

Quality Rice. Quality Life.



2017 National Rice R&D Highlights

THE FUTURE OF RICE FARMING IN THE PHILIPPINES (FUTURERICE)



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The Future of Rice Farming in the Philippines (FutureRice)

Roger F. Barroga

Executive Summary

Rice farming in the Philippines will face several challenges in the future. With a very limited irrigated area, it must produce enough rice to feed more than 100 million Filipinos. The impact of climate change has also brought further destruction of remaining irrigation systems, and in some areas, much flooding and landslide due to shift in cyclone path. High population growth rate and rapid urbanization contribute to further reduction of prime agricultural land in the Philippines. This scenario is compounded by the dwindling supply and increasing costs of petroleum-based products for farm fuel, pesticides, and fertilizers. The increasing production costs at the farm level is eroding potential income and profits of farmers.

With these challenges, there is a need to develop and test new crop management innovations that will promote self-sufficiency, sustainability and competitiveness in the 21st century. We need to revolutionize and transform our food production and delivery system through the application of engineering, information technology, and biotechnology. This means that we have to upgrade the skills of extension agents and farmers on green, practical, and smart farming. Finally, these efforts must act as catalysts to transform farming communities into ecologically vibrant and competitive economies.

Thus, the FutureRice Program explored ways to increase current rice output using 21st century and practical cutting-edge technologies; prepare farmers for the future of rice farming in the Philippines; inventory, test, and adapt local and global innovations on clean, green practical, and smart farming (Clean GPS) technologies; train farmers and extension agents on Clean GPS technologies; establish communities that use Clean GPS farming; and establish livelihood opportunities on Clean GPS.

FutureRice has four components: Rice Innovation Center; Establishment of a Model Farm; Farm Automation through the use of ICTs; and Advocacy, Capacity Building, and Agritourism Development. These components are integrated to establish a model and learning farm that promotes, uses, and applies technologies, innovations, and knowledge that could respond to the challenges brought by future farming scenarios.

I. Rice Innovation Center

Roger F. Barroga

Empowering rice farmers to adopt new technologies and techniques has always been one of the biggest challenge especially for extension workers. The natural resistance to change is a major factor. Another major challenge is the scattered channels of technologies. Most rice farmers have very limited funds and leisure time to visit different sites for different types of technologies. Building a collective demonstration site and test bed can be a cost-saving strategy to promote ready-to-adopt technologies. Furthermore, this project, "Rice Innovation Center," aims to collect and organize existing smart farming innovations to demonstrate and showcase to farmers and stakeholders so they can be empowered to adopt these practices and techniques in their own fields.

Farming Innovations

PV Carbungco and RF Barroga

The study on farm innovations aimed to scan, collect and organize Clean GPS farming technologies and compile in a book on high-tech, organic, mechanized and agro-tourism farms; and disseminate information about researched technologies and innovations. Through literature search, interviews with experts and farm owners, farm visits, and documentations, the FutureRice program published a compendium of agritourism farms in the Philippines. The book contains information about farms from Negros Occidental, Nueva Ecija, Pangasinan, La Union, Zambales, and Cavite. The program also updated two of its promotional materials to include farm tourism as a modality for learning and extension.

Use and Applications of Clean Energy Systems for Farm Operations

RF Barroga, MRO Anora, and PV Carbungco

The study demonstrated different forms of clean energy technologies and systems, and disseminate information about clean energy to farmers and other rice stakeholders. The following clean energy technologies were showcased at the FutureRice Farm: bioethanol distiller and bioethanol-powered water pumps, mobile rice husk gasifier, and zero-waste pig biogas (ZWaP). These technologies were showed to farmers during the PhilRice LakbayPalay 2017 Wet and Dry Seasons, and to FutureRice Farm visitors during farm tours.

Use and Application of Appropriate Farm Machinery for Farm Operations

RF Barroga, MRO Anora, and PV Carbungco

The study demonstrated different kinds of farm machinery and produced educational materials on their use and benefits. The following machines were demonstrated at FutureRice Farm during Lakbay Palay 2017 Wet and Dry Seasons: mechanical rice transplanter, mechanical rice seedling tray machine, mobile gasifier, bioethanol-injected water pump, and land preparation machines (roto tiller, boat tiller, laboy tiller). During regular farm tours, FutureRice demonstrated the mechanical rice transplanter and the mechanical rice seedling tray machine. Information about the different farm machines demonstrated by FutureRice are provided to farm visitors through the updated FutureRice technology brochure.

II. Establishment of a Model Farm for Future Farming Scenarios

Marian Rikka O. Anora

This project established an actual small-scale farm that serves as a demonstration and testing ground for technologies and innovations that will help in solving the effects of climate change, environmental degradation, post peak oil situation, and globalization. The first component of this project demonstrated natural or alternative farming technologies or products that can be used by farmers in order to strengthen sustainability, preserve biodiversity, lessen farm expenses, maximize yield, and minimize expenses. These included the uses of natural, organic, or green manure as alternative source of fertilizer, probiotics, biofertilizer, animal manure, and alternative farming technologies or innovations. The researchers demonstrated five biofertilizer products, which were tested based on the Clean, Green, Practical and Smart Framework.

Economics of Rice and Rice-Based Innovations

MRO Anora, RF Barroga, MB De Gracia, and RP Joson

Technological innovations were introduced to help the poor and marginalized people of the agricultural sector. However, not all technological interventions are practical and profitable to the farmers. Hence, this study provided economic analysis for selected farming technologies demonstrated at the FutureRice Farm. Results showed that the use of modern apps in nutrient management of rice provides fertilizer savings and increases yield return. Using Minus One Element Technique (MOET) app, farmer's potential income from sales and fertilizer savings is around P14,601-P32,830 per

hectare while savings from Rice Crop Manager ranged from P3,071 to P27,937.

Based on MOET app yield on dry and wet season 2017 data, gross income from rice may only range from P80,000 to P140,000 per season. An additional income of P160,000 is gained in goat raising. Fish production also provides additional source of income, approximately P650,000 per year.

The innovative solar-powered water pump system incurred an annual cost of around P27,980. Its daily operational expense could be higher at P75 than savings from electrical usage at P44.54. However, environmental benefits of reducing a 4.9kg of daily carbon dioxide should be taken into consideration as well.

Demonstration of Natural and Alternative Rice Farming Technologies MRO Anora and RF Barroga

This study demonstrated natural or alternative farming technologies to provide consumers the options on achieving safer, sustainable, and environmentally-sound agricultural production system. A guiding framework based on the Clean, Green, Practical and Smart Farming Technologies was used to determine the usefulness of the technologies. These technologies or innovations were then showcased during field tours and institutional events such as farm tours, R&Ds and Lakbay Palay where around 5,000 visited the farm. There were five 5 biofertilizer products demonstrated at the FutureRice Farm. Yield performance of Hakate and Vital N in dry and wet season showed comparable yield results with the farmers' practice. Nutrient efficient bioavailability (NEB) biofertilizer has shown a comparable yield result compared to the control set-up last dry season 2017. Results in the wet season showed its potential to increase yield and to maintain high yield even with reduced quantity of inputs; however, the difference was not statistically significant. AMO and Nahum/humus plus showed comparable yield results with the control setup. However, further testing is recommended as the experiments were conducted only in WS 2017.

Based on the Clean GPS for CSR framework, the five products passed the Clean, Green, and Practical Categories. On the Smart category, Hakate and Vital N biofertilizer showed no significant difference from the control setup. Further testing for NEB, AMO, and Nahum/humus plus if they are "smart" technologies.

Demonstration of High-Tech Rice and Rice-Related Farming Technologies MRO Anora and RF Barroga

This study demonstrated advances in rice development of high-yielding, nutrient-efficient, and stress-tolerant rice varieties. Modern machinery is also showcased to minimize high labor cost and crop production losses. The use of smartphone apps on nutrient management, the demonstration of newly selected rice varieties, and the hands-on training for the use of modern machines were also showcased.

Results showed that the use of MOET app brings an increase in yield ranging from 1 to 2.1t/ha while RCM registered a .17-1.6t/ha yield boost compared with the farmer's practice. A significant reduction in the use of synthetic fertilizers at 4 bags in each season was also achieved thru RCM. These modern apps help the farmer provide timely and accurate fertilizer management. As it uses modern tools, it also encourages the youth to engage in agriculture.

Performance of public hybrid varieties was comparable with the commercially or privately produced hybrid varieties. Public hybrid Mestizo 55 had the highest yield potential at 9.5t/ha while commercial Longping 905 yielded 9.2t/ha.

The study has also conducted two training courses on the use of modern machinery. A hands-on rice experience was attended by 31 newly hired PhilRice staff while another group of 21 farmers from Mabini Multi-Purpose Cooperative learned about different methods of seedling growing out on trays and the use of walk-behind mechanical transplanting machine.

Technology Demonstration on Organic-Based Rice Production and Azolla Production

EF Javier, XXG Sto. Domingo, AJ Espiritu, and JM Mercado

Azolla is an alternative source of nitrogen that can give more harvest and reduce environmental hazards. The study was conducted in continuous-flooded and well-drained rice environments. Fresh azolla, vermicompost, and chicken manure are good N sources.

III. Advocacy, Capacity Building, and Agritourism

Pamela V. Carbungco

For the Philippines to become rice self-sufficient, it must adopt farming technologies such as improved varieties and technological know-how. This project aimed to help in promoting knowledge of farming technologies and practices that would help farming communities mitigate the effects of aforementioned future scenarios. It has three components: Public Awareness and Campaigns, Communication and Social Change Research, and Agritourism Development. The first component, Public Awareness and Campaigns, involved the use of media platforms and channels to disseminate information and promote farming technologies to rice stakeholders. It also produced information and educational billboards promoting FutureRice Farm as a learning site. The Communication and Social Change Research aimed to increase farmers' engagement, knowledge, and skills on new technologies and innovations to address important rice farming issues in the community level. The two components are integrated to foster Agritourism Development, in which the FutureRice program will showcase all farming technologies in one operational farm tourism learning site.

Public Awareness and Campaigns

PV Carbungco and RF Barroga

The study produced print and online educational materials; generated free television, radio, and print exposures to promote the program, and its advocacies, technologies, and innovations; and increased audience and reach in FutureRice social media accounts. The program produced 127 informational field and technology labels in the farm; billboards supporting the "No Burning of Rice Straw" campaign were installed along Mabini Road. For social media, FutureRice Facebook page reach averaged to 1,576 people per post, while the number of followers increased by 987. FutureRice was also featured in 3 radio interviews, 1 broadsheet newspaper, 4 television shows, and 14 online articles.

Communication and Social Change Research

PV Carbungco and RF Barroga

The study aimed to conduct research on rice stakeholders' perceptions on agritourism, to raise awareness among farmers regarding important issues in rice farming, and to lead events in farming communities to address social change issues.

To raise awareness on the issue of burning rice straw among farming communities near the farm, FutureRice produced two billboards about

the economic benefits of recycling rice straw and the negative impacts of burning. Messages, primarily "Earn from Rice Straw," were derived from desk research.

To further strengthen the campaign, a rice straw art contest was organized in the farm during the dry season. Six groups, composed of students and members of farming communities, competed in employing the most creative use of rice straw in forming sculptures of friendly farm insects and a famous superhero.

Agritourism Development

PV Carbungco, RF Barroga, and MRO Anora

FutureRice Program is building a rice-based farm tourism site with learning and recreational facilities, and agritourism attractions to draw visits from tourists, farmers, students, and farming enthusiasts. To attract more visitors to the farm and boost interest in rice farming, FutureRice showcased two rice paddy artworks: Ang Probinsyano's Coco Martin and Fernando Poe Jr. and on-screen couple Kathryn Bernardo and Daniel Padilla. The rice paddy artworks were featured in 15 websites, including the Philippine Daily Inquirer. FutureRice also assisted Central Luzon State University and PhilRice branch stations in creating their rice paddy artworks. Development of the farm as an agritourism site was also continuous adding the urban and vertical style gardens, ornamental and flowering plants, mulberries, team building facilities, obstacle courses, and improved farm nature path.

IV. Farm Automation thru the ICT use

Nehemiah L. Caballong

This project showcased forms of ICTs applicable to rice-based farming systems to different audiences especially to the youth. Specifically, it aimed to (a) promote and deploy existing ICT products and services ready for farmer use; (b) customize industry-based ICTs to fit in the agriculture system; and (c) develop emerging ICTs for agriculture research and product model development.

Five studies were implemented. The first study focused on developing smartphone application tools to assist user in the rice farm and crop management operations. The next study's interest is on the use of unmanned aerial vehicles (UAVs) for rice research and development. UAVs are light-weight aircraft that can carry different kinds of sensing payloads. A study was also assigned to support the ICT needs of the FutureRice Farm as an agri-tourism business entity. One important requirement for the farm is connectivity. Thus, the farm's local area network was improved. The fourth

study explored advance ICTs and develop a wireless sensing network (WSN) model that may be expanded and further explored. The last study was implemented to promote development of ICT tools, systems, and agriculture services.

Development of Farm and Crop Management Apps

NL Caballong, PAA Alday, RF Barroga, DKM Donayre, EC Martin, PV Carbungco, and JK Pangilinan

Smartphones and tablets are versatile tools capable of processing and storing data and information, and connecting to the internet. Due to its availability and affordability, smartphones, tablets, and handheld computers will be widespread among Filipinos even to farmers. Thus, agriculture apps are being developed.

This study aimed to develop two apps – an electronic farm management app (AgRiDOC App), and weed identification app (Weed ID App). The AgRiDOC App can be used by rice-based farmers, farm managers, extension workers, and agricultural professionals. Its key functions include activity and expense recording, rice crop insight monitoring, geo-visualization, rice keychecks, and task scheduling. Meanwhile, the Weed ID App makes use of artificial intelligence, specifically machine learning engine TensorFlowTM. It can assist users to take photos or load images from the gallery of the weed they wish to recognize. The app produces a list of identified weeds, which resembles the image of the unknown weed. The app can now identify 22 weed species.

AgRiDOC App 1.0 Beta is now downloadable from Google Play while Weed ID App is on the prototyping development stage.

Development of UAV-Based Remote Sensing Platform for Rice RnD

NL Caballong, RF Barroga, and MA Ramos

This study's interest is on the use of unmanned aerial vehicles (UAVs) for rice research and development. UAVs are light-weight aircraft that can carry different kinds of sensing payloads. These sensing devices can be programmed to gather data and images from above while the UAV flies over rice fields. The data and images collected by the UAVs will be processed into different forms of digital maps using dedicated software. For 2017, the aircraft fleet, smartphone apps, mapping procedures, map processing software and repository server have been finalized and established to support research and development activities. Pilot testing were conducted at PhilRice CES and branch stations. There were also trials conducted for vegetation

indexing from the RGB-based imagery produced by the system. Researchers can now make use of the system in mapping areas and photogrammetry.

Setting up the ICT backbone of FutureRice Farm

NL Caballong, VJA Taylan, DG Cargamento, and RT Apuada

The FutureRice website was created as technology information compendium and as marketing tool. It has five main pages: Home, Showcase, Blogs, Events, and Contact. The Home page is where the website lands. The Blog page displays stories and features. Showcase page displays technologies, practices, and facilities demonstrated and promoted in the farm. It will also serve as introduce technologies to visitors who wants to visit the farm. The Events page displays upcoming happenings, events, trainings, or seminar for various audiences.

WordPress, a free website development platform, was used in developing the website,. It provides easy lay outting and content management to users. Parallax.js, an add-on aesthetics engine was also used.

Development of Advanced ICTs for Agriculture

NL Caballong, JG Tallada, PJS Quierra, and PAA Alday

This study explored advance ICTs and is developing a wireless sensing network (WSN) model . Nine wireless nodes comprising solar energy module, open source microcontroller, and sensors were deployed strategically throughout the FutureRice farm. Seven nodes with temperature and humidity sensors were placed on rice paddy plots. Two nodes with temperature, humidity, water conductivity, and pH sensors were also positioned in the aquaculture ponds. They are all connected wirelessly via ZigBee network protocol. All data gathered by the sensing nodes are automatically collected towards a coordinating node and are transmitted to an off-site server over the internet. The system model will serve as a platform for monitoring field and crop parameters and controlling devices and facilities.

Deployment, and Promotion of ICT for Agriculture

NL Caballong, RF BARROGA, and PAA Alday

AgRiHackathon Inter-SUC Challenge was conducted on March 24-25 and was participated by four SUCs – Central Luzon State University, Nueva Ecija University for Science and Technology, Cagayan State University, and Pangasinan State Universities. Their prototypes were exhibited to PhilRice researchers for comments and suggestions, and then they were given 24

hours to incorporate the recommendations on their project. Central Luzon State University emerged as the winner with their project, Crop+ +. It is an internet of things (IoT) concept system that can monitor the current temperature and humidity of a farm area through a temperature sensor. It can also detect movements within the area and capture photos to identify the presence of pests. Its soil moisture sensor is used for water sufficiency for better resource management. Other project entries were water quality monitoring system, vegetation index processing concept, marketing information system, and crop calendar app.

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 – cytoplasmic 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
 IRR – 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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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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