# NATIONAL RICE R&D CONFERENCE

7-8 September 2016

DEPARTMENT OF AGRICULTURE

**PhilRice**
PHILIPPINE RICE RESEARCH INSTITUTE

R4D &
RICE
SECURITY

# 29TH NATIONAL RICE R&D CONFERENCE

7-8 September 2016
PhilRice, Science City of Muñoz, Nueva Ecija

## Souvenir Program
## and Abstracts of Presentations

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# Rationale

Executive Order 1061 mandates PhilRice to develop and implement a national rice research for development (R4D) program to improve and sustain rice production in the country. Together with the Department of Agriculture (DA) and its regional field offices and attached agencies, local government units (LGUs), private sector, and international and non-government organizations (NGOs), PhilRice has succeeded in the implementation of rice R4D programs and projects on the ground with a positive outlook for wider coverage to reach more rice and rice-based farming communities nationwide.

PhilRice and the National Rice R&D Network have implemented projects consistent with the national rice R&D programs. Many of these projects were conducted in multiple locations, involving DA stations, state universities and colleges, NGOs, LGUs, farmer groups, and national and international agencies.

To present and review the accomplishments of these projects, PhilRice conducts a conference annually. The national conference provides a venue to acquire and exchange knowledge and experiences on rice R4D to address current issues and emerging problems besetting rice R4D and the industry, through paper and poster presentations, and field tours.

The 2016 conference will launch the vision, *"Rice-Secure Philippines"* of PhilRice and its partners. Rice security, in our parlance, means availability, affordability, and accessibility to high-quality and nutritious rice at all times. This vision, therefore, encompasses broad areas relating to rice cultivation, commerce, consumption, and competitiveness. It is founded on DA's vision of a "food-secure society where farmers enjoy decent and rising standards of living". Hence, the theme: "R4D and Rice Security".

Speakers will expound on rice science and technologies for increasing yields and profitability, systems, tools and models for climate change-resiliency and competitiveness, and technology promotion and delivery for accelerating adoption as well as sharing and learning from farmers' experiences and coping mechanisms. The R4D projects in support of DA's food staples sufficiency program in collaboration with international and national/local organizations will also be highlighted.

The conference consists of paper and poster presentations, focusing on integrated topics in five thematic areas:
• rice germplasm and breeding for improving yields, grain quality and nutrition, resistance to abiotic and biotic stresses;
• crop management options for increasing/sustaining yields and improving resource-use efficiency;
• technologies, systems, tools, and socio-economic information for efficient rice and rice-based farming; and
• technology promotion and delivery for accelerating adoption and achieving impacts on farm productivity and sustainability

# Objectives:

• To recognize and appreciate the accomplishments in rice R4D, and provide an opportunity for interaction among rice R4D workers;
• To identify appropriate and efficient strategies, and areas of collaboration with the different sectors in the rice industry in developing and promoting rice and rice-based technologies; and
• To gather feedback and advice from rice industry stakeholders on the relevant rice R4D thrusts and initiatives to achieve rice security particularly on competitiveness, sustainability, and resiliency in rice and rice-based farming.

# About the Guest of Honor and Speaker

## FORTUNATO T. DELA PEÑA
Secretary, Department of Science and Technology (DOST)

**PERSONAL INFORMATION:**
• Born in Bulacan, Bulacan on November 12, 1949. Youngest of three children of Emilio Banzon de la Peña and Luz Fajardo Tanseco.

• Married to Mariquit Tablan Banzon with whom he has five (5) children - Margarita, a medical doctor; Emil, a veterinary doctor; Fortunato, Jr., an assistant professor of industrial design; Miguel, an artist/entrepreneur; and Federico, an engineering geologist.

**EDUCATIONAL / ACADEMIC BACKGROUND:**
• B.S. Chemical Engineering, University of the Philippines (UP), 1969
• Diploma in Industrial Quality Control, BIE (Bouwcentrum International Education), Rotterdam, Netherlands, 1975
• M.S. Industrial Engineering, UP, 1976
• Graduate Studies in Operations Research, Polytechnic Institute of New York, 1982

**WORK EXPERIENCE:**

Served in the following capacities:
• Professorial Lecturer in Industrial Engineering, UP (2011-July 2016)
• Undersecretary, DOST (2001-2014)
• Professor of Industrial Engineering, UP (1973-2011)
• Vice-President for Planning & Development, UP (1993-1999)
• Director, Institute for Small Scale Industries, UP (1992-2001)
• Chairman, Department of Industrial Engineering, UP (1982-1988)
• Director, Technology Application and Promotion Institute, DOST (1989-1991)
• Planning Service Head, National Science and Technology Authority (1982-1984)
• Cost and Operations Engineer, ESSO Philippines (1969-1971)

International / Regional Assignments:
• Chairman, United Nations Commission on Science & Technology for Development (2011-2012)
• Interim Executive Director, APEC Center for Technology Training for Small and Medium Enterprises (ACTETSME) (1996-1998)

Involvement in Professional and Scientific Organizations:
• President, Philippine Association for the Advancement of Science and Technology (PhilAAST) (2011-Present)
• President, National Research Council of the Philippines (2002-2007)
• President, Philippine Institute of Chemical Engineers (1989-1990)
• President, Association of Management & Industrial Engineers of the Philippines (AMIEP) (1986-1988)

**AWARDS AND RECOGNITIONS:**
• Dangal ng Bayan Award, Civil Service Commission (2005)
• Outstanding Career Executive Officer, Career Executive Service Board (2005)
• Outstanding Professional in the Field of Chemical Engineering, Professional Regulation Commission (1999)
• Most Outstanding Chemical Engineer, Philippine Institute of Chemical Engineers (1998)
• Gawad Chancellor Award for Outstanding Administrator, UP Diliman (1994)
• Distinguished Alumni Award for Public Service, UP Alumni Association (2012)
• One of the 100 Outstanding UP Engineering Alumni of the Century 1910-2009 (2010)
• Most Distinguished Alumnus, UP Alumni Engineers (2003)
• Dangal ng Lipi Award, Provincial Government of Bulacan, (1997)
• Doctor of Philosophy, honoris causa, Rizal Technological University (2015)

# Overview of Activities

| Time | Day 1: 7 September (Wednesday) | Day 2: 8 September (Thursday) |
| --- | --- | --- |
| 7:00 - 8:00 | • Registration<br>• Opening program<br> • Opening/viewing of posters/exhibits<br> • Tour at Rice Science Museum<br> • Launching of knowledge products | |
| 8:00 - 9:00 | | Field Visit (7-9AM) |
| 9:00 - 10:00 | | |
| 10:00 - 11:00 | | 3 Concurrent Sessions (10:00-12:00) |
| 11:00 - 12:00 | Plenary Session 1 | |
| 12:00 - 1:00 PM | Lunch Break | Lunch Break |
| 1:00 - 2:00 | Plenary Session 2 | Plenary Session 3<br><br>Plenary Session 4 (Farmers' Best Practices and Experiences) |
| 2:00 - 3:00 | | |
| 3:00 - 3:30 | Coffee Break | |
| 3:30 - 4:30 | 3 Concurrent Sessions | |
| 4:30 - 5:30 | | Closing Program (4:00-5:00) |
| 6:00 - 8:00 | Fellowship and Dinner | |

Venues:

| | |
| --- | --- |
| Opening and closing programs, and plenary sessions | Social Hall |
| Concurrent sessions | Social Hall, IPR Room, FTIC Room 3 |
| Lunch, fellowship, and dinner | Multi-Purpose Crop Processing Shed (Toll Gate) |
| Breakfast | PhilRice Cafeteria |

# Schedule of Activities

| DAY 1: SEPTEMBER 7 (WEDNESDAY) | | SOCIAL HALL |
|---|---|---|
| 7:30 - 8:30 AM | Registration of Participants | Registration Committee |
| 8:30 - 11:00 | **OPENING PROGRAM** | |
| | *Master of Ceremonies:* **Diadem G. Esmero** | |
| | • Invocation and Singing of the National Anthem | **PalayMusika Chorale Ensemble** |
| | • Welcome Remarks | **Flordeliza H. Bordey, PhD** *Acting Deputy Executive Director for Development, PhilRice* |
| | • Opening Remarks & Introduction of the Guest of Honor and Speaker | **Sailila E. Abdula, PhD** *Acting Executive Director, PhilRice* |
| | Message of the Guest of Honor and Keynote Speaker **Secretary FORTUNATO T. DELA PEÑA** Department of Science and Technology | |
| | • Presentation of New PhilRice Knowledge Products | **Development Communication Division** |
| | • Opening and Viewing of Posters and Rice Museum | Secretary Dela Peña (to be assisted by PhilRice Board of Trustees and Officials) |

# 2016 PhilRice Knowledge Products

*Myriam G. Layaoen*

PhilRice, through the Development Communication Division,  develops knowledge products (KPs) that specifically address relevant and timely needs of its stakeholders.

For 2016, climate change and rice production primarily drove the conceptualization of KPs. Last year's tails of El Niño and the onset of La Niña prompted the development of materials on rice production technologies to help farmers adapt to the changing environment. The call to achieve rice security through improved competitiveness also inspired our production efforts.

Thus far, we have published 56 KPs in the form of print, audiovisual, and online materials for various audiences. These are new and updated reprints of materials on the latest technologies developed through rice R4D. We are launching the Infographic series and videos - a more simplified version of KPs, which specifically focus on rice statistics.  The 2014-2015 PhilRice Milestones will also be released as a testament of the breakthroughs that the Institute fashioned in the past 2years.

More than 120,000 copies of these materials have been distributed to farmers, information intermediaries, policy makers, and other stakeholders in the science community during events such as Lakbay-Palay, AgriDoc, Infomediary, and other training programs, visits to PhilRice, and engagements of the branch stations.

*Keywords: knowledge products, development communication, publications, communication materials, IEC*

| PLENARY SESSION 1 | SOCIAL HALL |
|---|---|

*Plans and strategies for attaining rice security*
*Chair: Marissa V. Romero, PhD*

| 11:00 - 12:00 | Roadmap for Impact: The PhilRice Strategic Plan, 2017-2022 | Sailila E, Abdula, PhD *Acting Executive Director, PhilRice* |
|---|---|---|

*Documenter: Shereen P. Razon*
*Rapporteurs: Rizzla S. Ona, Danny O. Alfonso*
*Photo/Video: Carlo G. Dacumos, Ashlee P. Canilang*

| 12:00 - 1:00 | LUNCH BREAK | Multi-Purpose Crop Processing Shed (Toll Gate) |
|---|---|---|

| PLENARY SESSION 2 | SOCIAL HALL |
|---|---|

*Technologies and extension system for increasing productivity and sustainability*
*Chair: Ronan G. Zagado, PhD*

| 1:00 - 1:30 PM | *Rice Crop Manager:* A Comprehensive Decision-Support Tool for Increasing Yields and Income for Farmers in the Philippines | Wilfredo B. Collado *PhilRice CES* |
|---|---|---|
| 1:30 - 2:00 | All-Season Rice Varieties for Transplanting and Direct Wet-Seeding Culture in Irrigated Lowlands (2009-2015) | Thelma F. Padolina *PhilRice CES* |
| 2:00 – 2:30 | From Transmission to Transformation: Reinvigorating the Rice Extension System | Karen Eloisa T. Barroga, PhD *PhilRice CES* |
| 2:30 – 2:50 | Development of Training Regulations on Grains Production NCII | Bernadette S. Audije *TESDA* |

*Documenters: Floper Gershwin E. Manuel*
*Rapporteurs: Lea Mari R. Santos, Jose Emmanuel G. Hernandez*
*Photo/Video: Carlo G. Dacumos, Ashlee P. Canilang*

| 2:50 - 3:30 | COFFEE BREAK / POSTER VIEWING |  |
|---|---|---|
| 3:30 - 5:50 | **CONCURRENT SESSIONS** |  |
|  | Concurrent Session 1 | Social Hall |
|  | Concurrent Session 2 | IPR Room |
|  | Concurrent Session 3 | FTIC Room 3 |

| CONCURRENT SESSION 1 | SOCIAL HALL |
|---|---|

*Technology and knowledge sharing for accelerating adoption and achieving impact*
*Chair: Maritha C. Manubay*

| 3:30 - 3:50 PM | Enabling the AgRiDOC: A New Breed of Rice Extensionists | Lea dR. Abaoag *PhilRice CES* |
|---|---|---|
| 3:50 - 4:10 | Are AgRiDOCs Techie? | May Angelica A. Saludez *PhilRice CES* |
| 4:10 - 4:30 | The Right Match Sets the Fire: Knowledge Sharing and Learning Formats for Strategic Groups of Rice Extension Intermediaries | Ev P. Angeles *PhilRice CES* |

| 4:30 - 4:50 | Listening Groups as a Knowledge Sharing and Learning Mechanism in Group Learning Activities among Farmers | Sonny P. Pasiona *PhilRice CES* |
| 4:50 - 5:10 | The Doctor is In: Ensuring Rice Doctor Consultations are Effective and User-Friendly | Jerome Cayton C. Barradas *IRRI* |
| 5:10 - 5:30 | The Ubiquity of Mobile Phones: Lessons for the Rice Crop Manager | Mary Jean C. Du *IRRI* |
| 6:00 - 8:00 | COCKTAILS/DINNER/SOCIALS | *Multi-Purpose Crop Processing Shed (Toll Gate)* |

*Documenters: Jan Lois Zippora A. Libed, Anna Marie F. Bautista*
*Rapporteurs: Mary Joy O. Garcia, Alpha Grace S. Ferriol*
*Photo/Video: John Glen S. Sarol*

## CONCURRENT SESSION 2                              IPR ROOM

*Crop management options and system for improving production and resource-use efficiencies*
*Chair: Jayvee A. Cruz*

| 3:30 - 3:50 PM | Pathogenicity Analysis of Philippine Isolates of Rice Blast Fungus (*Pyricularia oryzae* Cavara) Using the International Blast Designation System | Jennifer T. Niones, PhD *PhilRice CES* |
| 3:50 - 4:10 | Paperless Field Data Collection for Quick Data Turnover on a Nationwide Scale | Ulysses G. Duque *PhilRice CES* |
| 4:10 - 4:30 | Rodent Damage in the Philippines: PRiSM National Survey Results | Leonardo V. Marquez *PhilRice CES* |
| 4:30 - 4:50 | Effects of Water Management and Fertilizer N Levels on Rice Yield (PSB Rc82) and Incidence of Pests and Diseases in the Rainfed Rice Ecosystem | Anielyn Y. Alibuyog *PhilRice Batac* |
| 4:50 - 5:10 | Development of Capillary Irrigation (*Capillarigation*) System for Rice-Based Crops: Maximizing the Use of Water by Small-holder Farmers during Extreme Drought Conditions | Ricardo F. Orge, PhD *PhilRice CES* |
| 5:10 - 5:30 | Postharvest Management Key Checks and Best Practices for Improving the Rice Post-production System | Paulino S. Ramos *PhilRice CES* |
| 5:30 - 5:50 | Design and Testing of Far-Infrared Paddy Dyer | Bobby Y. Lived *PhilRice CES* |
| 6:00 - 8:00 | COCKTAILS/DINNER/SOCIALS | *Multi-Purpose Crop Processing Shed (Toll Gate)* |

*Documenters: Dona P. dela Cruz, Rachel Marie S. Martin*
*Rapporteurs: Lea Mari R. Santos, Roldan G. Antonio*
*Photo/Video: Jayson C. Berto*

## CONCURRENT SESSION 3            FTIC ROOM 3

*Rice breeding for improving yields, grain quality and nutrition, and value-added traits*
*Chair: Arlen A. Dela Cruz, PhD*

| | | |
|---|---|---|
| 3:30 - 3:50 PM | Technology Demonstration of Top Performing Chinese Hybrid Rice Lines in Six Major Rice Growing Provinces of the Philippines | Erickson C. Frediles *CLSU-PhilSCAT* |
| 3:50 - 4:10 | Grain Quality Evaluation of Introduced Chinese Hybrid Rice Lines and PhilSCAT-Developed Lines Planted during the 2012-2015 Preliminary Yield Trials | Erick Allain C. Flores *CLSU-PhilSCAT* |
| 4:10 - 4:30 | Characterization of $F_2$-Derived Lines of Sticky Rice under Irrigated Lowland Condition | Paulina J. Alvaran *Central Luzon State University* |
| 4:30 - 4:50 | IR10M300: The First High Zn-Rice Recommended for Commercial Release in the Philippines | B.P. Mallikarjuna Swamy *IRRI* |
| 4:50 - 5:10 | Isolation and Identification of Lignin-Degrading Bacteria and Screening for Low-Lignin Rices Suitable for Bioethanol Production | Reynante L. Ordonio, PhD *PhilRice CES* |
| 5:10 - 5:30 | Physicochemical Properties, Proximate Composition, and Antioxidant Activity of Popular Traditional Rice Varieties in the Philippines | Gerome A. Corpuz *PhilRice CES* |
| 6:00 - 8:00 | COCKTAILS/DINNER/SOCIALS | *Multi-Purpose Crop Processing Shed (Toll Gate)* |

*Documenters: Christopher C. Cabusora, Marie Antoinette F. Orbase*
*Rapporteurs: Rizzla S. Ona, Malvin D. Duldulao*
*Photo/Video: Jennifer D. Villaflor, Rommel P. Hallares*

## DAY 2: SEPTEMBER 8 (THURSDAY)

| | | |
|---|---|---|
| 7:00 - 9:00 AM | Tour of PhilRice Experimental Farm and Facilities | Field Tour Committee |
| 9:00 - 10:00 | COFFEE BREAK / POSTER VIEWING | |
| 10:00 - 12:00 | **CONCURRENT SESSIONS** | |
| | Concurrent Session 4 | Social Hall |
| | Concurrent Session 5 | IPR Room |
| | Concurrent Session 6 | FTIC Room 3 |

## CONCURRENT SESSION 4                                         SOCIAL HALL

*Socio-economic information and impact of technologies, and rice value chain*
*Chair: Jacqueline Lee O. Canilao*

| | | |
|---|---|---|
| 10:00 - 10:20 AM | Targeting Rice Security through Bridging Rice Yield Gap: An Analysis of the Yield Gap and Economic Efficiency in the Philippines | Mary Grace C. Lapurga *PhilRice CES* |
| 10:20 - 10:40 | Socioeconomic Impact of Adopting Rice Combine Harvester in the Philippines | Imelda A. Arida *PhilRice CES* |
| 10:40 - 11:00 | State of Farm Mechanization of Irrigated Lowland Rice in Region XI | Joepar C. Escario *DA-RFO 11* |
| 11:00 – 11:20 | Rice Value Chain Analysis in the Western Visayas | Joel A. Araquil, Sr. *West Visayas State University* |
| 11:20 – 11:40 | Baseline Characterization of PhilRice Mindoro Satellite Station | Jasmin I C. Santiago *PhilRice CES* |
| 11:40 – 12:00 | On-Farm Survey on Dry Direct-seeded Rice in the Drought-prone Environment of Pangasinan | Hoshie Ohno *IRRI* |
| 12:00 - 1:00 | LUNCH BREAK | Multi-Purpose Crop Processing Shed (Toll Gate) |

*Documenters: Roseleen M. Capiroso, Xarin Xara G. Sto. Domingo*
*Rapporteurs: Mary Joy O. Garcia, Malvin D. Duldulao*
*Photo/Video: John Glen S. Sarol, Ashlee P. Canilang*

## CONCURRENT SESSION 5                                         IPR ROOM

*Rice and rice-based products for better quality, health, and nutrition*
*Chair: Rosaly V. Manaois*

| | | |
|---|---|---|
| 10:00 - 10:20 AM | Causes of Cooked Rice Spoilage and Practical Ways of Retarding It | Evelyn H. Bandonill *PhilRice CES* |
| 10:20 - 10:40 | Antioxidant Capacities of Raw and Cooked Forms of Some Philippine Vegetables | John Edward I. Zapater *PhilRice CES* |
| 10:40 - 11:00 | Rice-based Product Concepts with Health and Nutritional Value: The Experts' Perspective on Consumer Trends | Josefina F. Ballesteros *PhilRice CES* |

| 11:00 – 11:20 | Encapsulation of Anthocyanin from Black Rice Bran Extract using Chitosan-Alginate Nanoparticles | John Paulo A. Samin *PhilRice CES* |
| 11:20 – 11:40 | Survey of Freshwater Aquatic Fauna Used as Food in Rice-Based Ecosystems in Luzon | Ma. Cristina V. Newingham *PhilRice CES* |
| 11:40 – 12:00 | Achieving Rice Biopharma Readiness in the Philippines: Challenges and Opportunities in Biotech Research for Development | Amor A. San Juan, PhD |
| 12:00 - 1:00 | LUNCH BREAK | Multi-Purpose Crop Processing Shed (Toll Gate) |

*Documenters: Jay Carl A. Cacerez, Joana Andrea C. Maningas*
*Rapporteurs: Roldan G. Antonio, Alpha Grace S. Ferriol*
*Photo/Video: Sonny P. Pasiona*

| **CONCURRENT SESSION 6** | **FTIC ROOM 3** |

***Knowledge management and sharing, and resource-use recovery in farming systems***
Chair: Fe A. Dela Peña, PhD

| 10:00 - 10:20 AM | Profile of Agricultural Extension Workers in the Philippines | Rhea V. Dones *DA-ATI* |
| 10:20 - 10:40 | Evaluating the 'Perceived' Effectiveness of Pinoy Rice | Hanah Hazel Mavi B. Manalo *PhilRice CES* |
| 10:40 - 11:00 | Information in Ink: The Relevance of PhilRice Knowledge Products in Print | Christina A. Frediles *PhilRice CES* |
| 11:00 – 11:20 | Are Youngsters Agri-inclined? Positive Answers from the Infomediary Campaign | Jennifer D. Villaflor *PhilRice CES* |
| 11:20 – 11:40 | Produce More with Sorjan | Jesusa M. Rivera *PhilRice CES* |
| 11:40 – 12:00 | Gasification Properties of Chopped Rice Straw | Alexis T. Belonio *PhilRice CES* |
| 12:00 - 1:00 | LUNCH BREAK | Multi-Purpose Crop Processing Shed (Toll Gate) |

*Documenters: Anna Marie F. Bautista, Jan Lois Zippora A. Libed, Shereen P. Razon*
*Rapporteurs: Danny O. Alfonso, Jose Emmanuel G. Hernandez*
*Photo/Video: Jayson C. Berto*

**PLENARY SESSION 3**                                                    **SOCIAL HALL**

*Technologies and systems for increasing yield and income in the rice farming communities*
*Chair: Rhemilyn Z. Relado*

| | | |
|---|---|---|
| 1:00 - 1:30 PM | Accelerating the Dissemination of Associated Technologies for Increasing Yield and Profitability in Irrigated Ecosystem: The Region 2 Experience | Evangeline B. Sibayan *PhilRice CES* |
| 1:30 - 2:00 | Capacity Enhancement and Enterprise-Building in Farming Communities | Ruben B. Miranda *PhilRice CES* |
| 2:00 - 2:30 | Supplying the Needs of a Highly-Diversified Filipino Diet through *Palayamanan* Plus | Rizal G. Corales *PhilRice CES* |
| 2:30 – 3:00 | COFFEE BREAK/POSTER VIEWING | |

*Documenter: Mary Grace C. Lapurga*
*Rapporteurs: Lea Mari R. Santos, Roldan G. Antonio*
*Photo/Video: Jennifer D. Villaflor, Rommel P. Hallares*

**PLENARY SESSION 4**                 **SOCIAL HALL**

*Farmers' Best Practices and Experiences*
*Chair: Albert Christian S. Suñer*

| | |
|---|---|
| 3:00 - 3:15 PM | Richard D. Balane *Olongtao-Ilaya, Macalelon, Quezon* |
| 3:15 – 3:30 | Fortunato R. Paje *Cabugao, Bacuag, Surigao del Sur* |
| 3:30 – 3:45 | Elizabeth A. Sol *Leganes, Iloilo* |
| 3:45 - 4:00 | *Open forum* |

| | | |
|---|---|---|
| 4:00-5:00 PM | **CLOSING PROGRAM** | **SOCIAL HALL** |
| | *Master of Ceremonies: Marissa V. Romero, PhD* | |
| | Synthesis | Eduardo Jimmy P. Quilang, PhD *Acting Deputy Executive Director for Research, PhilRice* |
| | Awarding of Best Posters | Posters and Awards Committee |
| | Closing Remarks and Vote of Thanks | Sailila E. Abdula, PhD *Acting PhilRice Executive Director* |

*Documenters: Joana Andrea C. Maningas, Xarin Xara G. Sto. Domingo*
*Rapporteurs: Rizzla S. Ona, Danny O. Alfonso*
*Photo/Video: Carlo G. Dacumos, Ashlee P. Canilang*

# POSTERS

*Theme 1: Rice germplasm and breeding for better yields, grain quality and nutrition, and resistance to biotic and abiotic stresses*

| | | |
|---|---|---|
| **1** | Impact of PhilRice GEMS Database Upgrade | MD Duldulao, MC Ferrer, LM Perez, XGI Caguiat, and MCV Newingham (PhilRice CES); GO Romero (Monsanto Philippines Inc.) |
| **2** | Hybrid Rice with Broad Resistance to Philippine Races of *Xanthomonas oryzae* pv. *oryzae* (*Xoo*) | MC Garcillano, JD Caguiat, JOS Enriquez, and FP Waing (PhilRice CES); KGD Waing (CLSU) |
| **3** | Rice Blast Disease Resistance Evaluation System at the PhilRice CES | MLB Palma, MC Garcillano, JA Poblete, JP Rillon, and JT Niones (PhilRice CES) |
| **4** | Diversity and Adaptability of Traditional Rice Varieties in Occidental Mindoro | XGI Caguiat, MD Duldulao, MIC Calayugan, MVG Embate, MC Ferrer, R Valdez, M Austero, and LC Javier (PhilRice CES) |
| **5** | Promising Rice Varieties in the Pipeline | TF Padolina, PAC Canilang, RC Braceros, EC Arocena, JM Niones, JF Pariñas, GM Osoteo, JM Dancel, TA Alegado, MT Garcia, GD Santiago, JP Rillon, and EH Bandonill (PhilRice CES) |
| **6** | Location-Specific Recommended Rice Varieties in the Philippines (2013-2015) | TF Padolina, PAC Canilang, RC Braceros, EC Arocena, OE Manangkil, WB Barroga, GM Osoteo, JF Pariñas, and JM Dancel (PhilRice CES) |
| **7** | Genetic Crop Improvement of Selected Rice Genotypes by Introgression of Effective Blast Resistance Genes in the Philippines | TE Mananghaya, JM Niones, JT Niones, JP Rillon, ML Palma, RP Mallari, ATD Aradanas, JBM Alvariño, TF Padolina, and LM Perez (PhilRice CES); E Gandalera (CLSU) |
| **8** | New Special Purpose Rice Varieties for Adaptation and Product Diversification | RC Braceros, TF Padolina, EC Arocena, OE Manangkil, PAC Canilang, LR Pautin, JF Pariñas, and JM Dancel (PhilRice CES) |
| **9** | Finding New Sources of Tungro Resistance Among Philippine Traditional Rice Varieties | AA Dela Cruz, MM Rosario, MJC Duque, and CL Diaz (PhilRice CES) |
| **10** | *Glh14* and *tsv1* Enhanced the Tungro Resistance of ARC11554-Derived Rice Lines | AA Dela Cruz, MJC Duque, MM Rosario, and DK Donayre (PhilRice CES); CU Seville (PhilRice Negros); SE Abdula and CG Flores (PhilRice Midsayap) |
| **11** | Heat Stress Evaluation under Field Condition | Luvina B. Madrid and Norvie L. Manigbas (PhilRice CES) |

| 12 | Robust Simple Sequence Repeat Markers Identified for Salt-Tolerant Line Selection | Jonathan S. Concepcion and Nenita V. Desamero (PhilRice CES) |
|---|---|---|
| 13 | Phenotyping *cum* Genotype Validation and Agronomic Trait Evaluation of Elite Rice Breeding Lines Under Managed-Submergence Stress and Non-Stress Conditions | NV Desamero, JS Concepcion, and JC Baggara (PhilRice CES) |
| 14 | Yield and Grain Quality Traits of Myanmar Mega and Newly Improved Pawsan Hmwe Lines | Htay Htay Aung, Min Soe Thein, Thura Shwe, Pa Pa Aung, and Nyo Nyo Mar (Ministry of Agriculture, Livestock and Irrigation, Republic of the Union of Myanmar); RP Tubera, JM Avila, EH Bandonill, LC Castillo, MB Castillo, RM Bulatao, and RV Manaois (PhilRice CES) |
| 15 | Diversity and Heritability of Quantitative Traits Based on Traditional Rice Varieties | AY Cantila, SE Abdula, and JL Balos (PhilRice Midsayap) |
| 16 | When Trait Clears Yield Threats: Understanding Floral Traits of Parent Lines of Mestiso 19 and 20 in Relation to Hybrid Rice Seed Production | RE Ragas, AG Ferriol, FKJ Padron, J Manangkil, and SM Brena (PhilRice CES) |
| 17 | Yield Performance of Selected GSR Lines in Adverse Ecosystem in Caraga Region | Cherry S. Estacion and Gerardo F. Estoy, Jr. (PhilRice Agusan) |
| 18 | Evaluation of High-Yielding Lowland Rice Lines and Varieties Tolerant to Major Abiotic Stress in Region XI | HA Jimenez, JD Tangog, JB Culiao, and GF Estoy, Jr. (PhilRice Agusan) |
| 19 | Adaptation and Stability Performance of Rice Breeding Lines in the Multi-location Yield Trial | HT Ticman, EC Arocena, MV Chico, AT Palanog, GC Nuñez, D Dela Cruz, and JM Niones (PhilRice CES) |
| 20 | Performance Evaluation of Philippine-Released Rice Varieties under Organic Farming System | AT Badajos and NL Manigbas (PhilRice CES); ES Romero, FL Porcuincula, PJ Alvaran, and QD Dela Cruz (CLSU) |
| 21 | Introgression of Drought-Tolerant QTLs into High-Yielding Rice Varieties | JD Caguiat, FP Waing, JOS Enriquez, XGI Caguiat, RA Millas, and JIIC Santiago (PhilRice CES); AD Palanog (PhilRice Negros) |
| 22 | Root System Developmental Responses of Selected Traditional Varieties to Upland Drought Condition | AB Aguelo, JM Niones, and RR Suralta (PhilRice CES) |
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| 27 | Three-Season Nutrient Status of Soils in Rice-Rice Cropping System Using the Minus-One Element Technique | JC Magahud, SLP Dalumpines, and WB Collado (PhilRice CES) |
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| 29 | Major Weeds and Weed Management Practices in Irrigated Lowland Rice Areas of Luzon | Edwin C. Martin and Dindo King M. Donayre (PhilRice CES) |
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| 35 | Reaction of Rice Sheath Rot Pathogen to Two *Trichoderma harzianum* isolates | MSV Duca, DKM Donayre, FR Sandoval, and ET Duque (PhilRice CES) |
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| 48 | Assessment of Fertilizer Nitrogen Use Efficiencies in Rice-Based Systems Using Lysimetric and Isotopic Techniques | ED Samar, AH Anida, MB Collado, MKD Tarriela, and RRB Raya (BSWM); RV Rallos and FG Rivera (PNRI) |

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| 52 | Development of a Sustainable Information Technology (IT) Infrastructure for the Philippine Rice Information System | A Rala, A Melquiades Callejo, D Diaz, MAR Gutierrez, A Laborte, A Nelson, and A Sparks (IRRI); JL de Dios, AC Arocena Jr., HDC Cayaban, M Barroga, EJP Quilang, CD Diaz, and LAI Tamani (PhilRice CES) |
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| 59 | Carbonized Rice Hull (CRH)-Insulated Rice Silo: A Solution to Rice Seed Storage Losses | LC Taguda, DP Dal-uyen, MAU Baradi, and BM Catudan(PhilRice Batac); CJM Tado and SM Brena (PhilRice CES) |
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| 62 | Characterization and Potential Encapsulation of Rice Bran Oil Using Chitosan-Alginate Nanoparticles | RP Tubera, RM Bulatao, and HM Corpuz (PhilRice CES); JR Salazar and JJ Monserate (Central Luzon State University) |
| 63 | Cell Toxicity on Normal Human Blood Lymphocytes of Antioxidant-Rich Bran Extract from Philippine Red and Black Rice Cultivars | RP Tubera, RM Bulatao, and JPA Samin (PhilRice CES); RR Huliganga, MAM Feliciano, and CV Ortinero (Central Luzon State University) |
| 64 | Snapshot of Rice-Based Farm Households' Food and Nutrition Security: The Case of Central Luzon | Riza A. Ramos and Josefina F. Ballesteros (PhilRice CES) |
| 65 | Labor Use and Mechanization: Impacts on Labor Productivity in Rice Production in the Philippines and Selected Major Rice- Producing Countries in Asia | AB Mataia, RB Malasa, JC Beltran, FH Bordey, CC Launio, AC Litonjua, and RG Manalili (PhilRice CES); PF Moya (IRRI) |
| 66 | New Tools for Predicting Chalkiness and Immature Grains in Milled Rice | IG Pacada, EH Bandonill, TMM Pascual, FJA Francia, and TF Padolina (PhilRice CES); APP Tuaño (PhilRice Los Baños) |
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| 71 | Impact of Increased Duck Stocking Density on Arthropod Population in the Rice-Duck Production System | JM Rivera,  EM  Valdez,  and RG Corales (PhilRice CES) |

*Theme 4:* *Technology promotion and delivery accelerating adoption and achieving impacts on farm productivity and sustainability*

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| 73 | PalaYamaNayon: Development of Community-based Agro-enterprises Using Agri-biomass as Resource Base in Candaba, Pampanga | RG Zagado, JS Maloles, PIH Duran, JP Masilang, AMV Bautista, and JDJ Ruz (PhilRice CES); GC Martin (DA-RFO 3) |
| 74 | Golden Rice in the News: 2013-2015 | Jungie Q. Amacanin and Karen Eloisa T. Barroga (PhilRice CES) |
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| 77 | Homestay as a Learning Strategy in the Agrisurvivors Module of the AgRiDOC Training Program | MVSG Asio, FR Leya, LdR Abaoag, KET Barroga, EP Angeles, IR Tanzo, and MAA Saludez (PhilRice CES) |
| 78 | KOICA Seed Distribution: A Strategy in Increasing Utilization of High-Quality Rice Seeds | GM De Gracia, JU Ramos, AM Corales, JV Pascual, and GD Martin (PhilRice CES) |
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| 80 | Empowering Farmers' Associations: A Sustainable Strategy for Promoting Rice-Based Technologies | MAC Tan, AM Corales, and RG Corales (PhilRice CES) |
| 81 | Extension with a Higher Mission: Increasing Rice Productivity in the Drought-Prone Lowlands in the Philippines | Royette C. Santos and Aurora M. Corales (PhilRice CES) |
| 82 | Intervention Results of the Heirloom Rice Project in Cordillera Administrative Region (CAR) | AJB Acierto , JD Batcagan, NA Sabigan, and RS Credo (PhilRice Isabela); RB Miranda and LL Mandia (PhilRice CES) |
| 83 | Getting the Message Out, Clearly, and Proactively! | MM Movillon, JLO Canilao, JN Puerto, MSM Canilao, and VM Ompad (PhilRice Los Baños) |
| 84 | Enhancing Resiliency and Food Security of Climate Vulnerable Communities in Tablas Island, Romblon | IDG Olvida, LG Alipio Jr., and GO San Valentin (PhilRice Los Baños);  JG Lucidos and GA Florendo Jr. (Romblon State University); E Torres and D Gacu (LGU-Looc and San Andres, Romblon) |
| 85 | Promoting Rice S&T through On-Farm Experiential Learning | STC Quiring, OH Abdulkadil, SA Balidiong, and RS Salazar (PhilRice Midsayap) |

| 86 | Engaging the Rice Extension Intermediaries in PhilRice Midsayap's Area of Responsibility | MMM Medura and OH Abdulkadil (PhilRice Midsayap); EP Angeles (PhilRice CES) |
| 87 | Enhancing the Livelihood of North Cotabato 4Ps Beneficiaries Through Rice Production | LMAD Domo, MMM Medura, AP Makakua, GD Balleras, SE Abdula, and PLP Sabes (PhilRice Midsayap) |
| 88 | Analysis of Rice Farming Practices of Selected Irrigator's Association in Midsayap, Cotabato through the PalayCheck System | Isagane V. Boholano and Irish Mae L. Bauzon (PhilRice Midsayap) |
| 89 | Paving Progress to Farmers: Adaptation and Commercialization of Korean Rice | Aurora M. Corales and Lord R. Aquino (PhilRice CES) |
| 90 | Agricultural Cooperatives: Key Partners in Technology Promotion and Rural Development | CFC Guittap, JV Pascual, and AMCorales (PhilRice CES) |
| 91 | Accelerating Development, Demonstration and Adoption of Palayamanan Plus in Lowland Farms | JVE Adolfo, AL Dela Cruz Jr, and DB Rebong lI (PhilRice Isabela); RG Corales and AM Corales (PhilRice CES) |
| 92 | What You Are and What You Can Do: A Role Recognition Activity for Rice Extension Intermediaries (REIS) | MC Manubay, AL Dela Cruz Jr., ML Pini, JVE Adolfo, and DB Rebong II (PhilRice Isabela) |
| 93 | Increasing Farmers' Income Through Development of Agri-Based Enterprise in Cabadbaran *PalaYamaNayon* Pilot Site | EM Gaquit, GF Estoy Jr., and AT Montecalvo (PhilRice Agusan) |
| 94 | Capacity Enhancement of Farmers on Rice-Based Farming Technology and Bangsamoro Women on Food Preparation in the Autonomous Region in Muslim Mindanao | JO Edraira, OH Abdulkadil, and SE Abdula (PhilRice Midsayap) |
| 95 | Pop-Themed Rice Paddy Art: A Farm Tourism Magnet | JLZA Libed, RF Barroga, MKO Añora, and NL Caballong (PhilRice CES) |
| 96 | Moving Towards a Market-based Rice Production: The BANERLE ARC Experience | Aurora M. Corales and Gerly D. Martin (PhilRice CES) |
| 97 | Promotion and Conservation of Philippine Cultural Rice-scapes through Rice Science Museum | FGE Manuel, DG Esmero, CLB Gado, and CN Bibal (PhilRice CES) |
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| 99 | Exploring New Ways to Engage the "Disinterested" Urban Youth | CLB Gado, FGE Manuel, and CN Bibal (PhilRice CES) |

# Abstracts of Paper Presentations

## PLENARY SESSION 1

## Roadmap for Impact: The PhilRice Strategic Plan, 2017-2022

The Duterte administration envisions the availability and affordability of food for all Filipinos, thus the DA has adopted a policy of achieving food sufficiency, especially for basic and staple food commodities like rice. To implement such a policy, it will pursue a program that calls for improved rice-farming technologies, the introduction of higher-yielding rice varieties, effective soil rehabilitation and nutrient management, and modern harvest and postharvest facilities.

PhilRice will provide science-based approaches on how to produce enough rice for all Filipinos. In consultation with our major partners and key stakeholders, we have mapped out this Strategic Plan for 2017-2022. Guided by our new vision, *"Rice-Secure Philippines"*, we and our partners will propose and execute strategies on how to create significant impacts on the lives of all our rice stakeholders. This Plan has three salient features:

1. We shift our operations from business-as-usual to business-unusual.
2. We move from a production orientation to the development of the whole rice industry focused on four Cs (cultivation, commerce, consumption, and competitiveness).
3. We re-focus on achieving strategic outcomes through impact-oriented and partnership-driven research for development (R4D).

By 2022, our aspired impact is for the country to have a competitive rice economy, with PhilRice and its partners generating and sharing cutting-edge agricultural innovations vigorously guided by science-based and supportive policies; resilient rice-farming communities benefiting from increased income in a sustainable environment; improved rice trade through efficient post production, better product quality and reliable supply, and distribution system; and responsible consumers having access to safe, nutritious, and affordable rice and rice-based products.

To help realize the foregoing, we will showcase that average rice yields can be increased by 1.0 t/ha (irrigated) and a minimum of 0.5 t/ha (rainfed) in our target sites. We will target provinces with yields of < 4t/ha in irrigated and <2.98 t/ha in rainfed areas; with more than 50,000 ha harvested area; and poverty incidence of > 25.23%. We will also help reduce postharvest losses from 16% to 10%. Likewise, we will help reduce the cost of rice production from the national estimate of PhP 12/kg to PhP 7/kg so our rice producers (especially smallholder farmers) will be competitive in an integrated ASEAN market.

Along with this, we will pursue seven strategic outcomes: (1) increased productivity, cost-effectiveness, and profitability of rice farming in a sustainable manner; (2) improved rice trade through efficient postproduction, better product quality, and reliable supply and distribution system; (3) enhanced value, availability, and utilization of rice, diversified rice-based farming products, and by-products for better quality, safety, health, nutrition, and income; (4) science-based and supportive rice policy environment; (5) advanced rice science and technology as continuing sources of growth; (6) enhanced partnerships and knowledge management for rice research for development (R4D); and (7) strengthened institutional capability of PhilRice.

*Keywords: PhilRice StratPlan, rice-secure, R4D*

## SAILILA E. ABDULA
Acting Executive Director, PhilRice



"Doc Sai" is the newly designated Acting Executive Director of PhilRice. He was the Acting Branch Director of PhilRice Midsayap before accepting his current designation. He rose from the ranks in his 20 years of service in PhilRice, from SRS I until he became Chief SRS.

He made significant contributions in rice R&D with the development of NSIC Rc120 and Rc226, which are tungro-resistant varieties. He is also developing transgressive lines dubbed as "Sige-Sige Rice". His interests extend to efficient and sustainable technology transfer strategies as he pioneered working with Muslim religious leaders as rice technology intermediaries. He has authored six scientific publications and co-authored others published in scientific journals.

His dedication to rice R&D earned him the Gawad Saka 2016 Outstanding Agricultural Researcher Award for Region XII. He also received from PhilRice the Scientific Productivity Award in 2012 and 2015.

Dr. Abdula, 44, is a son of Patadon, Matalam, North Cotabato where he finished his early education with honors. He obtained his bachelor's degree (BS in Agriculture Major in Plant Breeding and Genetics and Minor in Plant Pathology) from the University of Southern Mindanao as cum laude; his master's degree (MS in Plant Breeding) from UP – Los Baños; and his Doctor of Philosophy in Agriculture (Major in Functional Genomics) from Chungbuk National University in South Korea.

In early 2016, he obtained his Masters in Development Management from the Development Academy of the Philippines where he was recognized as having the Best Re-Entry Project.

## PLENARY SESSION 2

# *Rice Crop Manager:* A Comprehensive Decision-support Tool for Increasing Yields and Income for Farmers in the Philippines

*WB Collado and MJC Regalado (PhilRice CES)*
*BB Jardinero, EV Laureles, RT Castillo, and RJ Buresh (IRRI)*

*Rice Crop Manager* (RCM) is a web-based decision-making tool that extension workers and farmer-leaders can use through a computer, tablet, or smartphone to provide rice farmers with personalized crop and nutrient management recommendations. An initial version (1.0) of RCM was developed by IRRI and released through the Department of Agriculture (DA) in November 2013 for field evaluation and for the dissemination of RCM recommendations to farmers through the DA's Regional Field Offices.

PhilRice and IRRI completed 647 research trials in farmers' fields across 5 cropping seasons and 6 regions to generate essential data for the evaluation and enhancement of RCM for irrigated and rainfed lowland rice. Research trials for each season were continuously modified to further improve the RCM. Compared with the existing farmers' practice, RCM had increased the average grain yield by 370 kg/ha/season and augmented added net benefit to farmers by PhP4,337/ha/season, which was near the target of PhP4,500/ha/season. IRRI periodically upgraded RCM (http://webapps.irri.org/ph/rcm), which culminated the release of version 2.0 in November 2015.

*Keywords: rice crop manager, web-based, decision-support tool, irrigated, rainfed lowland rice*

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Mr. Wilfredo B. Collado is a pedologist who obtained his MS in Soil Science from the University of the Philippines at Los Baños and bachelor's degree in Agriculture from the Central Luzon State University.

Mr. Collado and his colleagues have published 16 provincial soil series guidebooks. He has authored and co-authored a number of scientific papers in national and international journals. He is a member of PhilRice's pool of technical experts and has delivered lectures and seminars on integrated nutrient and water management, soil-related production constraints in rice, soil characterization and land evaluation, and applications of geographical information systems and remote-sensing in agriculture.

His research interests include integrated crop management, soil characterization for land use, soil fertility, and climate change.

He is a member of the Crop Science Society of the Philippines, Conservation Farming Movement of the Philippines, and the Philippine Society of Soil Science and Technology, Inc.

# All-Season Rice Varieties for Transplanting and Direct Wet-Seeding Culture in Irrigated Lowlands, 2009-2015

*TF Padolina, PAC Canilang, RC Braceros, EC Arocena,  JM Niones, OE Manangkil,*
*WB Barroga, GM Osoteo, JF Pariñas, and JM Dancel (PhilRice CES)*

Rice breeding programs worldwide prioritize improving the yield potential of irrigated rice varieties to achieve food security and maintain political stability. Irrigated rice contributes the most abundant harvest to global production. With climate change-related problems experienced even in favorable rice areas, genotypes with superior yield performance and improved resistance to biotic stresses are needed to deliver suitable varieties to farmers. There were 21 rice varieties approved for commercial cultivation in irrigated lowland areas from 2009 to 2015.  However, only nine were identified for national release owing to their wide adaptation across the irrigated growing environments in the country.  The versatility of these varieties extends to their suitability as transplanted or direct-wet seeded crop in wet and dry seasons.

Released rice varieties NSIC Rc2009 Rc212, Rc214, Rc216, Rc222, Rc226, Rc240, Rc300, Rc302, and Rc400 are noted for their high yield performance in the National Cooperative Tests (NCT). They range an average yield of 5.7- 6.4 t/ha if transplanted and 5.1-5.8 t/ha when direct wet-seeded. These varieties exhibited a maximum yield of 9.5-10.6 t/ha and 7.4-12.6 t/ha if transplanted and direct wet-seeded, respectively. In terms of maturity, transplanted rice adapted varieties ranged from 106 to 120 days while for direct wet-seeded rice, maturity ranged from 104 to 113 days.  The nine varieties possess semi-dwarf stature (<110 cm, SES 5th Edition June 2014). It can be implied then that grain yield could be positively associated with days to maturity, plant height, and rice growing environment.

For grain quality characteristics, all nine varieties passed the standards including eating quality. Notable are the premium milling qualities of NSIC Rc240 and Rc300 and the remarkable extra-long and slender grains of NSIC Rc212, Rc214, and NSIC Rc302. In terms of disease resistance, NSIC Rc300, Rc240, and Rc302 at PhilRice exhibited intermediate reactions to blast, sheath blight, and bacterial blight.  For insect pests, NSIC Rc212, Rc214, and Rc400 showed intermediate to resistant reactions to yellow and white stem borer, brown plant hopper, and green leaf hopper. However, they should not be planted in tungro-hot spot areas.

Versatility of these rice varieties was exhibited in the participatory varietal selection (PVS), which provided opportunity for farmers to articulate their preference by participating in the field days. The PVS enhanced farmer's access to new and better varieties that will diversify their crop and eventually ensure food security. PVS results revealed that in the DS, NSIC Rc222, Rc226, Rc300, and NSIC Rc302 were among the preferred varieties in 15 regions, while NSIC Rc216, Rc222, Rc226, and Rc300 were chosen for WS adaptation in 10 regions.  Among the 9 varieties, 5 were bred by PhilRice and 4 by the IRRI.

*Key words:  Rice Technical Working Group (RTWG), National Seed Industry Council (NSIC), Multi-adaptation trials (MAT), National Cooperative Tests (NCT), irrigated lowland, transplanting culture, direct wet seeding culture*

### THELMA F. PADOLINA
Senior Research fellow
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Ms. Padolina is a Senior Research Fellow at PhilRice. She lead the NextGen Project under the Food Staples Sufficiency Project of the Department of Agriculture. As a rice breeder, she helped developed more than 25 rice varieties. Her commitment to provide better rice varieties to Filipino farmers continues to inspire her to further explore the yet unknown spheres of rice breeding. Believing that it is imperative to share this vision, she actively mentors young plant breeders and scientists who are expected to bring the Philippine agriculture to greater heights. Ms. Padolina served PhilRice in various capacities such as being head of the Plant Breeding and Biotechnology Division and project lead of several initiatives of the institute. She retired from government service in 2014.

## From Transmission to Transformation:
## Reinvigorating the Rice Extension System

*KET Barroga, LdR Abaoag, IR Tanzo, EP Angeles, FR Leya, MVSG Asio, KM delCastillo,*
*MAA Saludez, HJL Altamarino, EE Joshi, and ST Rivas (DA-PhilRice)*
*NN Pangilinan, AB Gasmen, EB Parot, and NP Arceo (DA-ATI)*
*JA Lapitan, MC Casimero, BA Pamatmat, LA Mateo, MJC Du, and JC Barradas (IRRI)*
*EJ Sana, AJ Tallada, and EC Yago (DA)*

In translating rice research results into sustainable improvements in farming communities, the country's agricultural extension system is considered a weak link. With new challenges in agricultural development and a more complex rice production environment, there is a need for a firmer resolve to reinvigorate extension to help attain and sustain rice sufficiency and food security. Project IPaD (*Improving Technology Promotion and Delivery through Capability Enhancement of Next-gen Rice Extension Professionals and other Intermediaries)* was implemented to help improve our extension system. Data gathered from stakeholders showed a need for a broader mission in doing extension work — from technology transmission to community transformation — and, consequently, new mindsets and capacities among its workforce. These led Project IPaD to focus on three activities: (1) implementing a training program for a new breed of rice extensionists; (2) engaging strategic partners in extension; and (3) facilitating enabling mechanisms for extension. The training program, which is now institutionalized at the Agricultural Training Institute (ATI), had graduated 117 AgRiDOCs (new breed of extensionists) from its pilot and national rollouts. More than 11,000 from private sector, media, academe, and community-based organizations have been oriented about the challenges and opportunities in agriculture and ways to help farmers through products and services of PhilRice, ATI, and the International Rice Research Institute (IRRI). To help sustain these interventions, the project crafted 15 recommendations to strengthen the extension environment; formulated with

Technical Education and Skills Development Authority (TESDA) the rice production training regulation to standardize competencies; provided more than a hundred nondegree training opportunities for extension personnel; and enhanced collection of and access to library resources and journal services at PhilRice to improve R&D productivity. The project is currently completing assessment of its activities, particularly the AgRiDOC program. Initial results in computing direct training cost was pegged at about P1,300/trainee/day and evaluation showed an increase in ICT-based tools/resources usage and implementation of projects proposed.

*Keywords: rice, agricultural extension, AgRiDOC, Project IPaD*

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**KAREN ELOISA T. BARROGA**
Chief Science Research Specialist
Philippine Rice Research Institute (PhilRice)

Over the years, in various capacities, Karen has applied her knowledge and skills in communication to many development/extension projects and management work. Examples of these include the promotion of hybrid rice and the use of certified seeds; the development of the PalayCheck System and its courseware; the innovative uses of video for research and learning; the organization of video and visual resources, and rice S&T information for easy access; the transformation of PhilRice Newsletter into a science magazine; the institutionalization of Rice S&T updates and communication research; the putting up of a Rice Garden at the Luneta; the publication of *PalayTandaan* and Rice Science for Decision-makers; and the implementation of an area-based technology promotion strategy. For her accomplishments in all this, she was recognized in several occasions by PhilRice as outstanding staff and official; and also by other organizations, such as the Crop Science Society of the Philippines that gave her an Achievement Award in Extension; and the Irrigated Rice Research Consortium (IRRC) of IRRI and the Swiss Agency for Development and Cooperation (SDC) that elected her to its Steering Committee. Recently, she was also tapped as an external reviewer of the project Closing Rice Yield Gaps in Asia (CORIGAP), again of IRRC-IRRI and SDC, and as a resource person on extension/development at the International Food Policy Research Institute in Washington DC, USA.

Karen obtained her BS and MS degrees in Development Communication, with cognates in Agriculture and Rural Sociology, respectively, from the University of the Philippines at Los Baños. For her PhD, she completed this at the University of Western Australia (UWA) under the John Allwright Fellowship of the Australian Centre for International Agricultural Research (ACIAR) and the UWA scholarship. At UWA, her dissertation was on the adoption of multi-component and preventive rice production technologies.

Currently, Karen is Chief Science Research Specialist at the Development Communication Division, where she leads the research project on enhancing knowledge sharing and learning; the information awareness activities for the Golden Rice project; and IPaD, a project that aims to help reinvigorate the extension system.

# Development of Training Regulations on Grains Production NCII

*Bernadette S. Audije (TESDA)*

The Technical Education and Skills Development Authority (TESDA) through Republic Act 7796 also known as the *TESD Act of 1994* is mandated to establish national occupational skills standards. In view of this, the Authority develops and implements a certification and accreditation program in which private industry group and trade associations are accredited to conduct approved trade test, and the local government units to promote such trade testing activities in their respective areas in accordance with the guidelines set by the Authority. These guidelines are anchored on a document called Training Regulations (TRs), which contains a set of policies for quality Philippine Technical Vocational Education and Training (TVET) program offerings and establishment of assessment and certification (National Certificate-NC) arrangement requirements for an individual to earn a qualification. TRs has four sections, namely qualification descriptor, competency standards, training arrangements, and assessment and certification arrangements. The development process of TRs comprises of series of consultations, deliberations, meetings and workshops involving the industry stakeholders, TESDA Board Members as well as regional, provincial, and executive offices. The process is industry-led hence, it starts with skills requirement identification on the basis of labor market demand to justify prioritization for skills standards development. The presentation will also highlight topics on Philippine Qualifications Framework (PQF), Quality Assured TESD Framework, Competency-Based TVET Framework and ISO-certified processes of TR Development and Competency Assessment Tools (CATs) development and deployment. It will also discuss the benefits of TRs to industry, training institutions, and the community. It is envisioned then that through the Training Regulations on Grains Production NCII, current and future generations will be equipped with knowledge, skills, and attitude to become competent and world-class rice producers delivering quality farm services and ensuring high production of quality rice.

*Keywords: training regulations, TESDA, rice, national certification, grains*

## BERNADETTE S. AUDIJE

Senior Technical Education and Skills Development Specialist
Technical Education and Skills Development Authority  (TESDA)

A graduate of UPLB, Ms. Audije has a long professional engagement with various field-based research projects on agriculture, environment, and biodiversity. Working with IRRI, NCPC-UPLB, ERDB-DENR, and ARCBC, she was exposed to research works, laboratory chores, experiments, and technical writing. She wrote and co-authored the Guidebook on the Phenology and Identification of Philippine Mangrove Species, and ASEAN's 100 Precious Plants, among other publications.

She handled TESDA's Agriculture, Forestry, and Fishery Sector since 2004, facilitating the development of Training Regulations for TVET offerings and certifications. She was involved in K-12 undertakings of the DepEd since 2010, particularly in the review of curriculum guide and training modules under the TechVoc Track.  She was part of a team who worked with Australian and Vietnamese counterparts under the Australian -funded Vocational Education and Training (VET) Qualification Benchmarking and Development Project. The project came up with occupational standards (OS) for benchmarking purposes.

Her heart stays with the Sector, helping equip individuals, particularly the younger generations, with knowledge, skills, and attitude to make them world-class workers in the fields of agriculture, forestry, and fishery.

# Accelerating the Dissemination of Associated Technologies for Increasing Yield and Profitability in Irrigated Ecosystem: The Region 2 Experience

*EB Sibayan, KS Pascual, JB Tapec, and HR Pasicolan (PhilRice CES)*
*RM Lampayan, RJ Cabangon, and M Burac (IRRI)*

Improvements in rice production can be achieved in two ways: increasing the area planted and increasing the yield per unit area. The area planted to rice is decreasing owing to urbanization. However, expanding rice areas is possible during the dry season as the irrigation system efficiency can be improved to increase cropping intensity (CI). Currently, the country's CI is at 1.6 as reported by National Irrigation Administration (NIA). If this can be increased to 1.7, an additional 10% of the irrigated area can be realized, which can be attained through water-saving technologies such as alternate wetting and drying (AWD and aerobic rice (AR) culture.  Increasing the yield is also possible as shown by farmers in Nueva Ecija who averaged 5 and 11 t/ha  during the wet and dry season,  respectively. These yields are higher than the national average, which is about 4 t/ha. The high yields achieved by the Nueva Ecija farmers were attributed to the high adoption rate of new rice production technologies such as use of certified and hybrid seeds, utilization of right quantity and timely application of fertilizer, low incidence of pest and diseases, and low postharvest losses, among other recommended farming practices.

This paper presents the dissemination, impact, and success story of the adoption of associated technologies for rice production in Region 2.  Series of appreciation seminars on science and technology updates on rice production with emphasis on water management  and on-site briefings of farmers for the establishment of technology demonstration farms (TDFs) were conducted in project sites from 2014 to 2016.

Results showed that in Tumauini Irrigation System (TIS) in Isabela, the CI of Liwanag IA was increased from 1.75 to 2.0 after BALUFIA IA adopted AWD; increased from 120 to 160 ha during the 2015 and 2016 DS. Similarly, yield of farmers increased by 23 to 45% using rice crop manager (RCM), AWD, and hybrid seeds in Mallig, Isabela and Aglipay, Quirino during the 2016 DS. Although, there was an increased production cost due to seeds and fertilizers, increase in net profit was achieved at 34-90%. In using AWD, reduction in the frequency of water pumping for irrigation with shallow tube wells  was also achieved from 2 to 3 times a week to once a week in Mallig. This resulted in the reduction of diesel consumption from 2.5 to 1.5 drum per cropping season.

*Keywords:  associated technologies, AWD, rice, profitability, yield*

**EVANGELINE BARROGA SIBAYAN**
Supervising Science Research Specialist and
Head, Rice Engineering and Mechanization Division, PhilRice

Vangie is an agricultural engineer who has worked extensively on developing innovative and improved soil and water management practices. She has authored national and international refereed journals and book chapters. She has also been engaged by the Food and Agricultural Organization (FAO) and other international organizations as consultant on irrigation and water management. Recently, the UNDP commissioned her to a study on the development of a Nationally Approved Mitigation Action (NAMA) in the agricultural sector on greenhouse gas emissions in rice cultivation in the Philippines.

# Capacity Enhancement and Enterprise-Building in Farming Communities

*RB Miranda, LL Mandia, JD Batcagan, NA Sabigan, RS Credo,*
*ED Maraganas, and AJB Acierto (PhilRice CES)*

The Heirloom Rice Project of the Department of Agriculture commenced in 2014. The aim was to enhance the productivity and enrich the legacy of heirloom rices through empowered communities in unfavorable rice-based ecosystems. Heirloom rices command higher prices in niche markets locally and internationally, but their potential as a lucrative livelihood is hindered by the inability of local farmers to produce them in higher seed quality, purity, and greater quantities.

To improve the capacity of Self-help Groups (SHGs) of farmers in increasing their productivity, income, and in operating smallholders enterprises, 14 Participatory Technology Demonstrations (PTDs) of 10-20 heirloom varieties were established per site. There were 112 varieties collected, characterized, and purified from 7 municipalities in CAR, 2 in North Cotabato, and 1 from Sultan Kudarat. From the established sites, 14 Farmers Field Schools were conducted in 6 provinces with 617 farmer-participants.

At least five traditional heirloom rice varieties, with high market potential, from each province were evaluated for their agronomic characteristics. In Ifugao, yield ranged from 2.24 to 3.9 t/ha where Minaangan yielded highest among the 12 varieties evaluated. In Kalinga, Ulikan Red, and Allugit attained the highest yield ranging from 1.7 to 3.1 t/ha. Balatinaw, being the top yielder, was from Benguet where varieties' yield ranged from 2.65 to 3.10 t/ha. Yields of heirloom varieties from the Mountain Province ranged from 2.2 to 2.9 t/ha. Kuyogyo had the highest yield among the varieties evaluated.

The project distributed and demonstrated the uses of 14 panicle threshers, 9 micro tillers, 9 grain moisture meters, 14 mini-threshers, 13 weighing scales, 26 knapsack sprayers, and 420 super grain bags to farmer-participants. This was expected to strengthen the operations of community SHGs established under the project.

*Keywords: heirloom, unfavorable rice-based ecosystems, self-help groups, Farmer Field School*

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### RUBEN B. MIRANDA
Chief Science Research Specialist
Technology Management and Services Division, PhilRice

Mr. Miranda served as the National Coordinator of the Upland Rice Development Program, with his team recognized as the best team during the *2015 Dangal ng PhilRice*. He is a recipient of various scientific best paper and poster awards as products. Some of his winning papers, mostly awarded during the Crop Science Society of the Philippines (CSSP) and Federation of CSSP national conferences, include "When parking the plow has more benefits", "Training program for new graduates of agri and other related sciences to help boost rice industry", "Development and promotion of location-specific high yielding technology for intensive irrigated rice areas in Nueva Ecija", and "Partnership for agricultural and rural transformation – Improving farmers' lives". In 2013, he was awarded CSSP Achievement Award in Extension.

Mr. Miranda coordinated various season-long training courses for rice specialists, including rice production training for Brunei Agricultural Technologists in 2009. He served as a rice growing expert in the Tripartite Agreement among the governments of Japan and ASEAN countries for the Rural Development and Resettlement Project in Cambodia in 1996 and 1998 to 2000 where he received recognitions, including the Medal Sahametrei order "de Chevalier', the second highest award given by the Kingdom of Cambodia for his outstanding contributions in rural development.

He earned his bachelor's degree in Agriculture and master's degree in Rural Development at the Central Luzon State University in 1979 and 2004, respectively.

# Supplying the Needs of a Highly-Diversified Filipino Diet through *Palayamanan* Plus

*RG Corales, JM Rivera, SE Santiago, PDO Roman, GA Bantonilo,*
*JT Sajor,  MAC Tan, GD Martin, RB Malasa, and AM Corales (PhilRice CES)*

Food is the basis of our social life. We eat three meals of white rice a day and two starchy snacks in between. We also enjoy noodles made from mungbean or wheat, which are usually mixed with meat and flavorings. Soups and stews made with meat or fish and vegetables are also consumed and often served as a main entree or side dish. Our diversified diet include fruits, vegetables, and grains that are high in complex carbohydrates, fiber, vitamins, and minerals, low in fat, and free of cholesterol. The rest of the diet comes from dairy products, lean meat and poultry, and fish.

Modern alternative food production systems are being developed towards producing more and affordable food, and reducing health, environmental, social, and economic impacts associated with intensive food production systems.

*Palayamanan* Plus is a food production system employing diversification, intensification, and integration of several farming ventures to ensure the availability and accessibility of affordable food for a highly-diversified diet to people all year-round, and increase rice farmers' sustainable source of income.

*Keywords: Palayamanan Plus, food production system, diversified diet, diversification, intensification, integration*

## RIZAL G. CORALES

Supervising Science Research Specialist
Climate Change Center, PhilRice

Mr. Corales currently leads the Intensified Rice-Based Agri-bio Systems Program, with Palayamanan as its core platform.  He and his team at PhilRice, its branch stations, and partners in other government agencies such as local government units and civic organizations are jointly developing the Palayamanan Plus – a rice-based production systems model directed towards increasing income and profitability in the rice environments. This is being done through purposive diversification, intensification, and integration of certain farming ventures and development of agri-enterprises that enhance value-adding and marketing of agricultural products.

He joined PhilRice in 1992 as a pest management specialist under the Rice-Based Farming Systems Program. He also served as facilitator/resource person in the conduct of Rice Specialist Training Course on IPM Farmers Field School.

After finishing his degree in Agriculture specializing in bioproduction in 2000, he started working on diversified integrated rice-based farming systems, following the "Bahay Kubo" concept to address food security and poverty. This system eventually evolved into its popular name, *Palayamanan*. As project lead of *Palayamanan*, he facilitated the development of several models in adverse rice environments such as rainfed, upland, saline, cool-elevated, and flood-prone communities. Several variants of *Palayamanan* were cooked up such as Palayamanan sa Paaralan (SUC and elementary), Palayamanan sa Kampo Militar, Palayamanan sa Bilanguan.

Palayamanan became a core platform of foreign-funded projects such as those by the Japan International Cooperation Agency and USAID. He also served as technical staff and consultant of the UN-FAO.

# PLENARY SESSION 4

## Farmers' Best Practices and Experiences

**Mr. Richard D. Balane** of Olongtao-Ilaya, Macalelon, Quezon has been farming for 21 years. He was awarded as the Outstanding Local Farmer Technician (LFT) for Region 4-A (CALABARZON) during the National LFT Conference in 2015. He practices integrated rice-based farming system or Palayamanan in his 2.25-ha farm, which also serves as a Palayamanan Model Farm for the province of Quezon.

He actively assisted PhilRice and the Local Government Unit of Macalelon in organizing the Olongtao-Ilaya Upland Farmers Association under the Location-Specific Technology Development and Upland Rice Development Program (URDP) and became the organization's first President. The organization's community seed banking system paved the way for all the association's members to plant upland rice and practice Palayamanan System. Their group is the major source of upland rice varieties, particularly Inipot-ibon and Pinalawan that are being distributed by DA-Regional Field Office IV-A to upland farmers of CALABARZON. Their upland rice also reaches some parts of MIMAROPA through the URDP.

His active involvement with the activities of other DA agencies linked him to different government programs. Seeing how his father prospers as a farmer and improves as an individual has encouraged his son, Rommel, to join the 4H Club and pursue series of training related to agriculture.

**Mr. Fortunato R. Paje** of Cabugao, Bacuag, Surigao del Sur has been farming for more than 40 years. He was a farmer-cooperator for rice and corn technology demonstration trials for several projects such as the Analysis and Mapping of Impacts under Climate Change for Adaptation and Food Security Project in 2012 and 2014 and the Expanded Modified Rapid Composting Project for 50ha in 2013. He also organized the Cabugao Farmers Rice and Corn Producers Association. He was selected as the Provincial Agrarian Reform Coordinating Committee farmer-representative in 2000 and elected as vice president of the municipal chapter of the Nagkahiusang Mag-uuma sa Surigao del Norte. He also participated in corn farmers' congress in Albay and Isabela, and in a series of training and seminars in Mindanao and Luzon. He is blessed with seven children.

**Mrs. Elizabeth A. Sol** of Leganes, Iloilo has been farming for 31 years. In 2015, she was awarded as the Outstanding Local Farmer Technician (LFT) for Region 6 during the National LFT Conference. In the same year, her 2.5-ha farm established as integrated rice-based farming system (RBFS) was awarded as the 2nd Place Model Farm under the RIC Program in Iloilo. She also received a Certificate of Merit with High Yield Increase for the NISRIP Agricultural Support Component in the Sta. Barbara RIS Season-Long Farmers' Field School (FFS) conducted by PhilRice Negros.

RBFS has helped her four children earn college degrees, and four of her scholars finished vocational courses. She actively supports farming-related projects, programs, and activities, sharing with and serving her fellow farmers in Iloilo. Since 2012, she has been helping the Leganes LGU conduct the FFS, leading the Bantay Peste weekly monitoring activities. She also leads in establishing demonstration trials for rice and FFS under the Better Rice Initiative in Asia (BRIA) Program. Since 2013, she chaired the Municipal Agricultural and Fisheries Council (AFC) of Leganes, and has been the treasurer of the Iloilo Provincial AFC. She is also a member of the AFC Provincial Monitoring Team that monitors and validates activities of DA and PCAF projects in Iloilo.

In 2013-2015, she participated as farmer-cooperator in the FFS conducted by PhilRice Negros in Sta. Barbara. Since then, she served as Vice-President of the Lapayon Farmers' Association, helping conduct monthly meetings, prepare reports, and consolidate issues, concerns, and recommendations submitted to the Municipal Agriculturist.

# Abstracts of Paper Presentations

## CONCURRENT SESSION 1

## Enabling the AgRiDOC: A New Breed of Rice Extensionists

*LdR Abaoag, KET Barroga, EP Angeles, IR Tanzo, MVSG Asio, and FR Leya (PhilRice CES)*

Season-long training programs in the past focused on developing rice extensionists' technical and facilitation capacities. However, with the current challenges in the crop production environment, a new training curriculum was developed under Project IPaD to address needed learning requirements and mindsets to effectively assist farming communities. Several stakeholder consultations and review of past and current training programs were made to guide curriculum development, which aimed to develop a new breed of rice extensionists, who have the technical competence not only on rice but also on rice-based farming, an entrepreneurial and community mindset, ICT skills, and core values and attributes relevant to development work. The new curriculum was offered as "Enabling the AgRiDOC: A New Breed of Rice Extensionists", employing fun, innovative, and experiential learning approaches. It has six modules: Be Transformed, AgRiCool, AgRiSurvivors, PalaYcheck and PalaYamanan v2.0, Rise with Rice, and Be RICEponsible, with an approved development/extension project proposal for the communities they serve as final requirement for graduation. Two pilot batches have been completed in 2014-2015, producing 50 AgRiDOC graduates nationwide. Initial monitoring and evaluation results revealed that the training program's biggest strengths are its high-calibre resource persons and holistic approach. Interviews with the participants cited the training as most effective in increasing their knowledge on rice and rice-based farming systems and community transformation; developing core values needed in doing extension work and a stronger sense of mission to catalyze development; and in improving skills in ICT-based tools and resources on rice/agriculture, developing project proposals, and entrepreneurship.

*Keywords: rice, agriculture extension, training, AgRiDOC, Project IPaD*

## Are AgRiDOCs Techie?

*MAA Saludez, IR Tanzo, and HJL Altamarino (PhilRice CES)*

A 4-month training program for 25 agricultural development and extension workers (AEW) from Luzon was completed in 2015 under the course, "Enabling the AgRiDOC: A New Breed of Rice Extensionists". To graduate as AgRiDOC (Agricultural Development Officer of the Community), one has to be proficient in using various ICT-based tools and resources to gain access to a wide-range of rice-related information and be guided in diagnosing farmers' field problems and giving management recommendations. These tools/resources include the PhilRice Text Center (PTC), Farmers' Text Center (FTC), Pinoy Rice Knowledge Bank, Rice Knowledge Bank, Rice Doctor, and MOET App. As AgRiDOCs, they were given a computer tablet each after the training to further hone their capacities in using ICTs. Through pre- and post-surveys, the improvement on ICT skills of these AgRiDOCs was monitored and evaluated. Focus group discussions (FGDs) were also conducted with the farmers and other stakeholders they assist to verify if the ICT tools and information gained from using these tools have been shared or taught to them by the AgRiDOCs. Results showed that the training had improved the ICT skills of the AgRiDOCs, with half of them professing greater confidence in using the internet and computer tablet. In addition, a huge improvement in their competencies was also reported. The AgRiDOCs showed positive change in the use of the ICT tools for extension work. The highest increase was in the use of the FTC developed by ATI. At 6 months after the training, the PTC appeared as the most commonly used ICT tool by the AgRiDOCs. In FGDs, the farmers and other clienteles of the AgRiDOCs reported that the PTC and some of the other diagnostic tools, especially the information from these tools, were shared to them by the AgRiDOCs.

*Keywords: ICT, PhilRice Text Center, training, AgRiDOC, Project IPaD*

# The Right Match Sets the Fire: Knowledge Sharing and Learning Formats for Strategic Groups of Rice Extension Intermediaries

*EP Angeles, KET Barroga, ST Rivas, IR Tanzo, and HJL Altamarino (PhilRice CES)*
*BA Pamatmat, and JC Barradas (IRRI)*

To keep pace with the increasingly complex challenges in agriculture, there is a need to complement and supplement government extension efforts by engaging other strategic groups of rice extension intermediaries (REIs). When formally recognized and equipped, REIs can serve as information conduits, agriculture and farming advocates, learning facilitators, and links to extension service providers. Through Project IPaD, group-specific formats for engaging agricultural input providers as private sector-based REIs, and faculty and students of major agricultural SCUs as academe-based REIs were defined. The target REIs were engaged through knowledge sharing and learning (KSL) events. These KSLs were generally designed to inform REIs of challenges in agriculture, commend them for what they have done to help farmers, offer them science- and ICT-based resources to strengthen their role as extension intermediaries, and challenge them to commit to do more to help farmers. Adjustments were made on the order of presentation, contents, and style of delivery of each KSL part to suit and maximize each group's position of strength. Results of quick after-event surveys showed that KSLs were seen by the randomly sampled REIs (private=175; academe=188) as informative, relevant, and effective in deepening their appreciation for agriculture and making them realize their role in helping farmers. Follow-up interviews with a sample of REIs 6 months after the KSLs revealed that 62% used the knowledge and skills they gained for their personal benefit, citing this as the most significant change brought by the KSL. In addition, 89% applied it to their work or organization and 49% used these to benefit their immediate community – farmers, family, students, and friends. The KSLs reached 11,609 rice stakeholders. It is recommended that engagement opportunities be continued and support mechanisms must be in place to enable REIs from the private sector and academe to effectively assist farming communities.

*Keywords: knowledge sharing and learning, intermediaries, rice, agricultural extension, Project IPaD*

# Listening Groups as a Knowledge Sharing and Learning Mechanism in Group Learning Activities among Farmers

*SP Pasiona, MGM Nidoy, and JA Manalo IV (PhilRice CES)*

This study explores the relevance of listening groups, a mechanism for knowledge sharing and learning, which was popular in Canada in the 1940s. Key aims are to see how this approach can be exploited to invite discussions among farmers, and thereby improve the learning climate in their respective areas; and explore its potentials to address issues surrounding expert availability in group learning activities. We have done some modifications with the original listening group methods. Among them is that the material is not broadcasted. We brought an audio file from the PinoyRice, an information portal on rice, and have 62 farmers listen to it across three research sites. Pre- and post-tests are being administered followed by a focus group discussion with five farmers in each site. This study is ongoing, and thus far, data collection was done in Central Luzon, Ilocos Norte, and Agusan Del Sur. Initial findings present a high-perceived usefulness of the listening group approach that could aid the farmers' knowledge learning and sharing activities. Top preferred topics of audio files are on preharvest management: land preparation (77.40%), crop establishment (72.50%), pest management (70.90%), nutrient management and varietal selection (69.30%), and water management (61.20%). Results also show that the listening groups is effective among younger and women farmers.

*Keywords: listening groups, group learning, broadcast media, radio forum, Farmers Field School*

# The Doctor is In: Ensuring Rice Doctor Consultations are Effective and User-Friendly

*JCC Barradas, LM Atienza, PR Shankar, and NP Magor (IRRI)*

Information and communications technologies (ICTs) create an impact in agricultural transformation by making information, knowledge, and expert support easily accessible to its users. This potential can only be realized if the users find the technology usable. For this reason, engagement of target users in usability testing becomes essential to any development process. This study determines the usability of Rice Doctor (RD), a mobile app that assists extension workers and farmers in making accurate and timely diagnosis of pests, diseases, and other agronomic problems in rice. RD was examined using to three important elements of usability – effectiveness, efficiency, and user satisfaction. In-field usability trials were done in three rice-producing areas in the Philippines.  In each area, three plots were selected; each with a rice expert-confirmed pest, disease, or agronomic problem. In each plot, rice extension workers divided into three groups of five diagnosed the crop problem: the first group did visual identification, the second was guided by printed materials; and the last used RD. They were asked to record their diagnosis and participate in a group discussion to talk about the experience of using RD.  Results of this study are expected tohelp make RD more user-friendly and establish its advantage over other modes of diagnosis.

*Keywords: information and communications technologies (ICTs), usability, extension workers, Rice Doctor*

# The Ubiquity of Mobile Phones: Lessons for the Rice Crop Manager

*MJC Du, B Pamatmat, MC Casimero, RJ Buresh, and RT Castillo (IRRI)*
*A Arceo and J Calasagsag (DA-ATI)*

Modern information and communications technologies (ICTs) such as mobile phones, the internet, and modern computers, now play an important role in linking rice farmers to agricultural information and innovations to make farming more productive and profitable. The emerging inquiry lies on the type of ICT tool to use and its most appropriate delivery mechanism in areas with poor internet broadband infrastructures and services. As ICT-based services grow in number and sophistication, the extent of farmers' ability to access these ICT-based services comes at fore. This study seeks to address these concerns using a baseline survey (n=198) with respondents randomly selected from four rice-producing provinces.

The study found that the median age of these farmers is 55 years, majority are males (81%), with high school (35%) or tertiary (31%) education, and an average of 25 years in rice farming. The potential for maximizing mobile phone-based services for farmers is high.  As much as 92% own or have access to mobile phones; 61% have 2 to 4 while 22% have 7 unit at home. Fifty-six percent of the respondents own and operate the phone by themselves, suggesting a direct interaction of farmers with phone-based services. Some 26% ask other household members to operate the phone on their behalf. The kinds of services to be developed should consider the type of phone farmers own as 57% have phones with basic functions and only 24% have smart phones.  Ninety-six percent of the respondents subscribe to prepaid mobile phone service. Hence, credit load is a significant consideration to access.

Some 51% use mobile services to access farming information, suggesting the familiarity of farmers to mobile-based agriculture information services. Seventy five percent expressed willingness to receive farming-related information through mobile phones.  Agricultural extension workers continue to be significant providers of crop advisory and information to some 62% of the farmers surveyed. Other sources of information are fellow farmers (15%) or other members of farmers' association (15%).

Mobile phones are increasingly used by farmers to access information and crop advisory services. RCM, being one of the more disseminated services, will do well to effectively marry its internet-based system to dissemination and adoption modalities that exploit the ubiquity of mobile telephony and basic phones as the main interface to farmers.

*Keywords: mobile phones, rice crop manager, RCM, ICT*

## CONCURRENT SESSION 2

# Pathogenicity Analysis of Philippine Isolates of Rice Blast Fungus (*Pyricularia oryzae* Cavara) Using the International Blast Designation System

*JT Niones, JP Rillon, and LM Perez (PhilRice CES)*
*MER Fabreag and Y Fukuta (JIRCAS, Tsukuba, Japan)*

Understanding the structure and dynamics of rice blast pathogen population *(Pyricularia oryzae* Cavara) is vital to develop varieties with durable resistance against the disease that continually poses a threat to rice production worldwide. To clarify the diversity and differentiation of blast races in the Philippines, we investigated the pathogenicity of 213 isolates from rice ecosystems in 30 provinces and characterized them using the international differential varieties (DVs) for 23 resistance genes and a susceptible variety Lijangxintuanheigu (LTH).

High frequencies of virulent blast isolates against LTH or differential varieties carrying *Pib, Pik-s, Pi12(t),* and *Pi19* were noted. Conversely, low frequencies of blast isolates were virulent to *Pish, Pii, Pi3, Pik-p, Pi9(t), Piz, Piz-5 and Pi20(t)*. The infection types of the differential varieties against blast isolates were used in cluster analysis, classifying them into Clusters I and II. Isolates under both clusters were equally distributed in Central and Southern Luzon. Isolates from the Caraga Region were mostly categorized into Cluster I. Meanwhile, isolates collected from Northern Luzon, Visayas, and Western and Southern Mindanao were mainly classified into Cluster II. Based on ecosystem, Clusters I and II had similar frequencies in rainfed lowland, while Cluster II was mainly found in irrigated, upland, and cool-elevated ecosystems. All isolates from the upland rice areas belonged to Cluster II. Blast isolates virulent to DVs for *Pib, Pit, Pia , Pik-s, Pi12,* and avirulent to DVs harboring *Pish, Pii, Pi3, Pi9,Piz, Piz-5, Piz-t, Pi20,* and *Pik-p* were common and in similar frequencies to both clusters, implying that these isolates were distributed in the rice growing areas in the Philippines. In contrast, substantial differences in frequencies between both clusters were found in the reactions of differential varieties carrying these genes in the *Pik* and *Pita* chromosome regions.

*Keywords: pathogenicity, rice blast fungus, Pyricularia oryzae, international blast designation system*

# Paperless Field Data Collection for Quick Data Turnover on a Nationwide Scale

*Ulysses G. Duque (PhilRice CES) and Joselito V. Villa (IRRI)*

Among the objectives of the Philippine Rice Information System (PRiSM) project is to provide timely and accurate information on the rice crop to support policy- and decision-making, and activity planning related to food security. With the use of pen and paper in the data collection, such objective of the PRiSM project can hardly met. In the conventional data collection, the collector uses pen and paper for data recording and encodes the information in a computer and analyzes it locally. Thus, it is difficult to compile and compare

information on a nationwide scale. In the PRiSM project, a standard data collection methodology is being followed. The data collector uses a specifically programmed Open Data Kit software installed to a smart phone to directly encode and send data to a cloud server for archiving and analysis. Analyzed data are interpreted and sent to the Department of Agriculture in the form of a bulletin. It is also uploaded to and may be accessed through the PRiSM website, www.philippinericeinfo.ph.

*Keywords: PRiSM, Open Data Kit software, data collection*

## Rodent Damage in the Philippines: PRiSM National Survey Results

*LV Marquez, UG Duque, and EC Martin (PhilRice CES)*

Rodents are a chronic pest of rice inflicting an average of 5-60% crop damage.  To help address rice rodent problems in the Philippines, the Department of Agriculture, PhilRice, and Sarmap (Switzerland) through the 4-year collaborative project, Philippine Rice Information System (PRiSM), conducted a nationwide rodent damage survey. Organized information on rice area, yield, and yield gaps and corresponding causes including rodent damage were gathered following a standard monitoring procedure for rodent damage sampling. We monitored 576 fields in 24 provinces to assess percent rodent damage during the second semester of 2015 and 548 fields were monitored in 24 provinces during the first semester of 2016. Rodent damages nationwide averaged to 2.11% in 2015 and 1.96% in 2016.  This information will educate policy makers on the economic importance of rodent management and help field technicians pinpoint the location and extent of rodent damage.

*Keywords: rodent damage, PRiSM*

## Effects of Water Management and Fertilizer N Levels on Rice Yield (PSB Rc82) and Incidence of Pests and Diseases in Rainfed Rice Ecosystem

*AY Alibuyog, SV Pojas, and ES Avellanoza (PhilRice Batac)*

A study was conducted at PhilRice Batac in WS 2014 and 2015 to determine the effects of water management and N fertilizer levels on the yield of PSB Rc82 and on pest and disease damages under rainfed condition. Fertilizer treatments (N) assigned as horizontal factors were as follows: (N1) no fertilizer applied, (N2) 60 kg N in two applications, (N3) 90 kg N in two applications, (N4) 90 kg N in three applications, (N5) 120 kg N in three applications, and (N6) 150 kg N in three applications. N6 was added in the N treatments in 2015. Water management (W) was assigned as the vertical factor. W1 was purely dependent on rainfall, W2 was applied with supplemental irrigation during fertilizer application only, and W3 was irrigated during critical periods. Treatments were laid out on Strip Plot Design with three replications.

Results showed that N levels significantly affected grain yield of PSB Rc82, but not with water management. Among the N levels, the application of 120 kg/ha (N5) in 2014 had significantly higher yield (2,728 kg/ha) than the rest of the N treatments. Among the treatment combinations, WR3N5 had the highest yield of 3,251 kg/ha. The same treatment effect of N was observed in 2015.  The highest yield was also observed from N5 (4,429 kg/ha), but it was comparable with N3, N4, and N6. The highest N level (N6) had numerically lower yield than N5. Yield data showed a 9.5% decline in yield if application is increased from 120 kg N to 150 kg N/ha. In both years, leaf area index (LAI) was also significantly affected by N levels. Generally, higher N levels gave higher LAI. The highest LAI was observed from N5 in 2014 and from N6 in 2015 but it was comparable with all the other N levels except for the control. In terms of nitrogen-use efficiency (NUE), W3 was statistically higher than W1 and W2 in 2014 but not in 2015. The application of 90-120 kg N/kg gave the highest NUE. Correlation analysis consistently showed that NUE and plant height were positively correlated to the yield of PSB Rc82. Likewise, LAI and seed weight were also positively correlated to yield in 2014. In 2015, tiller count showed positive correlation to yield.

Water management had no significant effect on yield but caused faster weed growth in W1 and W2. Higher N levels (N5 and N6) and lower N (N2) also resulted in higher weed population. Results implied that water treatment affects pest and disease occurrences. Less water may result in higher BPH population and brown spot infestation while more water favors infestation of whorl maggot. Water scarcity can also aggravate BS infestation, making some nutrients unavailable to the plants.

*Key words: fertilizer, water management, pest and diseases, rainfed, nitrogen-use effeciency*

# Development of Capillary Irrigation *(Capillarigation)* System for Rice-Based Crops: Maximizing the Use of Water by Smallholder Farmers during Extreme Drought Conditions

*Ricardo F. Orge and Derose A. Sawey (PhilRice CES)*

The World Resources Institute predicts that the Philippines, together with other Southeast Asian Countries, will experience severe water shortage in 2040.  Likewise, extreme drought (El Niño) comes every 2 to 7 years, causing significant losses in crop production due to its effect on irrigation supply.  While drip irrigation systems have been proven efficient, smallholder farmers could not usually afford to buy and install one owing to high acquisition costs.  Thus, this study was conducted to develop an improved system of drip irrigating rice-based crops using the capillary principle. It makes water delivery more efficient while simplifying the design and fabrication for farmers. Laboratory tests showed that capillary movement of water through a wick can be used as a simple means to deliver water to the crops like the emitters in drip irrigation systems.  Using this principle, the system can operate with very low pressure head addressing leak problems at pipe connections or along the delivery lines. This eliminates the use of sealants, rubber gaskets, and pipe fittings, among other things.  Results of field performance tests of the prototype *capillarigation* system using cotton yarn as wick and green pepper as test crop showed that the system can deliver water at an average rate of 1.8 L/h with water use efficiency (WUE) of 1.61g/L, which is 30% higher than the control (manual watering). Direct water application into the root zone (subsurface irrigation) reduced weed problem by as much as 58%. The field planted with tomato obtained a WUE of 5.47 g/L, which is 121.46% higher than the control. The system has very low water discharge, may operate 24 hours a day, 7 days a week, and does not need a valve to control water flow. It rids the farmers of the decision on when to irrigate or not. The system needs further refinements and field tests to address some problems (mold accumulation in the wicks) and evaluate its suitability to other crops.

*Keywords:  capillary irrigation, drip irrigation, El Niňo, extreme drought*

# Postharvest Management Key Checks and Best Practices for Improving the Rice Postproduction System

*Manuel Jose C. Regalado and Paulino S. Ramos (PhilRice CES)*

The integrated rice crop management system, PalayCheck®, needs to be enhanced with postproduction key checks and best practices. This protocol can help guide farmers, traders, and millers on techniques to reduce postharvest losses and achieve better product quality that would meet international standards. Various stakeholders from farmers' associations, rice trading/processing sector, academe, and the Philippine Grains Postproduction Consortium were gathered in workshops to identify key checks and corresponding best management practices. To validate the key checks, field experiments were conducted from 2014 to 2015 at PhilRice CES. Three rice cultivars, PSB Rc72H, NSIC Rc160, and MS-16, were planted in a 2.2-ha paddy field. Crops were harvested at three harvest dates, using four harvest methods. Grain losses incurred were determined using standard methods. Two sun drying methods, on concrete pavement and mechanical drying on a heated air flatbed dryer, were used. Storage methods included piling of 50-kg dried paddy in sacks at ambient conditions on concrete floor with and without plastic pallet, and using hermetic plastic cocoon. Paddy germination rates and storage losses were evaluated, and laboratory test milling was done after 6 months. Results show that the total losses for cutting, piling, and threshing operations across seasons were less than the national average of 5.2% when the 3 operations were done on the same day or when combine harvester was used, both at 5 days early and optimum harvest times. Combine harvesting even of a 5-day late crop still met PNS/PAES (Philippine National Standard/Philippine Agricultural Engineering Standard) performance criterion for maximum total machine loss of 3.5%. After 6 months of storage, higher germination rates, less storage losses, higher milling and head rice recoveries were attained with samples that were flatbed-dried and stored in a hermetic cocoon. The improved PalayCheck postharvest protocol is now ready for pilot-testing in farmers' fields and commercial rice mills.

# Design and Testing of Far-Infrared Paddy Dyer

*MJC Regalado, AT Belonio, and BY Lived (PhilRice CES)*

Drying paddy during the wet harvest season is a major problem in Philippine rice postproduction value charm. Wet paddy usually tends to spoil or germinate, resulting in reduced farmers' income. A far-infrared radiation (FIR) dryer was designed to reduce the moisture content of paddy from safe level for storage. The dryer consists of a surface emitter made of cement-ash mixture, which is heated by 0.8-m diameter gasifier using 50–60 kg/h rice husk as fuel to a proper temperature level to generate FIR. Grains are lifted by a 1-t/h bucket elevator then conveyed under the emitter by a 0.8-meter by 10-meter tray, which oscillates to improve retention time for effective drying.Paddy samples with low (16.8%) and intermediate moisture (19.6%) contents (MC) were used for drying trials. Results showed that low MC paddy could be dried to 13.2% after 3 passes in the dryer with emitter temperature at 138°C. Moreover, intermediate MC paddy could be dried to 15% after 4 passes with emitter temperature at 121°C. With this new system, faster second-stage drying was achieved owing to the penetration of FIR inside the kernel. Hence, overall drying time could be substantially shortened, implying lower drying cost and higher energy efficiency.

# Technology Demonstration of Top-performing Chinese Hybrid Rice Lines in Six Major Rice-growing Provinces in the Philippines

*CC Abon Jr., EV Sicat, FE Mina, EC Frediles, TV Soberano, AC Castillo,*
*R Fulgencio, C Guerrero, EAC Flores, and RR Carbonel (CLSU-PhilSCAT)*

Technology demonstration of Chinese hybrid rice lines were conducted by the Philippine-Sino Center for Agricultural Technology (PhilSCAT) to demonstrate the performance and adaptability of Chinese hybrid rice lines under Philippine conditions. This activity also shows the season-specificity of the Chinese hybrids. Demonstrations of two top-performing Chinese hybrid rice lines, particularly LP 937 and LP 952, were conducted in six select provinces: Ilocos Norte, Isabela, Nueva Ecija, Tarlac, Albay, and Occidental Mindoro. The two lines were found to be adaptable under local conditions, with LP 937 maturing within 110-114 days, LP 952 within 110-115 days. Yield data from Ilocos Norte showed that the lines can attain up to 10.83 t/ha for LP 937 and 10.05 t/ha for LP 952 during the dry season (DS). LP 937 was preferred in Isabela and Ilocos Norte. The farmers' main reasons for selecting LP 937 include plenty tillers, big grains, and short growth duration. More importantly, this line is also slightly resistant to major pests and diseases, a trait that is inherent to a good line. LP 952, on the other hand, was preferred in Nueva Ecija and Occidental Mindoro. This line is robust, sturdy, has plenty of tillers, and is slightly resistant to pests and diseases. PhilSCAT is conducting a test of these two lines in Vintar, Ilocos Norte in 2016 wet season to complete the 2-season trial. LP 937 has already passed the National Cooperative Tests evaluation for DS2016. It was found to be adaptable in all trial areas. LP 952 is on its third season in the evaluation phase.

*Keywords: Chinese hybrid rice lines, PhilSCAT, LP 937, LP 952*

# Grain Quality Evaluation of Introduced Chinese Hybrid Rice Lines and PhilSCAT-Developed Lines Planted during the 2012-2015 Preliminary Yield Trials

*EAC Flores, Cheng Liangji, Xiao Wei, Hu Jiyin, Sun Shenbiao, EV Sicat, CC Abon, Jr.,*
*FE Mina, TV Soberano, EC Frediles, and MP Mananguit (CLSU-PhilSCAT)*

Grain quality evaluation is performed after the end of each cropping season to provide seasonal data on the grain quality of introduced Chinese hybrid rice lines and PhilSCAT-developed lines, which were planted at PhilSCAT demonstration farm during the wet and dry seasons. Preliminary yield trials from 2012 to 2015 were evaluated based on milling potentials, and physicochemical and sensory characteristics. Milling potentials were evaluated by milling the samples using laboratory-type milling equipment and calculating their yield. Chalky grain percentages were determined by manual separation of chalky grains and subsequent weighing. Grain size and shape were determined by using an image-analysis software. Moisture contents were determined by oven-drying, gelatinization temperatures by alkali-spreading values, amylose contents by spectrophotometry, and crude protein contents using the Kjeldahl method. Samples for sensory evaluation were submitted to the Rice Chemistry and Food Science Division of PhilRice for sensory characteristic identification.

Results showed that the Chinese hybrid rice lines and PhilSCAT-developed lines have grain qualities comparable with local inbred and hybrid rice varieties, in terms of brown and milled rice yields, and physicochemical and sensory characteristics.

*Keywords: Chinese hybrid rice varieties, Chinese hybrid rice lines, grain quality evaluation, physicochemical characteristics, PhilSCAT, preliminary yield trials*

# Characterization of $F_2$-Derived Lines of Sticky Rice under Irrigated Lowland Condition

*PJ Alvaran, JA Nicolas, VA Cinense, and MP Astejada (CLSU)*

Agro-morphological characterization of nine breeding lines (CLH234-1, CLH155, CLH163, CLH83-3, CLH144, CLH296, CLH82, CLH298 CLH234) was conducted at the Research Experimental Station of Central Luzon State University during dry season (DS) 2014 and wet season (WS) 2015. All lines were found to be similar in terms of leaf blade pubescence (glabrous); basal leaf sheath color (light green); ligule color (white); ligule shape (cleft); collar color (light green); auricle color (light green); stigma color (white); secondary branching of panicles (heavy); panicle type (intermediate); secondary branching of panicles (heavy); panicle axis (droopy); sterile lemma color (straw); culm strength (strong); and panicle threshability (easy). Most lines produced 9-10 productive tillers with shorter stature (99.17-105.23 cm), shorter panicles ((24.05-26.35 cm), higher percent fertility (78.10-84.72%) and shorter maturity (93-108 DAS) during DS than in WS. The lines generally yielded higher (4.21-4.87 t/ha) during DS than in WS (2.58-3.73 t/ha) and were significantly higher than the check in both seasons except for CLH 83-3 during WS. Lines CLH 155, CLH 234-2, CLH 298, CLH 296 and CLH 234.-1 had high milling recovery (MR), 66.00-69.00% (Grade I) while CLH 234-2, CLH 298, CLH 296, and CLH 163 had head rice recovery (HR) of 57.10-70.20% (premium). Brown rice length was extra long to long; brown rice shape, medium to slender; 100-grain weight, 2.18-2.91g; and seed coat color, white. For eating quality (stickiness, tenderness, softness and aroma), CLH 144 was rated highest. This characterization may help breeders in identifying useful traits, which can be used as bases in selecting superior genotypes that have the potential to become a variety/ies or as a source of genetic variability that could be exploited for present and future breeding programs.

*Keywords. characterization, $F_2$-derived, sticky, irrigated lowland.*

# IR10M300: The First High Zn- Rice Recommended for Commercial Release in the Philippines

*BPM Swamy, R Russell, MAI Asilo, and A Amparado (IRRI)*
*EC Arocena, HT Ticman, and MV Chico (PhilRice CES)*

The World Health Organization estimates that over 60% of Asians is at risk of Zinc (Zn) deficiency. In the Philippines, more than 30% of the population is at risk of Zn deficiency. Zn deficiency causes stunting, diarrhea, and impaired immune system. The commercially available rice varieties are poor sources of vitamins and minerals in their polished form. Biofortification of rice with improved grain Zn is among the most sustainable and feasible approaches to tackle micronutrient deficiency in the Philippines. The International Rice Research Institute (IRRI) in collaboration with PhilRice is developing rice varieties with increased Zn concentrations in the milled grains and having high yield and desirable grain quality traits.

Eight high Zn rice breeding lines, MS13 (Zn check) and PSBRc82 (Yield check) were evaluated in the National Cooperative Tests-Special Purpose from 2014WS to 2015 WS. Overall performance showed that high Zn rice line IR10M300, recorded an average yield of 4.7t/ha with a 22% yield advantage over the micronutrient check MS 13 (3.8t/ha) but with comparable grain-Zn content (19.6 ppm). As compared with PSB Rc82 (5.0t/ha), its yield is lower by 7% but had an average Zn increment of 4.1 ppm (15.5ppm). IR10M300 was comparable to PSBRc82 in flowering date, plant height, and tillering ability. It has better resistance to blast, sheath blight, and green leaf hopper. The grain quality traits of both IR10M300 and PSBRc82 are similar with intermediate amylose content, gel consistency, and gelatinization temperature. The high Zn rice line IR10M300 has been recommended for release in the Philippines.

*Keywords: bio-fortification, micronutrient, micronutrient-malnutrition, variety, zinc deficiency*

# Isolation and Identification of Lignin-Degrading Bacteria and Screening for Low-Lignin Rices Suitable for Bioethanol Production

*RL Ordonio, JA Cruz, and TC Fernando (PhilRice CES)*

Rice is the staple food in the Philippines and its culture inevitably produces a lot of lignocellulosic biomass. Efficiently utilizing this biomass first requires the degradation of lignin, which encases cellulose fibers, hence, impeding saccharification. This study aims to identify local bacterial strains that can degrade rice lignin and to screen for rice suitable for bioethanol production to address global warming and climate change.

Rice lignin-degrading bacteria were isolated from carabao/cow manure collected. Profiling of elite rice varieties for lignin content was done using Safanin-O solution to stain the midsection of the first internode of 27 released varieties (3 plants/variety). Photo documentation was made under a fluorescence microscope. To indirectly measure lignin content, the images were analyzed using image software to determine and compare the lignified areas.

Under the study, 16 lignin-degrading bacteria were isolated, 9 of which were found to be thermophilic and these were mostly gram negative and coccus in shape. Biochemical tests showed that of the 9 isolates, 7 were positive for IAA production and 2 (6R-4 & 3-R-2-Sp) were able to solubilize phosphorus. 6R-4 was also the only isolate found to hydrolyze starch, indicating its usefulness for rice biomass degradation and saccharification. Moreover, siderophore production was detected from 6R-4 on CAS agar media, indicating that it can be used to improve soil fertility and act as a biocontrol agent. Of the 9 isolates, isolate 3-R-2-Sp was identified as *Bacillus amyloliquefaciens*, while another one was recognized as *Bacillus cibi* using the Biolog Gen II system.

Results demonstrate that carabao/cow manure hosts a variety of interesting lignin-degrading bacteria that can potentially be used in bioethanol production from biomass. We also found that rice vary in terms of lignin content across varieties. Testing our bacterial isolates with these varieties will reveal important factors governing lignin degradation.

*Keywords: rice biomass, lignin content, lignin-degrading bacteria, climate change, manure*

# Physicochemical Properties, Proximate Composition, and Antioxidant Activity of Popular Traditional Rice Varieties in the Philippines

*GA Corpuz, AJP Anies, HM Corpuz, HF Mamucod, and MV Romero (PhilRice CES)*

Traditional rice varieties, which include pigmented and aromatic rice, are known for their eating quality. They have also been reported to possess health-promoting properties. Despite this, the utilization of Philippine traditional rice varieties as popular food items has not been fully explored. To fully characterize these rice, popular white, red and black rice varieties from different provinces were evaluated for physicochemical properties, proximate composition and antioxidant activity. Amylose content of traditional rice varieties ranged from 3.42% (very low) to 23.34% (intermediate). Crude protein of unpolished white, red, and black rices ranged from 6.89 to 10.11%, 6.81 to 9.12%, and 6.12 to 9.03%, respectively, while crude ash ranged from 0.83 to 1.66%, 0.91 to 1.77%, and 1.00 to 1.84%. Highest crude fat content was observed for Tomindog (3.8%) in white, Denorado (3.75%) in red, and Tapol (3.25%) in black rices. Crude fiber ranged from 0.53 to 1.20% for white rices, 0.60 to 1.25% for red rices, and 0.72 to 1.40% for black rices in unpolished forms. Polishing significantly reduced the proximate composition of white, red, and black traditional rice variety. Total anthocyanin content of the unpolished black rices ranged from 43.25 to 3034.02% mg/kg, with Tapol as the highest. Lower anthocyanin content was observed for unpolished white rice (10.81-41.09 mg/kg) and unpolished red rice (6.49-598.30 mg/kg). Total phenolic content (TPC) ranged from 0.40 to 0.93 mg gallic acid equivalent (GAE)/g for white rices, 0.40-0.45 mg GAE/g for red rices, and 1.04-7.40 mg GAE/g

for black rices, Tapol had the highest TPC. Based on DPPH radical scavenging assay, the highest total antioxidant activities were observed in Pinili (92.45%), Dinorado (92.79%), and Black Rice M (90.51%) in white, red, and black rices respectively in unpolished form. Similar to proximate parameters, significant amounts of anthocyanins, phenolics, and antioxidants were also lost upon polishing. This study shows that in addition to good quality protein and relatively high proximate composition, local traditional pigmented rice varieties have high antioxidants which can inhibit the formation or reduce the amounts of reactive free radicals. Aside from being potential parents for the development of new rice varieties with excellent eating and nutritional qualities, these traditional rice varieties can be commercialized as high quality rice in the world market.

*Keywords:  traditional rice varieties, pigmented rice, amylose, proximate composition, anthocyanin, phenolics, antioxidants*

## CONCURRENT SESSION 4

## Targeting Rice Security through Bridging Rice Yield Gap: An Analysis of the Yield Gap and Economic Efficiency in the Philippines

*MGC Lapurga, JC Beltran, WB Collado, AC Litonjua, IA Arida, and FH Bordey (PhilRice CES)*

Rice yield in the Philippines varies across provinces, ecosystems, and years. It lags behind yields obtained in intensively cultivated and irrigated areas in other Asian countries. Hence, its is imperative to understand the causes of yield variations across provinces and countries. In this study, frontier analysis was applied to the data from the '*Benchmarking the Philippine Rice Economy Relative to Major Rice-producing Countries in Asia*' study, and the 'Rice-Based Farm Households Survey (RBFHS)'.

Results suggest that among the input variables, seed, herbicide, and machine rent are observed to be yield-increasing while insecticide is yield-decreasing. Rice farming in irrigated areas in Indonesia has 63% higher yield than the Philippines (*ceteris paribus*). Similarly, rice yield in Vietnam is 51% higher, China 36%, and Thailand 13%. Yield was also higher by almost 16% during high-yielding season. Across countries, yield on hybrids were 29% higher than inbreds. In particular, average yield of hybrid rice in the Philippines during DS is 7.20 t/ha, 5.28 t/ha for tagged and 4.13 t/ha for farmer seeds. Farmers who attended rice production related training (2008-2012) or those who obtained at least secondary education have higher yield than farmers without training or those who only finished elementary schooling. Thus, improving knowledge of farmers can be an important strategy to enhance yield in the Philippines.

Using the RBFHS data, results revealed higher average technical efficiency of farmers during DS (75.17%) than WS (72.71%). Regression estimates suggest that the amount of nitrogen, technical efficiency, fertilizer split, season (1=DS), and interaction of seed quantity and crop establishment method have significant positive effects on yield.

Narrowing rice yield gaps between potential and actual yields is a good approach to increase farm productivity and income, and eventually contributes to Philippine rice security.

*Keywords: yield gap, technical efficiency, allocative efficiency, economic efficiency, rice farming*

# Socioeconomic Impact of Adopting Rice Combine Harvester in the Philippines

*IA Arida, JC Beltran, FH Bordey, IR Tanzo, RZ Relado, RB Malasa,
and MJT Antivo (PhilRice CES)*

This study assessed farmers' perception and level of awareness on combine harvesters in five major rice-producing provinces. Determinants of combine adoption were identified using treatment effects model estimation. Combine harvester's adoption impact on productivity and profitability were assessed through costs and returns, and partial budget analyses, using DS and WS 2015 survey data. The study also determined the social welfare effects of this technology adoption through focus group discussions (FGDs) and key informant interviews (KIIs). In 2015, FGDs were conducted among four groups of participants that include farmers who availed combine services, farmers who have never used combine, agricultural technologists, and farm laborers or *landless farmers*. KIIs were also conducted to elicit information from *cabecillas*, RCH service providers, paddy traders, and rice millers. Results from these activities showed that, overall, rice farmers and farm laborers believed that it is time for the government to promote the technology. This was recommended not only due to the combine harvester's advantages in rice farming, but as well as for the government to take action on providing alternative means of livelihood to the affected displaced laborers. Preliminary results of the 2015 DS data also showed that 70% of farmers' awareness on combine generally started in 2013. Main reasons for adoption include fast performance and convenience that it provides to farmers, reduction in labor cost, non-availability of manual harvesters, credit tied-up with combine harvester service providers, among other factors. Partial budget analysis of 2015 DS data also showed positive effects of using combine that includes reduction in costs of labor on harvesting and threshing, sacks and twine, food, and hauling from farm to road. In contrast, adverse effect includes increased machine rent, specifically on combine. Generally, partial results showed about 20% difference in net income between usage and non-usage of combine, favoring farmers who used the technology. Similarly, labor requirement using combine was found to be 83% lower compared with non-users.

*Keywords: combine harvester, rice production, profitability, social welfare*

# State of Farm Mechanization of Irrigated Lowland Rice in Region XI

*JC Escario, M Pinohan, and D Langahin (DA-RFO 11)*

The project aimed to provide an updated regional profile of the level of mechanization of Region XI for the proper planning, identification, and allocation of interventions for irrigated lowland rice. It is important that there is reliable information on the degree of farm mechanization in rice-producing areas to formulate effective and sustainable program for mechanization. The survey was conducted using the five 5-year inventory of the DA RFO XI – Rice Mechanization Program and was individually validated. Farmer-beneficiaries were interviewed. Privately owned machins were also surveyed by tapping the local government units, irrigators association and cooperatives. Farm operations considered were land preparation, crop establishment, crop care and maintenance, harvesting and postharvest operations. It covers six provinces, namely: Davao del Norte, Davao del Sur, Davao Oriental, Davao Occidental, Compostela Valley, and Davao City. Results for Davao del Norte showed that among the farm activities, postharvest operations were already mechanized at 35.09%, comprising greater percentage was threshing at 59.8%. Planting operation had the lowest mechanization percentage at 0.45% followed by harvesting, crop maintenance, and land preparation with 14.47%, 17.51% and 32.47%, respectively. In all cities or municipalities in Davao del Norte, Tagum City had the highest level of mechanization with 3.06 hp/ha. In terms of land area, Carmen has the greatest actual mechanized area covering 1,104 ha with 0.34 hp/ha mechanization. Talaingod had the lowest mechanized land area but has a level of mechanization of 2.4 hp/ha.

*Keywords: farm mechanization, DA-RFO XI, rice mechanization program*

# Rice Value Chain Analysis in the Western Visayas

*JA Araquil, Sr., EL Alicante, GG Gabinete, and JA Brillion (West Visayas State University)*
*MAS Oren (DA-RFO 6)*

This study was conducted to determine the present status of rice production and marketing in the region, and determine the value added by farmers and traders in the rice value chain. Analysis of the income share of farmers and traders and their value added contribution was conducted using a cavan of palay as basis. Income share was 63.2% for farmers and 36.8% for traders. This share in net income, however, is disproportionate in favor of the traders. In terms of expenses, the study found that a farmer spends 77.9% (₱367.75) for a cavan of palay while traders only spends 22.1% (₱104.46). Furthermore, production period for farmers lasts more than 3 months, while only weeks for traders. In terms of value added to palay, results showed that farmers can produce palay valued at ₱674.96/cav with ₱367.75 production cost/cav during the first cropping season.  The traders raise the value to ₱950.93 after processing and milling, adding ₱275.97 for every cavan of rice. Of this value added, however, ₱104.32 represents cost to the traders, giving them a net income of ₱171.65.  Farmers cited climate change, more specifically inadequacy of water, as a prevalent problem. Traders mentioned about low selling price of milled rice and competition with imported rice.

*Keywords: rice value chain, value added, rice farming, rice trading*

# Baseline Characterization of PhilRice Mindoro Satellite Station

*JIC Santiago, CG Yusongco, JC Beltran, and  RZ Relado (PhilRice CES)*

PhilRice aims to expand its R&D activities in Region IV-B by establishing a new satellite station in Sta. Cruz, Occidental Mindoro. Determining the socioeconomic characteristics and current production practices of the farmers is valuable in designing project interventions aimed at increasing rice production and farm income in the region. This paper profiles the rice production system in Occidental and Oriental Mindoro. Specifically, it describes production and marketing practices, cost and profitability, technology awareness and adoption, and changes in the farming landscape. A baseline survey was conducted in select municipalities of Occidental and Oriental Mindoro. A sample of 100 respondents from the top rice-producing barangays in each province were interviewed in DS 2015 using a structured questionnaire.

Results showed that yield levels in both provinces are above the national DS 2015 average (4mt/ha). High adoption rate of high quality seeds was observed. However, awareness and adoption of some recommended practices and technology such as seeding rate, and use of drumseeder, leaf color chart (LCC), and minus-one element technique (MOET) were low. High adoption of combine-harvester was also observed although a few still harvest manually. Also, some preharvest activities were being done manually resulting in high labor input, thereby increasing production cost. Hired labor, land rent, and fertilizer represent the biggest share in the total cost. Rice productivity and profitability in the area can be improved through mechanization, adoption of lower seeding rate, appropriate application of fertilizer, and adoption of other recommended farm practices.

*Keywords: Mindoro satellite station, rice, yield, cost, profitability, rice production*

# On-farm Survey on Dry Direct-Seeded Rice in the Drought-prone Areas in Pangasinan

*H Ohno, N Banayo, C Bueno, and Y Kato (IRRI)*
*ED Gagelonia and EG Bautista (PhilRice CES)*

In the Philippines, around 30% of harvested area is still under rainfed, and the yield is low compared with irrigated areas. To improve and stabilize productivity in rainfed areas, it is imperative to look into cultivation methods aside from varietal selection. Dry direct-seeded rice (DSR) has recently been considered as among the options to address water and labor shortage. DSR on-farm demonstration and on-station experiments are ongoing to determine the effects of newly released drought-tolerant varieties and mechanization relative to conventional variety and method. In Umingan, Pangasinan, where rainfed is larger than irrigated areas, it has recently been observed that farmers are shifting from transplanted to DSR. This study aimed to compare the agronomic performance of two rice varieties, NSIC Rc348 and PSB Rc10, in DSR culture. On-farm trials were participated in by 22 farmers, and rice was grown under rainfed lowland conditions. In conjunction with the trial, farmer interviews were conducted to identify how they manage their fields for DSR culture. Preliminary results show that there are differences in knowledge and management relating to DSR among farmers. It is important to consider the prevailing situations of farmers in developing the appropriate DSR technology for wider acceptance.

*Keywords: dry direct-seeded rice, DSR, drought-prone environment, Pangasinan*

## CONCURRENT SESSION 5

# Causes of Cooked Rice Spoilage and Practical Ways of Retarding It

*EH Bandonill, MJC Ablaza, OC Soco, and GG Corpuz (PhilRice CES)*

Cooking rice once in the morning enough for the whole day's consumption is a common practice among Filipino households. In the absence of a refrigerator, cooked rice is usually kept at ambient temperature. However, in some instances, cases of food poisoning caused by the consumption of unrefrigerated cooked rice have been reported. To know the possible causes of cooked rice spoilage and discover practical ways of retarding it, the contribution of several factors (amylose content [AC] and gelatinization temperature [GT] combination, rice ageing, amount of rice cooked per batch, periodic reheating, different storage temperatures and reheating practices) in hastening/retarding cooked rice spoilage was investigated using IR64 and NSIC Rc160 varieties. Microbial load and sensory index (SI) of the samples were determined. Results showed that rice samples having high AC - low/intermediate GT (hard-textured); aged for a longer period (12 months); used lower amount in every batch of cooking (300g); reheated at 6 hour interval; refrigerated after cooking, and reheated through steaming had higher sensory index; were spoiled at a later period; remained acceptable at 21h; had extended SI up to 42h; had acceptable SI up to 4 days, and was more cohesive and moist, respectively. In contrast, samples with low AC - low to intermediate GT (soft-textured), aged for a shorter period (2 months), used higher amount in every batch of cooking (500g); unrefrigerated, and unreheated had high microbial load and had slightly perceptible to perceptible off-odor after 18h, were spoiled at a shorter period (15h), had acceptable SI up to 1 day, and less cohesive, respectively. Based on these results, it was concluded that soft-textured and freshly harvested rice is more prone to spoilage than hard-textured and aged sample; cooking greater amounts of rice has more tendency to spoil, among the samples tested; periodic reheating and storing of cooked rice samples at refrigerated temperatures can retard the spoilage up to 4 days, and reheating makes rice comparable with the quality of freshly cooked rice.

*Keywords: microbial load, sensory index, spoilage, reheated, refrigerated, off-odor*

# Antioxidant Capacities of Raw and Cooked Forms of Some Philippine Vegetables

*RV Manaois, JEI Zapater, and AV Morales (PhilRice CES)*

Plant antioxidants are gaining popularity due to their reported health benefits and easy incorporation into the diet. This work assessed the antioxidant capacity of vegetables commonly grown in rice-based farms in the country. This study evaluated the total phenolic content (TPC) and antioxidant capacities of 21 raw and boiled vegetables, comprised of 7 botanical fruits, 5 leafy and salad vegetables, 2 legumes, 2 tubers, 1 edible stalk, 1 edible mushroom, 1 rhizome, 1 cereal, and 1 botanical flower. The 2,2-diphenypicrylhydrazyl (DPPH) radical scavenging activity and 2,2-azinobis(3-ethylbenzothiazoline-6-sulfonic-acid)-diammonium salt (ABTS) cation-radical scavenging activity assays were used in the evaluation. The TPC of the raw vegetables ranged from 0.11 to 31.78 mg gallic acid equivalents/g dry weight sample, with the highest values recorded in jute leaves, eggplant, squash flower, chili, mustard, *pechay* and green pepper. DPPH values of the raw samples ranged from 1.24 to 239.32 µmol Trolox equivalents (TE)/g, while ABTS values ranged from 2.10 to 136.84 µmol TE/g. Raw jute, eggplant, upland *kangkong*, green pepper, ginger, and mustard consistently displayed the highest antioxidant capacities as measured by DPPH and ABTS techniques. Taro tuber and *okra* also exhibited high DPPH scavenging activities, whereas pechay also possessed high ABTS scavenging activity. Boiling generally reduced the TPC, DPPH and ABTS activities of the vegetables. The TPC values of raw and cooked vegetables were highly correlated with their DPPH (r=0.931 and 0.892, respectively) and ABTS (r=0.941 and 0.828, respectively) antioxidant activities). Increasing the consumption of these vegetables could help consumers maximize their dietary antioxidant intake.

*Keywords: vegetables, ABTS radical-cation scavenging activity, antioxidant capacity, DPPH radical scavenging activity, total phenolic content*

# Rice-based Product Concepts with Health and Nutritional Value: The Experts' Perspective on Consumer Trends

*JF Ballesteros, RA Ramos, and RV Manaois (PhilRice CES)*

Development of rice-based products results to profitability in rice-producing communities, thereby increasing their income and improving their nutritional status. This study aimed to develop rice-based products concepts with health and nutritional value based on the current market trends on health and wellness. Three (3) focus group discussions were conducted to explore views and perception of 24 experts with an average of 13.18 years of experience in the field of product development, marketing and distribution, nutrition and health from both the public (academia, research organizations, regulatory bodies, health agencies) and private sectors (food manufacturing and service companies, bakeshop company, chamber of health industries, marketing and distribution company, non-government organization). Experts perceived that health and wellness were mostly associated with concepts of food, diet and nutrition (27.7%). The most consumed products in snack, meal, beverage, beauty and hygiene, and nutraceuticals product categories were crackers and chips (23.1%), restaurant and fast food meals (57.3%), and ready-to-drink coffee-based drinks (12.8%), facial care products (16.4%), and food supplements (46.1%), respectively. Among the rice-based product concepts perceived by experts to have high market potential, the top five categories generated were rice-based flour food products (24.3%), rice-based personal care or hygiene products (13.5%), rice drinks or beverages (12.2%), special purpose rice products (8.1%), and instant rice meals (6.8%). Convenience, health, and beauty are the key consumer trends to be considered in developing rice-based products with high market potential.

*Keywords: consumer trend, focus group, health, nutrition, product development, rice-based products*

# Encapsulation of Anthocyanin from Black Rice Bran Extract using Chitosan-Alginate Nanoparticles

*JPA Samin and RM Bulatao (PhilRice CES); JR Salazar and JJ Monserate (CLSU)*

Anthocyanin, a group of flavonoids, has been reported to possess antioxidant, anti-inflammatory, antibacterial, and anticancer properties. Black rice varieties have high anthocyanin content. However, these compounds are highly reactive, which limits its applications. This study aimed to extract and encapsulate anthocyanin from black rice bran using chitosan-alginate nanoparticles. The anthocyanin was extracted from *Ominio* bran by defatting it with n-hexane, followed by soaking with 85% acidified ethanol. The crude anthocyanin extract (CAE) was freeze-dried and encapsulated by chitosan-alginate using the pre-ionic gelation and polyelectrolyte complex formation. The treatments applied were as follows: $T_0$-blank, $T_1$-10 mg CAE, $T_2$-20 mg CAE, and $T_3$-30 mg CAE. The resulting capsules were characterized in terms of chemical properties, surface morphology, particle size, encapsulation efficiency (EE), and DPPH radical scavenging activity. The CAE from *Ominio* bran was successfully encapsulated by the combination of alginate and chitosan polymers with a mass ratio of 100:10 as shown by the SEM images and FTIR spectra of the anthocyanin-loaded chitosan-alginate particles. Among the treatments, $T_3$ had the highest EE (68.92%) while $T_2$ had the lowest (56.34%). In addition, $T_3$ showed the highest % DPPH radical scavenging activity with a value of 38.32%. Ascending particle size was observed for $T_0$ (358.5 nm), $T_3$ (467.87 nm), $T_1$ (572.3 nm), and $T_2$ (635.9 nm). Nevertheless, all anthocyanin-loaded capsules were found to be nanocapsule (<1000 nm). This study suggests that chitosan-alginate nanoparticles can be a good encapsulating material for anthocyanin.

*Keywords: Anthocyanin, rice bran, pre-ionic gelation, polyelectrolyte complex formation, encapsulating material, encapsulation, chitosan-alginate nanoparticles*

# Survey of Freshwater Aquatic Fauna Used as Food in Rice-Based Ecosystems in Luzon

*MCV Newingham (PhilRice CES); M Halwart (FAO-UN)*
*EA Abella, EM Vera Cruz, and TA Abella (CLSU)*

The study was conducted to survey the available freshwater fauna being utilized as food in rice-based ecosystems, particularly in selected rural areas in Nueva Ecija, Bulacan, Pampanga and Ifugao. The study comprises thorough documentation, identification and validation of aquatic life forms by manual capture method from the source. Participatory Rural Appraisal (PRA) was employed to enable the people to participate in identifying threatened or introduced species through timeline and identify the threats to the ecosystem they depended on for food and livelihood. A total of 406 individuals, including eight elders, participated in the PRAs. The group listed 45 freshwater fauna species prior to the confirmatory survey. The list included 25 species of fish (eight indigenous), nine mollusks, five crustaceans, one insect, one amphibian, and four reptiles. However, after the confirmatory survey, only 35 species from the list were documented consisting of 23 species of fish, five species of mollusks, five species of crustaceans, and one species each of amphibians and reptiles. Threats to the ecosystem were also identified based on survey participants' perceptions. Further monitoring and innovation is necessary to conserve these economically important rice-based fish species.

*Keywords: rice-based ecosystem, freshwater species, participatory rural appraisal, conservation, food sufficiency*

# Achieving Rice Biopharma Readiness in the Philippines: Challenges and Opportunities in Biotech Research for Development

*Amor A. San Juan, PhD (amor.san_juan@upd.edu.ph)*

Revolutionary science heralds the advent of biopharmaceutical, a medicinal drug from natural resources that is produced by biotechnology. A future-ready Philippines indicates an outlook of adaptation towardthe era of transformation. Focused on developing health research, the Philippines has emerged into an evolving landscape of biotechnology. However, harnessing the full potential of botanical biopharming technology requires a consensus effort among scientists, policymakers, and business people. Research on rice biopharmaceutical in the country is new, and we have to learn from the success of B.t. corn and yet, the hurdles of B.t. eggplant and golden rice. Engineering rice towards biopharmaceutical drug development has a great potential to create medicines for humans at low production cost and less side effects. In this paper, the "pull and push" factors to achieve rice biopharmaceutical readiness in the country is discussed.

*Keywords: biopharmaceutical, drug discovery, genetic engineering, rice*

**CONCURRENT SESSION 6**

# Profile of Agricultural Extension Workers in the Philippines

*DA-Agricultural Training Institute (ATI)*

The country's agricultural extension workers (AEWs) are at the forefront in providing advisory and related services to farmers. As such, a clear understanding of their profile is central to efforts on improving the current agricultural extension system. The AEW profile to be presented includes those from the provincial, municipal, and city agriculture and veterinary offices nationwide. Data from a survey of 9,977 AEWs conducted from November 2014 to 2015 showed that of the 16 geographical regions, Region 3 has the most number of extension workers (1,167); while at the provincial level, it is Pangasinan with 335 AEWs. There are slightly more female (52%) than male AEWs and the average age is 49 years old. The majority of the AEWs are married (81%), permanently employed (89%), and serving (57%) up to 10 barangays. Monthly salary rates of agricultural technologists vary, with those from first class municipalities receiving an average of P 6,500 more than their counterparts in sixth class municipalities. Based on commodity, there are around 2,394 AEWs (24%) focused only on rice. Management and leadership capacities seem to increase with number of years in service; while ICT literacy decreases with increase in age. The AEWs claimed to be least knowledgeable about Plant Breeding and Plant Pathology. Their top sources of information are fellow agriculturists, reading materials, and the TV. AEWs expressed the lack of travel allowance and generally low salary as major impediments in providing quality service to farmers. To improve extension services, the respondents expressed the need for additional trainings, structural adjustments, and policies that create more enabling mechanisms to support their extension functions.

*Keywords: agricultural extension, extension workers, extension system*

# Evaluating the 'Perceived' Effectiveness of Pinoy Rice

*Hanah Hazel Mavi B. Manalo (PhilRice CES)*

Pinoy Rice Knowledge Bank or Pinoy Rice, an online platform, aims at providing the users with a one-stop source of relevant and up-to-date information on rice and rice-based farming. The website was launched for the use of extension workers in 2010. In June 2015, the platform has undergone changes and started to cater to other stakeholders such as teachers, students, researchers, and progressive farmers. To improve the website, its newer version was evaluated.

The evaluation of Pinoy Rice aims to assess the website's perceived effectiveness using the following parameters: ease of use, attractiveness, comprehension, acceptance, relevance, and self-involvement. The atomistic theoretical approach was used in evaluating the website. Evaluation was done among the 23 agricultural extension workers, teachers, students, and researchers who accessed the website for the first time during the evaluation proper.

Evaluation results showed that the Pinoy Rice is perceived as user-friendly, attractive, acceptable, understandable, useful, and has adequate, updated, and accurate rice and rice-based farming information.

*Keywords: Pinoy Rice, website evaluation, knowledge bank*

# Information in Ink: The Relevance of PhilRice Knowledge Products in Print

*MG Layaoen, CA Frediles, MGM Nidoy, JGS Sarol, JC Berto, and JD Villaflor (PhilRice CES)*

External program reviewers of the Philippine Rice Research Institute (PhilRice) suggested that the Institute's knowledge products (KPs) be evaluated to establish the relevance of government initiatives on the lives of its stakeholders. The reviewers wanted empirical evidence on PhilRice's contribution to the attainment of sectoral goals in agriculture as specified in the strategic plan. Thus, the study aims to explore the usefulness of the Institute's KPs on climate change and rice production as tangible manifestations of its research and development activities. It had three major components: the development of an evaluation mechanism for PhilRice KPs; documentation, compilation, and analysis of users' feedbacks; and identification and application of key areas for improvement. Data collection sites were rice-farming communities, one each, from the provinces of Aurora (Luzon), Leyte (Visayas), and Sarangani (Mindanao). The evaluation protocol developed through the project, along with the work plan, guided the implementation of activities. Comprehensiveness of content, understandability, readability and attractiveness, sensitivity to cultural norms and gender, value to rice production, and areas for improvement were the criteria used for evaluation. Results of the evaluation showed that farmers still value information from printed KPs. Content is comprehensive but requires some updating in terms of format and data. Generally, they consider the materials a useful ally in rice farming, especially in the advent of climate extremes. Recommendations on content and format from the farmer-informants and other stakeholders interviewed were processed and analyzed. The last component involved the revision of the KP based on the recommendations gathered from the evaluation. Subject matter specialists on climate change and rice production were requested to update the contents based on the suggestions while the production team worked on the aesthetics and other necessary revisions. The study addressed concerns relating to the need to evaluate PhilRice KP and improved it based on the needs and preferences of its intended audience. The evaluation will continue for other KPs and communication products and services.

*Keywords: knowledge products, print media, evaluation, farming information, evaluation protocol*

# Are Youngsters Agri-inclined? Positive Answers from the Infomediary Campaign

*JA Manalo IV, RT Hallares, and JD Villaflor (PhilRice CES)*

Since 2012, PhilRice has been engaging young people in agriculture through its Infomediary Campaign. Over the years, high school students from participating schools have been sending text messages to the PhilRice Text Center. This presentation peeks into the texting behavior of young people relating to searching for information on agriculture, particularly on rice. We did content analysis of all the text messages from our infomediaries (n=4,250) from May 2012 to June 2016. Data collected are presented using frequencies and percentages. We found that girls (62.3%) text more than boys (37.7%). Peak months of texting are June, July, and August. As topics of interest, seeds/ varietal information are almost the same between the infomediaries and farmers. Hence, we are inclined to believe that this is an indication of successful infomediation. Northern Samar, Tarlac and Ilocos Norte are the top three provinces with the most number of text messages sent. Results of this study can serve as productive inputs in successfully engaging young people as information providers in their rice-farming communities.

*Keywords: Infomediary Campaign, Text Center, Youth, Information-seeking*

# Produce More with Sorjan

*RG Corales, JM Rivera, IG Pineda, and PDO Roman (PhilRice CES)*

Sorjan cropping system is an indigenous technology composed of series of raised beds alternately placed between sinks or canals. It is a resource-use-efficient production system that could address food and nutrition sufficiency, higher income, and climate resiliency.

PhilRice evaluated the potential of sorjan production system in increasing productivity and income in irrigated rice environment.  The sorjan model was established in a 2,000 m2 area. Raised beds 1.5m wide and 0.3-m high for vegetable and cash crop production, and sinks 3m wide for rice and gabi production were alternately constructed. Pond refuge 1.5m wide and 1.2m deep were constructed around the area for fish production. Trellises for climbing vegetables were constructed above the pond refuge.

Salad and leafy vegetables, pinakbet vegetables, cucurbits, legumes, and corn were proven adaptable for sorjan production.  Climbing vegetables planted on the trellis were bottle gourd, ridge gourd, and bitter gourd. Rice (NSIC Rc160) planted on the sink yielded 5 t/ha, while the taro had 30 t/ha. The fish component is for further evaluation because most of the fish were washed out during the heavy rains.

Sustainably growing different crops using the sorjan production assures the family with food and income in a more stable manner. Producing high-value crops like tomato, leeks, and lettuce in Sorjan raised beds during off-season fetches high price and income.

The sorjan production system is a good adaptation strategy for climate change because the pond refuge and sink can be used as water harvesting and storage mechanism in drought-prone communities. It can also tame flash floods in flood-prone communities. The raised beds can be used for growing crops in flood-prone areas and the impounded water for growing crops in drought-prone areas.

*Keywords: climate change, food production, resource use efficiency, Sorjan, water harvesting*

# Gasification Properties of Chopped Rice Straw

*AT Belonio, KCVillota, PRCastillo, and MJC Regalado (PhilRice CES)*

Rice straw forms the largest portion of rice biomass, which is almost equivalent to the weight of paddy. They are usually burned and left in the field to rot and decay. Gasifying rice straw can turn its potential energy into power, which can be used to fuel small engines commonly used by farmers in their farms. A 15-cm Ø test rig was built to determine the gasification properties of rice straw. Chopped rice straw from threshed panicles (RSTP) and stubbles (RSS) were subjected to the rig for analysis. The gasification properties of rice straw at an air/fuel ratio (AFR) where gas is combustible were considered in the tests. Gasboard-3100P syngas analyzer was used to determine the composition of gases at the predetermined AFR. The proximate and ultimate analyses of char produced were also obtained to determine the carbon sequestration potential of the char samples. Results show that RSTP and RSS produced combustible gases at an AFR of 0.565 to 0.677 and 0.970 to 1.081, respectively. The specific gasification rate of the samples obtained varies from 118.2 to 123.3 kg/hr-m$^2$ for RSTP, from 98.3 to 138.2 kg/hr-m$^2$ for RSS. The lower heating value of gas ranged from 346 to 470 kcal/m$^3$ RSTP, from 527 to 535 kcal/m$^3$ for RSS

*Keywords: Gasification properties, rice straw, carbon sequestration potential*

# Abstracts of Poster Presentations

**Theme 1**
*Rice germplasm and breeding for better yields, grain quality and nutrition, and resistance to biotic and abiotic stresses*

## Impact of PhilRice GEMS Database Upgrade

*MD Duldulao, MC Ferrer, LM Perez, XGI Caguiat, and MCV Newingham (PhilRice CES)*
*GO Romero (Monsanto Philippines Inc.)*

Upgrading the current database system of the PhilRice Genebank is inevitable to optimize its use in support to rice conservation and management. The old Germplasm Management System (GEMS) was revamped using a cross-platform relational database - *Filemaker Pro 12 Advanced* with enhancements on *MySQL* connections, layout design tools, script debugger, and security. *GEMS v2.0* was developed through redesigning the whole system architecture to adopt these new features of the advanced version. The *GEMS v2.0* run as a standalone database focused for internal use in the genebank operations. Three significant improvement of the system were made: 1) data validation, 2) automation procedures, and 3) barcoding technology. The new system can deliver significant impact in Genebank operational efficiency and consequently provide accurate, timely, and up-to-date information to breeders, researchers, and other stakeholders.

*Keywords: germplasm, relational database, automation procedures, barcoding technology, data validation*

## Hybrid Rice with Broad Resistance to Philippine Races of *Xanthomonas oryzae* pv. *oryzae (Xoo)*

*MC Garcillano, JD Caguiat, JOS Enriquez, and FP Waing (PhilRice CES)*
*KGD Waing (CLSU)*

Breeding and development of resistant cultivars has been the most effective and economical strategy to control bacterial leaf blight (BLB) caused by *Xanthomonas oryzae* pv. *oryzae* (*Xoo*). This study aimed to evaluate the introgressed resistance genes (*Xa4* and *Xa21*) in improved parent lines and $F_1$ hybrid PR40638H against the 10 most prevalent *Xoo* races in the Philippines, and to compare the morpho-agronomic characteristics of the original and improved parent lines and $F_1$. Polymerase chain reaction (PCR) assay using sequenced tagged site (STS) markers showed that the improved parent lines and $F_1$ hybrid contained *Xa4+Xa21*, whereas the original parent lines and $F_1$ hybrid contained only *Xa4*. At 14 days after inoculation (DAI), the improved parent lines and F1 hybrid introgressed with *Xa4+Xa21* exhibited resistance to moderate resistance to all isolates of *Xoo* with shorter lesion length (LL) comparable to IRBB52 that contained *Xa4+Xa21*. A significant difference was noted between the original and improved parent lines and hybrids in terms of disease reaction. The improved parent lines and hybrid have increased resistance to all the isolates tested, which was comparable to that of the resistant check containing *Xa4+Xa21*. This suggests that the introgression of the resistance gene *Xa21* was successful. Differences on morpho-agronomic traits between the original and improved lines were detected, but it could be minimized through further backcrossing. The improved parent lines could be used in hybrid line development while the hybrid PR40638H is ready to be deployed in BLB-affected areas.

*Keywords: PR40638H, Xa gene, gene pyramiding, Xanthomonas oryzae pv. oryzae (Xoo)*

# Rice Blast Disease Resistance Evaluation System at the PhilRice CES

*MLB Palma, MC Garcillano, JA Poblete, JP Rillon, and JT Niones (PhilRice CES)*

Incorporating resistance genes against the devastating rice blast disease (*Pyricularia oryzae*) has been a vital component in the PhilRice genetic improvement program. Thus, an evaluation system for rice blast resistance plays a crucial part in the selection of breeding lines with true resistance against the disease. At PhilRice CES, screening and evaluation of breeding lines for rice blast resistance are established in a blast nursery and in a controlled blast screening facility. For the rice blast nursery evaluation, 10g of seeds per entry are planted in a 50cm row with 10cm spacing. In every 10 rows of test breeding lines, 1 row each of the following are planted: IR50 (susceptible check), PSB Rc10 (resistant check), and IR42 (local susceptible check). Moreover, prior to establishment, IR50 line, which is highly susceptible to rice blast, is planted and maintained within the periphery to ensure continuous source of inoculum and high disease pressure. Disease scoring is done 30 days after sowing, following the National Cooperative Tests manual for rice evaluation scoring for rice leaf blast resistance on a 1–9 disease scale. Accordingly, the resistance spectrum of select resistant breeding lines is determined by inoculating with standard differential blast isolates with known pathogenicity to known rice blast-resistant genes. Artificial inoculation is done under the controlled blast screening facility. Inoculated $(1x10^5$ spores/ml) plants are placed in a dew chamber for 18-24 hours and subsequently placed in a mist room (80-90%RH; 25-30°C) for disease development and scored at 6 - 7 days after inoculation. The disease reaction is classified on a scale of 0–5: 0-3 (resistant) and 4-5 (susceptible). The rice blast resistance screening and evaluation system allow us to identify breeding lines with broad spectrum and true resistance against rice blast disease.

*Keywords: rice blast disease, blast resistance, Pyricularia oryzae*

# Diversity and Adaptability of Traditional Rice Varieties in Occidental Mindoro

*XGI Caguiat, MD Duldulao, MIC Calayugan, MVG Embate, MC Ferrer, R Valdez, M Austero, and LC Javier (PhilRice CES)*

PhilRice Genebank aims to safeguard rice germplasm for present and future use. This vast reserve acts as a reservoir of novel traits that are key to development of superior rice varieties. A study was conducted to characterize and evaluate 30 *Tatak Mindoro* traditional rice varieties in Sta. Cruz, Occidental Mindoro using standard descriptors. Diversity analysis using unweighted pair group method with arithmetic mean (UPGMA) showed low diversity (0.16) for qualitative traits and moderate diversity (0.51) for quantitative traits. Higher variability was accounted for quantitative traits since these are easily affected by GxE interaction. Preliminary results showed 11 out of 30 TRVs can adapt to upland condition. Although these TRVs were collected from Occidental Mindoro a decade ago, not all can be reintroduced to the area. Climate change and shifting of cultural management are possible reasons for the unsuitability of the TRVs in the area. Diversity is vital to safeguard novel traits for direct and indirect users of the current and future generations, thus reintroduction is crucial to increase the diversity of currently cultivated rice varieties in the area.

*Keywords: diversity, qualitative traits, quantitative traits, simple matching, re-introduction*

# Promising Rice Varieties in the Pipeline

*TF Padolina, PAC Canilang, RC Braceros, EC Arocena, JM Niones, JF Pariñas, GM Osoteo,
JM Dancel, TA Alegado, MT Garcia, GD Santiago, JP Rillon, and EH Bandonill (PhilRice CES)*

Introduction of well-adapted and climate-resilient high-yielding rice varieties is in the right direction as far as food security goals are concerned especially for the highly productive irrigated lowland areas.  In May 2016, four high-yielding breeding lines were identified by the Rice Technical Working Group (RTWG) for further deliberation by the Technical Secretariat of the National Seed Industry Council (NSIC). Four advanced breeding lines: (PhilRice) PR36720-17-1-2-1 and PR37241-3-1-2-1-1;  (IRRI) GSR IR1-5-S6-S3-D1 and IR04A115 consistently yielded more than 5 t/ha, on average, either as transplanted or direct wet seeded rice, with a record high yield ranging from 9.0 t/ha to 10.8 t/ha. They are early-maturing (101 to 113 days) with <110 cm plant height.  Combined conventional and modern biotechnology process such as marker-assisted selection (MAS) with intensive phenotypic screening for biotic and abiotic stresses were used in developing these lines. They had intermediate to resistant reactions to biotic stresses like blast, bacterial leaf blight, sheath blight, stem borer, brown plant hopper, and green leafhopper. Additionally, they had low to intermediate amylose content, passed other grain quality standard parameters, and had high percentage acceptability compared with the eating quality check variety IR64. In the Distinctness, Uniformity, and Stability Tests (DUST), only slight seasonal variations in quantitative traits (traits measured by counts e.g.  plant height) were noted. For qualitative traits, only PR37241-3-1-2-1-1 had distinct purple color on margins, basal leaf sheath, ligule, collar, auricle, and apiculus in comparison with the green color of the other lines. Nucleus seeds of at least 10 kg/line were targeted in the Basic Seed Production (BSP) to serve as start-up materials for breeder seed production.

*Keywords: high-yielding rice, breeding line, Rice Technical Working Group (RTWG), National Seed Industry Council (NSIC), Distinctness, Uniformity and Stability test (DUST), Basic Seed Production (BSP)*

# Location-Specific Recommended Rice Varieties in the Philippines, 2013-2015

*TF Padolina, PAC Canilang, RC Braceros, EC Arocena, OE Manangkil, WB Barroga,
GM Osoteo, JF Pariñas, and JM Dancel (PhilRice CES)*

The need is high for high-yielding and location-specific rice varieties to effectively deal with climate change-related issues on rice production.  From 2013 to 2015, 9 location-specific rice varieties either as transplanted or direct-wet seeded for both dry and wet seasons, for irrigated lowland areas were approved for commercial cultivation. Released rice varieties, NSIC 2013 Rc308, NSIC 2014 Rc352, NSIC 2014 Rc356, NSIC 2014 Rc358 and NSIC 2014 Rc360 performed well under TPR with mean yield range of 5.0 t ha$^{-1}$ to 5.8 t ha$^{-1}$ and a maximum yield range of 8.2 t ha$^{-1}$ to 10.9 t ha$^{-1}$. NSIC Rc308 was recommended in Mindanao, NSIC Rc352 in Luzon, while NSIC Rc356, NSIC Rc358, NSIC Rc360 including NSIC Rc402 were recommended for cultivation in the Visayas. Under DWSR, NSIC 2015 Rc394, NSIC 2015 Rc396, NSIC 2015 Rc398, NSIC 2015 Rc402, and NSIC 2013 Rc308, showed yield performance ranging from 5.1 t ha$^{-1}$ to 5.5 t ha$^{-1}$ with a maximum yield range of 8.0 t ha$^{-1}$ to 14.0 t ha$^{-1}$. NSIC Rc308 and NSIC Rc396 were recommended in the Visayas while NSIC Rc394, NSIC Rc398 and NSIC Rc402 were recommended for Luzon. In terms of maturity, varieties recommended for TPR (NSIC Rc308, NSIC Rc352, NSIC Rc356, NSIC Rc358 and NSIC Rc360) matured from  111 to 118 days while those for  DWSR (NSIC Rc394, NSIC Rc396, NSIC Rc398, NSIC Rc402 including NSIC Rc308) had a maturity range of 105-107 days, 7-10 days earlier than TPR varieties. All these varieties were semi-dwarf (<110 cm, SES 5th Edition, June 2014). For grain quality characteristics, all varieties had intermediate amylose content (AC) except NSIC Rc396 with low AC; fair brown rice except NSIC Rc360 which had poor brown rice percentage; had grade 2 to premium milling potentials and passed grain quality standard parameters including eating quality as compared to the check varieties. In relation to pest resistance, NSIC Rc394, NSIC Rc396, NSIC Rc398, and NSIC Rc402 had resistance to white stemborer (WSB) in PhilRice Agusan while NSIC Rc308 (UPLB), NSIC Rc356 (PhilRice CES), NSIC Rc358

(UPLB), NSIC Rc360 (PhilRice CES, PhilRice Isabela and UPLB), and NSIC Rc398 (UPLB) were resistant to yellow stem borer (YSB). All rice varieties were intermediate to moderately resistant to other pests such as brown plant hopper (BPH) and green leaf hopper (GLH). For disease resistance, NSIC Rc360 had resistance to blast (induced) in PhilRice Isabela and UPLB; NSIC Rc356 and had resistance to bacterial leaf blight (induced) in PhilRice Midsayap while NSIC Rc396 in UPLB; NSIC Rc352 and NSIC Rc394 had resistance to sheath blight (induced) in PhilRice Isabela while NSIC Rc402 had resistance both in PhilRice Isabela and VSU. Yet, these rice varieties should not be planted in tungro-hot spot areas. Results of the Participatory Varietal Selection (PVS) of the NextGen project, conducted in on-farm trials in 15 regions identified NSIC Rc308, NSIC Rc352, NSIC Rc356, NSIC Rc358 and NSIC Rc360 as the preferred varieties in DS while for WS, NSIC Rc352, NSIC Rc358 and NSIC Rc360 were selected in 10 regions. Of the 9 varieties, 4 were bred by PhilRice, 3 from IRRI and 1 from UPLB.

## Genetic Crop Improvement of Select Rice Genotypes by Introgression of Effective Blast Resistance Genes in the Philippines

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Rice blast, caused by *Magnaporthe oryzae*, severely affects rice production both in the upland and irrigated ecosystems. The genetic variability and rapid evolution of the pathogen primarily cause the breakdown of host plant's resistance. In this study, blast resistance genes were pyramided into elite and high-yielding rice cultivars using conventional and marker-assisted breeding. Eight blast-resistant gene donors were used for genetic crop improvement: 4 monogenic lines (IRBL-9W, IRBLz5-CA, IRBLz-Fu, and IRBsh-S), 1 QTL donor (San Huang Zhan 2 [SHZ-2]), IR65482-4-136-2-2, Dacca 6, and Malay 2. Popular and high-yielding rice cultivars for genetic improvement were identified: NSIC Rc9, NSIC Rc194, PSB Rc10, Rc82, and PR34712-10-1-1-3-2*2. Two- and three-way crosses were used in pyramiding two or more blast R genes and QTLs including *Piz, Pi9, Pi40* and those from SHZ-2, Dacca 6, and Malay 2. Four advanced lines of PR 34712-10-1-1-3-2*2/SHZ-2 (F8) and 2 breeding lines of NSIC Rc9/SHZ-2//IRBLz-Fu in 2016 DS were introduced to multi-environment test (MET 0, 2015DS). These breeding lines were also evaluated for blast resistance in PhilRice-CES blast nursery using Maligaya race and found to have exhibited intermediate to resistant reaction to the rice blast pathogen. Three functional markers for rice blast were characterized and evaluated:  z565962 generated 267bp diagnostic to *Piz gene;* pBA14 showed 400bp diagnostic for *Pi9* and 9871.T7E2b; and CAPS marker produced 642bp for *Pi40 gene.* These PCR- based markers can be used in marker-assisted breeding for blast resistance of PhilRice. Development of genetic analysis of resistance of Malay 2 to rice blast is discussed.

## New Special Purpose Rice Varieties for Adaptation and Product Diversification

*RC Braceros, TF Padolina, EC Arocena, OE Manangkil, PAC Canilang, LR Pautin, JF Pariñas, and JM Dancel (PhilRice CES)*

From 2011 to 2015, 6 special purpose rice varieties were released: 3 Japonica types (NSIC Rc242SR [Japonica 2], NSIC Rc304SR [Japonica 3], and NSIC Rc414SR [Japonica 4]), 2 aromatics (NSIC Rc342SR [Mabango 4] and NSIC Rc344SR [Mabango 5]),  and 1 Glutinous (NSIC Rc21SR [Malagkit 5]).  Their average yield ranges from 3.0 to 6.0 t/ha with maximum yield range of 5.3 to 8.2 t/ha. Maturity ranges from 107 to 124

days, height from 84 to 116 cm, and productive tillers from 15 to 17. Amylose content was low for Japonica rice varieties, intermediate for aromatic rice varieties, and very low for the glutinous variety. All Japonica varieties have a wide spectrum of resistance to blast, bacterial blight, and sheath blight while intermediate to moderately resistant to white stem borer and yellow stem borer with high acceptability in their cooked form as compared with checks MS11 and IR64. Mabango 4 and 5 exhibited intermediate reactions to major pests and diseases in all sites, slightly aromatic when freshly cooked, and have high percentage acceptability compared with check NSIC Rc128. On the other hand, NSIC Rc21SR has an intermediate reaction to blast, stem borers, and hoppers, with slight aroma when cooked. The potential of these varieties in special niche markets is high owing to their value added traits, which could be utilized in product diversification. In 2016 DS, under the Participatory Varietal Selection (RVS) of the NextGenProject, these new special rice varieties were disseminated for further adaptation in 14 on-farm trials in Regions II, VII, IX, X, XI and XII. Japonicas 3 and 4, Malagkit 5, and Mabango 4 were developed by PhilRice, Japonica 2 and Mabango 5 by IRRI.

*Keywords: National Cooperative Testing (NCT), special rice (SR), Participatory Variety Selection (PVS), value added traits, product diversification, special niche markets*

# Finding New Sources of Tungro Resistance Among Philippine Traditional Rice Varieties

*AA Dela Cruz, MM Rosario, MJC Duque, and CL Diaz (PhilRice CES)*

Tungro is a serious rice viral disease incurring 20-100% yield loss. *Nephotettix virescens* or commonly known as green leafhopper (GLH) is the most efficient insect vector in the semi-persistent transmission of its causal viruses, particularly the rice tungro bacilliform virus (RTBV) and rice tungro spherical virus (RTSV). In breeding, finding different sources of resistance genes against insect vectors and rice viruses is necessary in diversifying the genepool of cultivated rice. Various Philippine traditional rice varieties (PTRVs) were observed to express resistance to tungro however rice breeders hesitate to use them because the corresponding resistance genes were yet to be identified. Hence, this study aims to identify alternative sources of GLH and RTSV resistance genes among PRTVs, and eventually produce common donors with combined tungro resistance genes. A total of 72 PTRVs were screened for reactions to GLH using preference and antibiosis tests. Generally, the observed reactions of PTRVs to GLH in the two tests supported one another. Based on the initial results, the 5 PTRVs that exhibited consistent resistant reactions to GLH are potential sources of resistance genes other than *Glh14*. Meanwhile, 4 promising GLH-susceptible PTRVs can be explored as potential sources of RTBV resistance genes or RTSV resistance genes other than *tsv1*. Results of this study will lead to mapping of novel tungro resistance genes, which will eventually help increase the use of PTRVs in rice breeding.

*Keywords: tungro, rice tungro spherical virus (RTSV), rice tungro bacilliform virus (RTBV), green leafhopper (GLH), Philippine traditional rice varieties (PTRV)*

# *Glh14* and *tsv1* Enhanced the Tungro Resistance of ARC11554-Derived Rice Lines

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Tungro causes severe stunting and yellowing in rice resulting in 20-100% crop losses. It is a complex disease caused primarily by rice tungro spherical virus (RTSV) and aggravated by rice tungro bacilliform virus (RTBV), which are both transmitted by green leafhopper (GLH). In PhilRice, ARC11554 has long been used as source of tungro resistance but previous marker-assisted breeding only focused on introgression of a DNA fragment from chromosome 4. Lately, the positions of *Glh14* resistance locus and *tsv1* gene in ARC11554 were found in chromosomes 4 and 7, respectively. Hence, this study aims to validate the

usefulness of *Glh14* and *tsv1*, along with their corresponding PCR-based molecular markers, for marker-assisted breeding. In this study, the effectiveness of *Glh14* and *tsv1* against dual infection of RTSV and RTBV is being evaluated among selected rice lines (RL) in field where the disease is naturally occurring and in screenhouse using forced inoculation. Significant resistance was observed in plants carrying at least the *tsv1*. Under field and screenhouse conditions, there were no interveinal chlorosis and leaf discolorations in two promising rice lines (RL1 and RL2) introgressed with both *Glh14* and *tsv1* while rice lines with *Glh14* or *tsv1* alone had less intense tungro symptoms compared with rice lines without any resistance genes. In the screenhouse, about 15% reduction in plant height was observed in RL1, while RL2 recovered efficiently from 67% height reduction (at 14 dpi) to 19% (at 21 dpi). In the field, tungro infection in RL1 was lower (5%) compared with RL2 (35%). Although the yield component trait of RL1 is better than RL2, both can still be used as common donors of *Glh14* and *tsv1* in breeding for tungro resistance.

*Keywords: tungro, rice tungro spherical virus (RTSV), rice tungro bacilliform virus (RTBV), green leafhopper (GLH), ARC11554*

# Heat Stress Evaluation under Field Condition

*Luvina B. Madrid and Norvie L. Manigbas (PhilRice CES)*

Heat stress is among the major constraints in rice production. Several research studies were already conducted under controlled environment but only a few under field condition. To evaluate the effects of heat stress under field condition, four rice varieties, namely IR72, NSIC Rc122, IR64, and N22 were planted during dry season of 2013, 2014, and 2015. Two replicated set- ups were established. One was scheduled to flower between last week of February and March, which served as the control. The second was arranged to flower between April 15 and May 15 for heat-stressed condition. Temperature and relative humidity were monitored using MINCER (Micrometeorological Instrument for Near Canopy Environment in Rice) set to record every 2min. Maximum temperature during non-stressed condition ranged from $18.39^0$C to $36.62^0$C while stressed set-up was from $22.82^0$C to $39.26^0$C. Although maximum temperature during non-stress reached more than $35^0$C, exposure only ranged from 1 to 5 days compared with stressed condition, which ranged from 1 to 25 days. Yield decline between 32.5 and 50.5% while spikelet fertility was reduced between 4.24 and 14.62%. Yield and spikelet fertility have negative significant correlation with temperature particularly within canopy. Decline in yield was positively correlated with grain weight, which is an indication of incomplete or faster grain development at high temperature.

*Keywords: spikelet fertility, heat stress, maximum temperature, relative humidity*

# Robust Simple Sequence Repeat Markers Identified for Salt-Tolerant Line Selection

*Jonathan S. Concepcion and Nenita V. Desamero (PhilRice CES)*

Salinity stress response in rice has long baffled plant breeders and molecular biologists due to the complexity the physiology and molecular genetics of salt tolerance. A major quantitative trait locus (QTL) - *SalTol* was mapped in the short arm of Chromosome 1 using Simple Sequence Repeat (SSR) Markers and minor QTLs located in 6, 8, 10, and 11 were also identified. However, due to the large number of SSR markers located in the *SalTol* QTL region, Marker Assisted Selection (MAS) for salinity tolerance has been a challenge for rice breeders. To address this concern, 20 SSR markers previously mapped and identified to flank the *SalTol* QTL region were evaluated for MAS. Initial evaluation of SSR markers using Pokkali-derived mutants in 2014WS identified 7 SSR markers associated with Pokkali, an identified salt-tolerant traditional variety. Further evaluation of SSR markers in 2015 utilized in $F_2$ segregating population from 4 crosses identified 10 SSR markers associated with Pokkali and FL478. Of which, 4 SSR markers, namely RM6711, RM7075, RM10793, and RM8094 were identified to be the most robust markers flanking the SalTol QTL region. Upon

utilization for MAS in NSIC Rc222-derived mutant lines, 84.67% of entries identified to be salt-tolerant in phenotypic screening were positive in 4 markers. However, only 29.13% were positive from identified salt-tolerant lines derived from PSB Rc50/NSIC Rc298 cross in 4 markers. In conclusion, four SSR markers, namely RM6711, RM7075, RM10793, and RM8094 were identified as robust markers flanking the *SalTol* QTL region. However, due to the QTL-based nature of the SSR markers identified further evaluation and association/linkage analysis is encouraged. Furthermore, the genotype dependence of identified SSR markers in association with phenotypic screening was elucidated.

*Keywords: Salt Tolerance, SalTol QTL, Simple Sequence Repeats, Marker Assisted Selection*

## Phenotyping *cum* Genotype Validation and Agronomic Trait Evaluation of Elite Rice Breeding Lines under Managed-Submergence Stress and Non-Stress Conditions

*NV Desamero, JS Concepcion, and JC Baggara (PhilRice CES)*

The Philippines was hit by 15 tropical depressions and typhoons in 2015, increasing the water level in majority of the country due to flash floods, resulting in severe loss in rice production, especially in rainfed and lowland areas. To mitigate the effect of submergence stress, advanced breeding lines were developed. Thirty-eight advanced breeding lines selected based on improved agronomic characteristics were evaluated for field performance under submergence stress at vegetative stage. Statistical analysis was generated using Statistical Tool for Agricultural Research [(STAR) IRRI, 2013] and Plant Breeding Tools [(PBTools) IRRI, 2013]. Breeding lines were genotyped for presence of *Sub1* gene using ART5 and SC3 primers. An average survival rate of 91% was observed in the breeding lines, with significant variation in plant survival percentage, plant height, and tiller number at 21 days after de-submergence. Variation was observed in plant height at maturity, culm length, and biomass under favorable condition under stress condition, and plant height at maturity under stress condition. Yield potential under non-stress condition ranged from 2.7300 t/ha to 8.0800 t/ha with an average of 5.5823 t/ha, wherein 6 (15.79%) of 38 advanced breeding lines have comparably higher yield potential than IR64 (6.2200 t/ha). Under submergence stress condition, yield potential ranged from 2.6273 t/ha to 5.6611 t/ha, with average of 3.8667 t/ha, wherein 20 (52.63%) of 38 advanced breeding lines have comparably higher yield potential than IR64 (3.7447 t/ha). FR13A allele was amplified in majority of breeding lines in both markers, verifying the presence of *Sub1* gene. From the advanced lines evaluated, 11 (28.95%) showed considerable performance in yield potential, agronomic trait evaluation, survival and recovery response. Developed advanced breeding lines performed better under submergence stress. Thus, the threat of submergence or flash flood stress in rice can be mitigated with the development of advanced breeding lines.

*Keywords: Submergence Stress, Sub1 Gene, Yield Potential, Survival Rate, Field Evaluation*

## Yield and Grain Quality Traits of Myanmar Mega and Newly Improved Pawsan Hmwe Lines

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Pawsan Hmwe (PSH) is an elite quality rice in Myanmar that is grown for a long time as a seasonal crop. It has strong aroma, good texture, and very elongated cooked rice. Although PHS is planted in 66% of the total growing rice area, problems with its lodging, low yield, and its being season-limited still need to be addressed. Breeding strategy has been set to address farmers' demands for high yield and capability for planting every season. Recently, two improved lines were selected from twelve recombinant inbred

lines (RILs) derived from Pawsan Hmwe-Tha Yaung Chaung (PSH-TYC) and IR-24 in Plant Biotechnology Center, Mingalardone, Yangon, Myanmar. The trait selected from RILs was its photoperiod insensitivity and for PSH, its high yield and consistent quality trait. Myanmar Mega PSH cultivars were planted in wet season while Shwe Nant Thar Pawsan-1 (SNTPS-1), Shwe Nant Thar Pawsan (SNTPS-2), and their parental lines were grown in wet and dry seasons in 2015-16 at Myanmar Rice Research Center, Hmawbi, Yangon, Myanmar. Morphological data such as plant height and yield components data were recorded. The grain quality traits were determined at PhilRice, Maligaya, Science City of Muñoz, Nueva Ecija, Philippines and were compared among SNTPS-1, SNTPS-2 and their parental lines, PSH-TYC, IR24; and two varieties, Pawsan Hmwe-Shwe Bo (PSH-SB) and Pawsan Hmwe-Pyapon (PSH-PP). Results of plant height showed that SNTPS-1 and SNTPS-2 had 125 and 123 cm, respectively, while plant height of PSH-TYC, PSH-SB, and PSH-PP ranged from 155, 170 to 172 cm, respectively. The yield of SNTPS-1 and SNTPS-2 was reported as 5.0-5.5 ton/ha, while those of PSH cultivars were 3.0-3.5 ton/ha. The result of dendogram suggests that there were two cluster groups plus PSH-SB based on physical attributes and physicochemical properties. SNTPS-1 and SNTPS-2 was with PSH-TYC group in terms of grain quality traits. PSH-SB was separated from the group mainly due to gel consistency. Laboratory panel evaluation showed that SNTPS-1 and SNTPS-2 had similarity to PSH-SB, PSH-PP, and IR-64 in tenderness and smoothness. SNTPS-2 was slightly better tasting than SNTPS-1, PSH-SB, PSH-PP, and IR-64. The breeding objectives of developing two new cultivars, SNTPS-1 and SNTPS-2, with higher yield and premium quality were therefore attained. Further study is needed to confirm the association between grain quality traits and their genetic background in newly improved PSH lines.

# Diversity and Heritability of Quantitative Traits Based on Traditional Rice Varieties

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Diversity is necessary as it aids breeders in developing best varieties. This study analyzed the diversity and genetic components of 55 traditional varieties (TRVs). Statistically significant (p<0.01) difference was observed among TRVs. Diversity index showed a range of 0.74 (days to maturity) to 0.95 (grain yield). Highest genotypic coefficient of variation (GCV) as well as phenotypic coefficient of variation (PCV) values were computed for grain yield and number of productive tillers. Grain yield had 42.07% GCV and 52.78% PCV, while number of productive tillers had 41.21% GCV and 50.64% PCV. High heritability of >70% was seen on days to maturity (73.68%), grain size ratio (79.3%), grain length (79.97%), days to flowering (83.78%) and plant height (83.79%). High genetic advance as percent of mean >20%, on the other hand, was observed on culm length (20.69%), plant height (22.24%), days to flowering (23.05%), grain size ratio (27.6%), number of productive tillers (69.09%) and grain yield (69.09%). The highest heritability with high genetic advance as percent of mean, however, was computed for plant height (83.79% and 22.24%), days to flowering (83.78 and 23.05%), and grain size ratio (79.3% and 27.6%), suggesting that this trait would respond to selection relative to their high genetic variability and transmissibility. Moderate heritability with high genetic advance also was computed for grain yield (63.54% and 69.09%) and number of productive tillers (66.24% and 69.09%), suggesting the role of both additive and non-additive gene action in their inheritance. The study revealed that better yield response can be attained through direct selection scheme in TRVs.

## When Traits Clears Yield Threats: Understanding Floral Traits of Parent Lines of Mestiso 18 and 20 in Relation to Hybrid Rice Seed Production

*RE Ragas, AG Ferriol, FKJ Padron, J Manangkil, and SM Brena (PhilRice CES)*

Success in hybrid rice seed production relies on successful cross-pollination. Floral traits and morphology of the parent lines are key contributors to efficient pollination. To investigate the floral traits of parental lines of Mestiso 19 and Mestiso 20, a study was conducted in 2016 dry season under field condition at the PhilRice Central Experiment Station. Floral traits (angle of spikelet opening, stigma size, and stigma exsertion rate) of female and (anther length, pollen count, and pollen diameter) of male parents were analyzed. Results showed that while the two parents flower at a different time, flowering synchrony is achieved but only for the latter 35 minutes of anthesis. Between female lines of the two hybrids, angle of spikelet opening of the female line (PRUP TG101) of Mestiso 19 is smaller (18.01 ± 0.56) than that of Mestiso 20 (20.07 ± 0.22). However, it was observed that PRUP TG101 has a relatively longer stigma size (2.13 ± 0.02mm) resulting in higher stigma exsertion rate of PRUP TG101 (59.00 ± 5.60) in contrast to female line of Mestiso 20 (38.00 ± 1.80). In both hybrids, seed setting rate increases progressively as the angle of spikelet opening, days of flowering, and percentage of stigma exsertion increases. Pollen grains of male parents of Mestiso 19 (TG101M) are larger (58.84 ± 0.58) than the male parent of Mestiso 20 (51.37 ± 0.43). Large and heavy pollen limits pollen dispersion and thus out-crossing; resulting in lower seed sets on panicle rows (5, 6, and 7) far from the pollen source.

*Keywords: floral traits, TGMS, seed production, two-line hybrid rice.*

## Yield Performance of Selected GSR Lines in Adverse Ecosystem in Caraga Region

*Cherry S. Estacion and Gerardo F. Estoy, Jr. (PhilRice Agusan)*

The evaluation of Green Super Rice (GSR) lines in adverse ecosystem was conducted to subject promising lines to field screening for adaptation in Caraga Region before they are recommended as a location-specific variety.

Seven sites in Caraga Region were identified using the following lines: GSR 5, GSR 11, GSR 12, GSR 12A, GSR 21, and GSR 22. The sites are found in Surigao del Norte (Mainit and Bacuag), Surigao del Sur (Bislig City and Hinatuan), Agusan del Sur (San Francisco and Trento), and Agusan del Norte (PhilRice Agusan).

In July-December 2015, GSR 12 had the highest yield in irrigated areas in PhilRice Agusan and Mainit, Surigao del Norte. In PhilRice Agusan, GSR 12 attained the average yield of 6.45 t/ha. In Mainit, Surigao del Norte, GSR 12 had an average yield of 5.44 t/ha. In January–June 2016, GSR 12 also obtained the highest yield in both rainfed areas in Bacuag, Surigao del Norte with an average yield of 7.78 t/h. In Bislig City, Surigao del Sur, GSR 12 and GSR 21 had an average yield of 7.59 t/ha. In Mainit, Surigao del Norte, GSR 12 obtained an average yield of 6.23 t/ha.

Among the lines used, GSR 12 was consistent as the highest yielding lines in both cropping seasons in irrigated and rainfed ecosystems in Caraga Region. Other lines such as GSR 21 and 22 had promising results in Hinatuan, and Bislig City, Surigao del Sur.

*Keywords: GSR, yield performance, promising rice lines, adverse ecosystem, Caraga region*

# Evaluation of High-Yielding Lowland Rice Lines and Varieties Tolerant to Major Abiotic Stress in Region XI

*HA Jimenez, JD Tangog, JB Culiao, and GF Estoy, Jr. (PhilRice Agusan)*

Flooding is one of the major abiotic stresses affecting rice production in CARAGA and Davao regions. Hence, the use of submergence-tolerant rice lines and varieties is the most effective and economical way to manage the said stress. Nineteen submergence-tolerant rice lines along with four released varieties were subjected to flooding for two cropping seasons at PhilRice Agusan to test their yield potential. From the station-based controlled flooding experiment, eight best performing rice lines and two susceptible check varieties, particularly NSIC Rc122 (Angelica) and IR64 were tested for their yield potential under normal condition but in a flash flood-prone on-farm demonstration. During the January to June cropping season, three lines from the on-farm demo performed well with 1.6-4.4% yield advantage over the check variety NSIC Rc122 (6.2 t/ha). During the July to December 2015 cropping season, five lines from the on-farm demo had a yield advantage of 2-18% over the check variety NSIC Rc122 (5.2 t/ha). Across two cropping seasons, two lines had stable yields, particularly IR10F336 and IR10F548 with average yields of 6.0 t/ha and 5.9 t/ha, respectively. IR10F336 and IR10F548 can be recommended for flood-prone rice growing areas in Mindanao.

*Keywords:  flood-prone area, abiotic stress, rice lines, yield potential, yield advantage*

# Adaptation and Stability Performance of Rice Breeding Lines in the Multi-location Yield Trial

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Multi-location yield trials are generally carried out by breeders to select and recommend high-yielding and stable genotypes for wider adaptation. Identification of rice varieties with wider adaptability and stability are the important aspects in varietal recommendation.  The study aims to evaluate and identify rice breeding lines with stable yield and wider or location-specific adaptation. During the 2016 DS, 95 rice breeding lines together with 5 check varieties were evaluated at CES and in PhilRice stations in Negros, Bicol, and Central Mindanao University (CMU). The entries were divided into two groups: (Group I) early-maturing entries and (Group II) medium to late-maturing entries. In Group I, combined analysis shows there was a high significant difference in the genotype (G), environment (E), and genotype x environment (GxE) interaction (P<.0001) with a mean yield of 5,664 kg/ha and cv of 17.7%.  Principal component (PC) 1 and 2 were highly significant (P<.0001) and explained 82.8% of the total variation due to G and GxE interaction. AMMI biplot analysis and yield stability index (YSI) incorporating AMMI stability value (ASV) show that PR41804-3B-67-1 as the most stable and adapted genotype in four test locations. It ranked first both in ASV (1.386) and YSI (8) with mean yield of 6,345 kg/ha and yield advantage of 5.2% over PSB Rc82 (6,034kg/ha) the highest yielding check variety. The following genotypes were also identified with location-specific adaptability:  PR43299-1-12-1 (Negros) and PR41818-3B-47 (Bicol, CMU, and CES). Additionally, in Group II, there was also a high significant difference in G, E, and GxE interaction (P<.0001) with a mean yield of 5,033 kg/ha and cv of 18.0%. PR39878-3B-1-2-2-1-2 was identified the most stable (YSI=16) and widely adapted (ASV=1.4387) genotype. Other genotypes identified with location-specific adaptability were PR43299-1-10-1, PR40240-2B-B-54-2-2-4-4 (CMU and Negros), and PR43790-B-32-1-1 (Bicol). Overall performance showed PR41804-3B-67-1 as the most stable and widely adapted across all four test locations.

*Keywords: multi-location yield trial, adaptability, stability, AMMI biplot analysis, yield stability index, AMMI stability value, breeding line*

# Performance Evaluation of Philippine-Released Rice Varieties under Organic Farming System

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While interest on organic and low input agriculture have gained following, it seems that the present pool of rice varieties are not well suited to these agronomic systems. Hence, it would be ideal if breeding objectives can accommodate this concern. In 2015 WS, 40 Philippine-released varieties, using random complete block design, were initially tested for yield performance and identify organic rice with high rate of varietal adaptation in 3 sites under conventional and organic systems.

Differences in yield among cultivars across systems were observed. Organically grown cultivars generally had higher yields than those grown inorganically or using the conventional system. In Nueva Ecija, NSIC Rc354, 240, and 360 had the highest yields ranging from 6.1 to 6.2 t/ha. In Mindoro, NSIC Rc134, Rc214, and Rc142 had the highest yields ranging from 5.6 to 5.8 t/ha. Mean yield ranges from 2.4 to 6.2 t/ha in Nueva Ecija, from 3.4 to 5.8 t/ha in Mindoro and from 0.3 to 3.5 t/ha in Negros. Results indicated that varieties have variable performance across locations, which could be attributed to differences in crop management practices.

*Keywords: conventional system, organic system, rice, yield*

# Introgression of Drought-Tolerant QTLs into High-Yielding Rice Varieties

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Drought causes about 50% of rice production losses globally. One of the most effective ways to combat drought is the development of tolerant varieties through introgression of Quantitative Trait Loci (QTL) linked to the drought-tolerant genes using molecular markers. This study reports the introgression of QTL that combines genotypic and phenotypic evaluation to develop rice lines with high yield and drought tolerance. $BC_4F_4$ populations of PR47201 in NSIC Rc222 (*qDTY12.1*) background was developed from the cross between NSIC Rc222*3/IR84984-83-15-481-B while PR47202 in NSIC Rc160 (*qDTY2.2 and qDTY4.1*) background was developed from the cross between NSIC Rc160*3/IR87707-445-B-B-B. These lines were genotyped using SSR markers and evaluated on both drought stress and non-drought stress field conditions. Average grain yield of PR47201 population under drought stress was 928 kg/ha with yield ranging from 111 to 3,057 kg/ha while PR47202 population had an average yield of 862 kg/ha with yield ranging from 247 to 2,159 kg/ha. PR47201-A102A-29-14-1 (with *qDTY12.1*) outyielded all other entries with 50% yield advantage over the tolerant check (Vandana NIL) under the drought stress condition while PR47201-A102A-28-123-B obtained the highest yield with 21% yield advantage over the recurrent parent NSIC Rc222 under the non-stress condition. PR47202-A103A-18-236-1 (with *qDTY 2.2 and 4.1*) had the highest yield of 2,159 kg/ha among PR47202 populations under drought stress while PR47202-A103A-18-87-1 had the highest yield of 7,269 kg/ha under non-stress field. The presence of QTL in identified high-yielding lines was confirmed through its genotype data and supported by its phenotype data. This study utilized the importance of combining genotype and phenotype data in order to accelerate the development of drought-tolerant varieties with high yield.

*Keywords: Drought stress, drought screening, NSIC Rc160, NSIC Rc222, SSR markers,*
*QTL for drought tolerance*

# Root System Developmental Responses of Selected Traditional Varieties to Upland Drought Condition

*AB Aguelo, JM Niones, and RR Suralta (PhilRice CES)*

Rice crop productivity in an upland ecosystem is greatly affected by limited water supply. With this, the deep root system development is identified as one of the key traits of varieties to maintain productivity in an upland rice ecosystem. Hence, this study assessed the root system development and dry matter production of six selected genotypes previously subjected to soil moisture stress under upland drought condition. The genotypes Arabon, Bihod, Goberno, Minindoro, Nagsalay, and Sinanduyo with IR64 and IR62266 as susceptible controls were subjected to progressive drought using the raisedbed system. The bed was constructed by adding 30-cm thick topsoil layer above a 5-cm thick gravel layer, which blocks the capillary rise of water thereby creating two distinct soil layers: dry surface layer, which dries more easily and frequently, and a wet deeper soil layer. Among the genotypes, Arabon had the heaviest shoot dry matter (SDW) of 30.49 g/plant$^{-1}$ and lowest canopy temperature (CT) estimates of 32.91$^0$C. SDW had a significant negative correlation with CT (r=-0.48, p=0.05). This indicates that while Arabon had the lowest CT during drought, it had also produced the heaviest shoot dry matter. Arabon also produced the longest root length below the gravel layer, which enabled it to access available soil water and nutrients to maintain transpiration and photosynthesis during drought. Thus, we identified Arabon as a potential parent to improve deep root system development, which is one of the key traits considered in upland rice breeding.

*Keywords: deep root system, drought, upland ecosystem, shoot dry matter*

# Agro-Morphological Characterization and Promotion of Traditional Upland Rice in Ilocos Norte

*Menisa A. Antonio and Araceli J. Badar (Mariano Marcos State University)*

Traditional upland rice (TUR) is indispensable in many upland households in Ilocos Norte. With the likely risk of genetic erosion, MMSU embarked on germplasm conservation and management which encompassed documentation, characterization, and promotion of these genetic resources.

A high diversity of TUR is still found in Ilocos Norte (H'=0.68). Of the 146 accessions in the germplasm collection, 54 were assembled from the Municipality of Adams. The varieties are generally tall (91 to 175 cm), grains are either awned or unawned, and awns vary from short to long, black, blond, yellow, or white. Seed coats are either purple, dark brown, bright yellow brown, purplish brown, mixture of brown and black, plain golden brown, golden brown with dark brown, or purple furrows. Dehulled grains have a variety of color: dull white, shades of reddish brown, pinkish, black with white at one end, and brown. On-farm data gathered from 18 varieties in the Swidden farms of Adams recorded an average yield of 2.2 tha-1while on-station data obtained from 50 accessions in upland Batac had 3.32 t/ha.

Series of agronomic evaluation and mass production of identified high yielding varieties were continually undertaken. Twenty-three farmer-beneficiaries from four municipalities received free planting materials. Two on-farm demonstration sites were established in WS 2016 in Batac and Vintar, in coordination with the MMSU Extension Directorate and the Municipal Agriculture Office of Vintar. Display and sale of milled rice under the brand name Isek during trade fairs in Batac and Metro Manila, presentation in scientific and farmers' fora, and distribution of IEC materials were also undertaken.

*Keywords: traditional upand rice, germplasm collection, characterization, promotion*

**Theme 2**
*Crop management options for improving/sustaining yields and resource-use efficiencies*

# Seed Germination and Root System Development in Rice as Influenced by Pre-Sowing Treatment with Radiation-Modified Carrageenan (RMC)

*JAC Maningas, HD Villanueva, JM Niones, RR Suralta, and LM Juliano (PhilRice CES)*

The Philippines supplies 40% of the raw material required for carrageenan production in the world. Carrageenans are polysaccharides widely used as food stabilizers and gel thickeners. To diversify the use of carrageenans, the Philippine Nuclear Research Institute in partnership with PhilRice investigated the effects of radiation-modified carrageenan (RMC) on seed germination and root system development in rice using NSIC Rc216. The seeds were soaked in different concentrations of RMC at 100, 200, and 300 ppm and a control treatment ($H_2O$) for 24hr followed by incubation for 30hr. Seed germination rate (%) was analyzed. Then, the pre-germinated seeds were subsequently sown in soil under greenhouse condition for 15 days. Thereafter, the shoots were harvested, washed, and oven dried at 70°C. Roots were also sampled for determination of root length and root dry weight. Seed germination rate was significantly higher in all RMC concentrations (99-100%) than the control (97%). In the greenhouse, pre-sowing treatment with RMC regardless of concentration had significantly higher shoot dry weight of 0.57 g/plant than the control with 0.50 g/plant. On the other hand, root system development based on total root length and root dry weight was not significantly influenced by pre-sowing treatment of RMC regardless of concentration. The result showed that pre-sowing treatment enhanced seed germination rate and shoot growth but not root system development of NSIC Rc216 under short duration of growth in soil.

*Keywords: pre-sowing treatment, radiation-modified carrageenan, rice, root system development, seed germination*

# Effect of Nitrogen on Severity of Bacterial Leaf Blight, Growth, and Yield of Rice

*JC Magahud, SLP Dalumpines, JP Rillon, ND Santiago, and JA Cruz (PhilRice CES)*

While high application rates of nitrogen (N) fertilizer promote luxuriant vegetative growth with dense foliar canopies, it also accelerates development of rice diseases like bacterial leaf blight (BLB). BLB is among the major diseases of lowland rice, which can reduce yield by up to 75%. This study was conducted to determine the amount of N fertilizer that will give the maximum growth and yield, and at the same time reduce BLB damage in rice. NSIC Rc226, a BLB-susceptible rice variety, was planted in pots in the screenhouse for two seasons, wet and dry. N fertilizer treatment levels were 0, 31, 63, 95, 127, 158, 190 and 221 kg/ha. For every treatment, at least 5 potted rice plants were inoculated with BLB while at least 3 remained uninoculated. Rice growth parameters and chlorophyll levels were recorded weekly until harvest while yield data were gathered during and after harvest. BLB severity was evaluated on five leaves per plant by computing the percentage of leaf length affected by water-soaked lesions. Results showed that plant height, number of tillers, chlorophyll levels or leaf greenness, and number of panicles were significantly highest among rice samples fertilized with 221 kg N/ha across cropping seasons. During DS, yields among rice samples, BLB-inoculated or not, were highest at 221 kg N/ha. Least BLB severity of 20-25% was observed at 0 and 31 kg N/ha in DS, 27% at 0 kg N/ha in wet season.

*Keywords: bacterial leaf blight, nitrogen fertilizer, bacterial leaf blight severity, rice growth, rice yield*

## Effect of Nitrogen on Severity of Sheath Blight, Growth, and Yield of Rice

*JC Magahud, SLP Dalumpines, JP Rillon, ND Santiago, and JA Cruz (PhilRice CES)*

Sheath blight (ShB), caused by *Rhizoctonia solani*, is among the major diseases of lowland rice, which can reduce yield by up to 25%. Application of high levels of N fertilizer favors pathogen multiplication and lesion enlargement. Thus, this study was conducted to determine the amount of N fertilizer that will give maximum growth and yield, and at the same time reduce ShB damage in rice. NSIC Rc226 was planted in pots in the screenhouse for two seasons, wet and dry. N fertilizer levels were 0, 31, 63, 95, 127, 158, 190 and 221 kg/ha. For every treatment, at least 3 potted rice plants were inoculated with ShB, and at least 3 remained uninoculated. Rice growth parameters and chlorophyll levels were recorded weekly until harvest, while yield components were gathered during and after harvest. ShB severity was assessed in every hill for dry season, and in five tillers per hill for wet season. Results showed that plant height, number of tillers, chlorophyll levels or leaf greenness, and number of panicles, were significantly highest in rice fertilized with 221 kg N ha$^{-1}$ across cropping seasons. During DS, yields among rice samples, ShB-inoculated or not, were highest at 221 kg N/ha. ShB severity of 0% was observed at 0 kg N/ha in DS, of 27-29% at 0 kg N/ha in wet season.

## Three-Season Nutrient Status of Soils in Rice-Rice Cropping System Using the Minus-One Element Technique

*JC Magahud, SLP Dalumpines, and WB Collado (PhilRice CES)*

Productivity of irrigated rice fields is controlled by nutrient status of soils. However, nutrients can be depleted in continuously cropped soils when the amounts of nutrients removed during harvesting exceed those returned through application of fertilizers and incorporation of rice straw. This study was conducted to determine the nutrient status of irrigated soils under rice-rice cropping system in 2015 WS, and 2016 DS and WS; and to recommend appropriate nutrient management practices. Soil samples were collected from four rice fields each in Sta. Cruz, Laguna (Lipa series), Science City of Muñoz (Maligaya series), and San Manuel, Pangasinan (San Manuel series). Soil samples were prepared, and rice plants were grown in plastic pails until the maximum tillering stage to determine nutrient deficiency using the Minus-One Element Technique (MOET). Biomass and tiller count of rice plants grown in omission pots were compared with rice plants supplied with complete set of nutrients. Results showed that irrigated soils of the three series were deficient in nitrogen across seasons. Thus, these soils should be regularly applied with nitrogen fertilizers. Maligaya and Lipa series were deficient in potassium and sulfur; hence, regular application of chemical fertilizers that contain potassium and sulfur, and incorporation of rice straw should be practiced in these soils. Copper was sufficient or a bit deficient in the study sites. Zinc was either sufficient or a bit deficient in Maligaya and San Manuel series.

## Popular Rice Varieties Grown and Frequency of Insecticide Sprays to Manage Insect Pests by Rice Farmers in the Philippines

*BS Punzal, GS Arida, LV Marquez, UG Duque, DKM Donayre, EC Martin (PhilRice CES)*
*NP Castilla, JM Villa, and JBM Macasero (IRRI)*

As part of Philippine Rice Information System (PRiSM) a nationwide survey was conducted on the production situation of farmers from different regions. The most common varieties grown and the frequency of insecticide application were recorded in order to determine farmers' insect pest management options

against rice insect pests. The three most commonly grown varieties were NSIC Rc222, NSIC Rc216, and NSIC Rc160. These varieties were resistant or moderately resistant to insect pests of rice and were planted by farmers in all regions in 2015 wet season and 2016 dry season. The frequency of insecticide spray varies among regions. Majority (56%) of farmers nationwide spray insecticides once or twice per season. Some farmers in regions 6 and 8 applied insecticides up to 7 times. Thirty percent of rice farmers in all regions did not spray insecticide at all.

*Keywords: frequency of insecticide spray, rice varieties*

## Major Weeds and Weed Management Practices in Irrigated Lowland Rice Areas of Luzon

*Edwin C. Martin and Dindo King M. Donayre (PhilRice CES)*

There are a variety of weed populations in any given field. Weed management practices (any practice, not just herbicide application) have different effects on weed species. Over time, continued use of one practice can lead to the population being dominated by one species or a group of species. Weed species and weed management practices were gathered from select irrigated lowland areas in Luzon during the 2015 dry and wet cropping seasons. Of the total fields monitored, 35% had 1-10% weed infestations both above and below rice canopies. Grasses were the most dominant followed by broadleaves, sedges, and unidentified small weeds. Most common weed species were *Echinochloa colona* and *E. crus-galli* (grass); *Fimbristylis miliacea, Cyperus difformis, C. iria*, and *C. rotundus* (sedges); and *Sphenoclea zeylanica* (broadleaves). Herbicide application was the most common weed management technique used to combat weeds. Butachlor was the most commonly used herbicide both at seedling and tillering stages of the rice crop.

*Keywords: Luzon, Philippines, major weeds, weed management, irrigated lowland rice*

## Reactions of Weedy Rice Variants to Rice Tungro and Bacterial Leaf Blight

*FR Sandoval, EC Martin, MSV Duca, CB Codod, CA Valdez, and ER Tiongco (PhilRice CES)*

While weedy rice appears to be a major threat to rice production, recent studies show that they can be a major source of resistance to major rice diseases. In 2014 to 2015, 20 weedy rice biotypes (WRB) were screened for resistance to rice tungro disease (RTD) and bacterial leaf blight (BLB). In 2016 DS, another trial was conducted on select WRB. It was found that weedy rice biotypes WR-B3, WR-B13, WR-Ilo2, and WR-Ilo3 conferred resistance to RTD with a rating of 0-40% infection at 30 and 45 days after sowing (DAS). Three weedy rice biotypes (WR-B3, WR-B5, and WR-B6) showed intermediate reaction to BLB and one biotype showed resistance with an average infection of 8.2% when inoculated 30 DAS.

*Keywords: weedy rice, resistance, BLB, tungro*

## Resistance Stability of High-Yielding Varieties to Major Insect Pests and Diseases of Rice

*GD Santiago, MSV Duca, and EM Valdez (PhilRice CES)*

Use of resistant rice varieties reduces losses caused by insect pests and diseases in irrigated rice. The stability of resistance depends on the genetic interaction between the rice host, insect herbivore, and pathogen. Variety with durable resistance is expected to relieve rice farmers of the need to change varieties often. Durability combined with multiple insect pest and disease resistance will further reduce the need to apply

pesticides.  In 2016 DS, resistance stability of 42 high-yielding/popular rice varieties to major insect pests and diseases was evaluated. At 48 DAT, 11 varieties including the susceptible check (TN1) were infested by brown planthopper (BPH).  Majority (64.28%) of the varieties had intermediate (I) reaction to deadheart (DH) and 42% to whitehead (WH). Additionally, majority (69.05%) of the varieties were resistant (R) to bacterial leaf blight (BLB), blast (90.48%), and sheath blight (90.48%).

## Seasonal Fluctuations of Major Insect Pests of Rice at PhilRice CES

*GD Santiago, EM Valdez and AA Garcia (PhilRice CES)*

Light trapping is a known method in determining population fluctuations of insect pests. Determining population fluctuations is useful in looking at the activity of insect pests in relation to some weather factors, and also helps in studying the population dynamics of insects during a particular period. A light trap was installed at PhilRice CES to know the population dynamics of major insect pests. The weekly trap collections that started in January were analyzed at PhilRice's Entomology Laboratory.  During the 2016 DS, insect pest population peaked from March to mid-April. For yellow stemborer peak population (YSB) was observed in April while brown planthoppers (BPH) peaked in March (17,643 catches). The same trend was observed for other hoppers: zigzag leaf hopper (1,805); green leafhopper (973) and whitebacked planthopper (458). Results of this study are important inputs in pest management.

## Ecological Engineering as an Option for Managing Rice Insect Pests in Farmers' Fields in Nueva Ecija

*GS Arida, LV Marquez, and BS Punzal (PhilRice CES); J Settele (Legato, Germany)*

A pioneering study was conducted in farmers' fields in Sto. Domingo and Munoz, Nueva Ecija to  determine the effect of planting flowering plants along margins close to rice fields on the population  of the different arthropods functional groups, key insect pests, natural enemies, and damage caused by stemborer and defoliators.       Collected rice arthropods using sweep net and Blow-vac suction machine showed that rice fields close to field margins with flowering plants had lower population of herbivores (48) compared to fields without flowering plants (270). Parasitoids collected using yellow sticky traps were higher in fields close to flowering plants (266) compared to fields without flowering plants (11). This was recorded in Sto. Domingo, NuevaEcija and Munoz, Nueva Ecija.  Additionally, damage caused by defoliators and stem borer was higher in fields without flowering plants (Defoliators- 7%, WH 5%) compared with fields close to flowering plants (Defoliators- 4%, WH 1%). Results of this study indicated that ecological engineering offers immense opportunities for rice insect pest management using non-chemical methods leading to economic, health and environmental benefits.

## Seasonal Patterns of Brown and White-Backed Planthopper Populations in Rice

*GS Rillon, CCB Encarnacion, and AJ Gabriel (PhilRice CES)*
*Jang-Kyun Seo (NAAS, RDA, Korea)*

A light trap was established at the PhilRice CES to monitor rice planthopper (RPH) population during the 2014-2015 period. Highest populations were recorded in March to April and August to September.

Considering the months of January to June, there was about 72% reduction in RPH populations in 2014 than in 2015. Higher population, however, was noted from July to December 2015 period than in the same months in 2014. Field populations of planthoppers were determined using sticky traps in two sites: PhilRice CES and in Mabini, Sto. Domingo, Nueva Ecija. During the 2015 dry season (DS), highest population was in the months of March to April, which was 200% lower during the same months in 2014. Planthopper and spider population ratio was recorded high at about 1:1. Higher planthopper population was observed in 2015 wet season (WS) than in 2014 WS. High population of RPH monitored using sticky trap coincided with the reproductive to ripening phases of rice plants in the field. It was further observed that planthopper adults invaded rice at its reproductive phase, and it seemed that they invaded rice earlier during WS. For both seasons, it was found that white-backed planthopper usually colonized the rice plants first followed by brown planthopper.

*Keywords: brown planthopper, white-backed planthopper, seasonal populations, rice*

# Reaction of Rice Sheath Rot Pathogen to Two *Trichoderma harzianum* isolates

*MSV Duca, DKM Donayre, FR Sandoval, and ET Duque (PhilRice CES)*

*Sarocladium oryzae* (Sawada) W. Gams & D. Hawksworth is the causal pathogen of rice sheath rot disease. Depending on the severity of infection, the disease can result in yield loss ranging from 20-85% as documented in Taiwan, the Philippines, Vietnam, and India. One of the most effective management options against the pathogen is the application of *Trichoderma harzianum* as biological control. This study was conducted to determine the efficacy of the two *T. harzianum* isolates (T5Oi and TMDRi) of PhilRice as biological control against *S. oryzae*. Antagonistic activities of *T. harzianum* isolates to *S. oryzae* were evaluated using the dual culture and hyperparasitism tests. Results from the three *in vitro* experiments showed that T5Oi and TMDRi were highly effective in outgrowing the mycelia (vegetative part of fungus) of *S. oryzae*. Both *T. harzianum* isolates strongly inhibited the growth of the pathogen. The hyphal growth of T5Oi and TMDRi colonized the hyphae of *S. oryzae*, thus leading to coiling, breakage, and shrinking of its hyphae (one of the threadlike elements of the mycelium).

*Keywords: sheath rot, Sarocladium oryzae, Trichoderma harzianum*

# Reactions of Rice Varietal Mixtures to Tungro Disease

*ND Santiago, MLB Palma, IG Pacada, and JP Rillon (PhilRice CES)*

Varietal mixtures can reduce the rate of disease progress owing to multiple epidemiological and physiological mechanisms. This study assessed reactions of rice varietal mixtures under rainfed lowland condition in Albay against the rice tungro disease (RTD). Twenty treatments comprised of 12 varietal mixtures and their corresponding 6 single varieties and 2 yield checks were evaluated. The set-up was subjected to natural pest pressure. At tillering stage, the initial incidence of RTD, which started in 8 plots of varietal mixtures and 2 single varieties with incidence ranging from 0.13% to 0.75% have no significant differences. As disease severity progressed at booting and dough stage, the following were not infected: varietal mixture of NSIC Rc298, NSIC Rc214, NSIC Rc216, and NSIC Rc238; single varieties of NSIC Rc214 and NSIC Rc216; and check variety NSIC Rc222. Single varieties of NSIC Rc298 and PSB Rc82 had 7.5% to 12.5% disease incidence and were comparable with the single variety of NSIC Rc300 with 27.5% disease incidence at booting stage. At dough stage, NSIC Rc300 was significantly different among all treatments. The four varietal mixtures with NSIC Rc300 having 2.5% to 17.5% RTD incidence have significant lower incidence compared with single variety of NSIC Rc300 with 42.5%. This study concludes that it is of extreme importance to test the effectiveness of varietal mixtures in suppressing RTD. On the other hand, one must also weigh the benefits of this scheme against agronomic and production system requirements.

*Keywords: tungro, varietal mixtures, rainfed*

## Morphological Variability of *Magnaporthe grisea* in the Philippines

*Roda G. Capacao and Fe A. Dela Peña (PhilRice CES)*

Blast caused by *Magnaporthe grisea* is a major rice disease which can significantly damage the rice crop resulting in yield loss ranging from 10-30%. A critical and comprehensive knowledge of the variability, nutritional patterns and factors influencing the growth of fungi is a pre-requisite for any study leading to the understanding of host-pathogen relationship. Hence, the morphological variability and sporulation of *M. grisea* isolates were studied in four solid media: Potato Dextrose Agar (PDA) + Biotin + Thiamine, Host leaf extract + 2% Sucrose Agar, Oatmeal Agar and Richards's Agar. They were subsequently characterized based on colony color, form, elevation and margin. Results showed considerable variations among the isolates in every media used. There were 4 growth patterns identified in PDA + Biotin + Thiamine; 4 in Host leaf extract + 2% Sucrose Agar; 4 in Richard's Agar and 6 in Oatmeal Agar. Among the four media used, *M. grisea* isolates showed excellent sporulation in Oatmeal Agar. Morphological study of the blast pathogen will be helpful for further investigations on the physiology of the fungus which could serve as an input in the management of the disease.

*Keywords: Magnaporthe grisea, morphological characteristics, sporulation*

## Optimizing Rice Yield Performance through Varietal Demonstration with Ecological Engineering for Pest Management in Selected Irrigated Areas of North Cotabato

*IV Boholano, GD Balleras, SE Abdula, and IML Bauzon (PhilRice Midsayap)*

The study assessed the yield performance of newly released high yielding varieties on farmer's field with ecological engineering approach as a pest management strategy. It also identified and provided most functional components of biodiversity in rice paddy by developing practical guidelines for farmers on habitat manipulation methods to improve integrated pest management. The study was established in two varietal trial set-ups in three identified municipalities of North Cotabato (ecological engineering approach vs. conventional method). It was properly laid out in a Factorial Experiment with Randomized Complete Block Design (RCBD) using two-way ANOVA and hypothesis test: independent between groups (t- test, pooled variance) for yield and population dynamics of insect pest's population and natural enemies between different field sites. Results showed that the mean population count of natural enemies (spiders, beetles, mirid bugs, wasps and damselflies) using sweeping method were significantly higher in ecological engineering approach compared to the conventional method. For insect pests population (green leaf hopper, brown plant hopper, rice bug and stem borer), results showed significant less population compared to the conventional method. Furthermore, varietal trial results showed that the ecological engineering approach was highly significant in the mean yield of different varieties tested compared to the conventional method. However, newly released varieties did not out yield local check variety (NSIC Rc158 and NSIC Rc222). Varieties, such as NSIC Rc308, Rc352, and Rc354, showed comparable result to the local check variety. Therefore, ecological engineering approach in rice farming combined with other integrated pest management programs is a practical way in addressing problems on insect pest population. It can also contribute in increasing the population count of natural enemies over the insect pests.

*Keywords: ecological engineering, insect pests, natural enemies, newly released variety, varietal trials*

# Maturity, Yield, and Nitrogen Use Efficiency of Inbred Rice Varieties in Response to Nitrogen Management

*MD Malabayabas, NR Dadufalza II, and RT Cruz (PhilRice CES)*

Nitrogen (N) is critical to the attainment of yield potential of rice varieties. Thus, a study was conducted at PhilRice CES in 2015 Dry Season (DS) and Wet Season (WS) to determine the yields of 8 early-to-medium-maturing varieties and their response to N management. N treatments were: (1) control or N omission plot (NOP); (2) PalayCheck recommendation of 6 bags 14-14-14-12S in DS and 4 bags in WS, applied at 14 days after transplanting plus N topdressing of 35kg/ha in DS and 23kg/ha in WS when Leaf Color Chart (LCC) reading fell below 4; and (3) fixed N rate for a total of 190kg N/ha in DS and 95kg/ha in WS, and each applied in 3 splits. In all N treatments, each $P_2O_5$ and $K_2O$ rates were applied at 40kg/ha.

In DS, PSB Rc18 and NSIC Rc122 had the lowest yields due to stem borer infestation, hence, were excluded in the analysis. Across PSB Rc82, NSIC Rc238, NSIC Rc240, NSIC Rc302, NSIC Rc308 and NSIC Rc360, maturities were 111 days for the NOP, 113 days for LCC-based N management, and 116 days for fixed-rate N management. Although there were no significant differences in maturity of varieties in each N management, the average crop maturity was lengthened by 3 days with LCC-based N method and 6 days with fixed-rate N method. In the NOP, there were no significant differences in yield among the varieties with an average yield of 4.6t/ha. In the LCC-based N method with some 77 to 112kg N/ha, yields of varieties did not differ significantly with an average yield of 7. 3t/ha. However, in the fixed-rate N method with some 190kg/ha, yields of varieties differ significantly: PSB Rc82 had a yield of 9.4t/ha, NSIC Rc238, NSIC Rc240, NSIC Rc302, and NSIC Rc308 had similar yield (8.1t/ha), and NSIC Rc360 had 6.6t/ha. In the LCC-based N method, the average agronomic N use efficiency (ANUE) ranged from 23.4 to 36.3kg grain kg $N^{-1}$ and generally did not differ among the varieties. In the fixed-rate N method, ANUE ranged from 11.65 to 25.4kg grain kg $N^{-1}$ and generally did not differ among the varieties.

In WS, PSB Rc18 had low yield due to stem borer infestation and hence, was excluded in the analysis. Maturities of NSIC Rc122, NSIC Rc240, NSIC Rc302, NSIC Rc308, and PSB Rc82 were lengthened by 2-4 days with LCC-based N management and 5 days with fixed-rate of 95kg N/ha. On the other hand, maturity of NSIC Rc360 was not affected by N management. Grain yields with LCC-based N management and the fixed-rate of 95kg N t/ha were significantly higher than the NOP but both N treatments did not differ significantly. Grain yields in the NOP had an average of 4.3t/ha, 6.2t/ha in the LCC-based N management and 6.3t/ha in the fixed-rate of 95kg N/ha. Grain yields among the varieties did not differ significantly. Likewise, ANUE between N treatments and among the varieties did not differ significantly. The results in grain yield and ANUE during WS can be attributed to low irradiance.

*Keywords: maturity, nitrogen use efficiency, variety, yield*

# Performance of Green Super Rice to Vermicompost and Bio-N (*Azospirillum brasilense*)

*BE Temanel,  FB Temanel, and E Lacueva (Isabela State University)*

Biofertilizers and the use of vermicompost are becoming increasingly popular for many crops, but very few studies on their effect on grain yield have been conducted in Green Super Rice under upland conditions. We evaluated Bio-N and varying rates of vermicompost in Green Super Rice (GSR) under upland condition at Isabela State University, Echague, Isabela during the WS 2015 using four different rates of vermicompost (100%RR Vermicompost alone, Bio-N alone, 100% RR Vermicompost plus Bio-N, 75% RR Vermicompost plus Bio-N, 50% RR Vermicompost plus Bio-N, 25% RR Vermicompost plus Bio-N, RR (40-60-45 NPK kg ha$^{-1}$, and no fertilizer as Control). The results showed that in all the parameters tested, except for plant height at maturity and weight of 1000 seeds, the plots applied with 40-60-45kg/ha and 100% RR Vermicompost +

Bio-N were comparable to each other in terms of yield. The lower rates of vermicompost + Bio-N proved to be insufficient to sustain the optimum growth and yield of the Green Super Rice 11. Aside from using the recommended rate (based on soil analysis) for the GSR 11, the rate of 100% RR Vermicompost ha$^{-1}$ + Bio-N can be used for rice production to reduce inputs of chemical fertilizers and sustaining soil fertility. Likewise, the trends in our results seem to indicate that Bio-N and vermicompost might be most helpful in rainfed environments. Furthermore, plots fertilized with 100% RR Vermicompost ha$^{-1}$ + Bio-N obtained the highest return on investment of 66.64%.

# Increasing Farmers' Productivity through Adoption of AWD and Associated Rice Production Technologies in Regions IX, XI (Davao Del Sur), XII, and ARMM

*RS Salazar and OH Abdulkadil (PhilRice Midsayap); EB Sibayan (PhilRice CES)*

This three-year study was initiated to increase production and reduce inputs through dissemination and adoption of appropriate crop management technologies in irrigated ecosystems. There were 27 technology demonstration farms (TDFs) established throughout Regions IX, XI, XII and in the Autonomous Region in Muslim Mindanao (ARMM) that showcased the best crop management practices on variety selection, water, nutrient, pest, and post-harvest management. Stakeholders meeting, pre-implementation meeting, consultation and on-site technical briefings were conducted. These helped equip and enhance the farmers' capacity in implementing the alternate wetting and drying (AWD) and associated rice production technologies. The AWD helps minimize number of irrigation events in the entire cropping season, thus decreasing water consumption.

The number of irrigation events diminished from an average of 12 times to 6 times (50% reduction) per season. The average yield increment across sites was 0.03t/ha in 2014 (0.52%), 0.36t/ha in 2015 (7.42%), and 0.30t/ha in 2016 dry season only (5.8%). Production cost was reduced through the use of the plastic drum seeder that lessened seed requirement per hectare and labor cost during transplanting. Also, nutrient management was corrected with the use of Leaf Color Chart (LCC) and Rice Crop Manager (RCM).

# Adoption of Alternate Wetting and Drying (AWD), Rice Crop Manager, and Minus-One Element Technique with App in Increasing Yield in Shallow Tube Well Irrigation System

*HR Pasicolan, JB Tapec, and NR Gawat (PhilRice Isabela)*
*MJC Regalado and EB Sibayan (PhilRice CES)*

This project is in support to the Food Staple Sufficiency Program (FSSP) of the Department of Agriculture (DA) which aims to increase profitability and sustain production growth of rice farming communities. The magnitude of and variation in yield gaps in rice production need to be addressed through continuous research and development. Increase in yields (through adoption of best crop management practices) and optimized market returns are important factors in addressing the problems in rice production. The results of the technology demonstration farms (TDFs) in 2015 project implementation across sites obtained an average yield of 6.65t/ha (actual yield) compared to 5.15t/ha (baseline yield). Thus, the yield increment attained was 1.51t/ha. The alternate wetting and drying (AWD) decreased the water requirement and the amount of fuel consumed (from 500-300 L of diesel) of the STW site, with an irrigation interval of 7-8

days in tillering to early flowering stage. Nutrient management tools RCM, and the minus one element technique (MOET) app  recommended the correct fertilizer recommendation in obtaining the maximum yield potential of the crops. The combination of the technologies gave an increase in yield at favorable rainfed areas.

*Keywords: alternate wetting & drying, technology demonstration, shallow tube well, irrigation, rainfed*

## Adoption of Alternate Wetting and Drying (AWD) in Community-Wide Irrigation System in Tumauini, Isabela

*NR Gawat, HR Pasicolan, and JB Tapec (PhilRice Isabela)*
*MJC Regalado and EB Sibayan (PhilRice CES)*

The project aims to increase production and reduce inputs through development, dissemination, and adoption of appropriate crop management technologies in irrigated and rainfed ecosystems. The participatory adaptive trial involved the establishment of demonstration farms on alternate wetting and drying (AWD) involving clustered 30-50 ha (or the service area of a turn out, the smallest group of water users in an irrigated system) from which 2-3 farmer cooperators were selected as farmer partners (FPs). These FPs were closely assisted by PhilRice, NIA, and IRRI to ensure that the recommended crop management practices were followed. Data gathering on hydrology (water availability, groundwater, and others) and agronomic (yield and yield parameters) was conducted during and after the course of adaptive trials. The result showed an increase of 35% water delivery on the irrigation canal without stress in rice with 5-7 days interval of irrigation in every turn outs.

*Keywords: alternate wetting and drying, technology demonstration, irrigation, water user, water delivery*

## Harnessing Wind and Solar Energy for Crop Irrigation in Ilocos Region

*MG Galera, ND Ganotisi, CT Dangcil, MLO Quigao, and MAU Baradi (PhilRice Batac)*

PhilRice Batac has developed a hybrid wind-solar pump system that aims to harness wind and solar energy to pump water for annual crops. Specifically, it aims to design and develop a wind-solar pump system suitable in Ilocos Region to irrigate rice and rice-based crops, and  evaluate its capacity and efficiency. Existing technologies in the market which include the 600W-apacity wind turbine and 300W–capacity solar panel to charge a common 600 ampere-hour (AH) battery and inverter to drive an electric water pump, were utilized to construct the system.

The component parts were connected to come up with a hybrid wind-solar pump system. The power output of the solar panels and the wind turbine were connected using a common 600AH battery. The inverter was connected to the battery and converted DC to AC power to run an electric pump. The pump discharge was gathered using the volumetric method. An AC/DC clamp meter was used to measure the charging capacity of the wind-solar and the discharging capacity of the electric pump.

The hybrid wind-solar pump system was evaluated based on the volume of water discharged and its capacity to charge and discharge the battery. Three pumps were tested: 0.5hp submersible, 1.5hp top-mounted, and 12VDC pump with potential pump discharges of 9.22, 5.67, and 6.40 m$^3$/day, respectively. Investment costs for using the three different pumps were P100, 560, P138, 560, P85, 160 for the 0.5hp, 1.5hp, and 12VDC, respectively.

The hybrid wind-solar had an average 53A daily charging capacity, taking 5–6 days to fully recharge the battery from 50% depletion. Considering the 0.5hp, the pump had 9.22 m$^3$/day that could irrigate

roughly 1,900 m² or 700 m² of tomato or rice with an average water requirement of 4.83 and 13.31 mm/day, respectively. For longer battery life, pumping should be sustained up to 10hr only to limit within 50% battery discharge.

The pump used was considered in determining the investment costs of the hybrid wind-solar pump system. For the 1.5hp top-mounted electric pump, the system would cost almost P140, 000; P100, 000 for 0.5hp submersible pump, and P85, 000 for 12VDC pump.

## The Influence of Timing and Level of Nitrogen and Potassium Application on Physiological Traits Responsible for Yield on Hybrid Rice

*Marnellie L. Pini (PhilRice Isabela)*

The study was done to evaluate the influence of timing and level of nitrogen and potassium application on the physiological traits of hybrid rice. It was conducted in PhilRice Isabela Experiment Station. The set-up was laid out in a split-plot design with three replications in a 20m² plot. Mestizo 48, a new hybrid variety released by PhilRice, was used in the study. The treatments were applied in different level and timing. Chemical control for weeds, snails, and prevalent insects were applied to minimize the damages caused by these pests. In dry season 2015, the 100kg N, 60kg P, and 60kg K per hectare with two splits at 14 days after transplanting and 28 days after transplanting, attained the highest tiller count, biomass in grams, and yield (t/ha). Heading of the plants were first observed in 150kg N, 60kg K per hectare. In wet season 2015, the 120kg N and 60kg K per hectare with three splits at 14, 28 and 35 days after transplanting, attained the highest yield (6.97t/ha). Heading of the plants were first observed in 150kg N per hectare. Based on the observations made during the crop development, the timing and level of fertilizer application had an effect on the heading and flowering of the rice variety planted.

## Utilizing the Benefits of Plant Microbial Interactions in Suppressing Rice Blast (*Pyricularia Oryzae*) in Rice

*Jerome V. Galapon and Anna Theresa Isabel O. Rebong (PhilRice Isabela)*

Biological control is an effective and powerful alternative to synthetic chemicals in controlling rice diseases. This study evaluated the effects of *Trichoderma sp, Metarhizium sp*, and vascular arbuscular mycorrhiza (VAM) against rice blast (*Pyricularia oryzae*) and on the growth and development of rice plants. Varieties used in the study were Mestizo 1, Mestiso 20, and NSIC Rc150. Pure cultures of the said microorganisms were collected and used in laboratory and field trials. Dual assay test results between each microorganism and blast showed the antagonistic behavior of *Trichoderma sp*, and *Metarhizium sp* resulting in the overgrowth of rice blast. Under field conditions, spraying of a spore suspension of *Trichoderma sp, Metarhizium sp*, and VAM as treatment significantly reduced disease severity (DS) and disease incidence (DI) on the plant leaves. However, root and shoot lengths during the vegetative stage did not show significant differences among treatments used. Evaluation for other agronomic parameters is  under further verification.

# *Bacillus* spp. and mycorrhiza for Growth and Sheath Blight Disease Management in Rice

*Ann Jhudeil C. Santos and Evelyn B. Gergon (PhilRice Los Baños)*

Sheath blight (ShB) caused by *Rhizoctonia solani* is among the major diseases of rice. The present study evaluated *Bacillus* spp. and vascular arbuscular mycorrhiza (VAM) as growth promoters and biocontrol agents against ShB. Initial screening using multiple culture assay of 111 *Bacillus* sp. isolated from rice seeds showed that 46 isolates grew profusely ($\geq 2.0$cm) inhibiting the mycelia of *R. solani*. Further screening using disk assay method showed that 2 out of the 46 isolates, EG130 and EG 108, markedly inhibited *R. solani* after having profused growth of 5cm. Plant growth-promoting activities of select *Bacillus* isolates were carried out *in vivo* by seed bacterization for 24 hours using dilutions. As root inoculant, VAM was also evaluated as growth promoter using rice variety NSIC Rc240 under screenhouse conditions at different fertilizer levels (full recommendation, half, and no fertilizer). Seeds bacterization with EG130 at $10^8$ concentration significantly increased the root and shoot length and the total biomass of rice seedlings at 14 DAS. Higher concentrations ($10^6$ and $10^7$) of both EG 130 and EG108 also increased the growth of the seedlings compared with the control. There were no significant differences among the varying concentrations of EG108. Rice inoculated with VAM were also significantly taller and have longer roots than non-mycorrhizal plants at harvest. VAM also helped increase the number of leaves and lower the incidence of damaged panicles. It also contributed to the increase of grain weight by 42.9%.

*Keywords: vascular arbuscular mycorrhiza (VAM), sheath blight, Rhizoctonia solani*

# Assessment of Fertilizer Nitrogen Use Efficiencies in Rice-Based Systems Using Lysimetric and Isotopic Techniques

*ED Samar, AH Anida, MB Collado, MKD Tarriela, and RRB Raya (BSWM)*
*RV Rallos and FG Rivera (PNRI)*

Available nitrogen (N) is among the limiting factors to rice productivity. Growth performance and fertilizer nitrogen use efficiencies (FNUE) of inbred rice variety in inorganic and organic-based fertilization under irrigated and rainfed conditions were assessed using 15N Isotope tracer in portable drum lysimeter. Likewise, the study determined the N loss through leaching of applied fertilizers. Experiments were conducted at the National Soils and Water Resources Research and Development Center (NSWRRDC) for Lowland-Upland Pedo-ecological Zone at San Ildefonso, Bulacan. Inorganic fertilizer at 0, 45, 90, 135, 180, and 225kg N/ha were applied to irrigated rice while rates of 0, 45, 90, and 135kg N/ha were applied to rainfed rice. For organic-based fertilization, 0, 45, 90, and 135kg N/ha combined with 300kg of commercial organic fertilizer were used. Blanket application of P and K at rate of 60kg/ha each was done. Significant difference in grain yield was observed from four cropping seasons of irrigated rice applied with inorganic fertilizer. Using 15N tracer, combined results from four experiments based on WS 2013 showed low FNUE (<30%) from both inorganic and organic-based fertilization in irrigated and rainfed rice. The increased N rate application did not directly translate to an improved FNUE. Using lysimeter, comparison of N from leachate taken from DS 2014 and 2015 showed N loss at less than 2% of applied N in inorganic fertilization of irrigated rice. Results of this study will be used as benchmark to refine N loading estimates from ricelands into Manila Bay considering FNUE of 50.7% as adopted from an earlier study.

*Keywords: fertilizer nitrogen use efficiency, isotopic technique, lysimetric technique, rice-based systems, nitrogen loss*

## Testing the Applications of UAV-based Aerial Imagery in Rice R&D

*Nehemiah L. Caballong and Roger F. Barroga (PhilRice CES)*

Unmanned Aerial Vehicles (UAV) present a whole new way of looking at a phenomenon. This system can aid researchers in gathering and monitoring precise data for a wide range of experiment setups, community wide observations, and technology impact evaluation, among others. A DJI Phantom 3 Professional quadcopter was tested for the following applications: photography and videography; field mapping and photogrammetry; and image processing for vegetation indexes. Photography and videography are its basic functionalities. The attached camera provided high-resolution-top-view-angle shots of experiment plots. Field mapping was used for site development planning of the FutureRice farm, 5-ha agri-tourism site. Through photogrammetry, measurements such as area and distance were rapidly conveyed. Moreover, the maps generated were post-processed to provide raster calculation of vegetation index using a cross-platform free and open-source desktop geographic information system (GIS) application. There are different image processing algorithms to get the numerical value of the greenness of the crop canopy. Normalized Green Red Difference Index (NGRDI) was used in the testing.

*Keywords: drone, aerial imagery, remote sensing, low altitude*

## Efficient Farming System Using Mechanically Seeded Aerobic Rice Culture

*JB Tapec and HR Pasicolan (PhilRice Isabela); MJC Regalado and EB Sibayan (PhilRice CES)*

Several rice production technologies have been developed to reduce vulnerability of rice against the effects of climate change in agriculture. These labor-saving and cost-effective technologies and practices increase crop productivity. Dry seeding (aerobic rice culture) instead of transplanting may help solve the problem on water scarcity. It requires less water during land preparation, and less labor during crop establishment. The results of the technology demonstration farms (TDFs) in wet season 2015 project implementation in LAVERMOS IA covering two barangays obtained an average yield of 3.08t/ha. Dry direct seeding using a multi-planter was also used at a 60kg seeding rate. The multi-planter can plant 3ha/day that drill, plant, fertilize and cover the seeds in linear row. NSIC Rc192 (Sahod Ulan 1), known to withstand adverse conditions such as drought, was used. Results of the study showed that the aerobic rice culture can help farmers obtain higher yield.

*Keywords: aerobic, multi-planter, technology demonstration, seeding rate, cropping*

## IT Moves Beneath the Ground:
## A Soil Information System for Improving Agricultural Productivity

*WB Collado, RV Bermudez Jr., J Gamilla, AC Arocena Jr., and JL De Dios (PhilRice CES)*

The Philippine agriculture is in need of a user-friendly and readily-available data set on soils in achieving national food security. The available soil information in the form of survey reports or other similar publications are limited, too technical, and difficult to understand by end-users particularly farmers, agricultural extension workers, and policymakers in the field of agriculture.

A web-based soil information system is necessary in providing users with valuable information on the soil resources of a particular area. When coupled with an interactive application mechanism, it can provide better and more efficient identification of the actual kind and type of soils based on the soil series level of classification. This will then reduce the risks of incompatible management recommendations, selection, and transfer of knowledge or technologies. Once the soil has been properly identified, information on soil physical properties as fertility indicators, productivity index for lowland rice, soil limitation affecting crop growth, soil taxonomic classification, crop suitability analysis, and appropriate soil management recommendations are derived.

In this study, information technology was used to provide a comprehensive set of soil information in the selection of crops, establishment of appropriate and effective crop management, and enhancement of agricultural productivity.

*Keywords: information technology (IT), soil series, web-based, agricultural productivity*

# Development of a Sustainable Information Technology (IT) Infrastructure for the Philippine Rice Information System

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*JL de Dios, AC Arocena Jr., HDC Cayaban, M Barroga, EJP Quilang, CD Diaz,*
*and LAI Tamani (PhilRice CES)*

The Philippines recently embarked on an effort to develop a national rice mapping and monitoring system named as Philippine Rice Information System (PRISM). PRISM provides reliable, accurate, timely, detailed, location specific, and sustainable rice-monitoring information to drive decisions for improving rice production in regions with high potential yield gains, to target and prioritize interventions, to mitigate the impacts of natural calamities, and to reduce yield loss caused by pest injuries. PRISM uses data from high resolution multi-temporal Synthetic Aperture Radar (SAR) imagery, crop growth simulation model, smartphone-based field and farmer surveys, and cloud computing. Target products are precise rice crop area estimates, cropping calendar, production and yield estimates, crop health, and crop damage assessment (due to flood, drought, and pest and disease injuries). These PRISM products are presented in the form of maps, graphs, and reports that are consolidated, validated, stored in a cloud-based database, and conveyed through a secure web-portal (www.philippinericeinfo.ph).

Accessible forecast on area planted to rice and yield on a national scale is rare, and most of the time non-existent. This is a result when implementing the conventional data collection, consolidation, encoding, and sequential processing. Thus, risks in transporting the survey questionnaire is imminent, as well as the database media which is prone to damage. These risks and delays in the delivery of outputs makes the information unusable for the national government's decision-making and planning activities.

PRISM utilizes the potentials of information technology (IT) with the integration of smartphone applications, information system (IS), and cloud computing to deliver timely and accurate information on rice area and production situation in the Philippines.

The system uses smartphone for field data collection and transmit these data via the internet. The cloud-based information system (IS) receives these transmitted data for organization, storage, processing and sharing. Data control environment ensures accuracy and validity of ground information before processing. There are different levels of statistical and logical processing performed automatically and progressively. Processing includes the use of custom software, third party applications, and algorithms embedded in the system. These generated outputs were then classified by a Sharing Policy to ensure that the system will only show information intended on the privilege of the user.

To ensure the efficiency and security of the system infrastructure, modular implementation of web and database systems and services with multi-location mirror were implemented. The web service infrastructure implemented load balancing to ensure scalability and agility to meet workload demands and improve the system's overall availability. The database system used master to slave design to maintain data security. To ensure the information systems' availability at any given situation, a Risk Management Plan provided the information on how to efficiently manage and recover the system.

PRISM demonstrated the convergence of cutting-edge technologies to deliver actionable information on rice production at national and regional levels. This should help the national government make the necessary provision to address food security.

*Keywords: Information System, SAR, Smartphone, IT, internet*

## Field Evaluation of Rice Crop Manager in Los Angeles, Butuan City

*CS Agting and GF Estoy Jr. (PhilRice Agusan); WB Collado and MJC Regalado (PhilRice CES)*

The Rice Crop Manager (RCM) is a decision-making tool that provides the farmers with a personalized crop management recommendations. It is used specifically for irrigated and rainfed rice areas surrounded by bunds. The tool aims to empower farmers with appropriate and modern precision farming based on an approach developed through nutrient manager for rice. It was also developed, released, evaluated, and upgraded for computers and smartphones in 2013-2015 cropping seasons. Despite these developments, continued research is still needed to further enhance the capabilities of RCM in meeting the emerging needs of rice farming in a changing climate. This research evaluation was conducted to develop and enhance a climate-informed RCM.

The tool was tested in Brgy. Los Angeles, Butuan City with 11 farmer cooperators (FC). The FCs were carefully chosen based on their willingness to conduct the research in their respective fields. Each field has an area of 300-700 square meters for every treatment or plot. Rice crops were managed based on RCM recommendation (RCM 1), RCM enhanced (RCM 2), and farmers' practice (FP).

Based on the results of RCM trial in Los Angeles, Butuan City in January-June 2016 cropping (phase II, season 1), rice grain yield of RCM recommendation (RCM) and RCM Enhanced (RCM 2) achieved an average yield of 4.57t/ha and 4.65t/ha, respectively. Meanwhile, the Farmers' Practice (FP) achieved 4.27t/ha only. These results indicate that despite the previous progress in the RCM field trials, continuous research is still needed to further enhance the capabilities of RCM in meeting emerging needs of rice farming in a changing climate.

*Keywords: RCM, rice crop manager, farmers' practice, decision tool*

## Evaluation of Rice Crop Manager in Cauayan City, Isabela

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*RJ Buresh and ET Moscoso (IRRI)*

Rice Crop Manager (RCM) is a comprehensive decision-making tool for increasing yield and income of farmers in the Philippines. It contributes to the implementation of modern precision farming by giving farmers a personalized recommendation specific to their rice-growing condition. This can be accessed at http://webapps.irri.org/ph/rcm through a computer or smartphone. The said decision-making tool was evaluated for further improvement in Cauayan City, Isabela in 2015 wet season. RCM yielded 6.3t/ha, RCM2 had 6.2t/ha, and farmers' practice (FP) achieved 5.8t/ha. Results showed an improved income of P5, 613 when supplemented with other factors aside from RCM recommendations, such as varietal selec-

tion, water, weed, and pest management, and climate change adaptation and mitigation. The calculation for fertilizer recommendation was based on the interview conducted using the http://webapps.irri.org/ph/rcmsurvey.

*Keywords: decision tool, precision farming, rice crop manager, modern, climate change*

## Farm Wise Despite Water-scarce: Characterization of Post-Rice Garlic Cultivars Grown in Occidental Mindoro, Philippines

*REG Ragas, FKJR Padron, AGS Ferriol, MYAD Ruedas, and JM Manangkil (PhilRice CES)*

In the Philippines, there is a resurgence of interest in local garlic cultivars as a crop planted after rice for income opportunities in areas where water scarcity during the dry season makes rice production impossible. Occidental Mindoro shares 17% of the country's national garlic production and ranks as second garlic-producing province in the Philippines. Garlic cultivars grown in the province include *Lubang*, *Mindoro White*, *Batanes White*, and *Ilocos White*. Morphological and anatomical traits were used to evaluate the diversity of garlic cultivars. Significant differences in bulb weight, bulb diameter, and clove weight were observed among cultivars. Minimal variation was observed on the qualitative bulb traits (number and color of sheath) of each cultivar as it was highly affected by its environment. Among the four cultivars, *Batanes White* produced the biggest (4.03cm ± 0.06) and heaviest bulb (22.38g ± 0.94) while *Mindoro White* has the smallest (3.29cm ± 0.05) and lightest (13.78g ± 0.50). Across cultivars, epidermis is single layered with cuboidal cells. Ground tissue is multilayered and parenchymatic cells vary from hexagonal to ovoidal. Epidermal and parenchymatic cells differ in length and width. Differences in the number of vascular bundles among cultivars were also observed. This study can provide information to help in market recognition as well as in farmers identification of production-quality garlic.

*Keywords: morphological, anatomical, Lubang, Mindoro White, Ilocos White, Batanes White*

## Economic Analysis of Oyster Mushroom Production (*Pleurotus* sp.) at PhilRice Midsayap

*IML Bauzon, SE Abdula and IV Boholano (PhilRice Midsayap)*

Agricultural waste, such as rice straw, are being utilized as substrates for mushroom instead of burning them in the open field after harvest. This study conducted an economic analysis of the oyster mushroom (*Pleurotus sp.*) production using rice straw as substrates. It specifically aimed to: identify the production level of oyster mushroom under the PhilRice Midsayap condition; determine the actual operational analysis and actual analysis for one fruiting bag; and conduct profitability analysis for a larger scale mushroom operation (at least 1, 000 fruiting bags).

The total cost of production of 1000 fruiting bags was P7,560 at P7.56 per fruiting bag. Three highest gross incomes were as follows:  P461.32 when sold at P180.00/kg; P512.58 when sold at P200.00/kg; and P640.72 when sold at P250.00/kg. Results showed deviations from first to last harvest in gross income ranging from P64.10 to P1, 879.20 at a corresponding mushroom harvested per batch of 0.32kg to 10.44kg, respectively. The data suggests that a pricing strategy for the product is a potential solution to optimizing profit for oyster mushroom production.

*Keywords: agricultural waste, economic analysis, fruiting bags, Pleurotus sp.*

# Propagation of Blue-Green Algae and Evaluation of their Nitrogen Fixation Ability for Rice Paddy Algalization

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*MR Martinez-Goss (IBS, UPLB)*

With the growing concern on the harmful effects of continuous use of chemical fertilizers in rice production, nitrogen-fixing blue green algae (BGA) may be explored as an ecologically-sound alternative for increasing rice productivity through algalization. This technology is the practice of incorporating algae into the rice paddies where their growth is enhanced while intercropped with rice. To exploit BGA as cheap and renewable source of biofertilizer (particularly N) for rice cultivation, four BGA strains namely, *Anabaena variabilis* (Ns71Ph), *Nostoc commune* (Ns21Ph), *Nostoc A UPLB* (Ns07Ph), and *N. Maahas* (Ab23Ph) were propagated using trough method. Their nitrogen fixation ability was evaluated indirectly through measurement of filament length and vegetative cell diameter, and by counting the number of vegetative cells, heterocysts, akinetes, and dividing cells per filament in relation to the ammonia content of algal liquid media. Non-spherical algae grew faster compared with the spherical type. Decreasing order in algal flake yield was observed for Ab23Ph (12.09g), Ns07Ph (9.61g), Ns71Ph (7.58g), and Ns21Ph (6.88g). The nitrogen content of the algal flakes ranged from 1.00-1.14%. In the initial observations of the first trial, filament length and number of vegetative cells per filament showed significant correlation (-0.97 and -0.98, respectively) to the ammonia content of the BG11-N (no nitrogen) media, where Ns71Ph showed the highest filament length (125.30μm) and number of vegetative cells (20). However, in the second trial, only the filament length showed significant correlation (0.987) during final observations where Ab23Ph showed the highest filament length (185.11μm) and ammonia content (3.63ppm). Based on these results, Ns71Ph was selected for mass propagation prior to initial pot experiment and identification of the best algal and chemical fertilizer combination for rice cultivation to be followed by Ab23Ph.

*Keywords: blue-green algae, algalization, nitrogen-fixation ability, biofertilizer*

# Iron and Zinc Rice Lines: A Peek on their Grain Quality and Mineral Concentration

*RA Ramos, JPA Samin, and EC Arocena (PhilRice CES)*

As rice is the main source of nutrients for most Filipinos, the works on breeding for high-micronutrient rice continues. Hence, this study evaluates the grain quality characteristics, and iron and zinc concentration of six rice lines bred for high zinc and iron. Brown and milled rice, head rice recoveries, size and shape, % amylose and crude protein contents, and mineral concentration were measured using flame atomic absorption spectroscopy in 2014 wet season and 2015 dry season. In terms of milling recovery, most of the rice lines passed the recommended values for brown rice (>75%), milled rice (≥65%), and head rice (≥48%) recoveries. Most of the rice lines were long and slender (≥6.6mm and >3.0), which are preferred by Filipino consumers. Majority of the samples have intermediate amylose content (17.1–22.0%), which indicates good eating quality. Crude protein ranged from 6.7-9.0%. Iron content in unpolished and polished rice ranged from 15.4-35.9 and 9.2–28.2μg $g^{-1}$, respectively. Zinc content, on the other hand, was 24.9–36.7μg $g^{-1}$ in unpolished rice and 20.6–30.5μg $g^{-1}$ in polished rice. These results showed acceptable good grain quality of rice lines being developed for higher iron and zinc contents for improved nutrition. In addition, the mineral concentration in unpolished rice is mostly above the breeding target (13μg $g^{-1}$ Fe and 28μg $g^{-1}$ Zn), which accentuates the importance of brown rice consumption of the high-nutrient rice for optimal nutritional benefits.

*Keywords: rice, iron, zinc, grain quality, nutrition*

# Carbonized Rice Hull (CRH)-Insulated Rice Silo:
# A Solution to Rice Seed Storage Losses

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*CJM Tado and SM Brena (PhilRice CES)*

Maintaining the viability of rice seeds for a longer period is a constant problem in the Philippines due to environmental factors and pest infestation. Existing storage facilities of farmers cannot fully protect the seeds from insect and rodent damages. Unfavorable ambient conditions cause microbial and fungal proliferation. Hence, a one-ton capacity rice silo insulated with carbonized rice hull (CRH), was developed to reduce storage losses. CRH was used as insulator for its wide availability, low thermal conductivity, high moisture retention, and pathogen-free capability. The silo (1.9m height and 1.25m diameter) was made of double walls of GI sheets, 4cm apart. The inner wall was perforated with evenly distributed 1.2cm diameter holes. The space between the walls was filled with CRH. The inner wall was lined with a permeable clothe to prevent the CRH from mixing with the stored seeds. The top of the silo had a detachable conical cover to prevent rain water and moisture accumulation. The bottom was slanted at 30° with a square chute opening (20cm x 20cm) at the lowest part, covered with sliding door for easy unloading. The silo was elevated by 40cm with a frame.

The silo was situated outdoors to expose it to various weather conditions throughout its year-long evaluation. It was filled with NSIC Rc216 in July 2015 from an April harvest. Seed samples, from 12 equidistant sampling points 10cm away from the inner cylinder and 3 sampling points at the center, were obtained once a month for analysis on selected variables. Samples were stratified to bottom, middle, and top categories.

The silo maintained the viability of the stored NSIC Rc216 seeds for 10 months. Although all other variables were still within the acceptable range after 12 months of storage, germination rate dropped below 85% after 10 months. For 10 months, the germination rate ranged from 89.7-97.3% and moisture content stayed within 10.6-12.5%. Over 100 weevils and 1.2% damaged seeds were recorded from each of the three 750g samples.

In the seed vigor test, above the 85% cut off level germination rate was maintained for 7 months in the 3-day accelerated aging test and 2 months in the 5-day accelerated aging test.

*Keywords: carbonized rice hull (CRH), rice seed storage, loss prevention, rice pests*

# Ultrafiltration Improves the Quality and Stability of Rice Wine

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*CJC Apellido, JRS Crisologo, CNX Tutaan, and MC Almendrala (DLSU)*

Rice wine or "tapuy" is an important ceremonial drink in the Philippines, particularly in Northern Luzon. Rice wine produced by traditional method oftentimes has problems with sedimentation, browning, souring, and short shelf-life lasting only for a few weeks. PhilRice conducted extensive research to help address these concerns. Through optimization of the process, the quality of rice wine was significantly improved and its shelf-life was made longer to about six months at room temperature and even more stable at refrigerated temperature. However, the development of off-odor/off-flavor and browning, which is usually caused by proteins and polyphenols, still persists upon storage at room temperature. This study evaluated the use of crossflow ultrafiltration (1" diameter hollow fiber ultrafiltration membrane) cartridges to remove these compounds. Freshly harvested rice wine was filtered using cartridge with 500 kDA molecular weight cut-off and after aging for a month, the samples were further passed through 10, 50, and 100 kDA. Evaluation for protein, polyphenols, physicochemical properties, sensory quality, and microbial load was conducted at two-week intervals. Results showed that ultrafiltration caused a considerable 16% reduction in crude protein without varying the physicochemical properties of the wine during aging. The sensory properties of ultrafiltered wine were comparable with the control (charcoal-filtered). Based on

microbiological examination (total plate count, yeasts and mold, *E.coli* and coliforms), ultrafiltration was able to make the wine biologically safe and stable even without pasteurization. Lightest yellow color (7.46-8.53 *b* value) and lowest amount of polyphenols (594-664 gallic acid equivalent) were observed with 10 kDA filter membrane. Wine filtered using 100 kDA membrane and pasteurized after bottling had the highest sensory scores for aroma (9.39), smoothness (10.08), and overall acceptability (10.72). It is therefore evident that ultrafiltration of unpasteurized freshly harvested rice wine using 500 kDA membrane and further filtration through 100 kDA after aging is effective in clarifying the wine and removing unstable proteins and polyphenols that contribute to browning.

*Keywords: rice wine, ultrafiltration, protein, polyphenols, physicochemical properties, sensory quality*

# Bioactivity and Profiling of Enzymatic Hydrolysates from Rice Bran Soluble Proteins

*RC de Leon, MJFA Magnaye, and APP Tuaño (PhilRice Los Baños); MAO Torio (UP Los Baños)*

Rice bran proteins (RBP) have high nutritional value, bioactivity, and nutraceutical properties. However, little is known about the antihypertensive activity of RBP and their hydrolysates. This study aimed to compare the antihypertensive activities of enzymatic protein hydrolysates from defatted rice bran using the angiotensin I-converting enzyme (ACE) inhibition assay. RBP had a protein concentration of 1.99mg/ml as determined by Biuret assay following alkali extraction. Pepsin, trypsin, chymotrypsin, and thermolysin were used to hydrolyze the RBP. Sodium dodecyl sulfate – polyacrylamide gel electrophoresis (SDS-PAGE) confirmed the presence of various RBP bands and the efficacy of enzymatic hydrolysis. Undigested protein showed prominent bands with approximate molecular weights ranging between 6-55 kDa. Enzymatic hydrolysis treatments showed differences in electrophoretic profile. The peptic digest had the highest ACE inhibition and the lowest $IC_{50}$ value, followed by chymotryptic, tryptic, and thermolytic digests, respectively.

*Keywords: antihypertensive activity, enzymatic digests, rice bran proteins*

# Characterization and Potential Encapsulation of Rice Bran Oil Using Chitosan-Alginate Nanoparticles

*RP Tubera, RM Bulatao, and HM Corpuz (PhilRice CES)*
*JR Salazar and JJ Monserate (Central Luzon State University)*

Rice bran oil (RBO) is a healthy product from bran that contains high amount of antioxidants such as vitamin E and γ-oryzanol. These antioxidants are important in the regulation of different biological activities in the body, thus contribute significantly to the prevention of some chronic diseases. However, use of RBO as antioxidant supplement and ingredient for various food preparations is very limited due to its high susceptibility to spoilage.  To help address this problem, RBO was nanoencapsulated.  Purified RBO from NSIC Rc160 was encapsulated using chitosan-alginate nanoparticles in varying ratios: 1:1, 1:2, and 1:3. The encapsulated RBO samples were characterized for surface morphology, particle size, polydispersive index, chemical properties, and antioxidant activity. Scanning electron microscopy analysis revealed that the prepared nanocapsules had smooth surface with some spherical shapes, indicating the presence of RBO. This observation was confirmed by Fourier Transform Infrared analysis, which showed prominent peaks at 2913, 2855, and 1750cm$^{-1}$, similar with that of RBO. The particle size of encapsulated RBO ranged from 308.9-581.9nm, which falls under the nanocapsule category (<1000nm). Moreover, their polydispersive indices ranged from 0.57-0.74, suggesting that the nanocapsules had uniform particle size. Among the samples, the highest antioxidant activity was noted in 1:1 chitosan-alginate/oil ratio (27.7%). Hence, chitosan-alginate nanoparticles can be a good encapsulating medium for RBO for better stability and wider applications.

*Keywords: rice bran oil, nanoencapsulation, antioxidant, chitosan-alginate, nanoparticles, polydispersive index*

# Cell Toxicity on Normal Human Blood Lymphocytes of Antioxidant-Rich Bran Extract from Philippine Red and Black Rice Cultivars

*RP Tubera, RM Bulatao, and JPA Samin (PhilRice CES)*
*RR Huliganga, MAM Feliciano, and CV Ortinero (Central Luzon State University)*

Antioxidants are widely known for their immune-enhancing and disease-preventing properties. They are known to be effective in neutralizing excess free radicals, thereby protecting cells against oxidative damage. However, recent studies showed that synthetic antioxidants posed carcinogenic effect on human cells. This paved the way to search for alternative sources of antioxidants from natural sources such as pigmented rice. Thus, ethanolic bran extracts of different red and black rice cultivars were evaluated for their bioactive compounds, antioxidant activities, and human cell toxicity using trypan blue exclusion assay. The bran extracts exhibited high amount of phenolic compounds (70.1-178. 4mg gallic acid equivalent/g), flavonoid (123.3-378.0mg rutin hydrate equivalent/g), and anthocyanins (0.8-152.5mg/g), which are predominant among black rice samples. The antioxidant activities of pigmented rice bran extracts ranged from 116.4-461.7 mg TE/g for Ferric reducing antioxidant power and 85.4-367.7mg TE/g for ABTS radical cation scavenging activity. All sample extracts showed low levels of $EC_{50}$ (11.6-30.3mg/L) and $EC_{25}$ (1.2-10.1mg/L), which is a good indication of high antioxidant activities. Furthermore, the black and red rice bran extracts (100-1000ppm) showed no toxic effect on normal human blood lymphocytes. This implies that pigmented rice bran extracts are safe for human consumption at those identified concentrations. Hence, pigmented rice bran extracts can be used as ingredient in the development of different functional food and pharmaceutical products.

*Keywords: antioxidants, radicals, carcinogenic, flavonoids, normal human lymphocytes, scavenging activities, rice bran extracts*

# Snapshot of Rice-Based Farm Households' Food and Nutrition Security: The Case of Central Luzon

*Riza A. Ramos and Josefina F. Ballesteros (PhilRice CES)*

Agricultural productivity largely affects food and nutrition security. Adequate nutrition depends on available food sources in the locality. This study assessed the food quality and dietary-intake of individual members of 385 rice-based farm households in Central Luzon. The dietary intake of a random sample of 1618 respondents (55% males and 45% females) was assessed using a three-day 24-hour food recall through a household survey. The mean per capita calorie intake in the region was 1467.60 ± 649.92kcal, which is below the recommended daily energy intake of 2000kcal. There were only 46.47%, 50.61%, and 65.94% who were within the acceptable macronutrient distribution range of protein, fat, and carbohydrate consumption, respectively. The average iron and vitamin A intakes per capita were 10.59 ± 11.40mg and 337.52 ± 539.23µg RE, respectively. A large percentage of household members were below the estimated average requirement of iron (60.42%) and vitamin A-intake (82.08%) per day. Cereals and products (60.39%) were the most consumed and contributed an average of 836.00 ± 431.54kcal per capita, which was 56.96% of the total average per capita calorie intake. Other food groups commonly consumed were meat, fish poultry and products (19.48%); sugar, syrup and confectionery (7.97%); vegetables, legumes, and root crops (5.94%); fruits and products (2.04%); milk, yogurt, and cheese (1.62%); fats and oils (1.29%); alcoholic beverages (0.83%); and spices and condiments (0.44%). Mean per capita calorie-intake from rice in the region was 720.93 ± 371.39kcal, which was 49.12% of the total average per capita calorie-intake. The results showed that low-quality diet and nutrient inadequacy were prevalent among the rice-based farm households in the region. Public health intervention should be food and agriculture-based and nutrition-sensitive to ensure food and nutrition security among all members of the rice-based farm households.

*Keywords: calorie-intake, diet quality, food security, nutrition security, rice*

# Labor Use and Mechanization: Impacts on Labor Productivity in Rice Production in the Philippines and Selected Major Rice-Producing Countries in Asia

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and RG Manalili (PhilRice CES); PF Moya (IRRI)*

Farm labor accounts for about 36% of the total rice production cost. This could be attributed to either the high labor required to produce rice per hectare or to high agricultural wages. Hence, reducing labor cost is among the major approaches to improve competiveness and increase labor productivity in the light of trade liberalization brought about by the ASEAN Economic Integration. This study examined the status of labor use and mechanization, and their implications on labor productivity and cost in Philippine rice production relative to selected major rice-producing countries in Asia: Indonesia, India, China, Thailand, and Vietnam. A quota sample of 100 farmers was set per sample province per season per country with total samples of 600. Data were gathered in all rice planting seasons during crop year 2013-2014 using structured electronic questionnaires in MS Access format. Descriptive statistics were mostly used in data analysis. Results showed that the total labor use in rice production exceeds 65 man-days/ha in the Philippines, Indonesia, and India. In China, Thailand, and Vietnam, labor use is about 10-20 man-days/ha. Widespread use of machines such as four-wheel tractors in land preparation and combine harvesters in harvesting and threshing, and the adoption of direct seeding in crop establishment are among the reasons for the low labor requirement. Consequently, China, Thailand, and Vietnam are among the countries with high labor productivity due to less use of labor input and highly mechanized operations. In the Philippines, low rate of mechanization keeps labor productivity low and makes rice production less competitive. Mechanization can reduce total production cost and enhance competitiveness as well as increase labor productivity resulting in higher rural incomes.

*Keywords: labor, mechanization, labor productivity, competitiveness*

# New Tools for Predicting Chalkiness and Immature Grains in Milled Rice

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APP Tuaño (PhilRice Los Baños)*

Developing rice varieties with the desired quality requires intensive evaluation especially for physical attributes. In milled rice, physical attributes consist of four parameters, namely: chalkiness, immature grains, grain length, and grain shape. Skilled classifiers manually assess these traits using their naked eye. Annually, classifiers usually evaluate 600-800 promising elite lines using duplicate samples of 30g milled rice. However, the process is time consuming and tedious. This study aimed to develop tools that can predict physical attributes of milled rice and automate the classification process. The predicting value of the developed PhilRice grain classifier software (PGCS) has shown an $R^2$ of 0.80 to 0.90 using the four parameters. In addition, during the protocol optimization of preparing milled rice samples, timing of harvest, proper drying, and appropriate milling procedure played an important role in obtaining accurate classification. The comparison between visual and automated process of evaluating chalkiness showed significant difference in the number of samples that can be evaluated and manpower needed to accomplish the task in a day. This investigation confirmed that visual judgment is influenced by various human factors while PGCS provides faster, straight-forward, more accurate, and stable results. From this study, two utility models were submitted to Intellectual Property Office of the Philippines (IPOPHL). The outcome of this work will benefit several concerned individuals such as the physical attribute classifiers by simplifying their strenuous work, the plant breeders by helping them objectively assess the genetics of the chalk trait, and the farmers by assuring them of a variety with premium grain quality, thereby increasing their profitability.

*Keywords: image processing software, grain quality, chalkiness, milled rice, grain classifier*

## Handtractor-drawn Multipurpose Seeder with Ride-on Operator

*EG Bautista, ED Gagelonia, and HV Valdez (PhilRice CES)*
*Y Kato and N Banayo (IRRI); R Lugto (VAL Agri)*

Due to scarcity of irrigation water, farmers in rainfed rice growing areas in the Philippines practice dry seeding of *palay*. Farmers usually do manual broadcasting of *palay* seeds in previously leveled or furrowed field. They complain on uneven seed distribution, high seed rate, and laborious method due to unavailable machine to ease the existing method.

The multipurpose seeder was designed to help local farmers in addressing such problems in the rainfed areas. The machine is attached to customarily used handtractor with ride-on operator for mechanical direct seeding of palay, mungbean, and corn in dry field condition. Seeds were evenly distributed using a metering device that controls the amount of seed, dropped it in the furrow created, and closed it to protect from birds and rodent. Multipurpose seeder can plant 2.67ha/day for mungbean at 60cm row spacing, 1.6ha/day for corn at 60cm, and 2.42ha/day for rice at 20cm.

*Keywords: handtractor drawn seeder, multi-purpose seeder with ride-on operator*


## Performance Testing and Evaluation of 100kw$_e$ Rice Husk Gasifier

*MJC Regalado, JA Dela Cruz, AT Belonio, JA Ramos, and ED Gagelonia (PhilRice CES)*

The cost of energy to provide power for various agricultural mechanization tasks is a major problem in rice production. In 2012, PhilRice through its Rice Engineering and Mechanization Division started its rice husk energy R&D for electric power generation. A 100-kW$_e$ rated rice husk gasifier was developed. It is a moving-bed downdraft gasifier system with components such as reactor, counter-flow impact type wet scrubber, horizontal-packed bed rice husk primary filter, foam-packed secondary filter, and holding tank. An 8-cylinder gasoline engine is direct-coupled to 100kW$_e$ rated generator as prime mover to produce electric power.

Four trials of the gasifier lasting at least 8 hours each were conducted. Engine transmission was set at $4^{th}$ gear(1800-2000rpm) to drive the generator with electrical output ranging from 180-200volts, and about 24kW$_e$. Electrical loads used were 12pcs. 1-kW$_e$ bulbs and 3pcs. Nichrome wire at 4kW$_e$ each. Parameters such as temperature, noise, gas quality, and moisture content were gathered during the test.

The investment cost for the gasifier-generator system is P3,250,000. It requires two persons to operate the gasifier. Results of trials showed that the gasifier can produce a steady supply of electrical power of at least 24kW$_e$ output for an 8-hour continuous operation with an hour rest at 4-hour interval with rice husk fuel comsumption rate of only 46kg per hour.

*Key words: electric power generation, gasifier, rice husk*


## Improving the Performance of Flatbed Drying Operation through Adoption of a Continuous-Type Rice Hull Gasifier and an S-Vane Tube Axial Air Moving Device

*JA Ramos, MJC Regalado, and AT Belonio (PhilRice CES)*

The flatbed dryer is a drying facility most known to farmers. The Department of Agriculture has distributed thousands of flatbed dryers in the last five years through its Mechanization Support Program. This facility is more popular because of its simplicity and affordability. However, the exposure of the grain to ash

and soots through the use of direct furnace remains an issue. The use of indirect fired furnace is a better option to address the problem but it is not cost-effective. An alternative is the use of gasifier technology as heat source for the drying system. This study was conducted to test if a relatively efficient dryer can be made more efficient and cost-effective by using a continuous-type rice hull gasifier as heat source and a new s-vane air moving device. Results showed that new fan can provide airflow and static requirement for a 6-tonner flatbed dryer. Based on tests, the fan can provide airflow of 10,000-18,000 $ft^3$-$min^{-1}$ under increasing speed of 900 to 1700 rpm. Static pressure ranged from 12-38 mm of $H_2O$ under the same speed condition. Initial drying test showed acceptable performance of the gasifier with a 60-cm diameter reactor in providing heating requirements for the 6-ton/batch dryer. Rice husk consumption was about 40 kilograms per hour. Measured plenum temperature reached as high as 50°C but temperature was easily maintained at 43°C. As farmers continue to improve its drying operations, using rice hull gasifier technology can find a niche and become a more economical and energy-efficient alternative to mechanical drying operation.

*Keywords: flatbed drying, continuous-type rice hull gasifier, s-vane tube axial air moving device*

## Pilot-testing of Retrofitted Engines for Mechanized Farming Operation

*AT Belonio, KC Villota, ML Rafael, PR Castillo, ED Gagelonia, and MJC Regalado (PhilRice CES)*

Three spark-ignition engines were retrofitted to fuel hydrous bioethanol (95%v/v) by providing separate fuel tank and a feeding device that bypassed the carburetor and directly injected the alcohol fuel into the intake manifold of the engines. Three engines were pilot-tested: (1) 3.5-hp engine for 2" water pump, (2) 6.5-hp engine for powering a pump boat, and (3) 1.1-hp engine driving a grass cutter.

Results showed that the engine for pump irrigation can supply water to a 500-900m² rice field at PhilRice Central Experiment Station for one cropping season. The pump discharges 13-18 $m^3h^{-1}$ at 2700-3350 rpm engine speed with fuel consumption of 1.7-1.9 $Lh^{-1}$. Pump boat application of the engine in Infanta, Quezon for transporting nipa sap in one season showed that the average hydrous bioethanol fuel consumption is 1 $Lh^{-1}$ and 0.7 $Lh^{-1}$ with gasoline. Testing the engine for grass cutter in cleaning levees in a 2.5ha of rice fields showed that the average hydrous bioethanol consumption is 0.75 $Lh^{-1}$ while consumption using gasoline is 0.5 $Lh^{-1}$.

*Keywords: spark-ignition engine, hydrous bioethanol, gasoline*

## Impact of Increased Duck Stocking Density on Arthropod Population in the Rice-Duck Production System

*JM Rivera, EM Valdez, and RG Corales (PhilRice CES)*

The rice duck production system is traditionally practiced in China, Japan, and Korea. There are many symbiotic benefits in growing ducks alongside rice. The rice environment provides bountiful food sources for ducks such as weeds, seeds, snails, and insects. On the other hand, presence of ducks results in the reduction of golden apple snail, weeds, and insects. Additionally, wading of the ducks in between the rice plants enhances growth and yield. The normal stocking density of ducks in the rice-duck system is from 100 to 200 ducks/ha.

Results showed that increased duck stocking density of the local duck species (Pateros) reduced arthropod population in the rice paddies. The noted arthropod reduction was higher in the dry season than in the wet season. It was further observed that the incidence of stemborer was not affected by duck integration as indicated by high white heads in all plots including those with ducks. Increased duck stocking density slightly increased rice yield, and provided higher additional income.

*Keywords: Arthropod population, duck stocking density, rice-duck, stemborer*

**Theme 4**
*Technology promotion and delivery accelerating adoption and achieving impacts
on farm productivity and sustainability*

## To See Is to Believe Remains the Name of the Game:
## Use of Farmers' Farms as Knowledge Sharing and Learning Avenues

*RG Zagado, JP Masilang, PIH Duran, and JS Maloles (PhilRice CES); EGaquit (PhilRice Agusan);
RT Dollentas (PhilRice Bicol); KCQ Saraos (PhilRice Los Baños)*

A great challenge facing agriculture nowadays is the declining interest to venture into it. However, some farmers testify that farming is a profitable enterprise. The Department of Agriculture, through its *Gawad Saka* Program, annually honors farmers who make it big in farming.This project aims to use the farms of selected *Gawad Saka* rice-based farmers as avenues to inspire farmers, the youth, and other stakeholders. This year, four farmers' farms were transformed and launched into knowledge sharing and learning (KSL) farms in Nueva Ecija, Batangas, Albay, and Agusan del Norte. There were  244 participants (composed of farmers, students, and extension workers) who participated in the launch. KSL activities conducted during the launch were: 1) farm tour with Q&A; 2) farmer's testimony; and 3) forum with the rice experts. During these KSL activities, knowledge relating to farm diversification, intensification, and integration surfaced and were emphasized by the farmer-hosts as good practices. Survey results indicate that majority of the participants (96%) have improved their perception of farming after the KSL farm visit. They have realized that farming can be a promising enterprise and that the use of farms for KSL is an effective strategy. Moreover, they said they would apply and share what they learned to their fellow farmers and their own family. With this project, a list of *Gawad Saka* rice-based farmers including their locations and contact details is also made accessible and available at http://www.philrice.gov.ph/rtm/ index.php/about-us/our-ksl-sites/ for those who are interested to visit their farms.

*Keywords: knowledge sharing, rice-based farming, farmers' farms*

## *PalaYamaNayon:* Development of Community-based
## Agro-enterprises Using Agri-biomass as Resource Base
## in Candaba, Pampanga

*RG Zagado, JS Maloles, PIH Duran, JP Masilang, AMV Bautista, and JDJ Ruz (PhilRice CES)
GC Martin (DA-RFO 3)*

Candaba ranks as the second  poorest town in Pampanga. It is an agricultural town predominantly dominated by small-scale farmers who grow rice and corn as their main sources of income. From these crops, voluminous amount of agricultural biomass with an estimated 643.05 MT of rice straw and 3,360.15 MT of corn stalks are produced every year. Open-field burning of these biomass is a common practice in the area, which emits greenhouse gases into the atmosphere. This project aims to address this problem by offering local farmers with alternative and profitable management options for agricultural biomass. Local farmers were engaged in mind-setting, enterprise development, and community organizing. Specifically, they were introduced to and trained on the following enterprises: (1) mushroom production, (2) vermiculture, (3) rice-based food products, (4) goat-raising, and (5) biomass art making for the youth. The *PalaYamaNayon* is still ongoing, but progress is already evident through improved community's perceptions, attitude, knowledge, and practices toward agri-biomass. Local farmers, particularly the farmers' housewives, are currently active in producing mushroom as their added source of income. Since the May training, farmers have already produced 7,000 fruiting bags with 5% contamination rate. Selling 50% of which at P20 per

fruiting bag, farmers are expected to earn around P66,500. Every day, farmers harvest an average of 4kg of oyster mushroom sold at P160/kg.  Reported income from mushroom production, thus far, is P26,000. Other activities conducted were market study and partnership building with DOST and DTI.

# Golden Rice in the News: 2013-2015

*Jungie Q. Amacanin and Karen Eloisa T. Barroga (PhilRice CES)*

Given the agenda-setting nature of the mass media, this study analyzed how the Golden Rice project was reported in local online news. It determined the major sources of Golden Rice articles and their general tone during a 3-year period: January 2013 to December 2015. These years were relevant to the Golden Rice project implementation in terms of activities, accomplishments, and challenges encountered. Local news reports collected online were individually analyzed and classified as **positive** (i.e., generally positive, factual information); **neutral** (i.e., with balanced reporting); and **negative** (i.e., generally negative information, oppositions). Data were analyzed using frequencies and percentages. Results showed a slightly more negative (44%) than positive (39%) coverage of Golden Rice within the three-year period. The top three sources of positive news were from Manila Bulletin, Business Mirror, and Philippine Star, which dealt with the potential benefits of Golden Rice. Negative news focused on the anti-GM's stand and activities. In 2013, which was highlighted by the Golden Rice vandalism in Bicol and visit of GM activist Jeffrey Smith, there was an almost equal positive (44%) and negative (43%) coverage of Golden Rice. In 2014, there was an increase of negative (55%) articles, mostly tackling anti-GM groups' call to ban Golden Rice. In 2015, however, there were more positive (53%) news coverage, which could be attributed to important Golden Rice-related events, such as Bill Gates' and Patrick Moore's visits to the country.

# A Zillion Information at Your Fingertips

*EE Joshi, VP Salvador, MB Sison, and KET Barroga (PhilRice CES)*

Access to international scientific journal databases is difficult and expensive for research and development (R&D) personnel in developing countries, such as the Philippines. This partly contributes to low quality R&D outputs.  Through Project IPaD of the DA Food Staples Sufficiency Program funded by the Bureau of Agricultural Research, the PhilRice library now provides access to the following full-text online databases: Science Direct, SpringerLink, Proquest Agriculture, OECD iLibrary, EBSCO, and Gale at <u>www.philrice.gov.ph/libraryweb</u>. In addition, the library has purchased 330 books in hard and e-copies from local and international dealers from 2014-2015. To promote awareness and wider use of these resources, seminars were conducted at all PhilRice stations, other DA agencies, and some local government units and community stakeholders. Requests for copies of relevant articles from agricultural extension workers were attended to while new acquisitions are announced as these arrive. All these efforts resulted in higher usage of these resources, with downloads valued at P25.9M in 2015 and P23.04M in the first half of 2016. This partly means a 257% return on investment.  An increase in number of publications among PhilRice personnel by 47% in 2015 was also noted.  For e-books, PhilRice now ranks 1 out of 9 organizations, having a recorded growth rate of 176% based on Springer Nature usage data.

## *Tulong Pa More*: How are New Intermediaries Helping Rice Farming Communities

*HJL Altamarino, IR Tanzo, RF Ibarra, and MAA Saludez (PhilRice CES)*

Every Juan can support the agriculture sector and help our rice-farming communities. However, not everyone gets involved. Being aware of the need to have more pathways for rice information and technologies, Project IPaD engaged various and relatively new extension intermediaries in a series of knowledge sharing and learning (KSL) events held nationwide, and equipped them with skills to enable the use of ICT-based tools/resources aimed at improving rice farming. These intermediaries include those from the private sector, academe, media, and community-based organizations. Six months after the KSL events in select major rice-producing provinces in the Philippines, a survey was conducted to determine how the new intermediaries are helping rice-farming communities. There were 133 who agreed to be surveyed through face-to-face interview, phone call, and/or e-mail. The research found that they shared the ICT-based tools they learned from the KSL to their community. The PhilRice Text Center was rated highly, which suggests that they are now linking their communities to rice experts for inquiries on seeds, pests, and diseases. In addition, they also reached out and shared information they gained to some 3,000 farmers, friends, and family members.

*Keywords: extension, intermediaries, PhilRice Text Center, ICT tools, Project IPaD*

## Homestay as a Learning Strategy in the Agrisurvivors Module of the AgRiDOC Training Program

*IR Tanzo, and MAA Saludez (PhilRice CES)*

Project IPaD's AgRiDOC training program for new breed of rice extensionists has transformational leadership as its foundation. To build on this, a module titled AgRiSurvivors was developed to acquaint trainees to the various players, especially farmers/farm families, in the rice farming community. An experiential training approach, in particular, homestay, was used. It was supplemented by reflection journals, debriefing, and processing to allow a deeper appreciation and understanding of farmers/farm families' coping mechanisms given the current rice production challenges. The module was pilot-tested on two batches of trainees from Luzon, Visayas, and Mindanao provinces. Use of the homestay revealed the following coping mechanisms of farmers/farm families: 1) directly solving the problem; 2) positively viewing the problem; 3) emotionally expressing the problem; 4) seeking social support to ease the problem; and 5) avoiding the problem. In addition, monitoring and evaluation results revealed that through this module, the trainees: 1) realized the value of their task to link farmers to service/product providers; 2) were impassioned to help farming communities become resilient; and 3) were encouraged to use homestay as a learning strategy in their extension activities.

*Keywords: homestay, learning strategy, experiential learning, coping mechanism, Project IPaD*

## KOICA Seed Distribution: An Effective Strategy to Increase Utilization of High-Quality Rice Seeds

*GM de Gracia, JU Ramos, AM Corales, JV Pascual, and GD Martin (PhilRice CES)*

Use of high-quality seeds is key to attaining optimum rice yield. Inaccessibility and unavailability of newly released and popular varieties, low quality and proliferation of untagged certified seeds in the market, and high price hinder the adoption of high-quality rice seeds. With these, the Korea International Cooperation Agency (KOICA) in collaboration with the DA-PhilRice, Bureau of Plant Industry-National Seed Quality and Control Services, DA Regional Field Offices, Office of the Provincial Agriculturists and Local Government Units of Pangasinan and Nueva Ecija entered into an agreement to effectively distribute

high-quality seeds to farmer-members of select cooperatives in the two provinces. In Nueva Ecija, 450 bags of PSB Rc18, NSIC Rc169, Rc216, Rc22, and Rc308 were distributed to farmer-members of select cooperatives in Guimba, Lupao, Zaragosa, and Gen. Natividad. In Pangasinan, 350 bags of the same varieties except PSB Rc18 were distributed to farmers in Mangatarem, Sual, Sta. Barbara, and Alaminos City. High repayment of 85% (Banerle ARC in Sta. Barbara, Pangasinan) to 100% (Guiset Credit Coop and Parista BDS MPC in Nueva Ecija) was recorded. Money collected was then used to buy seeds for the next batch of farmer-beneficiaries. Each coop-partner has, thus far, established its own strategy to increase the revolving seed capital so they can serve more of their farmer-members as regards use of high-quality seeds.

*Keywords: high-quality seeds, partner-cooperatives, distribution, utilization, technology adoption*

# Field Validation and Assessment:
# Key to Effective Technology Promotion and Adoption

*AM Jose, LdR Abaoag, JV Pascual, and AV Capistrano (PhilRice CES)*

The absence of a standard evaluation and assessment process to ensure technology acceptability and adoption is among the major reasons for low to zero technology uptake among intended users. The Technology Assessment and Mature Technology Identification Project commenced worked on standardizing procedures in determining technologies that are ready for promotion and commercialization. Pilot tests were conducted on the MOET App and the Rice Hull Gasifier Stove (RHGS). For MOET App, the criteria used revolved around its accuracy in predicting yield. Tests were conducted for three cropping seasons (DS 2015, WS 2015 & DS 2016) in collaboration with rice stakeholders. Results were generally favorable as regards technical accuracy and cost-effectiveness. For RHGS, assessment involved actual demonstration and utilization. RHGS units were used by farmers and/or household members for two months. Performance, endurance, design, capacity, and ease of use were the key parameters used for evaluation. Users found it useful and economical as a supplementary cooking tool; easy to operate and maintain; and can reduce household spending on conventional fuel sources.

*Keywords: technology assessment, validation, MOET Application, rice hull gasifier stove, farmers, promotion*

# Empowering Farmers' Associations:
# A Sustainable Strategy for Promoting Rice-Based Technologies

*MAC Tan, AM Corales, and RG Corales (PhilRice CES)*

In 2013, farmers in Brgy. Pulungmasle, Guagua, Pampanga were not yet organized. They individually availed of, to their disadvantage, custom services of farm machines, input subsidies, training programs, and other capacity enhancement activities. These resulted in low productivity, inefficient production, and monocropping. Cognizant of the situation, PhilRice partnered with the local government of Guagua to organize farmers in Pulungmasle for registration to the Department of Labor and Employment as KUMON Farmers' Association. The farmers' association rallied the use of high-yielding rice varieties and adoption of various rice-based technologies among its members. These were supported by input subsidies on seeds and fertilizers, technology demonstrations, and training programs and linkage with other government agencies for farm machines provision. After two cropping seasons, the following have been achieved: increased yield from an average of 4.77t/ha in 2014 to 5.29t/ha in 2015; encouraged machine ownership (they now have 1 unit each of tractor and mechanical transplanter), established other sources of income such as from cash crop, poultry, and mushroom production; increased fund from P76, 560.00 in 2014 to P89, 640.00 in 2015; and increased membership from 50 to 64 farmer-members. The project has started exploring market linkages for the farmers' produce. The project was implemented using participatory approach among partner-agencies, farmers' association, and other stakeholders.

*Keywords: rice-based technologies, farmers' association, productivity*

# Extension with a Higher Mission: Increasing Rice Productivity in the Drought-Prone Lowlands in the Philippines

*Royette C. Santos and Aurora M. Corales (PhilRice CES)*

Rainfed areas comprise about 26% of the total rice production area in the Philippines. This means they can significantly contribute to increasing rice productivity. In 2015, PhilRice showcased drought-tolerant rice varieties to increase rice production in the drought-prone areas in Regions 1 and 3. The project employed various approaches and activities to enhance validation, testing, wider promotion, and adoption of drought-resistant technologies in the rainfed areas. Initial results of the study showed that the grain yield of the four varieties, namely NSIC Rc280, 282, 346, and 348 ranged from 4.84t/ha to 7.41t/ha. They outyielded the baseline yield by 1.44t/ha, on average. Due to high demand for *Sahod-ulan* seeds, PhilRice's CURE team distributed 3,860kg to 180 farmers covering 43 municipalities in Region 1, and 11 municipalities in Region 3. The aim was to test for their grain yield and yield stability in 2016 wet season. Currently, 45 farmers field schools are being conducted and participated in by more than 1,000 farmers. These are in collaboration with the Department of Agriculture-Regional Field Office 1, local farmer-technicians, and research centers.

*Keywords: rainfed, drought-prone varieties, productivity, partners*

# Intervention Results of the Heirloom Rice Project in Cordillera Administrative Region (CAR)

*AJB Acierto , JD Batcagan, NA Sabigan, and RS Credo (PhilRice Isabela)*
*RB Miranda and LL Mandia (PhilRice CES)*

The DA-IRRI Heirloom Rice Project aims to increase productivity of the highland rice varieties. One of its project components is the "Capacity Enhancement Activities through Highland PalayCheck System Farmers Field School (FFS)". Interventions were based on the needs identified through the participatory needs and opportunities assessment and series of meetings. Ten FFS, participated by 12 self-help groups from the 4 provinces of CAR (Benguet (2), Mt. Province (3), Ifugao (2), and Kalinga (3)), were conducted. Varietal demonstration was among the interventions essential to the farmers because it allowed them to closely evaluate and observe the morphological characteristics and performance of the heirloom varieties. The demonstration plots, which used the 20 x 20 cm planting distance, 2-3 seedling/hill seeding rate, and 35-45 DAS seedling age, achieved better yields. Moreover, the use of compost and foliar fertilizer had resulted in better yield than the use of solely foliar and farmers' practice. Microtiller was observed to have finished 0.8ha/hr with 2.24l/hr fuel consumption, which is less labor intensive compared to foot trampling. The threshing machines, on the other hand, need slight modifications to suit the needs of the community.

*Keywords: Heirloom Rice Project, Highland PalayCheck, Study plots, Interventions*

# Getting the Message Out, Clearly, and Proactively!

*MM Movillon, JLO Canilao, JN Puerto, MSM Canilao, and VM Ompad (PhilRice Los Baños)*

Information campaigns and exhibits serve as effective avenues for knowledge and technology promotion for the public. When a topic, product, or service becomes interesting and inviting through these types of promotion, individuals and organizations would surely buy or adopt it. There were major campaigns conducted by PhilRice Los Baños, which include the "Be Riceponsible", Choose Brown Rice Advocacy, "PalayamaNayon", El Niño and La Niña phenomena, and the CleanGPS for CSR, which stands for "clean, green, practical, and smart technologies for competitive, sustainable, and resilient rice-based farming

communities". Campaign and exhibit activities were strategically carried out. From January to June 2016, more than 3,000 people were informed about the latest rice and rice-based technologies and campaigns through exhibits. The exhibits were showcased in PhilRice events as well as in some inter-agency events, such as the 2016 Super National Science and Technology Week SyenSaya/Wonderama held at PCAARRD-DOST with more than 7,000 participants (composed of students, teachers, and farmers). A mobile one-stop information campaign was also conducted in selected schools in CALABARZON. Using a popularized vehicle, this mobile campaign allowed the target audience and the general public to become aware and well-informed on the latest agricultural campaigns, information, and technologies.

*Keywords: information campaign, technology promotion, knowledge management*

# Enhancing Resiliency and Food Security of Climate Vulnerable Communities in Tablas Island, Romblon

*IDG Olvida, LG Alipio Jr., and GO San Valentin (PhilRice Los Baños)*
*JG Lucidos and GA Florendo Jr. (Romblon State University)*
*E Torres and D Gacu (LGU-Looc and San Andres, Romblon)*

Most rainfed and upland farmers are considered highly vulnerable groups because they are mostly poor, live in marginal areas, and lack access to most services. Their situation is exacerbated by the changing climate that results in their further entrenchment in the economic margins. This project aims to strengthen resiliency of select climate vulnerable rainfed and upland communities of Tablas Island in Romblon. It particularly seeks to enhance the capacities of the communities to produce their own food despite the climate challenges. Thus far, the local farmers have been equipped with the following capacities: adjustment of planting calendars based on weather conditions; adoption of diversified and integrated rice-based farming systems; judicious use of appropriate rice varieties based on ecosystem; planting of suitable crops based on local condition, and climate change awareness. Already in its third year of implementation, the project has continued to carry out farmers' field school, addressing the needs of the communities. To ensure project sustainability, the local partners are being mobilized and engaged. A tripartite partnership between a national agency (PhilRice), a state university (Romblon State University), and LGUs (Provincial and Municipal Government of Romblon) has been found to be a good combination in implementing a development project like this.

*Keywords: climate change, resiliency, Romblon, farmers' field school (FFS), farmer, rainfed, upland, FGD, KII, community meetings*

# Promoting Rice S&T through On-Farm Experiential Learning

*STC Quiring, OH Abdulkadil, SA Balidiong, and RS Salazar (PhilRice Midsayap)*

PhilRice Midsayap devotes a 1500m² area for on-farm experiential learning of training participants and visitors to understand and appreciate rice science and technology. This area consists of a practicum area for basic farm operations and a showcase area for rice relay planting featuring the seedling, tillering, flowering, and maturity stages of a rice plant.

There were 875 training participants who learned from the practicum area and rice relay planting set-up. These participants include those from four batches of the Rice Boot Camp, Enhanced PalayCheck and Palayamanan Plus Training Course for PhilRice Midsayap Staff, Rice S&T Updates and Appreciation Seminar for Local Executives and Agriculture Extension Workers (AEWs) of PPALMA, Five-day Specialized Training of AEWs on Rice-Based Farming System and Facilitation Skills (JICA TCP5); and Skills Competency Training on Rice Production Training and Management for the Pantawid Pamilyang Pilipino Program Beneficiaries from Identified Municipalities in North Cotabato. The average knowledge

gain of participants from their on-farm experiential learning was 35.64%. Some 80 on-the-job trainees from schools offering agriculture courses within the station's area of responsibility also benefitted from on-farm experiential learning as indicated by a 63% knowledge gain.

*Keywords: training, experiential learning, on-farm*

## Engaging the Rice Extension Intermediaries in PhilRice Midsayap's Area of Responsibility

*MMM Medura and OH Abdulkadil (PhilRice Midsayap); EP Angeles (PhilRice CES)*

The limited number of government extension workers is one of the factors that affects agricultural productivity because it slows down the dissemination of latest farming technologies. Through a knowledge sharing and learning activity (KSL), strategic groups of rice extension intermediaries (REI) were rallied to do more in supporting agriculture and helping the farmers. They were updated on challenges and issues in agriculture and introduced to available ICT-based resources and tools on rice and agriculture that they can use to better help farmers.

Some 355 rice extension intermediaries participated in five KSL activities in the provinces of North Cotabato, Maguindanao, and Zamboanga Del Sur. Survey results revealed that the lecture on climate change and the rice industry garnered the highest ratings for the clearest (99%) and most useful (92%) among the topics discussed.

*Keywords: ICT, knowledge sharing and learning, extension, rice*

## Enhancing the Livelihood of North Cotabato 4Ps Beneficiaries Through Rice Production

*LMAD Domo, MMM Medura, AP Makakua, GD Balleras, SE Abdula, and PLP Sabes (PhilRice Midsayap)*

The Pantawid Pamilyang Pilipino Program (4Ps) of the Department of Social Welfare and Development (DSWD) was created in response to the Millennium Development Goal of the government to eradicate poverty and ensure environmental sustainability in the Philippines. A total of 585 4Ps beneficiaries in the municipalities of Libungan, Aleosan, and Pigcawayan in North Cotabato participated in the four-day kills competency training on rice production and management. The training focused on topics, such as PalayCheck System, *Palayamanan*, IPM using ecological engineering approach, soil fertility conservation and management, and agro-entrepreneurship. The training was a collaboration of DSWD Units of the respective municipalities and PhilRice Midsayap. Most of the participants were female, around 30-39 years old, and with a very limited knowledge on the latest technology on rice production

*Keywords*: *Rice Production, 4Ps, Training, PalayCheck System, Palayamanan*

# Analysis of Rice Farming Practices of Selected Irrigator's Association in Midsayap, Cotabato through the PalayCheck System

*Isagane V. Boholano and Irish Mae L. Bauzon (PhilRice Midsayap)*

The study analyzed rice farming practices of irrigators' associations of Midsayap, Cotabato through the PalayCheck System in irrigated lowland rice. It also assessed if there was any significant relationship between the select rice farmers and their Key Checks achieved as farm management practices to attain good yield. This study adopted a descriptive-correlation method and survey research with stratified-purposive sampling design. The respondents were the rice farmers of Irrigators' Association of NIA-Libungan River Irrigation System. Data analyses used were descriptive statistics, correlation, and comparative analysis of Key Check adoption. Results revealed that the yield obtained by farmers increased as the number of Key Checks achieved increased. Key Check 2 (Good Land Preparation), Key Check 6 (Good Water Management), and Key Check 8 (Harvest Management) were the strengths of the selected irrigator's associations. On the other hand, Key Check 1 (Use of High Quality Seeds), Key Check 3 (Synchronous Planting), Key Check 4 (Crop Establishment), Key Check 5 (Nutrient Management), and Key Check 7 (Pest Management) were the weaknesses of their rice farm practices. Interviewed rice farmers who did not achieve an average of five to six Key Checks had an estimated yield reduction of 56% on their grain yield. Key Check 1 was identified as the most important crop management area that needs to be improved by farmers in the locality followed by Key Checks 3 and 7. Results also showed that Key Check achieved had a significant relationship between dependent variables (yield) within 5% and 1% level of significance, respectively. Therefore, the PalayCheck System must be efficiently adopted by rice farmers to enhance their crop management practices.

*Keywords: interrelated, interdependent, irrigator associations, Key Checks, Key Check adoption, PalayCheck System, rice farming practices*

# Paving Progress for Farmers: Adaptation and Commercialization of Korean Rice

*Aurora M. Corales and Lord R. Aquino (PhilRice CES)*

In 2012, Korean rice varieties were introduced to Filipino farmers under the Korea Project on International Agriculture. Adaptability testing was done in San Manuel, Pangasinan, and Sta. Ignacia and Paniqui, Tarlac. The varieties introduced were Taebaegbyeo, Hanareumbyeo 1, Hanareumbyeo 2, Milyang 23, Milyang 248, Dasanbyeo, Saegyejinmi, and Hangganchal 1. After two years of testing, farmers have identified four varieties suited to their field condition and resources. These are Hanareumbyeo 2 with an average yield of 6.37t/ha, Milyang 23 – 5.91t/ha, Taebaegbyeo – 5.78t/ha and Dasanbyeo - 5.55t/ha. However, even with positive yield results, farmers cannot market their produce at a higher price because these varieties were the Japonica type, that is, short with round grains. In dry season 2016, partnership with Korean entrepreneurs was established. Their interest was on the good quality of these varieties that most Koreans prefer. For the initial market testing, two farmers in Cuyapo and four farmers in Isabela participated in the initial marketing. A one-peso incentive over the prevailing market price was given to farmers. Milling was channeled to the Rice Processing Complex in Pangasinan. For next season, expansion is expected as more farmers see the benefits of growing Korean rice.

*Keywords: Korean rice varieties, Adaptability testing, Japonica type, partnership, market test*

# Agricultural Cooperatives:  Key Partners in Technology Promotion and Rural Development

*CFC Guittap, JV Pascual, and AM Corales (PhilRice CES)*

Agricultural cooperatives are viewed as an important vehicle in promoting rural development and overall efficiency in agriculture. It is necessary to continue empowering and strengthening farmers' organizations or agricultural cooperatives through capacity building to respond to rapid technology development and the challenges for modern agriculture. In wet season 2015, PhilRice established a partnership with the Parista Barangay Defense System Multi-Purpose Cooperative in Lupao, Nueva Ecija to capcitate its farmer-members; establish coop-managed demonstration fields, variety promotion and seed multiplication trials; promote farm mechanization and crop diversification; and empower the operations of the cooperative.

Two season-long training courses were conducted with 58 graduates from the coop-members obtaining a relatively high average of 48.50% gain in knowledge, and with the majority (78%) rating the training course as 'very satisfactory'. Dry Season (DS) 2016 data showed that the Parista BDS-MPC participating farmers achieved a yield ranging from 4.5 to 7.8t/ha and averaging 5.48t/ha, which is higher compared with the DS 2015 average yield of 4.74t/ha. Out of 59 farmers, 43 had a yield increment ranging from 0.08 to 3.60t/ha; 16 of them had more than 1t/ha increase in yield ranging from 1.23 to 3.6t/ha. After two cropping seasons, the participating farmers' level of technology adoption was at 78%, which is equivalent to a high level of adoption.

Results also showed that empowering agricultural cooperatives could help in sustaining promotion and adoption of high-yielding technologies, enhancing farmer's knowledge and skills, and strengthening their organization. In general, this study may serve as a guide in implementing development activities that promote location-specific rice and rice-based technologies to improve farmers' lives and welfare.

*Keywords: agricultural cooperatives, empowerment, partnership, technology, sustainable promotion*

# Accelerating Development, Demonstration and Adoption of *Palayamanan* Plus in Lowland Farms

*JVE Adolfo, AL Dela Cruz Jr, and DB Rebong lI (PhilRice Isabela)*
*RG Corales and AM Corales (PhilRice CES)*

The increasing demand for food production due to environmental degradation paved the way for the development of profitable and resource-efficient farming systems. The *Palayamanan* Plus is an intensified rice-based production system that aims to increase agricultural productivity and profitability in the rice environments through purposive integration and diversification of farming components. It aims to generate database for on-site profile and market information needed in designing *Palayamanan* Plus models; develop models based on the local resources and agro-climatic conditions; enhance the capacity of farmer-beneficiaries, and implementers in the implementation; and assess its the sustainability. The community-based technology assessment cluster approach was used in evaluating the *Palayamanan* Plus model.

In Isabela, the project was implemented in partnership with the local government unit of Quirino, and Isabela State University, Roxas Campus. A core group of 30 farmer-beneficiaries who own an aggregate area of 25 ha of rice field received initial inputs for rice, vegetable, and livestock components as loan subject to a rollover scheme.

Mushroom and vermiculture sheds were also constructed as part of the project to serve as sources of income of the organized farmers. However, other sectors of the community were also tapped to participate in the project. Housewives and some out-of-school youth were trained in mushroom and vermicompost

productions. Income from the established enterprises will be used as seed money for the group. farmers field school on *PalayCheck* and *Palayamanan* Systems is being conducted for capacity building and enhancement. As a tool for sustainability, the group was registered to the Department of Labor and Employment as an association to ensure accountability and establish legal identity.

It is expected that the establishment and adoption of the *Palayamanan* Plus in the community will increase agricultural productivity and profitability.

*Keywords: environmental degradation, resource-efficient, purposive integration and diversification, agricultural productivity and profitability, sustainability.*

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# What You Are and What You Can Do: A Role Recognition Activity for Rice Extension Intermediaries (REIS)

*MC Manubay, AL Dela Cruz Jr., ML Pini, JVE Adolfo, and DB Rebong II (PhilRice Isabela)*

Rice extension intermediaries (REIs) play an important role in rice extension and delivery system, as they are significant sources of information and services for farmers. This study aims to enable REIs to recognize the roles they play in agriculture through a role recognition activity. The 66 REIs involved in this study were categorized under private sector, student/academe, government, national government organization (NGO)/cooperative, and farmer/community leader-based. The REIs were participants in the knowledge sharing and learning activity conducted under the *Improving Technology Promotion and Delivery through Capability Enhancement of the Next-Generation of Rice Extension Professionals and Intermediaries* or IPaD project. The respondents filled-in the necessary information to complete the sentence "I am a/an… and I can help farmers through…" (*Ako ay isang…at tutulungan ko ang mga magsasaka sa pamamagitan ng…*). Based on the results, the respondents' extent of commitment varied depending on which category they belong to. Collectively, REIs committed to share their knowledge on the different credit scheme as source of farming capital; apply knowledge gained from school, seminars and conferences; provide technical assistance on newly-developed technologies; and assist in choosing and producing right and quality rice varieties. The conduct of such role recognition activity can be a powerful starting point for making the REIs more aware about their roles in agriculture. Building on what the REIs can commit can be used as baseline information in developing future agriculture programs involving them.

*Keywords: rice extension intermediaries, IPaD project, knowledge sharing and learning, rice extension and delivery system*

# Increasing Farmers' Income Through Development of Agri-Based Enterprise in Cabadbaran *PalaYamaNayon* Pilot Site

*EM Gaquit, GF Estoy Jr., and AT Montecalvo (PhilRice Agusan)*

*PalaYamaNayon* is a movement that mobilizes various experts, organizations, and resources for rural transformation. Rural transformation should bring positive and relevant change in farmers' perceptions, attitudes, practices, and life chances with rice-based agriculture as the driver of inclusive and sustainable growth in rural farming areas.

Generally, the objective of this project is to improve the well- being of the farmers in Barangay La Union, Cabadbaran City by organizing them to run a social enterprise using pigmented rice, vermi-culture products, and *Law-uy* vegetable soup as their products.

Agusan del Norte is one of the major rice-growing areas where yield level is low and where poverty incidence is high. One of the reported low-income rice-based communities in the province is Barangay

La Union, one of the 31 barangays in Cabadbaran City. Farming is the major source of livelihood of the community cultivating more than 800ha land with rice, coconut, banana, and some vegetable as the main crops. The farmers in the area are predominantly small land-owners and tenants.

Currently, the Bukid-bukid Farmers Association has 28 farming household members. The members were categorized based on the land ecosystem, 52% is irrigated while 48% is rainfed or upland. Based on the data collected from the CLGU-Cabadbaran, barangay La Union yield ranges from 3-4t/ha in irrigated area in dry season 2014. However, there were times when the farmers were not able to plant rice due to insufficient irrigation, even in irrigated areas. Moreover, the upland areas were not fully utilized due to the lack of water supply and knowledge how to cultivate rice.

The project helped the farmers in barangay La Union to increase rice production and income through training programs on *PalayCheck* System, upland rice production, and integrated, intensified, and diversified farming.

*Keywords: rural transformation, diversified farming, agri-based enterprise, PalaYamaNayon*

## Capacity Enhancement of Farmers on Rice-Based Farming Technology and Bangsamoro Women on Food Preparation in the Autonomous Region in Muslim Mindanao

*JO Edraira, OH Abdulkadil, and SE Abdula (PhilRice Midsayap)*

In 2012, the Autonomous Region in Muslim Mindanao (ARMM) has a poverty incidence of 56%. To help alleviate poverty in ARMM, Japan International Cooperation Agency through the Technical Cooperation Project (TCP) 5 aimed to reach the secluded rice-producing areas in ARMM's five provinces. Since 2012, the project has already conducted series of training for farmers and Bangsamoro women. A total of 299 agricultural extension workers (AEWs) were trained with an average of 49.82% gain in knowledge. The AEWs established 100 participatory techno-demo farms across the region that served as learning farm and trained 3228 rice and cassava farmers through farmer field school (FFS) with an average of 91.93% gain in knowledge. From the FFS trained farmers, 74 farmers underwent an intensified training on rice-based farming technology; served as farmer-extension workers; led the establishment of 73 Palayamanan model farms; and trained 719 farmers, 102 of which were women (16%). Also, a Rice Crop Manager adaptability trial was established at Manongkaling, Mamasapano, Maguindanao on May 2015 and 20 farmers were trained. On the other hand, 312 Bangsamoro women were trained on food preparation and processing.

*Keywords: JICA TCP5, participatory techno-demo farms, FFS, palayamanan model farms, farmer-extension worker, Bangsamoro women*

## Pop-themed Rice Paddy Art: A Farm Tourism Magnet

*JLZA Libed, RF Barroga, MRO Añora, and NL Caballong (PhilRice CES)*

The main challenge in developing and sustaining an agritourism site is to keep tourists coming. Providing appealing attractions to target audience is the key strategy. Thus, FutureRice Farm creates rice paddy art every season to stir up the interest of the public, especially the youth, and bring them to the farm. In choosing the subject for the art, Filipino pop culture is engaged.

For the dry season 2016, FutureRice exhibited a rice paddy art with the image of the popular love tandem of Alden Richards and Maine Mendoza, more commonly known as AlDub. The art, which was tagged as 'AlDub Rice' became visible for two months from tillering up to the heading stage. From the 3,000 visitors

of the site, 100 respondents were randomly selected for feedback. Two-thirds of respondents is less than 35 years old. Most of the visitors learned about AlDub Rice from online social media. Ninety-nine percent of the respondents gave a high satisfaction rating. Moreover, if given a chance, most of them plan to come back to learn more information, relax and have fun, or learn new skills in farming with their family and friends. Aside from the overwhelming flow of guests, AlDub Rice also boosted the Farm's media promotion such as increase in engagement in social media accounts, free television air time through news coverages, broadsheet newspaper features, and online news write ups. Furthermore, this project has also helped promote the corporate image of PhilRice in general.

*Keywords: rice paddy art, marketing strategy, agritourism*

# Moving Toward a Market-based Rice Production: The BANERLE ARC Experience

*Aurora M. Corales and Gerly D. Martin (PhilRice CES)*

Working collaboratively is key to achieving meaningful development. PhilRice forged partnership with rice value chain enablers, namely the Department of Agriculture Regional Field Office 1, Bureau of Plant Industry-National Seed Quality Control Services, provincial agriculturist office of Pangasinan, local government unit of Sta. Barbara, Catholic Relief Services, Pangasinan Rice Processing Complex, and the BANERLE Agrarian Reform Cooperative in Sta. Barbara, Pangasinan. In general, the project employed participatory, multi-sectoral, and community-based approaches. Value chain approach was employed among cooperative farmer-members. This enabled the farmers to deliver their products to consumers more efficiently and at a higher quality. They employed a wide range of activities such as ensuring access to cheaper inputs, facilitating the delivery of financial services, enabling the flow of information, and increasing access to higher-value markets.

The partner-agencies, in collaboration with the cooperative, implemented capacity-building activities such as technical briefings and training programs through the farmers field school. After almost a year, the following have, thus far, been achieved: sustained partnership with the cooperative through the promotion of high-yielding rice and rice-based technologies, increased use of high-quality seeds among farmer-members (from 22% to 45%), and developed market linkage wherein 29% of the participating farmers' produce in BANERLE ARC was sold to Pangasinan Rice Processing Complex.

*Keywords: collaborative partnership, development change, higher-value market, capacity-building, market linkage*

# Promotion and Conservation of Philippine Cultural Rice-scapes through Rice Science Museum

*FGE Manuel, DG Esmero, CLB Gado, and CN Bibal (PhilRice CES)*

The paper presents the findings of an observational study of rice science museum visitors in their analysis of the concepts and understanding on the presentation of two exhibits. Findings are recast in the light of the four approaches described to offer an integrated framework for the promotion and preservation of Philippine Rice-scapes through exhibits. The study argues that the museum should enhance the research and presentation of distinctive features of local rice cultural heritage, through cultural mapping, and rice science breakthroughs, both to promote the understanding of its complex value and reach varied audiences.

*Keywords: Rice-scapes, rice cultural heritage, rice cultural mapping*

# The Role of Science Museum in Philippine Rice Research and Development

*DG Esmero, FGE Manuel, CLB Gado, CN Bibal, and RB Bajit (PhilRice CES)*

The products of rice research and development continue to shape the nature of Philippine farming landscape and influence economic and political activities with rice as a staple crop. It is with this context that the Rice Science Museum has been re-launched in 2014 in the Science City of Muñoz, Nueva Ecija, dubbed as the rice basket of the Philippines. This aims to promote rice history and its cultural value; influence generations of Filipinos to appreciate rice science on a different light; and encourage farming communities to practice advanced rice farming technologies. Moreover, the Museum serves as an anchor in the national effort of preservation, revitalization, and integration of rice farming history, culture, arts, science, and technology.

More than its projected purposes, Rice Science Museum also plays extensive social tasks. It plays a key role in sharing best farming practices among farmers. It also serves as a venue among scientists to see the gaps in technological innovations through feedback among museum visitors. Rice Science Museum also promotes social cohesion through museum visitors' appreciation and understanding of the diversity of Philippine rice farming culture. In its recent undertakings, the Rice Science Museum became 'agents of societal change and development' through some advocacy exhibits that primarily call for action.

At its infantile stage, the Rice Science Museum continues to generate support from various stakeholders. It is being developed to be more 'proactive, innovative, people-oriented, and community-minded' so that it becomes a major player in Philippine rice research and development.

*Keywords: Rice Science Museum, museum's social tasks, Philippine rice research and development*

# Exploring New Ways to Engage the "Disinterested" Urban Youth

*CLB Gado, FGE Manuel, and CN Bibal (PhilRice CES)*

This study was conducted to test alternative ways of involving the youth in agriculture and encouraging them to take active roles in food production.

As the farmers' population declines, the engagement of youth in agriculture is seen as one of the solutions for the country to be food-sufficient. However, in our country with a median age of 24, it can be observed that the youth lack apathy in food security as shown in their attitude on wasting rice and indifference in agriculture. They are not interested in joining the agriculture sector owing to the supposed back-breaking work, perceived lack of profit from food production, and low regard for farming (Pakisama, 2014).

This study analyzed the drawings and impressions gathered from 24 students, aged 7 to 16, who participated in the education programs facilitated by the Rice Science Museum of Philippine Rice Research Institute. Elementary and high school students in Metro Manila were exposed to a week-long Rice Science and Art Camp and half-day mobile museum exhibit with talks on Paglaki ko, Gusto kong maging Agricultural Scientist (I want to be an Agricultural Scientist when I grow up!).

The drawings provided perspectives on how the youth's perception about rice and farming were changed through the creative pedagogies. Decoding the drawings further showed a transition from merely sympathizing with the farmers to becoming empowered in helping the farmers by considering a career in agriculture; thus, implying that youth can be engaged in agricultural issues and discussions through creative educational programs.

*Keywords: Rice art, rice mobile museum, creative educational programs*

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| Moderators and Session Chairs | **Marissa V. Romero,** Diadem G. Esmero, Ronan G. Zagado,  Maritha C. Manubay, Jayvee A. Cruz, Arlen A. Dela Cruz, Jacqueline Lee O. Canilao, Rosaly V. Manaois, Fe A. Dela Peña, Rhemilyn Z. Relado,  Albert Christian S. Suñer |
| Posters and Exhibit | **Henry F. Mamucod,** Rodel M. Bulatao, Gerome A. Corpuz, Jerry D. Adriano, John Michael C. Avila, Oliver C. Soco, Reniel P. Tubera, Maricar B. Castillo, Ivan John V. Balmeo, Bernando S. Peralta |
| Awards and Tokens | **Ronell B. Malasa**, Anna Liza P. Labay, Aileen C. Litonjua, Ailon Oliver V. Capistrano |
| Fellowship | **Hanah Hazel Mavi B. Manalo,** John Glen S. Sarol, Melchor Diamsay, Jungie Q. Amacanin, Perry Irish H. Duran, Ma. Victoria Stephane G Asio, Mary Grace M. Nidoy, Laarnie L. Mandia, Vanneza B. Isidro, Jonathan U. Cabral, Herminigildo U. Gandeza, Nehemiah L. Caballong, Jayvee A. Cruz, Reynante L. Ordonio, Dindo King M. Donayre, Ian H. Veneracion, Jayvee A. Garcia, Iahleah R. Besas, Christian Flor C. Guittap, Leonilo V. Gramaje, Mahalene Kristine R. Bajit, Jerry D. Adriano, John Michael C. Avila, Jaime A. Manalo IV |
| Finance | **Adelaida B. Giray**, Mary Grace D. Corpuz, Babylinda O. Reyes, Marychelle B. Salvador, Erla Q. Diaz |

| | |
|---|---|
| **Supplies and Materials** | **Fe G. Alonzo,** Drafno R. Arocena, Hermogenes J. Camangeg, Gladys Jane B. Casiano, Diomel L. Cayetano, Cherry May I. Eligado, Imelda A. Fernandez, Felylee B. Hibionada, Monique B. Jimenez, Raychell S. Luna, Angemil Mayette F. Magtalas, Marck Tistan B. Martin, Necitas B. Malabanan, Christopher Dave B. Musa, Madel B. Perez, Anjennette F. Patricio, Judielyn S. Turalba, Grace S. Villaroman, Cynthia M. Wy |
| **Transportation** | **Gina B. Narca,** Shirley Diaz, Bernie S. Dela Cruz, Ariston Asuncion, Dennis Alcantara, Jayson Rivera, Dante De Luna, Melquiades Coloma, Elmer Talaguit, Braulio Valdez, Ariel Patricio |
| **Accommodation** | **Ma. Cielo J. Tibayan**, Cesar A. Barawid, Gary A. Santos, Gerlie Q. Pascua, Gina M. Villa, Cristina B. Ocampo, Lorna V. Braceros, Danica C. Gaspar |
| **Food** | **Joy Bartolome A. Duldulao**, Sarah Joy Alvior, Oliver Domingo, Jomari Pinili, Michael Reyes, Jahzeel Bautista, Crizza Agapay, Mary Jane Romero, Mary Ann Gadiana, Glenda D. Ravelo, Ethel Gibe, Myline A. Dilla, Elizabeth P. Molina, Amelia Morales, Lynnden Castillo |
| **IMS and First Aid/ Emergency** | **Hazel Jane M. Orge**, Angelica M. Francisco, Erwin E. Fulgencio, Adriano L. Lubrica, Mary Jane F. Martin, Rommel A. Salagubang, Jerry D. Santos, Froilan A. Serrano, Welliam G. Villanueva |
| **Field Tour** | **Joel V. Pascual,** Richard D. Romanillos, Marvin DJ. Manalang, Dindo M. Patonona, Mark Angelo A. Abando, Magiting T. Garcia, Rustum C. Braceros, Paul Nathaniel M. Marcelo, Leonilo V. Gramaje, Frederick M. Saludes, Kremlin M. del Castillo, Jhoemar B. dela Cruz, Joselito J. dela Cruz, John Harold T. Cortes, Christian Flor C. Guittap, Royette C. Santos |
| **Physical Arrangement** | **Antonio S. Noriega Jr.**, **Gina B. Narca,** Joel G. James, Sally Grace Osorio, Ian Rodriguez, Jose Hechanova, Eduardo Catanghal, Reynaldo Milanda, Danilo Tapic, Virgilio Patricio, Napoleon Sicat, Jerry Evangelista, Juliet Padua, Jairus Jeryll Molina, Charisse Anne Rodriguez, Raymond Pajarillo, Daryl General, Rammel Castro, Rizalino Vigilia, Ileto Fulgencio, Felomino Dacles, Louie Ignacio, Jason Bruno, Emarlito Delos Santos, Brenn Carlo Chico, Noel Fulgencio, Robinson Catalon, Von Christopher Galvan, Nestor Cabanatan, Joseph Lawagan, Niño Martin, Rodrigo dela Cruz, Darwin Corpuz, Mario Luquias, Marvin Martin, Philip Audencial, Michael Salcedo, John Ross Milanda, Ralph Manzano<br><br>*Backdrop:* **Carlo G. Dacumos, Carlito N. Bibal**<br><br>*Photos:* **Carlo G. Dacumos,** Jayson C. Berto, John Glen S. Sarol, Sonny P. Pasiona, Jayvee P. Masilang, Anna Marie F. Bautista, Jennifer D. Villaflor, Rommel T. Hallares, Perry Irish H. Duran<br><br>*Video:* **Ashlee P. Canilang,** Jayson C. Berto, Mahalene Kristine R. Bajit<br><br>*Computers and Network:* **Luis Alejandre I. Tamani,** Christian U. Sicat, Victor Joseph A. Taylan, Dennis G. Cargamento, Ronie T. Apuada, Ryan F. Santiago, Kieth Rick M. Piniera, Benjamin C. Sotto<br><br>*Sounds and Lighting:* **Alvin P. Lucero,** Carlito N. Bibal and Napoleon V. Sicat |

*House Rules*

- PhilRice is IMS-certified. It has a clean and green campus. Please help us maintain its status by disposing your trash properly, and smoking only in designated areas.
- Register in both morning and afternoon sessions (for PhilRice participants). Registrants after 9AM will not be counted for lunch reservation for the day. Always bring and present your ID during meals.
- Wear your ID/name tag all the time. Always bring and refer to your copy of the program.
- Actively attend sessions. Please set your cellphones into silent mode during sessions.
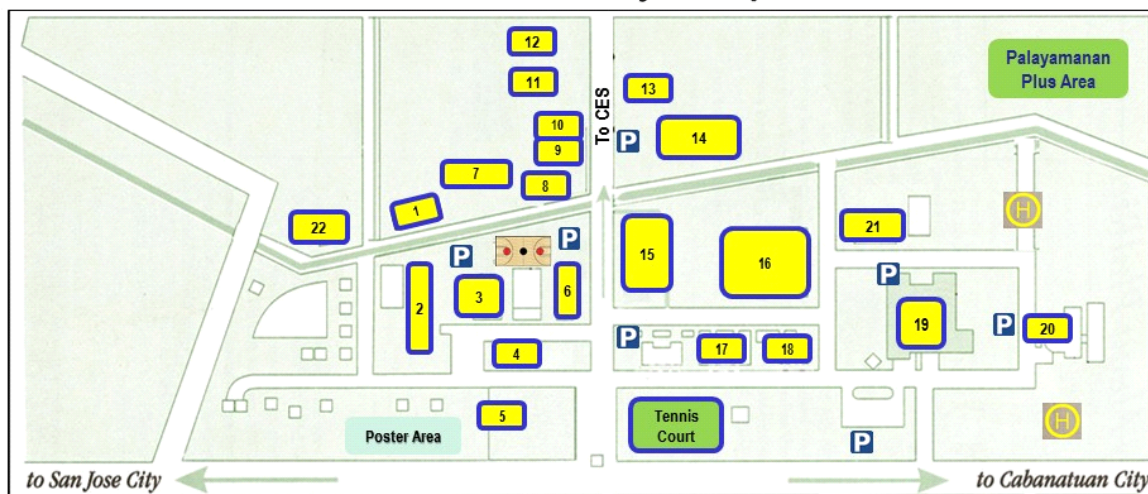- Observe time for snacks/meals, chatting, listening to speakers, and talking.

*Venues*

- Social Hall: opening & closing ceremonies; plenary sessions; concurrent sessions 1, and 4
- Farmers' Training and Information Center (FTIC): concurrent sessions 2, and 5 (IPR Room); concurrent sessions 3, and 6 (FTIC Room 3)
- Multi-Purpose Crop Processing Shed (Toll Gate): lunch and dinner; and fellowship
- Training Dormitory & Cafeteria: accommodation, and breakfast
- Training Dormitory Basement: gym facilities

*Reminders for Presenters in the Plenary and Concurrent Sessions*

- **Plenary presenters** will be given 20 minutes each (maximum of 17 slides), and 10 minutes for Q&A.
- **Concurrent presenters** will be given 15 minutes (maximum of 12 slides), and 5 minutes for Q&A.
- **All PowerPoint presentations** should be submitted to the Documentation/Rapporteur Committee on or before Sept. 1. The committee will check the number of slides, and their compatibility with the assigned computer. Presentations exceeding the maximum number of slides will be returned to the presenter for revision. Final e-copy of the PowerPoint presentations will be uploaded on Sept. 6.
- All presenters are requested to be in the session hall at least 10 minutes before the start of the session for briefing by chairs/moderators.
- All presenters are requested to start and end their presentations on time.

*Posters (in PDF file and tarpaulin) should be submitted to the Poster Committee on September 1, 2016*

## PhilRice Nueva Ecija Campus



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|---|---|---|---|
| 1. Seed Warehouse | 7. Business Development Division | 13. Multi-Purpose Crop Processing Shed (Toll Gate) | 19. Main Laboratory Building |
| 2. Farmers' Training and Information Center (FTIC) | 8. National Seed Quality Control Services (NSQCS) | 14. Rice Engineering and Mechanization Division | 20. Cafeteria and Training Dormitories |
| 3. Social Hall | 9. Seed Technology Division | 15. Crop Service Building | 21. Records Office |
| 4. Rice S&T Museum | 10. KOPIA Center-Philippines | 16. Greenhouses/Screenhouses | 22. KOICA Seed Processing Facility |
| 5. Hardin ni Mang Tico | 11. Physical Plant Division | 17. Regional Crop Protection Center | P  Parking Area |
| 6. Visitors & Conference Services Office (VCSO) | 12. Supplies and Property Office | 18. Hybrid Rice Building | H  Ground Helipad |

**Department of Agriculture**

# PhilRice ®

**PHILIPPINE RICE RESEARCH INSTITUTE**

We are a 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 and cost-reducing technologies 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-sufficiency; 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 (Environmental Management), and OHSAS 18001:2007 (Occupational Health and Safety Assessment Series).

**CERTIFICATION INTERNATIONAL**