from 33 customers, with a net income of P133,072.98. Feedback of customers showed high satisfaction on the services provided by the project. Customers rated 100% on on-time delivery of service. On the quality of produce, 38% gave excellent rating, 50% said it was very satisfactory, and 12% posted satisfactory.

Abbreviations and acronyms

AYT - Advanced Yield Trial
ABE - Agricultural and Biosystems Engineering
AEW - Agricultural Extension Worker
ATI – Agriculture Training Institute
AESA - Agro-ecosystem Analysis
AC - Amylose Content
BLB - Bacterial Leaf Blight
BLS -Bacterial Leaf Streak
BCA - Biological Control Agent
BS - Breeder Seeds
BPH -Brown Planthopper
BPI - Bureau of Plant Industry
CGMS - Cytoplasmic Genic Male Sterility
COF - Commercial Organic Fertilizer
CDA - Cooperative Development Authority
DAS - Days After Sowing
DAT - Days After Transplanting
DF - Days to Flowering
DM- Days to Maturity
DAR - Department of Agrarian Reform
DA-RFOs - Department of Agriculture-Regional Field Offices
DoF - Department of Finance
DOLE - Department of Labor and Employment
DTI - Department of Trade and Industry
DSR - Direct-seeded Rice
DS - Dry Season
FBS – Farmers' Business School
FC - Farmers' Cooperative
FSM - Farming Systems Models
FAA - Fish Amino Acid
FGD - Focused Group Discussion
FSP - Foundation Seed Production
FRK - Farm Record Keeping
GABA - Gamma-aminobutyric Acid
GT - Gelatinization Temperature
GAD - Gender and Development
GYT - General Yield Trial
GCA - Genetic Combining Ability
GIS - Geographic information system
GEMS - Germplasm Management System
GAS - Golden apple snail
GL - Grain length
GQ - Grain quality
GW - Grain Weight
GY - Grain Yield
GLH - Green Leafhopper
GOT - Grow Out Test
HR - Head Rice
HRA - Heat Recovery Attachment
HIPS – Highly-intensified Production System
HQS - High-quality Rice Seeds
HON - Hybrid Observational Nursery
HPYT - Hybrid Preliminary Yield Trial
ICT - Information and Communication Technology
IEC - Information Education Communication
IBNM - Inorganic-based Nutrient Management
ICM - Integrated Crop Management
IPM - Integrated Pest Management
JICA - Japan International Cooperation Agency
IRRI - International Rice Research Institute
IA - Irrigators' Association
KP - Knowledge Product
KSL - Knowledge Sharing and Learning
LCC - Leaf Color Chart
LFT - Local Farmer Technicians
LGU - Local Government Units
LPS - Low Pressure Steam-operated
SB - Stemborer
LE-CYPRO - Lowland ecotype Cyperus rotundus
MFE - Male Fertile Environment
MSE - Male Sterile Environment
MAS - Marker-assisted Selection
MRL - Maximum Root Length
MR - Milled Rice
MER - Minimum Enclosing Rectangle
MOET - Minus-one Element Technique
MC - Moisture Content

MAT - Multi-Adaptation Trials
MCRTP - Multi-crop Reduced Till Planter
MET - Multi-environment Trial
MYT - Multi-location Yield Trial
NAAP - National Azolla Action Program
NCT - National Cooperative Test
NFA - National Food Authority
NRAM - National Rice Awareness Month
NSIC - National Seed Industry Council
NSQCS - National Seed Quality Control Services
N - Nitrogen
NBSP - Nucleus and Breeder Seed Production Project
NFGP - Number of Filled Grains Panicle
ON - Observation Nursery
OSIS - One Stop Information Shop
OBNM - Organic-based Nutrient Management
PL - Panicle Length
PW - Panicle Weight
PVS - Participatory Varietal Selection
PWD - Person with Disabilities
PhilMech - Philippine Center for Postharvest Development and Mechanization
PRISM - Philippine Rice Information System
PhilRice - Philippine Rice Research Institute
PSA - Philippine Statistics Authority
PTC - PhilRice Text Center
P - Phosphorus
PVS - Plant Variety Selection
K - Potassium
QTL - Quantitative Trait Loci
RCBD - Randomized Complete Block Design
RSP - Registered Seed Production
RBB - Rice Black Bug
RCEF - Rice Competitiveness Enhancement Fund
RCEP - Rice Competitiveness Enhancement Program
RCM - Rice Crop Manager
RHGEPS - Rice Hull Gasifier Engine Pump System
RPH - Rice Planthopper
RSTC - Rice Specialists' Training Course
RTV - Rice Tungro Virus
RBFHS - Rice-based Farming Household Survey
KQ - Kernel Quality
SV - Seedling Vigor
ShB - Sheath Blight
ShR - Sheath Rot
SMS - Short Messaging Service
SNP - Single Nucleotide Polymorphism
SWRIP- Small Water Reservoir Irrigation Project
SRB - Stabilized Rice Bran
SUCs - State Universities and Colleges
SB - Stem Borer
TESDA - Technical Education and Skills Development Authority
TDF - Technology Demonstration Farm
TRV - Traditional Rice Varieties
TOT - Training of Trainers
TPR - Transplanted Rice
URBFS - Upland Rice-Based Farming
WS - Wet Season
WCV - Wide Compatibility Variety
YSB - Yellow Stemborer

Editorial team

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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