Quality Rice. Quality Life.

2017
National Rice R&D
Highlights

INTENSIFIED RICE-BASED AGRIBIO SYSTEMS

(PALAYAMANAN PLUS PROGRAM)

Philippine Rice Research Institute
Central Experiment Station
Maligaya, Science City of Muñoz, 3119 Nueva Ecija

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Intensified Rice-Based Agribio Systems Program (Palayamanan Plus Program)

Rizal G. Corales

Executive Summary

The Palayamanan Plus program focused on the development of rice-based production system directed towards increasing income and profitability through purposive diversification, intensification, integration of certain farming components, and development of agri-enterprises such as crops, livestock, aquaculture, mushroom, and biomass recovery system.

The project on Palayamanan Plus model development and assessment established and evaluated the Crops + Livestock + Mushroom + Organic fertilizer rice-based production systems model.

The crop enterprise was composed of rice seed production + vegetable, rice-cash crop cropping systems, vegetable production, and rice + duck production system. The area intended for rice seed production was 3.25 ha; rice-cash crop, 1.0 ha; vegetable production, 0.25 ha; and rice + duck production, 0.15 ha.

The livestock component was composed of dairy buffalo production and layer duck production. Five heads of Italian breed dairy buffaloes and three calves were maintained. The mushroom enterprise comprising oyster (Pleurotus), milky (Calocybe), and paddy straw (Volvariella) species generated an annual income of P292,040. Grain spawn of oyster mushroom yielded 899 bags, of which 586 were sold and profited P87,900. Paddy straw mushroom spawns, which produced 145 bags, recorded an income of P2,500 from the sale of 64 bags. A total of 24,686 oyster mushroom fruiting bags were produced with an average monthly production of 2,244 fruiting bags. An income of P8,800 was gained from 440 fruiting bags. Sales from 1, 607kg of fresh oyster mushroom were recorded at P192,840. The enterprise contributed around P26,000/month additional income while mushroom substrate (SMS) was used in vermicomposting.

The organic fertilizer production added value as biomass by-product from the livestock and mushroom component. The substrates for vermicomposting is a mixture of 70% SMS and 30% buffalo manure inoculated with African night crawler (ANC). Vermicompost produced from January to November was around 4,203 kg, which was used in the vegetable production. Effective microorganism (EM) microbial inoculant was also used in the vegetable production and in the sanitation of the livestock component.

The Sorjan production models that were established and assessed included: Vegetable + Fish, Rice + Vegetable + Fish, and Rice + Taro + Vegetable + Fish. Vegetable + Fish Sorjan model gained P29,348; Rice + Vegetable + Fish Sorjan, P11,943; and Rice + Taro + Vegetable + Fish, P39,663.

The project on the development and marketing of Palayamanan products aimed to develop processed foods with high market appeal and enhance the capacity of farming households in producing nutritious food products from their fresh produce. Two knowledge products Mushroom Recipe book published in December 2016 and the personal planner produced in October 2017 featuring innovative dishes and recipes of vegetables and brown rice, were produced to increase awareness, appreciation, and consumption of products from rice-based farms.

The rice-ice cream bread and rice-taro crinkle premix are new products developed in collaboration with the Department of Food Science and Technology (DFST) of the College of Home Science and Industry at Central Luzon State University (CLSU) for children and the general public. The rice-ice cream bread received high acceptability ratings (rating of 8-9, with 9 as the highest) from consumer sensory panelists. Physicochemical analysis showed that water activity of the bread and rice ice cream were similar (0.871 and 0.878, respectively) indicating that no water migration between the two commodities would likely occur, resulting in a more stable product. About 60% of the more mature panelists (>21 y/o) said that they "will probably buy it" while 40% said a more definite positive response. The chocolate crinkle premix formulation showed that the optimum formulation was composed of 46.99% taro flour (TF), 18.17% rice flour (RF), and 34.83% all-purpose (AP) with high consumer acceptability.

Training programs on rice-based food product development in rice-producing communities were conducted to promote value-adding of rice and help farming groups establish rice and rice-based food product enterprises as additional sources of income.

The project on Capacity Building for Entrepreneurship aimed to create sustainable capacity to promote entrepreneurship and strengthen the entrepreneurial spirit among partners in the project sites. In 2017, the project focused its activities on developing the entrepreneurial skills of women, housewives, farmers, and individuals on mushroom enterprise. The Kinikilala Ng Lungsod Agham (KKLA in Maligaya Chapter) obtained an income of P31,658 from the 5,068 fruiting bags they produced from July to November 2017. Members of Bantug Primary Multi-Purpose Cooperative (Bantug PMPC)produced 2,226 fruiting bags valued at P16,419.

I. Development, Establishment, and Assessment of Intensified Rice-Based Agribio Systems Model (Palayamanan Plus Model)

Rizal G. Corales

- The Palayamanan Plus model included Crops + Livestock + Mushroom + Organic fertilizer production systems model. A total income of P601,534 were generated from the 4.65 while the current livestock inventory was valued at P450,000.

- The crop component enterprises generated an income of P309,494. The income was generated from the registered rice seed production with an average gross margin of P130,482/ha (Table 1). The rice – corn cropping system highlighted rice seed production plus green and young corn production also generated an annual income of P84,000. The vegetable production contributed only 12% of the total cash income of the crop component but it has big contribution to the whole production system (Table 2). The vegetable as part of the diversification and intensification strategy helps in the ecological balance and sustainability of the production system, source of food, and the income generated contributed to economic stability by providing the necessary cash for immediate expenses while waiting for the rice income at harvest. Growing green corn after rice also provided substantial income and generated additional biomass, which are important for the livestock component as feeds.

- The livestock component including the buffaloes did not bring additional cash income because of insufficient feeds. However, it contributed to the sustainability of the production models because it served as bioconverter of farm biomass into organic fertilizers or substrates in the production of organic fertilizers. The ducks component also did not yield economic gains but they helped in managing pests and weeds in a safer and environment-friendly manner. These are essential in the production system and in fostering better ecosystem.

- The operation of mushroom component was slowed down owing to limited volume of substrates collected and stored and to the adjustment of the pasteurizer and other equipment to reduce contaminations. Despite these challenges, an income of P292,040 was generated.

- The organic fertilizer component was implemented to support the other components like the conversion of spent mushroom substrate, livestock manure, and other farm biomass into more valuable materials like compost or organic fertilizers for the crop production component. Vermicomposts, CRH, fermented organic materials, and EM microbial base inoculants were produced and used in the crop production component and for sanitation of the livestock component.

- Farm and aquatic resources such as rice, vegetables, cash crops and fish were simultaneously cultivated in the same land through the sorjan production system models. The cash crop+fish production model generated an annual income of P39,000; rice+cash crop+fish, P19,700; and rice/taro+vegetable+fish production, P26,300 The results showed that the more diversified and intensified model generated more income.

Table 1. Economic analysis of registered rice seed production per hectare, PhilRice CES.

ITEM	Amount
Materials	**P20,118**
Seeds	3,750
Fertilizer	8,875
Pesticide	1,304
Fuel	646
Sacks	5,543
Labor	**P43,758**
Land preparation	8,050
Crop establishment	8,867
Fertilizer application	550
Irrigation	2,337
Pest management	2,658
Rouging	1,833
Harvesting	12,000
Postharvest activities	7,463
TOTAL VARIABLE COSTS	**P 63,876**
GROSS INCOME	**P 194,358**
GROSS MARGIN	**P 130,482**

Table 2. Income from vegetable production. PhilRice CES.

Particular	Jan-July	Aug	Sept	Oct	Nov	Total	Gross Sales
Bottle Gourd		3.25	33.6	1.2		38.05	**761**
Eggplant	31.40	65.2	162.15	134.60	205.50	598.85	**23,954**
Finger Pepper	17.50	10.10	24.00	15.20	1.10	67.90	**2,716**
Mungbean	13.75					13.75	**343.75**
Mustard				28.60	7.20	35.80	**1,432**
Papaya			15.3	61.2		76.50	**3,060**
Pechay				34.40	11.20	45.60	**2,280**
Ridged Sponge Gourd		17.27	12.80	2.20		32.27	**1,290.80**
Sweet potato			1.1	17.8	9	27.90	**558**
Tomato	45.40					45.40	**681**
Upland Kangkong			3.7	6.4		10.10	**202**
Total							**37,278.55**

Processing of corn cilage for livestock feeds.

Sorjan A (Vegetable+Fish), PhilRice CES, October 3, 2017.

II. Development and Marketing of Food Products from Palayamanan Plus Crops

Rosaly V. Manaois

Vegetables and fruits are significant components of Palayamanan Plus farming system. However, one major concern in vegetable production is the seasonality of the crops. These crops take a very short time to mature and usually simultaneously, flooding markets, and driving the prices down. Often, there are high amounts of food wastage. Strategies such as improved postharvest practices, effective utilization of agricultural wastes, and shelf life extension of agricultural crops should be in place and advocated (Baqui, 2011; Briones, 2009; FAO, 2000).

A system of prolonging the shelf life of fresh produce through food processing has not been fully established in the current Palayamanan Plus system setup. Product innovations using different components of Palayamanan Plus, particularly the crops, has to be made, their marketability established, and the production methods disseminated to clienteles. Hence, this study aimed to encourage the cultivation of various foodstuffs from rice-based farms (e.g. various vegetables, mushroom) through the development of processed foods with high market appeal and enhance the capacity of farming households in producing nutritious food products out of their fresh produce.

- Two popular publications were produced to increase awareness, appreciation, and consumption of the general public of important rice-based food. These are mushrooms and vegetables, particularly the leafy greens and brown rice. Cook fests were conducted and the unique recipes featured in the competitions were compiled, verified, and prepared into popular knowledge products. Launching of the Mushroom Recipe book, which was published in December 2016, was held during the first quarter of 2017. In July 2017, a cookfest showcasing innovative dishes and recipes of vegetables and brown rice, was conducted and the winning recipes were featured in a personal planner produced in October 2017.

- Two new food products were developed using rice and rice-based crops: rice-ice cream bread and rice-taro crinkle premix. These products were intended as healthy products for children and the general public and were conceptualized based on the results of a market study conducted at RCFSD (Ballesteros et al., 2017) and demands based on feedback from internal sources (i.e. other PhilRice staff). Product development activities were accomplished through a

collaboration with the Department of Food Science and Technology (DFST) of CLSU's College of Home Science and Industry.

- DFST's technology of rice-ice cream was utilized as a filling in a bun. This product was inspired by the "dirty" ice cream served in a bun, which is enjoyed by Filipinos of all ages. The product was tested for consumer sensory evaluation by elementary pupils (n=30) and senior high school students (n=30) from CLSU. The product received high acceptability ratings (rating of 8-9, with 9 as the highest) from both groups of consumer sensory panelists. Physicochemical analysis showed that water activity of the bread and rice ice cream were similar (0.871 and 0.878, respectively) indicating that no water migration between the two commodities would likely occur, resulting in a more stable product. The panelists, aged 14-17, also said that they will buy the product if it is available in the market, with 60% responding with "I will probably buy it" while 40% gave a more definite positive response.

- Taro is one crop commonly cultivated in rice based farms. Processing taro into food products adds value to its production. In this project, taro was prepared into flour and incorporated to rice flour and tested in the preparation of chocolate crinkles, a baked product that requires low gluten content. Chocolate crinkle premix formulation was generated using D-optimal mixture design with the following parameters: bulk density, water activity, moisture content, and amylose content of the flours. The premixes were evaluated for oil and water holding capacities. The recommended optimum composition of chocolate crinkle-premix was performed to verify the optimum values predicted by a model. Tests such as spread ratio and overall acceptability through consumer sensory evaluation (n=50) were also conducted to determine the significant differences among the optimized solutions. Results showed that the optimum formulation was composed of 46.99% TF, 18.17% RF, and 34.83% AP with high consumer acceptability.

- Awareness toward crinkles and consumer acceptability and preferences for the recently developed rice-taro crinkles was also assessed through concept testing (n=197). This testing was conducted to children and teenagers (10-19 y/o) in the Nueva Ecija, who were presented with a prototype of the product. Results revealed that the awareness toward crinkles was very high (97.5%). Rice-taro crinkles achieved high acceptability scores that ranged from "like very much" to "like extremely" from children and teenagers in terms of serving size (4.0 ± 1.2), appearance (4.1 ± 0.9), color (4.0 ± 1.0), aroma (4.1 ± 1.3), flavor (4.4 ± 0.9), and price at (P1/pc) (4.7 ± 0.8). Majority of them also preferred the current serving size (74.2%), color (64.7%), and aroma (71.6%) of the rice-taro crinkles. Despite high number of similar products, target market still perceived the rice-taro crinkles as new and different (16.3-25.3%) and relevant (10.5-23.7%). Therefore, the rice-taro crinkles was highly accepted and preferred by children and teenagers in terms of its current size, appearance, color, aroma, flavor, and price.

- Trainings on rice-based food product development in rice-producing communities around the country were conducted to promote value-adding of rice and help farming groups establish rice and rice-based food product enterprises as additional sources of income. Training of new trainors (new staff) was conducted with four food technologists of RCFSD as participants. They were coached on delivering lecture on rice-based food product development, basics on cost analysis, and food safety and handling and trained on the preparation of PhilRice-developed rice-based food products. Trainings were then conducted as requested by external clients: (1) three hands-on training sessions for the Department of Agriculture-Regional Field Office V, Pili, Camarines Sur (April, August, and October), (2) one session on mushroom processing for Palayamanan Plus farmer cooperators, and (3) rice-based processing seminar conducted by the DA-Agricultural Technology Institute, Quezon City in November.

III. Capacity Building for Entrepreneurship

Aurora M. Corales

The 2017 project implementation focused on mushroom production as an enterprise that can provide additional income to farmers, women/housewives, and youth, working or living in the farming community. Project partners were identified through site validation. Thirteen members of Kababaihang Kinikilala Ng Lungsod Agham (Maligaya Chapter) or KKLA, a registered group of women at Maligaya, Science City of Muñoz, Nueva Ecija and 15 members of Bantug Primary Multi-Purpose Cooperative also known as Bantug PMPC, a registered cooperative from Bantug Science City of Muñoz, Nueva Ecija were selected.

- Stakeholder Meeting. A stakeholder meeting was conducted involving PhilRice staff and officers and members of the two groups to discuss project objectives. A list of interested individuals who are willing to engage on mushroom production was also provided. Memoranda of Agreement (MOA) between PhilRice and with each of the group were prepared setting the roles and responsibilities of each party (Table 3).
- Capacity Enhancement. The project conducted two batches of three-day training on mushroom production and processing. The training included topics on mushroom industry, oyster, straw, and milky mushroom production, and troubleshooting in mushroom production and recommended solutions. Hands-on preparation of fruiting bags/beddings, inoculation, fruiting, and harvesting were also included in the training programs. In addition, cooking demonstration using different types of mushroom was conducted in coordination with PhilRice's RCFSD. The first training involved 18 participants mostly from KKLA. The participants registered an average knowledge gain of 25% with an average score of 10 points in pre-test and 12.5 in post-test. Fifteen members from Bantug PMPC participated during the second batch of training on mushroom production held on June 20-22, 2017. The average knowledge gained of the trainees reached 42%.

- Market Scanning. Restaurants and markets were visited and some individuals were interviewed to identify the demand for fresh mushroom in the area (Table 4). As of November 2017, however, project partners are yet to market their produce to these establishments owing to the limited supply of fruiting bags and fresh mushroom. .

- Monitoring and Meeting. Regular monitoring and meeting was conducted to ensure smooth implementation at the project site. Monthly meeting was conducted to discuss with the project partners some issues and concerns regarding mushroom production. Monitoring of yield, income, and cost were also done.

- Marketing and promotion. The common buyers of fresh mushroom were neighbors, relatives, friends, and individuals who visited the production site. The group also catered to individuals who were not able to buy fresh mushroom from PhilRice. To promote mushroom enterprise and expand the market for fresh mushroom and fruiting bags, the two groups participated in the 2017 WS Lakbay Palay at PhilRice CES on September 14-15, 2017 where they sold fresh mushroom and fruiting bags.

- Mushroom Enterprise. KKLA started their mushroom enterprise on July 2017, a month after their training. Starter-kit of 2-liter capacity drum was provided to the project partners to jumpstart their production. A trial was done producing 155 mushroom fruiting bags, which were distributed to the members for them to grow mushroom in their houses while other fruiting bags were sold. After the trial, a mushroom growing house with a capacity of 2,500 fruiting bags was established in the site. Group members contributed P12,260, which were used to buy construction materials for the mushroom growing house. The group produced 5,068 fruiting bags from July to November 2017 obtaining a gross income of P31, 658. The initial capital and cost of establishing the mushroom growing house were returned after almost five months of operations (Table 3).

- Bantug PMPC started its mushroom production on August 2017 producing 2,226 fruiting bags. Gross income obtained from the sales of fruiting bags and fresh mushroom had increased from August to October 2017 was P37,111 with a gross margin of 16,419.50 (Table 4). It financially assisted its members involved in mushroom enterprise in the establishment of the mushroom growing house.

- PhilRice assisted the two sites in acquiring high quality grain spawn for their mushroom production. The fruiting bags were pasteurized using the steel drums provided to the farmer beneficiaries after their training.

Table 3. Profitability analysis of mushroom enterprise in Maligaya, Science City of Muñoz, Nueva Ecija, July-November 2017.

Item	Value(P)
Production Cost	30,411
Mushroom growing house	12, 260
5,068 fruiting bags	18,151
Gross Income	31,658
Sales from fruiting bags	27,488
Sales from fresh mushroom	4,170
Gross Margin	1,247

Table 4. Profitability analysis of mushroom enterprise in Bantug, Science City of Muñoz, Nueva Ecija, August-October, 2017.

Item	Value(P)
Production Cost	
2,226 fruiting bags	20,691.50
Gross Income	37,111
Sales from fruiting bags	33,811
Sales from fresh mushroom	3,300
Gross Margin	16,419.50

KKLA Maligaya Chapter and Bantug PMPC mushroom booths during the WS 2017 Lakbay Palay at PhilRice CES.

Training on Mushroom Production and Processing at PhilRice CES.

Abbreviations and acronymns

ABA – Abscicic acid
Ac – anther culture
AC – amylose content
AESA – Agro-ecosystems Analysis
AEW – agricultural extension workers
AG – anaerobic germination
AIS – Agricultural Information System
ANOVA – analysis of variance
AON – advance observation nursery
AT – agricultural technologist
AYT – advanced yield trial
BCA – biological control agent
BLB – bacterial leaf blight
BLS – bacterial leaf streak
BPH – brown planthopper
Bo - boron
BR – brown rice
BSWM – Bureau of Soils and Water Management
Ca - Calcium
CARP – Comprehensive Agrarian Reform Program
cav – cavan, usually 50 kg
CBFM – community-based forestry management
CLSU – Central Luzon State University
cm – centimeter
CMS – cystoplasmic male sterile
CP – protein content
CRH – carbonized rice hull
CTRHC – continuous-type rice hull carbonizer
CT – conventional tillage
Cu – copper
DA – Department of Agriculture
DA-RFU – Department of Agriculture-Regional Field Units
DAE – days after emergence
DAS – days after seeding
DAT – days after transplanting
DBMS – database management system
DDTK – disease diagnostic tool kit
DENR – Department of Environment and Natural Resources
DH L– double haploid lines
DRR – drought recovery rate
DS – dry season
DSA - diversity and stress adaptation
DSR – direct seeded rice
DUST – distinctness, uniformity and stability trial
DWSR – direct wet-seeded rice
EGS – early generation screening
EH – early heading
EMBI – effective microorganism-based inoculant
EPI – early panicle initiation
ET – early tillering
FAO – Food and Agriculture Organization
Fe – Iron
FFA – free fatty acid
FFP – farmer's fertilizer practice
FFS – farmers' field school
FGD – focus group discussion
FI – farmer innovator
FSSP – Food Staples Self-sufficiency Plan
g – gram
GAS – golden apple snail
GC – gel consistency
GIS – geographic information system
GHG – greenhouse gas
GLH – green leafhopper
GPS – global positioning system
GQ – grain quality
GUI – graphical user interface
GWS – genomwide selection
GYT – general yield trial
h – hour
ha – hectare
HIP - high inorganic phosphate
HPL – hybrid parental line
I - intermediate
ICIS – International Crop Information System
ICT – information and communication technology
IMO – indigenous microorganism
IF – inorganic fertilizer
INGER - International Network for Genetic Evaluation of Rice
IP – insect pest
IPDTK – insect pest diagnostic tool kit
IPM – Integrated Pest Management
IRRI – International Rice Research Institute
IVC – in vitro culture
IVM – in vitro mutagenesis
IWM – integrated weed management
JICA – Japan International Cooperation Agency
K – potassium
kg – kilogram
KP – knowledge product
KSL – knowledge sharing and learning
LCC – leaf color chart
LDIS – low-cost drip irrigation system
LeD – leaf drying
LeR – leaf rolling
lpa – low phytic acid
LGU – local government unit
LSTD – location specific technology development
m – meter
MAS – marker-assisted selection
MAT – Multi-Adaption Trial
MC – moisture content
MDDST – modified dry direct seeding technique
MET – multi-environment trial
MFE – male fertile environment
MLM – mixed-effects linear model
Mg – magnesium
Mn – Manganese
MDDST – Modified Dry Direct Seeding Technique
MOET – minus one element technique
MR – moderately resistant
MRT – Mobile Rice TeknoKlinik
MSE – male-sterile environment
MT – minimum tillage
$mtha^{-1}$ - metric ton per hectare
MYT – multi-location yield trials
N – nitrogen
NAFC – National Agricultural and Fishery Council
NBS – narrow brown spot
NCT – National Cooperative Testing
NFA – National Food Authority
NGO – non-government organization
NE – natural enemies
NIL – near isogenic line
NM – Nutrient Manager
NOPT – Nutrient Omission Plot Technique
NR – new reagent
NSIC – National Seed Industry Council
NSQCS – National Seed Quality Control Services
OF – organic fertilizer
OFT – on-farm trial
OM – organic matter
ON – observational nursery
OPAg – Office of Provincial Agriculturist
OpAPA – Open Academy for Philippine Agriculture
P – phosphorus
PA – phytic acid
PCR – Polymerase chain reaction
PDW – plant dry weight
PF – participating farmer
PFS – PalayCheck field school
PhilRice – Philippine Rice Research Institute
PhilSCAT – Philippine-Sino Center for Agricultural Technology
PHilMech – Philippine Center for Postharvest Development and Mechanization
PCA – principal component analysis
PI – panicle initiation
PN – pedigree nursery
PRKB – Pinoy Rice Knowledge Bank
PTD – participatory technology development
PYT – preliminary yield trial
QTL – quantitative trait loci
R - resistant
RBB – rice black bug
RCBD – randomized complete block design
RDI – regulated deficit irrigation
RF – rainfed
RP – resource person
RPM – revolution per minute
RQCS – Rice Quality Classification Software
RS4D – Rice Science for Development
RSO – rice sufficiency officer
RFL – Rainfed lowland
RTV – rice tungro virus
RTWG – Rice Technical Working Group
S – sulfur
SACLOB – Sealed Storage Enclosure for Rice Seeds
SALT – Sloping Agricultural Land Technology
SB – sheath blight
SFR – small farm reservoir
SME – small-medium enterprise
SMS – short message service
SN – source nursery
SSNM – site-specific nutrient management
SSR – simple sequence repeat
STK – soil test kit
STR – sequence tandem repeat
SV – seedling vigor
t – ton
TCN – testcross nursery
TCP – technical cooperation project
TGMS – thermo-sensitive genetic male sterile
TN – testcross nursery
TOT – training of trainers
TPR – transplanted rice
TRV – traditional variety
TSS – total soluble solid
UEM – ultra-early maturing
UPLB – University of the Philippines Los Baños
VSU – Visayas State University
WBPH – white-backed planthopper
WEPP – water erosion prediction project
WHC – water holding capacity
WHO – World Health Organization
WS – wet season
WT – weed tolerance
YA – yield advantage
Zn – zinc
ZT – zero tillage

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

With a "Rice-Secure Philippines" vision, we want the Filipino rice farmers and the Philippine rice industry to be competitive through research for development in our central and seven branch stations, coordinating with a network that comprises 59 agencies strategically located nationwide.

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

PhilRice Central Experiment Station; Maligaya, Science City of Muñoz, 3119 Nueva Ecija; Tel: (44) 456-0277 •
Direct line/Telefax: (44) 456-0112; Email: prri.mail@philrice.gov.ph; PhilRice Text Center: 0917 111 7423;
Websites: www.philrice.gov.ph; www.pinoyrice.com

BRANCH STATIONS:

PhilRice Agusan, Basilisa, RTRomualdez, 8611 Agusan del Norte; Telefax: (85) 343-0768; Tel: 343-0534; 343-0778; Email: agusan.station@philrice.gov.ph
PhilRice Batac, MMSU Campus, Batac City, 2906 Ilocos Norte; Telefax: (77) 772- 0654; 670-1867; Tel: 677-1508; Email: batac.station@philrice.gov.ph
PhilRice Bicol, Batang, Ligao City, 4504 Albay; Tel: (52) 284-4860; Mobile: 0918-946-7439 ; Email: bicol.station@philrice.gov.ph
PhilRice Isabela, Malasin, San Mateo, 3318 Isabela; Mobile: 0908-895-7796; 0915-765-2105; Email: isabela.station@philrice.gov.ph
PhilRice Los Baños, UPLB Campus, Los Baños, 4030 Laguna; Tel: (49) 536-8620; 501-1917; Mobile: 0920-911-1420; Email: losbanos@philrice.gov.ph
PhilRice Midsayap, Bual Norte, Midsayap, 9410 North Cotabato; Tel: (64) 229-8178; 229-7241 to 43; Email: midsayap.station@philrice.gov.ph
PhilRice Negros, Cansilayan, Murcia, 6129 Negros Occidental; Mobile: 0932-850-1531; 0915-349-0142; Email: negros.station@philrice.gov.ph
PhilRice Field Office, CMU Campus, Maramag, 8714 Bukidnon; Mobile: 0916-367-6086; 0909-822-9813
Liaison Office, 3rd Floor, ATI Bldg, Elliptical Road, Diliman, Quezon City; Tel: (02) 920-5129

SATELLITE STATIONS:

Mindoro Satellite Station, Alacaak, Sta. Cruz, 5105 Occidental Mindoro; Mobile: 0908-104-0855
Samar Satellite Station, UEP Campus, Catarman, 6400 Northern Samar; Mobile: 0948-800-5284