Philippine Rice R&D Highlights 2013

RICE ENGINEERING AND MECHANIZATION DIVISION

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RICE ENGINEERING & MECHANIZATION DIVISION

Division Head: EC Gagelonia

Executive Summary

The Department of Agriculture (DA) has been encouraging various stakeholders to find ways and means to lower production costs, improve product quality, and reduce postproduction losses in order for farmers and processors alike can be competitive with their counterparts in neighboring countries. To help reduce costs and improve production and postproduction efficiencies, appropriate mechanization and postharvest technologies must be developed, promoted, and eventually adopted by farmers and processors. The development of production and postproduction farm machinery includes the development of farm machinery that will improve existing practices from land preparation to harvesting of the grains to increase productivity. For the development of palay check protocol for land preparation, this study aims of establishing an ideal condition to provide uniform crop growth and maturity and better yield. The development of ride-on stripper combine and improvement of combine harvester will address the timely operation in harvesting and reduction of grain losses.
In 2013 DS, grain yield was significantly affected by the degree of leveling the soil ($P<0.05$). The 21d-well leveled soil obtained the highest (6.94 t/ha) while 21d-not-so-leveled soil obtained the lowest (5.21 t/ha).
Final design of the stripper combine harvester was conceptualized. The design will have a 1.2m harvesting width and 3 ha/day field capacity with manual transmission and rubber crawler. A pre-cleaner will also be incorporated after the threshing system and double air stream will be employed in the cleaning system. Screw conveyor will be used in conveying grains.

For the improvement of the 1.3 combine harvester, pneumatic tire will be replaced by rubber crawler for ease of mobility in wet fields and double sieve cleaning system will be incorporated in the design for high performance and capacity.

However, the net income generated by the project on custom services from 2006 to 2011 was not sufficient to cover the operating cost and increasing amortization every year. The need to increase the service area, to cope up with the increasing amortization was not met. Also, non-payment of services from farmers were encountered, thus, custom services provision is not viable when operated by a government agency.

On the development of an integrated postharvest management system for the rice postproduction industry palay check for rice postharvest management was finalized and validation in the field is on-going, 3 clusters of milled rice in the market were categorized based on AC and techniques

for quick determination of AC was developed. Further refinements and validation of the developed methods were done before pilot testing.
For the commercialization of matured engineering technologies, intensive promotion is needed for farmers to adopt the suitable technologies needed. Linkage with manufacturers is necessary for the transfer and mass production of the technologies ready for commercialization.

Through these major activities being undertaken, such as the development of production and postproduction farm machinery, development of an integrated postharvest management system for the rice postproduction industry, and commercialization of matured engineering technologies, PhilRice hopes to contribute its share in attaining the rice self-sufficiency goal and in improving not only the country's rice mechanization level but also farm labor productivity.

I. Development of Production and Postproduction Farm Machinery
Project Leader: CJM Tado

A well-prepared land provides a soil condition favorable for plant growth. It also facilitates good management on water, nutrient, weed and pest. Proper leveling in the field, for example, solves more than 50% of the problems in rice production. However, in the Palay Check System, Key Check of a well-leveled soil having 2 to 3cm water depth is difficult to achieve in actual field condition. Hence, a protocol on land preparation must be developed to ensure that the soil is ideal for crop establishment and plant growth.

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 of the major rice-producing areas in the country. A mini-combine harvester featuring cutter blades, axial flow threshing system, and bagging components that is being developed by PhilRice from the original Chinese design provides a bright prospect of addressing the problem essentially because it is appropriate to operate in small field parcels which is common in the country. Initial field evaluation of the mini-combine showed promising results in terms of improving timeliness of operation and reduction of postharvest losses. Improvement is necessary to ascertain its durability and establish the machine's performance in wet field condition.

The stripper harvester, a machine which strips the grains leaving the straw still uncut in the field takes only less than half of the material that is being handled by cutter bar combines. Thus, a lighter machine with lower power requirement is possible with the stripper combine.

The custom service provisions in rice mechanization had been implemented by PhilRice for timely operation as well as for reduction of production costs. In 2006, from the proceeds of loan in Agricultural Competitive Enhancement Fund (ACEF) of the Department of Agriculture, sets of farm machinery for land preparation, crop establishment, harvesting including hauling of harvests were procured for custom services provision to farmers.

Development of stripper combine harverster
CJM Tado and DP Ona

The Combine Rice Harvester, a machine that aims to make harvesting rice efficient, has been introduced throughout the country in previous years. However, the level of adaptation is still very low due to various reasons. One of these reasons is the rapid changes of atmospheric conditions in which the continuous rain drops before and during harvest season tremendously affects the soil condition of the field that limits its utilization.

Thus, a new study is being proposed to develop a lighter and low cost combine harvester for small farmers. This hopes to provide a bright prospect in addressing the problem essentially because its size and weight is appropriate to operate in small field parcels which is common in the country. Concept of the prototype had been finalized (see Figure 1). The design will incorporate the following features:

- 1.2m harvesting width
- Rubber crawler
- Manual transmission
- 3 ha/day field capacity

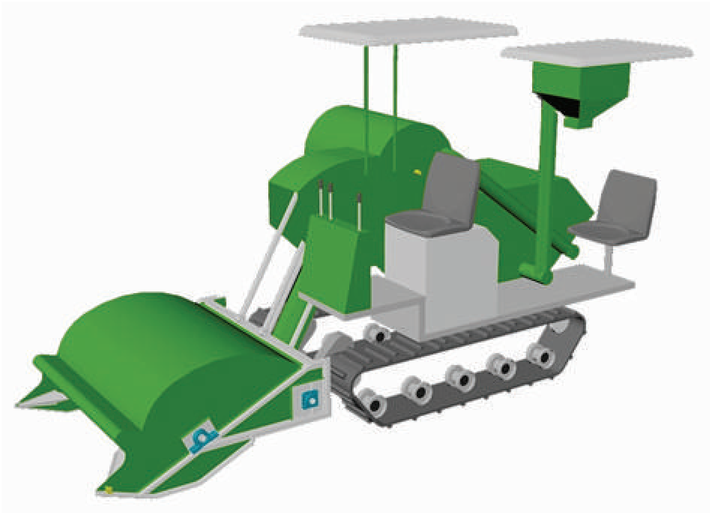

Figure 1. Final Design Concept of the stripper harvester

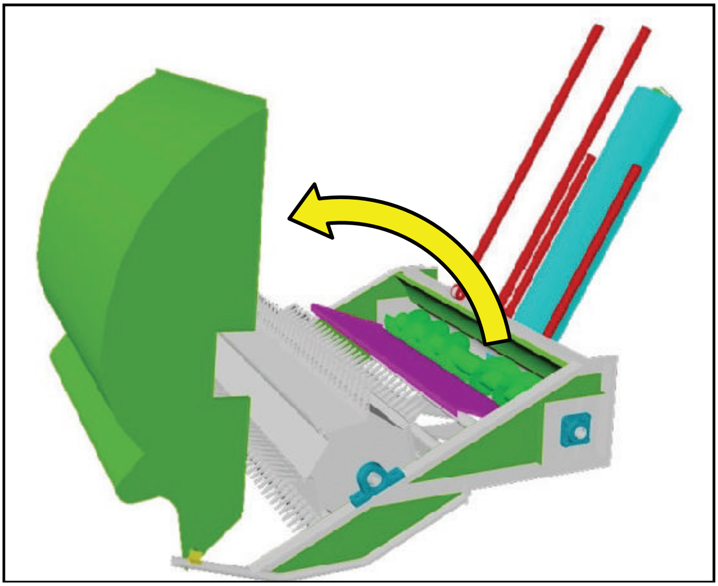

Figure 2. Retractable Hood

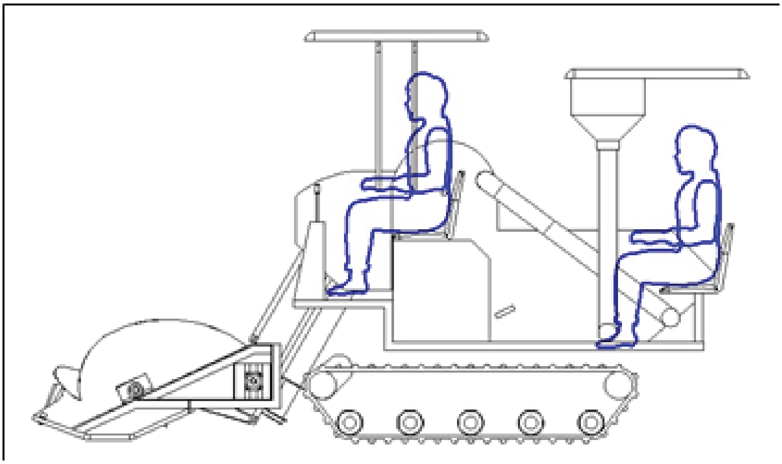

Figure 3. Operator Positions

- 2 operators
- Retractable hood (see Figure 2)
- 4-link header attachment
- With pre-cleaner (see Figure 3)
- Double airstream (see Figure 3)
- Screw conveyor (see Figure 3)

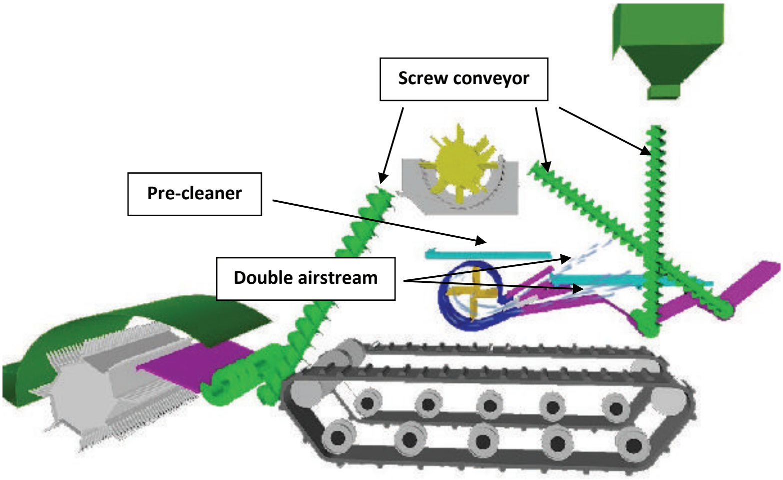

Figure 4. Stripper Combine System

Highlights:

- At the same horsepower rating, vertical three-cylinder engine normally weighs half of the horizontal single cylinder

- Use of nylon engineering plastics for bushings with continuous rotation and extreme bearing loads

- Screw conveyors have less vibration and handle materials more gently

- Double sieve for high capacity and high performance grain cleaner

- The study on grain cleaning performance will require test rig

Improvement of the 1.3 combine harverster
CJM Tado and DP Ona

The current design of mini-combine rice harvester has been proven for its efficient performance on dry field condition. This machine has been introduced throughout the country in previous years. However, the level of adaptation is still very low due to various reasons. One of these reasons is the rapid changes of atmospheric conditions in which the continuous rain drops before and during harvest season tremendously affects the soil condition of the field that limits its utilization. Also, some users of this machine complained about the difficulty of adjusting the header and on the noticeable crack grains on the harvest.

Thus, a new study is being proposed to further improve the 1.3m combine harvester. Concept of the prototype had been finalized (see Figure 1). The design will incorporate the following features:

- 1.3m harvesting width
- 3-cylinder diesel engine
- Rubber crawler
- Manual transmission
- 2 ha/day
- 2 operators
- Double sieve cleaner

Figure 5. Final prototype concept

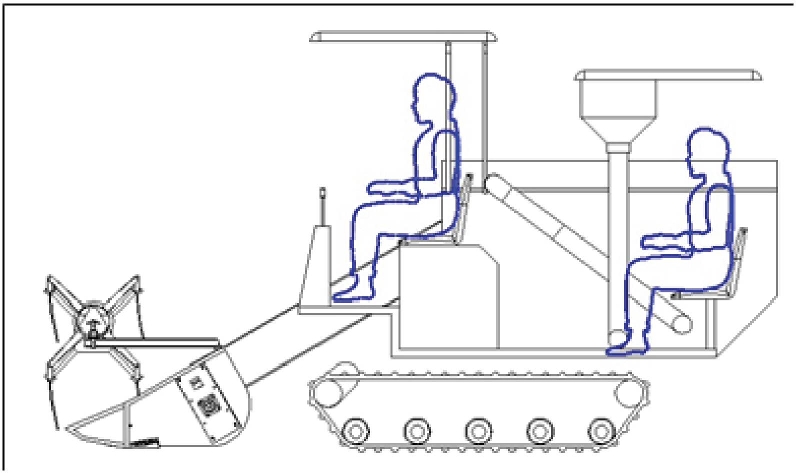

Figure 6. Operator Positions

Highlights:

- Adaption of the mini-combine for harvesting of mungbean
- On-going research for the possible revision of the previously designed header for multi-crop capability
- Replaceable sieve assembly to accommodate specific crop (rice or mungbean)
- At the same horsepower rating, vertical three-cylinder engine normally weighs half of the horizontal single cylinder
- Use of nylon engineering plastics for bushings with continuous rotation and extreme bearing loads
- Screw conveyors have less vibration and handle materials more gently
- Double sieve for high capacity and high performance grain cleaner
- The study on grain cleaning performance will require test rig

Development of palaycheck protocol for land preparation
HV Valdez, K Samoy-Pascual, EG Bautista and EC Gagelonia

Land preparation is one of the most important processes in rice production. A well-prepared land provides a soil condition favorable for plant growth. It also facilitates good management on water, nutrient, weed and pest. Proper leveling in the field, for example, solves more than 50% on the problems in rice production. This study evaluated different duration of land preparation and degree of final leveling in the field to assess their effect on the agronomic performance on the crop and weed incidence. It also aims to improve and develop a protocol of land preparation for PalayCheck in order to establish an environment ideal for crop growth.

For 2013 dry and wet season, two factorial combinations was used with land preparation as the main plot, and degree of leveling as the sub-plot laid out in split plot design in RCBD. The 3 durations were: (1) 7d with one day interval of plowing, first harrowing, second harrowing, and leveling; (2) 14d with 5 days interval of plowing, first harrowing, second harrowing, and leveling; and (3) 21d with 7d interval of plowing, first harrowing, second harrowing, and final leveling. The degree of leveling were: (1) well-leveled soil achieved at least 3x passing of a wooden plank leveler; and (2) not-so-leveled soil achieved at only one passing of a wooden plank leveler.

Highlights:

- Farm tractor (4-wheel) with rotovator attachment was used during first operation (dry land operation) and power tiller for the succeeding operations during DS & WS 2013. Final leveling was done using wooden plank.

- In 2013 DS, grain yield (Table 1) was significantly affected by the interacting effects of both treatments and also affected by the degree of leveling the soil ($P<0.05$). The 21d-well leveled soil obtained the highest (6.94 t/ha) while 21d-not-so-leveled soil obtained the lowest (5.21 t/ha).

- Among the degree of leveling, grain yield of a well leveled soil was higher by 13% compared with the not-so-leveled soil.

- In 2013 WS, at 15, 30 and 45 DAT, weed densities (Table 2) were not significantly influenced by duration of land preparation and the degree of leveling the soil. At 15DAT, weed density was lowest at 4.5 plants/m2 at the shortest duration (7d), but not significantly different with 15d and 21d.

Table 1. Grain yield of NSIC Rc222 under different land preparation duration and degree of leveling the soil, 2013 DS

Treatments	Well-leveled soil	Not-so-leveled soil
Duration		
7	6.42 $^{A\ a}$	5.62 $^{AB\ b}$
14	6.38 $^{A\ a}$	6.42 $^{A\ a}$
21	6.94 $^{A\ a}$	5.21 $^{B\ b}$

Data in columns followed by a different capital letters are significantly different at 5% level using LSD.
Data in rows followed by a different small letters are significantly different at 5% level using LSD.

Table 2. Weed density (plants/m2) under different land preparation duration and degree of leveling the soil, 2013 WS

Treatments	Weed density, plant per m2		
	15DAT	30DAT	45DAT
Duration			
7	4.50a	101.75a	87.50a
15	55.63a	38.50a	37.67a
21	44.38a	38.38a	41.17a
Degree of leveling			
Well leveled soil	29.67a	66.25a	59.78a
Not so leveled soil	40.00a	52.83a	51.11a

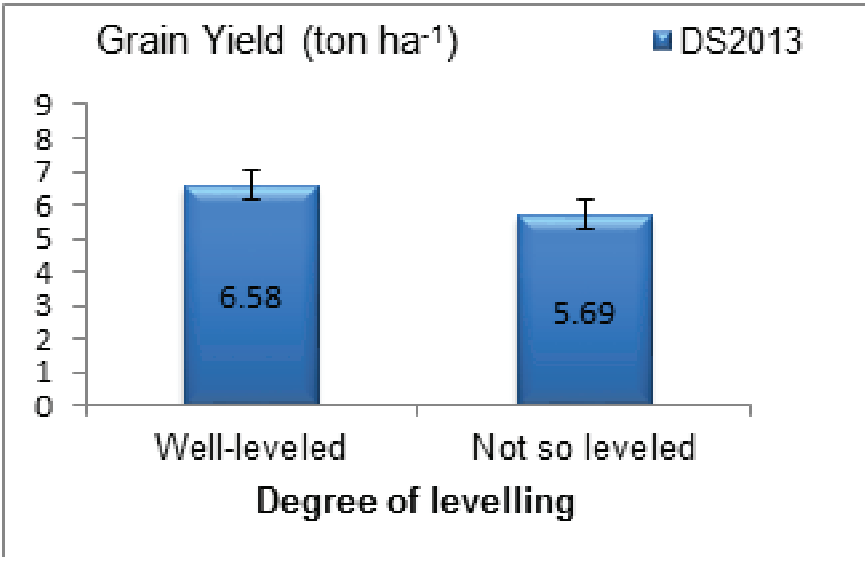

Figure 7. Grain yield of NSIC Rc222 under different (a) duration of land preparation and (b) degree of leveling the soil, 2013 DS. (Means ± SE)

Evaluation of the PhilRice-ACEF project on custom service provision in rice mechanization
EC Gagelonia and RA Villota

Rice mechanization has been known in developed countries to contribute not only in reducing costs and labor but also in directly increasing crop productivity. Rice farms in the country have low productivity not only as a result of poor crop management but also because of low mechanization level. Several field operations have to be mechanized in order to improve productivity as well as reduce costs: land preparation, transplanting, harvesting and drying.

The direct effects of mechanization on crop yield include timeliness, precision in the conduct of operations especially in direct seeding or transplanting, provision of sufficient water during critical stages of the plant, and reduction of field losses in harvesting up to drying.
There are several ways to improve our country's level of rice mechanization and labor productivity. One of these is to promote the use of farm machinery/equipment that are tested and proven to be efficient, appropriate and adapted to local conditions through the provision of custom services and pilot utilization of technologies.

PhilRice through loan from Agricultural Competitive Enhancement Fund (ACEF) established the Custom Services in Rice Farm Mechanization offering operations from land preparation to milling with the main goal of mechanizing the farm operations. A total of Php17 million was released by ACEF which is payable in 6 years (inclusive of a 1 year grace period) without interest.

Out of this Php17 million, PhilRice was able to acquire sets of farm machinery and equipment- such as, 4-wheel tractors, hand tractors, transplanters (including trays and flow-line seeder), reapers, threshers, hauling trucks and office equipments to start the custom service provision in the vicinity of PhilRice.

Highlights:

- UMAIKAMI Cooperative in Maragol, Science City of Munoz was selected as beneficiary of the custom services in rice mechanization in addition to the seed production area of PhilRice.

- Initial result for the first year of operation (2006) showed that the project has the potential to produce more income and help the farmers who cannot afford to pay the fee immediately after the operation.

- On the second year of operations, the agreement with UMAIKAMI was terminated due to problems on payment of services and disputes among officials operating the cooperative, thus, the Bantug Primary Multipurpose Cooperative in Science City of Munoz, Nueva Ecija was identified as replacement for the UMAIKAMI Cooperative.

- The net income generated by the project from 2006 to 2011 was not sufficient to cover the operating cost and increasing amortization every year. The need to increase the service area, to cope up with the increasing amortization, was not met. Thus, to regularly pay the amortization, restructuring of the loan for another five years was made.

- It was also noticed that there were unpaid services from 2006-2010 from the members of the previous and present cooperating cooperatives as well as farmers who are not members of the cooperative and PhilRice employees that were able to avail of the services of the project.

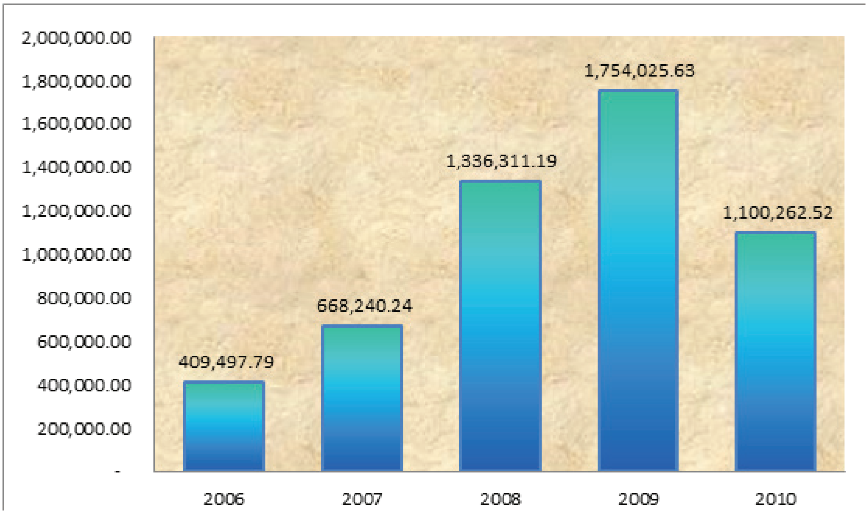

Figure 8. Income generated from 2006-2010

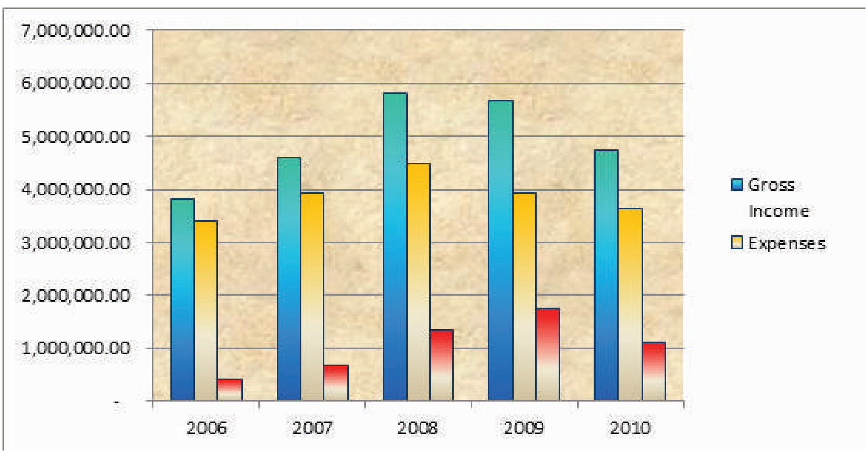

Figure 9. Income and Expenses from 2006-2010

II. Development of an Integrated Postharvest Management System for the Rice Postproduction Industry

Project Leader: MJC Regalado

Postharvest losses can be as high as 30% of production depending on processing and handling circumstances. Physical losses are mainly due to spillage or pest infestation. The more critical losses are t in the quality due to bio-deterioration, and damage to the grain during drying, storage, and milling. Qualitative losses are also due to discoloration, presence of contaminants, varietal mixing, and grain fissures that wind up as broken kernels during milling. Severe grain fissuring causes a reduction in milling recovery, and broken grains sell for only half the price of head rice. All of these losses can be minimized through technology, information dissemination, and training of technicians. A focus on producing good quality rice automatically reduces postharvest losses.

Minimizing postharvest losses and producing good quality milled rice are two sides of the same coin, and is dependent on the farming system and associated practices of producing good quality palay and the downstream processing industry.

In the post-production system, the way of doing things with the aid of tools, machines, or processing equipment, in short, use of technology, are key elements. Harvesting machines to provide timeliness, mechanical dryers to arrest bio-deterioration of the wet harvest, good storage facilities, and efficient rice milling machines are required. It is sad to note that despite rice being the staple food of the country, the confluence of negative events contributes to an obsolete post-production system that we have today. Thus, this project was conducted to develop and test a PalayCheck® system for integrated rice postproduction management, develop clusters of rice varieties according to their similarities in physical, chemical, cooking and eating characteristics, and come up with improved trade standards for paddy (palay), and milled rice.

Improvement, validation and application of field test methods for market quality identification and milled rice clustering in the market

BO Juliano, APP Tuaño, AD Peñaloza, AR Agarin, and MM Pontañez

Market price of milled rice is primarily determined by its physical attributes (e.g. size, shape, and translucency, broken and head rice). Aside from its physical attributes, cooked rice texture is also considered by consumers when purchasing milled rice in the market. Apparent amylose content (AC) of milled rice is the main determinant of cooked rice hardness. In 2002, Kongseree et al. developed a field test for AC to identify mixture of high-AC in Jasmin or Khao Dawk Mali 105. The method was optimized and adopted in 2009 by Tuaño et al. for AC- type determination and rice quality classification of milled rice samples in the market.

The proposed rice quality clusters in 2006 is a good means to ensure the quality of certain rice types available in the market. Further refinement of developed methods and their validation must be in place prior to the pilot-testing of the clustering regime and classifications tools. Trends of rice quality will also be determined to predict its implications in the national rice breeding program.

Highlights:

- Three clusters of milled rice in the market were categorized based on AC.

- Techniques for quick determination of AC was developed. Further refinements and validation of the developed methods were done before pilot testing.

- Out of 389 non-waxy milled rice samples collected from market retailers in Nueva Ecija, Ilocos Norte, Negros Occidental and Agusan del Norte, 218 were intermediate AC, 140 were high AC, 30 were low AC. High AC rice predominated in Nueva Ecija, but intermediate AC rice was predominant in Ilocos Norte, Negros Occidental and Agusan del Norte.

III. Commercialization of Matured Engineering Technologies

EC Gagelonia, CJM Tado, JA Ramos, EG Bautista, JEO Abon, DB Ona, LB Molinawe, HV Valdez and EB Sibayan

PhilRice, through its Rice Engineering and Mechanization Division, has been at the forefront in the development of machinery and postharvest equipment for rice production. To date, several of these technologies have already been successfully developed by PhilRice engineers. A vigorous manufacturing strategy is therefore needed in order for these pieces of equipment to be adopted by farmers in the countryside. Linkage with other manufacturers is also necessary in the promotion and commercialization of these technologies.

The problems causing low adoption of locally developed machines were inadequate machinery technology promotion and low quality of developed machines. There were accredited manufacturers on these developed machines but some of them lacked quality control measures, promotion capability and poor marketing strategies.

Rice mechanization has been known in developed countries to contribute not only in reducing costs and labor but also in directly increasing crop productivity. Rice farms in the country have low productivity not only as a result of poor crop management but also because of low mechanization level. Several priority field operations have to be mechanized in order to improve productivity as well as reduce costs.

With Republic Act No. 10601, which is the Agricultural Fisheries and Mechanization Development or AFMech Law, the development and promotion on the adoption of modern, appropriate and cost-effective farm machinery must be strengthened to enhance farm productivity and efficiency and in order to achieve food sufficiency and increase farmers' income.

Agricultural mechanization is not just the promotion and use of mechanical and powered farm machines and equipment, but also the development of skills among farmers and technicians alike to use these machines efficiently, maintain them properly, and troubleshoot/repair them expertly.

Competitiveness of Philippine agriculture, in general, and rice farming, in particular, is not merely attaining high yield or crop productivity, but more so labor productivity and energy efficiency.

Local assembling and manufacturing of farm machinery must also be strengthened as another source of livelihood for the farm workers who will be displaced in the implementation of the AFMech Law.

Highlights:

- One (1) patent application (mobile gasifier system) submitted to IPO and 1 patent drafted (reversible airflow dryer) for submission to IPO.

- Participated in 6 field days of PhilRice-CES (March & September 2013) and PhilRice-Isabela and Los Banos (April & October 2013) on the demonstration of matured engineering technologies. Also participated on 6 exhibits (UPLB, March 2013: DOST, SMX Convention Hall, July 2013: NAST, Manila Hotel, July 2013: DOST-Region III, Walter Mart, August 2013; MAKINASAKA, PhilMech & Lingayen, Pangasinan, May & October 2013).

- Four (4) technologies are widely adopted by farmers: microtiller in CAR (50 units in 2012 & 60 units in 2013 were fabricated and delivered to recipients of rice mechanization program), seed cleaner being used by majority of seed growers in Luzon & Visayas based on 2013 Farm Equipment Loan at PhilRice and deliveries at DA-Regional Offices for recipients of rice mechanization program, ride-on attachment to handtractor in Central Luzon and Isabela based on record of sales of an accredited manufacturer in Isabela (MTP) and cooperating manufacturer in Guimba, Nueva Ecija (Val Agri-machinery), reversible airflow dryer adopted by palay traders/rice millers & cooperative in Quirino, Nueva Ecija and Bukidnon, brown rice mill adopted by Heirloom Rice/Rice Inc. & Dr. Mamaril.

- Two (2) manufacturers were accredited as non-exclusive manufacturer of the mobile gasifier, the Blue Flame in Metro Manila and Suki Trading in Cebu City.

- 100% of fabricated units conformed with PAES and industry standards, PhilRice commercial engineering technologies were subjected to AMTEC test, an example of which is the microtiller and seed cleaner, AMTEC test was required to manufacturer and all farm machinery bidding at DA also required AMTEC test.

Figure 10. Mass fabrication of Microtiller for DA-CAR

Figure 11. 8-ton capacity reversible airflow dryer installed in San Antonio, Nueva Ecija

Figure 12. Demonstration of the Mobile Gasifier Pump System during Field Day at UPLB

Figure 13. Participation in the MAKINASAKA exhibit in Lingayen, Pangasinan and DOST, Region III

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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Table 2. Weed density (plants/m2) under different land preparation duration and degree of leveling the soil, 2013 WS 9

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

We accomplish this mission through research and development work in our central and seven branch stations, coordinating with a network that comprises 57 agencies and 70 seed centers strategically located nationwide.

To help farmers achieve holistic development, we will pursue the following goals in 2010-2020: attaining and sustaining rice self-suffiency; reducing poverty and malnutrition; and achieving competitiveness through agricultural science and technology.

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

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