2015 National Rice R&D Highlights

Rice Engineering and Mechanization Division

Department of Agriculture
PHILRICE
PHILIPPINE RICE RESEARCH INSTITUTE

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RICE ENGINEERING AND MECHANIZATION DIVISION

Division Head: EB Sibayan

The Rice Engineering and Mechanization Division aims to improve the national level of farm mechanization and modernize rice production and postharvest operations. It also strengthens the Institute's capacity to design, develop, manufacture, and market farm machinery for rice production and postproduction operations while considering the needs and conditions of our rice farmers.

In 2015, there were three major projects implemented under the division to address its functional objectives: (1) Development of Production and Post-production Farm Machinery; (2) Development of an Integrated Postharvest Management System for the Rice Postproduction Industry in the Philippines; and the (3) Promotion of Matured Engineering Technologies. In addition to these, REMD also implemented three externally-funded projects in relation to water management of rice: (1) Greenhouse Gas Mitigation Potential of Water Saving Technologies; (2) Technology Development for Circulatory Food Production Systems Responsive to Climate Change: Development of Mitigation Option for Greenhouse Gases Emissions from Agricultural Lands in Asia (MIRSA 2); and (3) Application of Nuclear Analytical Technique for Efficient Nutrient and Water Management in Rice Production.

Efficient on-farm operations, reduced post harvest losses, and alternative method of irrigation were addressed by developing a ride-on stripper combine, carbonized rice hull (CRH)-insulated rice silo, and hydraulic ram pump for irrigating rice and rice-based crops in Ilocos under project 1. For project 2, PalayCheck® system for integrated rice postproduction management was tested covering harvesting, threshing, hauling, cleaning, drying, storing, and milling operations to produce a good quality rice with minimal post-harvest losses. Project 3 aims to reach out to more farmers through dissemination of matured rice engineering technologies.

I. Development of Production and Post-production Farm Machinery

Project Leader: CJM Tado

Development of ride-on stripper combine

CJM Tado and DP Ona

Postharvest losses start during harvesting and threshing operations. Timely harvesting and threshing is essential if we are to keep losses to a minimum. However, harvesting in the Philippines is still mostly done manually, requiring 16 to 25 man-days per hectare. Furthermore, labor shortage at harvest time is now a reality in many major rice-producing areas in the country. A combine harvester that can operate well in Philippine rice fields is thus essential in improving timeliness of operation and reduction of postharvest losses, especially in large rice-producing provinces where harvest labor is now becoming scarce.

Highlights:

- The prototype design is ongoing. Design of undercarriage assembly and screw conveyor was accomplished.
- Spur gears for the final drive and bevel gears for the screw conveyor and system drive were designed. Prospective fabricator for these parts was identified.
- Ongoing hiring of technician for the fabrication of components.

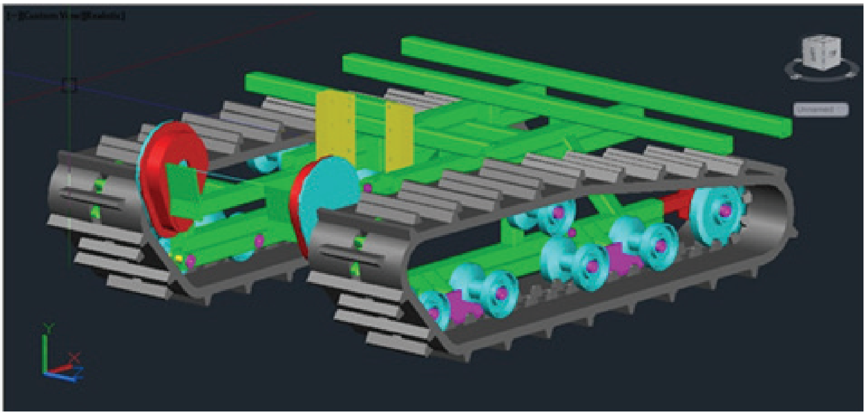

Figure 1. Undercarriage Assembly 3D model

Design and development of carbonized rice hull (CRH)-insulated rice silo to reduce storage losses

LC Taguda, DP Dal-uyen, CJM Tado, MAU Baradi, BM Catudan, FP Bongat and SR Brena

The net amount of rice available in the market has significant discrepancy from the volume of production because of losses from harvest to postharvest operations. Losses from harvesting to storage were estimated by Castro (2003) to be roughly 15% on the average, ranging from 1 to 32%; 18% of which are incurred during storage. This translates to 2.7% contribution of storage to overall harvest and postharvest losses. With the 18.4 million metric tons (MT) paddy produced by the country in 2013 (BAS, 2015), this translates 0.5 million MT lost from storage. At 65% milling recovery, this loss from storage can feed 2.7 million Filipinos in a year.

Hence, a one-ton capacity silo with CRH insulation is being developed to reduce storage losses. The CRH insulation controls the temperature fluctuation between the outer and inner cylinder and absorbs the moisture that accumulates inside the silo due seed respiration. Furthermore, the CRH-insulated silo protects the grains from insects, rodents, and birds; eases loading and unloading paddy; minimizes use of space since the silo is designed to be located outdoors; and eases maintenance and management of the system.

Highlights:

- Experiment is being conducted to evaluate the performance of a 1 ton CRH-insulated rice silo. Newly harvested registered NSIC Rc216 seeds were stored in the silo beginning July 2015. Samples are taken every month to determine the quality (moisture content, germination rate, seed vigor and seed health) of the seeds).

- Initial findings on the quality of the seeds stored in the silo
  a. Moisture content
  1. Fluctuations of moisture content (MC) of the stored seeds in the silo can be observed which may be caused by changes in weather condition. The moisture content of seeds at the top of the silo has gained higher increase in moisture content compared to the seeds at the middle and bottom portions of the silo (Figure 2).
  2. The silo was able to maintain the moisture content of the seeds below 14% wet basis which is ideal to maintain the seeds germination, vigor and health.

  b. Germination rate
  1. The germination rate of the seeds increased during the

second and third months but subsequently decreased in the succeeding months. Moreover, the seeds at the top of the silo had slightly lower germination rate than those at the middle and bottom portions of the silo (Figure 3). This may be due to the increased in moisture content of the seeds at the top portion.

2. The silo was able to maintain the stored seeds germination rate beyond 85% which is the allowable germination rate of rice seeds.

c. Seed vigor

1. The germination rate of seed samples subjected to accelerated aging for three days and five days increased during the second and third months but subsequently decreased in the succeeding months. The germination rate of the seeds at the top of the silo was slightly lower than those at the middle and bottom portions (Figure 4 and Figure 5). This may be due to the increase in moisture content of the seeds at the top portion.
2. The silo was able to maintain the vigor of the stored seeds. Seeds subjected to 3-days and 5-days accelerated aging maintained seed vigor (above 85% germination rate) for five months and two months, respectively.

d. Insect count and damaged grains

1. The number of insects and damaged grains at the top of the silo were greater than those at the middle and bottom portions. This may be due to the increase in moisture content of the seeds at the top portion. Moreover the longer the seeds are stored, the greater the number of insects and damaged grains (Figure 6 and Figure 7).

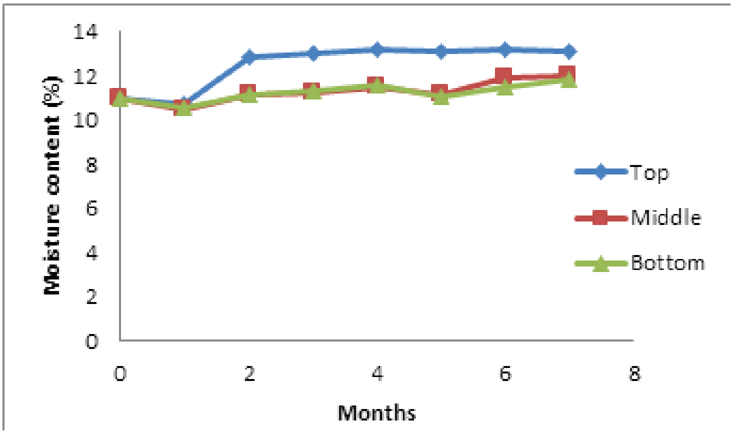

Figure 2. Changes in the moisture content of stored NSIC Rc216 using the rice hull-insulated silo.

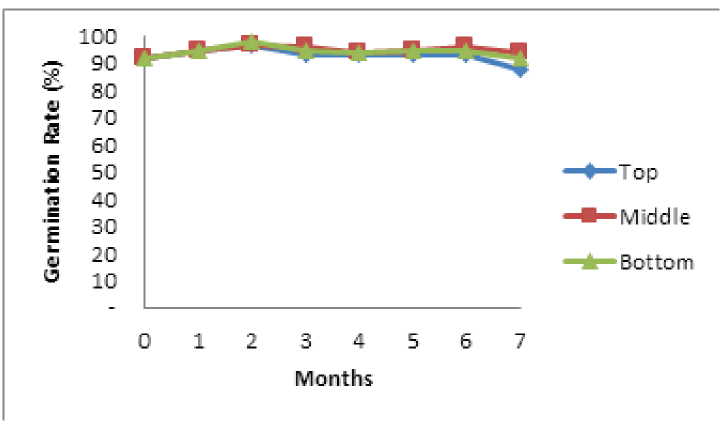

Figure 3. Changes in the germination rate of stored NSIC Rc216 using the rice hull- insulated silo.

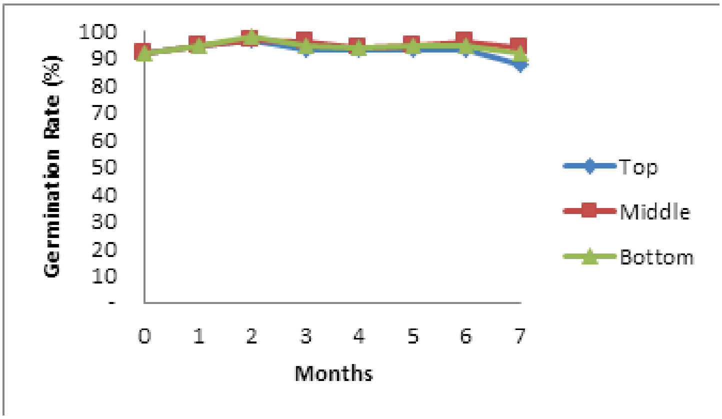

Figure 4. Changes in the germination rate of stored NSIC Rc216 using the rice hull-insulated silo exposed to accelerated aging for 3 days.

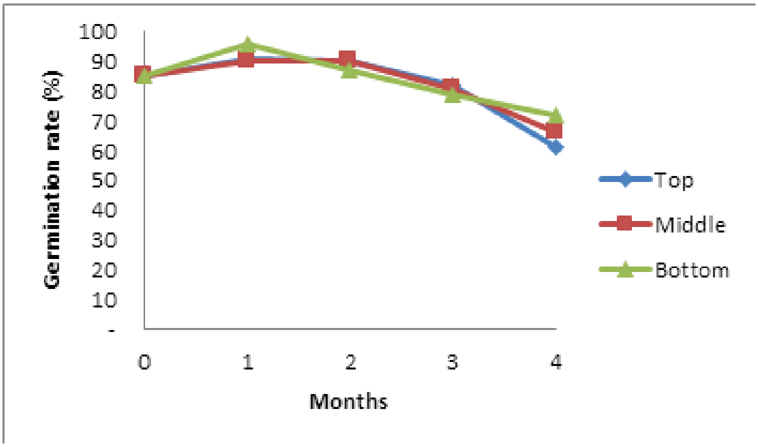

Figure 5. Changes in the germination rate of stored NSIC Rc216 using the rice hull-insulated silo exposed to accelerated aging for 5 days.

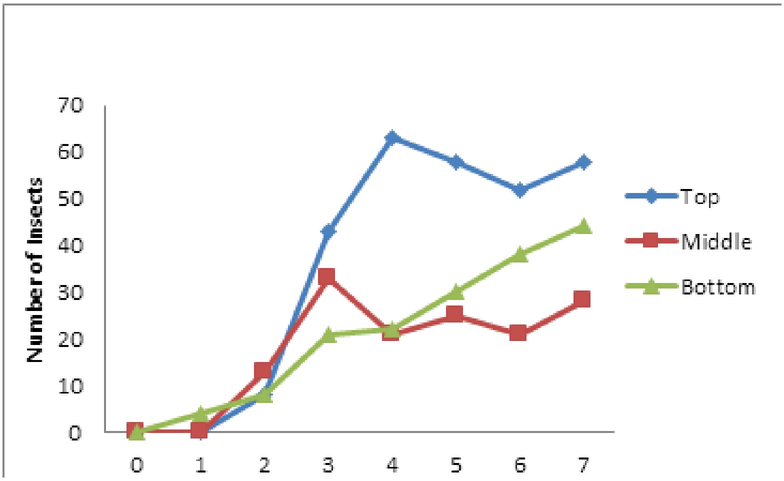

Figure 6. Number of insects gathered (weevil) from the monthly samples gathered from the stored NSIC Rc216 using the rice hull-insulated rice silo.

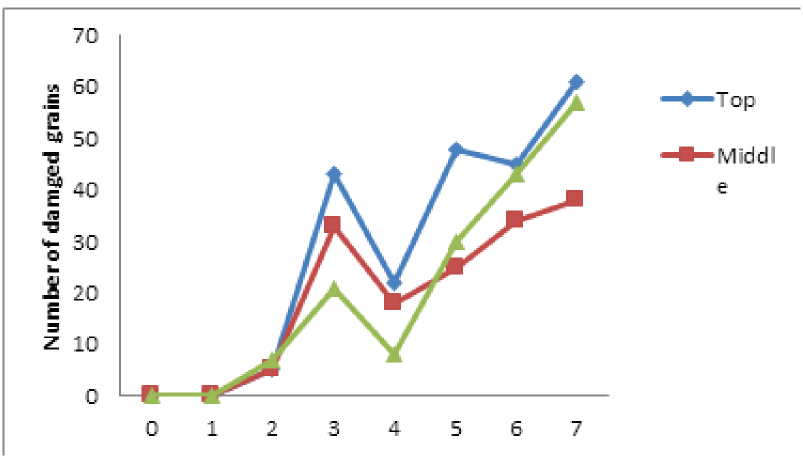

Figure 7. Number of damaged grains from the monthly samples gathered from the stored NSIC Rc216 using the rice hull-insulated silo.

Performance evaluation of a hydraulic ram pump for irrigating rice and rice-based crops in Ilocos
ND Ganotisi, MLO Quigao and CJM Tado

A study aimed at identifying suitable areas for hydraulic ram pump for Northwest Luzon conditions and to evaluate the performance of a hydraulic ramp pump was conducted. A survey of existing hydraulic ram pump (HRP) in the country particularly in Bago City, Negros Occidental and identification of suitable areas for hydraulic ram pump operation in Ilocos Norte were undertaken.

Highlights:

- The Alternative Indigenous Development Foundation (AIDFI) hydraulic ram pump factory in Bacolod City, Negros Occidental was visited. The AIDFI has 20 years experience in the ram technology; has a pool of experienced ram technicians; owns a well equipped shop for quality manufacturing (Figure 8); has done installations nationwide and also in Japan, Cambodia, Afghanistan, Nepal and Colombia. The AIDFI has developed several units with corresponding flow rates as shown in Table 1.

- Based from profiling and characterization, the HRP installed in Brgy. Ilijan, Bago City, Negros Occidental has a twin pump and the pump body was made of steel. The flanges are mild steel plates, with air chamber made of G.I pipe with 3″ and 4″ diameter. It was fabricated using lathe machine made from iron plate. It has a discharge pump rate of 200,000 li per day with the elevation of the catchment of 3m from the pump and lift the water to the storage tank at 50 to 60m above the pump. The water is use for irrigating crops like lemon grass and sugarcane. It is being operated by the Nakalang Padilla Farmers Workers Association (NaPFWA) of Brgy. Ilijan, Bago City, Negros Occidental.

- Also, results of survey and characterization of petential areas for HRP installations were as follows: 1) Barangay Anggapang Currimao, Ilocos Norte: has a creek that discharges to the sea with minimal water during the dry season (Figure 9); 2) Caparispisan and Agassi, Pagudpud, Ilocos Norte: has a creek with minimal water during the dry season, and 3) Garnaden Nueva Era, Ilocos Norte; has a creek with minimal water during the early part of the dry season and dries comletely during summer. With little intervention on these creeks by creating drop water can make them suitable for hydraulic ram pump operatio

Table 1. Ram pump size and corresponding flow rates developed by AIDFI.

Ram pump size	Flow rates, L/min
¾" Ram pump	10-15
1"Ram pump	15-30
1-1/2"Ram pump	60-120
2" Ram pump	90-200
3" Ram pump	200-480
4" Ram pump	450-900
5" Ram pump	900-1300
6" Ram pump	Under testing

Figure 8. Fabricated unit of hydraulic ram pump, AIDFI, Bacolod City.

Figure 9. Site in Anggapang Norte, Currimao, Ilocos Norte where HRP may be applicable.

Table 2. Particulars and descriptions of a twin hydraulic ram pump installed in Brgy. Ilijan, Bago City, Negros Occidental.

Particular	Description
Site	Brgy. Ilijan, Bago City, Negros Occidental
Latitude	10^{o} 26’ 31.26”
Longitude	123^{o} 03’ 12.23”
Water source	creek
Months of water availability	Whole year round
Installation date	March 2015
Size of drive pipe	2” and 3”
Length of pipe from source	10 m
Size of delivery pipe	1” and 1.5”
Length of delivery pipe to discharge outlet	1 km
Height of discharge from the pump	50-60 m
Air chamber size	3” and 4” diameter GI pipes, 4 feet long
Discharge type	Water tank
Purpose	Irrigation
Area served	37 ha
Number of farmers benefited	36 farmers

II. Development of an Integrated Postharvest Management System for the Rice Post Production Industry in the Philippines

Project Leader: MJC Regalado

While substantive strides have been made in the Philippine rice production sector, developments in the postproduction industry apparently have not kept pace with increased production. To address the inefficiencies, a sound integrated crop management (ICM) system should incorporate not only the production aspects, but the postharvest process as well, to cover palay harvesting, threshing, cleaning, drying, milling and storage operations. A study that would enhance the ICM for irrigated rice, also known as PalayCheck® system shall cover key checks and best practices in the postproduction processes to maintain better quality and market price.

Development of postharvest management keychecks and best practices for improving the rice post-production system

MJC Regalado and PS Ramos

An integrated rice postharvest management protocol anchored on the PalayCheck® system is being developed and packaged for the rice postproduction industry. This shall serve as a training and educational tool to equip farmers, traders, millers, and operators on how to achieve better quality palay and milled rice that would meet international standards. This study aims to: (1) develop a system of key checks and recommended best practices for an integrated rice postharvest management, covering harvesting, threshing, hauling, cleaning, drying, storing, and milling operations; and (2) incorporate postharvest key checks and best practices in the PalayCheck® system, then validate and refine the system.

To further validate the key checks developed for harvesting to milling, field experiments, which started in 2014 DS at PhilRice CES, were conducted from 2015 DS to 2015 WS. Three rice cultivars, namely: hybrid variety PSB Rc72H (Mestizo 1) and inbred varieties NSIC Rc160 and MS-16, were planted in a 2.8ha paddy field. The crops were harvested at three different harvest dates: optimum harvest date, five days before optimum harvest, and 5 days after optimum harvest. Harvest methods included: 1) manual reaping on the first day, collection and piling on second day, and mechanical threshing on third day; 2) manual reaping and collection and piling on the first day, and mechanical threshing on the second day; 3) manual reaping, collection and piling, and mechanical threshing on the first day; and 4) combine harvesting on the first day. Grain losses incurred during each harvest operation were determined using standard assessment methods. Drying methods used were sun drying on concrete pavement and mechanical drying in a heated air flatbed dryer. Storage methods included:

1) pile of 50kg capacity plastic sacks of dried paddy at ambient air condition directly on concrete floor without plastic pallet; 2) pile of 50kg capacity plastic sacks of dried paddy at ambient air condition on plastic pallet; and 3) 50-kg capacity plastic sacks of dried paddy inside a PhilRice "saclob" or cocoon (plastic hermetic storage system). Germination rate for MS-16 and NSIC Rc160 and storage losses for the three varieties were also evaluated at the end of the six-month period. Laboratory test milling of samples from the dried paddy harvest lots were done one month and six months after storage to determine total milling and head rice recoveries.

Highlights:

- Results showed that the aggregate losses for reaping or cutting, piling and threshing operations across seasons were less than the national average of 5.2% (Francisco 2010) for the three operations when the crop was either cut, piled, and threshed on the same day or combine harvested, both at five days early harvest and optimum harvest times. However, when harvest time was five days late all harvest methods, except combine harvesting, incurred losses more than the national average.

- Use of the combine at five days late harvest resulted in grain losses attributed to the machine of 2.9% in the dry season and 3.5% in the wet season. But this still meets the standard performance criterion for maximum total machine loss of 3.5% (Philippine National Standard/Philippine Agricultural Engineering Standard 224:2005).

- Cutting and piling the crop on the first day and threshing on the second day incurred losses not significantly different from 5% when done either five days earlier or at optimum harvest time. Nevertheless, when this method was done at 5 days late harvest, losses rose to more than 10%.

- Highest losses were incurred when the crop is reaped on the first day, piled on the second day, and threshed on the third day, relative to the three other methods, and these were seriously high at 18 to 19% when harvest time was delayed by five days.

- Viability of paddy seeds was preserved well through flatbed drying and hermetic storage in a plastic cocoon (PhilRice "saclob"), with germination rates decreasing only from 100% to 98% for MS-16 and from 99% to 98% for NSIC RC160 after six months. Germination rates dropped by 10 percentage points or more after six months with ambient pile storage, with or without plastic pallet, although the viability of the paddy seeds is above the norm set by the BPI-NSQCS which is 85%.

- After six months of storage, significantly higher milling recovery percentages were also attained with MS-16, Mestizo 1, and NSIC Rc160 samples which were flatbed dried and stored in a hermetic cocoon. However, in terms of head rice recovery, although the percentages were also higher with the flatbed dried and hermetic cocoon stored paddy samples, the difference from the two other drying and storage methods were not significant.

- Germination tests, storage loss determination, and milling tests for the 2015 WS paddy harvest are still to be carried out six months after the harvest was done in November.

III. Promotion of Matured Engineering Technologies

Project Leader: EC Gagelonia

Promotion of matured engineering technologies

EC Gagelonia, JA Ramos, CP Ariola, GB, Palanca, EG Bautista, and EB Sibayan

The task of improving productivity in rice cultivation through the use of yield-enhancing and cost-reducing mechanization technologies falls on the shoulders of PhilRice, as one of the lead rice R&D institution in the country. In fact, PhilRice, through its Rice Engineering and Mechanization Division, has been at the forefront in the development of production machinery and postharvest equipment for rice production. At present, more of these technologies have already been successfully developed by PhilRice engineers. A vigorous technology transfer strategy is therefore needed in order for these equipment be adopted by farmers in the countryside. A strong partnership with agri-machinery manufacturers is also necessary in the promotion and commercialization of these technologies.

The objectives of the project are: 1) Promote matured engineering technologies for adoption by farmers/stakeholders, 2) Transfer matured engineering technologies to manufacturers for mass production and commercialization, 3) Application of patent for new technology prior to commercialization, 4) Promotion of matured engineering technologies, 5) Accreditation of manufacturers, 6) Monitoring of accredited manufacturers for quality validation of the equipment, and 7) Mass production of matured technologies.

Highlights:

- Two new manufacturers (Table 3) were issued a license to manufacture laboy tiller, seed cleaner, and flatbed dryer.

Table 3. New accredited manufacturer, CY 2015.

Manufacturer	Address	Equipment	License validity
D. Perez Metal and Machine Shop	*Brgy. San Jose, Digos City, Davao del Sur*	Seed cleaner and Flatbed dryer	March 6, 2017
Lambs Agri Mechanicals	*Km. 61.9 National Hi-way, Anos, Los Baños, Laguna*	Laboy tiller	February 13, 2017

- At present, several equipment consists of laboy tiller, microtiller, seed cleaner, micromill, gasifier stove, and combine harvester have been provided to 5 branch stations (Table 4). Proper documentation for the transfer of equipment was prepared in close coordination with the property office.

Table 4. List of Equipment provided in the branch stations, CY 2015.

Station	Equipment	Remarks
PhilRice Agusan	seed cleaner	MR on process
PhilRice Batac	brown rice mill, micromill, seed cleaner	MR on process
PhilRice Negros	brown rice mill, micromill, laboy tiller, microtiller, gasifier stove	MR on process
PhilRice Isabela	laboy tiller, microtiller, mini combine, micromill, gasifier stove	MR on process
PhilRice Samar	seed cleaner	MR on process

- Technologies were showcased during the Lakbay Palay of PhilRice held in April 14-15, 2015. During the event, farmers have witnessed the operation and demonstration of rototiller, gasifier stove, and microtiller. Posters of other farm equipment were also featured. In an event sponsored by DA-PhilMech held on December 1-3, 2015 which they called Makinasaka, PhilRice agri-machineries were also showcased.

- In partnership with DevCom, promotion materials have been developed which include machine catalogue and video material of PhilRice REMD technologies. It will be given away during exhibits, field days, and other events of rice stakeholders.

- A set of blower and furnace for a 4-ton and 8-ton reversible airflow dryer each was fabricated through the request of a private individual. The 4-ton model was installed at Sitio Crossing, Barangay Malicboy, Pagbilao, Quezon (Figure 1) while the 8-ton was installed at Plaridel, Bulacan.

Figure 10. Installation of flatbed dryer at PhilRice Bicol.

- Two sets of blower and furnace for a 6-ton flatbed dryer were also completed installation at PhilRice Bicol (Figure 10).

- A week-long training was conducted for the operation, maintenance and trouble-shooting of agri-machineries developed by PhilRice. The training was composed of lectures and hands-on operation of different agri-machineries which joined by technical staff and farm operators coming from the branch

- Various equipment were acquired by private individuals and government offices through the project which include laboy tiller, carbonizer, gasifier stove, and rotary weeder (Table 5). Thirty units of microtiller were also acquired by DA-CAR.

Table 5. Summary on sales of equipment, CY 2015.

PAYOR	DATE PAID	OR	PARTICULARS	Qty	Unit cost	Total
Richmond Decuzar	1/12/2015	7770213	blower and furnace	1	29,000.00	29,000.00
Jayson Mendoza	1/17/2015	7770234	Weeder	3	1,500.00	4,500.00
Avelino Mejia	1/19/2015	7770233	Carbonizer	1	1,100.00	1,100.00
PGSO- Baler, Aurora	1/22/2015	0047261104	Carbonizer	20	1,100.00	22,000.00
Edwin Martin	1/29/2015	7770255	Weeder	1	1,500.00	1,500.00
Rodolfo Aviedo	2/10/2015	7770276	Carbonizer	1	1,100.00	1,100.00
Municipality of Laoac	2/24/2015	7770303	Carbonizer	4	1,100.00	4,400.00
Rivera Farms	3/2/2015	7770307	Carbonizer	1	1,100.00	1,100.00
Bulacan Agricultural State College	3/4/2015	7770310	Weeder	1	1,500.00	1,500.00
Primitivo Angonan	3/9/2015	7770326	Weeder	1	1,500.00	1,500.00
Julieta Parinas	4/4/2015	7770393	Carbonizer	1	1,100.00	1,100.00
Magdaleno andres	4/15/2015	7770413	Carbonizer	1	1,100.00	1,100.00
Naty P. Valles	4/15/2015	7770415	Gasifier stove	1	2,000.00	2,000.00
Morena Kemper	4/20/2015	7770426	Weeder	1	1,500.00	1,500.00
Nelson Regudo	4/21/2015	7770427	Carbonizer	1	1,100.00	1,100.00
Ariel Villariza	4/29/2015	7770457	Weeder	2	1,500.00	3,000.00
RWAN	4/29/2015	7770460	Weeder	15	1,500.00	22,500.00
Melchor Garcia	6/6/2015	7770592	Carbonizer	1	1,100.00	1,100.00
BFAR- San Fernando	6/5/2015	7770554	Laboy tiller	3	73,875.00	221,625.00
Leonie Agri Corp.	7/1/2015	7770614	Carbonizer	1	1,100.00	1,100.00
Rico Ramon Pagkalinawan	7/29/2015	7770713	blower and furnace	1	100,00.00	10,000.00
Franco Uminga	8/24/2015	7770757	Carbonizer	1	1,100.00	1,100.00
Eladio R. Gales Jr.	9/29/2015	7770824	blower and furnace	2	99,000.00	99,000.00
Richmond Decuzar	10/28/2015	7770895	blower and 4-ton reversible dryer	1	29,000.00	29,000.00
Richmond Deczar	10/28/2015	7770896	blower and furnace	1	58,000.00	58,000.00
Ronald Ramiro	10/28/2015	7770894	blower furnace	1	80,000.00	80,000.00
SB Eco Farm	10/9/2015	7770856	Weeder	1	1,500.00	1,500.00
Aljuna V. Milambiling	11/5/2015	7770913	Weeder	1	1,500.00	1,500.00
Wilson T. Gardoce	11/16/2015	7770933	Weeder	3	1,500.00	4,500.00
Perla Alas	12/11/2015	7770992	Carbonizer	2	1,100.00	2,200.00
Ricky Belmonte	12/18/2015	7794004	Gasifier stove	2	2,500.00	5,000.00
DA-CAR	12/21/2015	7794006-017	payment for 12 units microtiller	12	7,500.00	90,000.00
Total						**766,625.00**

Abbreviations and acronymns

ABA – Abscicic acid
Ac – anther culture
AC – amylose content
AESA – Agro-ecosystems Analysis
AEW – agricultural extension workers
AG – anaerobic germination
AIS – Agricultural Information System
ANOVA – analysis of variance
AON – advance observation nursery
AT – agricultural technologist
AYT – advanced yield trial
BCA – biological control agent
BLB – bacterial leaf blight
BLS – bacterial leaf streak
BPH – brown planthopper
Bo - boron
BR – brown rice
BSWM – Bureau of Soils and Water Management
Ca - Calcium
CARP – Comprehensive Agrarian Reform Program
cav – cavan, usually 50 kg
CBFM – community-based forestry management
CLSU – Central Luzon State University
cm – centimeter
CMS – cystoplasmic male sterile
CP – protein content
CRH – carbonized rice hull
CTRHC – continuous-type rice hull carbonizer
CT – conventional tillage
Cu – copper
DA – Department of Agriculture
DA-RFU – Department of Agriculture-Regional Field Units
DAE – days after emergence
DAS – days after seeding
DAT – days after transplanting
DBMS – database management system
DDTK – disease diagnostic tool kit
DENR – Department of Environment and Natural Resources
DH L– double haploid lines
DRR – drought recovery rate
DS – dry season
DSA - diversity and stress adaptation
DSR – direct seeded rice
DUST – distinctness, uniformity and stability trial
DWSR – direct wet-seeded rice
EGS – early generation screening
EH – early heading
EMBI – effective microorganism-based inoculant
EPI – early panicle initiation
ET – early tillering
FAO – Food and Agriculture Organization
Fe – Iron
FFA – free fatty acid
FFP – farmer's fertilizer practice
FFS – farmers' field school
FGD – focus group discussion
FI – farmer innovator
FSSP – Food Staples Self-sufficiency Plan
g – gram
GAS – golden apple snail
GC – gel consistency
GIS – geographic information system
GHG – greenhouse gas
GLH – green leafhopper
GPS – global positioning system
GQ – grain quality
GUI – graphical user interface
GWS – genomwide selection
GYT – general yield trial
h – hour
ha – hectare
HIP - high inorganic phosphate
HPL – hybrid parental line
I - intermediate
ICIS – International Crop Information System
ICT – information and communication technology
IMO – indigenous microorganism
IF – inorganic fertilizer
INGER - International Network for Genetic Evaluation of Rice
IP – insect pest
IPDTK – insect pest diagnostic tool kit
IPM – Integrated Pest Management
IRRI – International Rice Research Institute
IVC – in vitro culture
IVM – in vitro mutagenesis
IWM – integrated weed management
JICA – Japan International Cooperation Agency
K – potassium
kg – kilogram
KP – knowledge product
KSL – knowledge sharing and learning
LCC – leaf color chart
LDIS – low-cost drip irrigation system
LeD – leaf drying
LeR – leaf rolling
lpa – low phytic acid
LGU – local government unit

LSTD – location specific technology development
m – meter
MAS – marker-assisted selection
MAT – Multi-Adaption Trial
MC – moisture content
MDDST – modified dry direct seeding technique
MET – multi-environment trial
MFE – male fertile environment
MLM – mixed-effects linear model
Mg – magnesium
Mn – Manganese
MDDST – Modified Dry Direct Seeding Technique
MOET – minus one element technique
MR – moderately resistant
MRT – Mobile Rice TeknoKlinik
MSE – male-sterile environment
MT – minimum tillage
mtha^{-1} - metric ton per hectare
MYT – multi-location yield trials
N – nitrogen
NAFC – National Agricultural and Fishery Council
NBS – narrow brown spot
NCT – National Cooperative Testing
NFA – National Food Authority
NGO – non-government organization
NE – natural enemies
NIL – near isogenic line
NM – Nutrient Manager
NOPT – Nutrient Omission Plot Technique
NR – new reagent
NSIC – National Seed Industry Council
NSQCS – National Seed Quality Control Services
OF – organic fertilizer
OFT – on-farm trial
OM – organic matter
ON – observational nursery
OPAg – Office of Provincial Agriculturist
OpAPA – Open Academy for Philippine Agriculture
P – phosphorus
PA – phytic acid
PCR – Polymerase chain reaction
PDW – plant dry weight
PF – participating farmer
PFS – PalayCheck field school
PhilRice – Philippine Rice Research Institute
PhilSCAT – Philippine-Sino Center for Agricultural Technology
PHilMech – Philippine Center for Postharvest Development and Mechanization
PCA – principal component analysis
PI – panicle initiation
PN – pedigree nursery
PRKB – Pinoy Rice Knowledge Bank
PTD – participatory technology development
PYT – preliminary yield trial
QTL – quantitative trait loci
R - resistant
RBB – rice black bug
RCBD – randomized complete block design
RDI – regulated deficit irrigation
RF – rainfed
RP – resource person
RPM – revolution per minute
RQCS – Rice Quality Classification Software
RS4D – Rice Science for Development
RSO – rice sufficiency officer
RFL – Rainfed lowland
RTV – rice tungro virus
RTWG – Rice Technical Working Group
S – sulfur
SACLOB – Sealed Storage Enclosure for Rice Seeds
SALT – Sloping Agricultural Land Technology
SB – sheath blight
SFR – small farm reservoir
SME – small-medium enterprise
SMS – short message service
SN – source nursery
SSNM – site-specific nutrient management
SSR – simple sequence repeat
STK – soil test kit
STR – sequence tandem repeat
SV – seedling vigor
t – ton
TCN – testcross nursery
TCP – technical cooperation project
TGMS – thermo-sensitive genetic male sterile
TN – testcross nursery
TOT – training of trainers
TPR – transplanted rice
TRV – traditional variety
TSS – total soluble solid
UEM – ultra-early maturing
UPLB – University of the Philippines Los Baños
VSU – Visayas State University
WBPH – white-backed planthopper
WEPP – water erosion prediction project
WHC – water holding capacity
WHO – World Health Organization
WS – wet season
WT – weed tolerance
YA – yield advantage
Zn – zinc
ZT – zero tillage

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