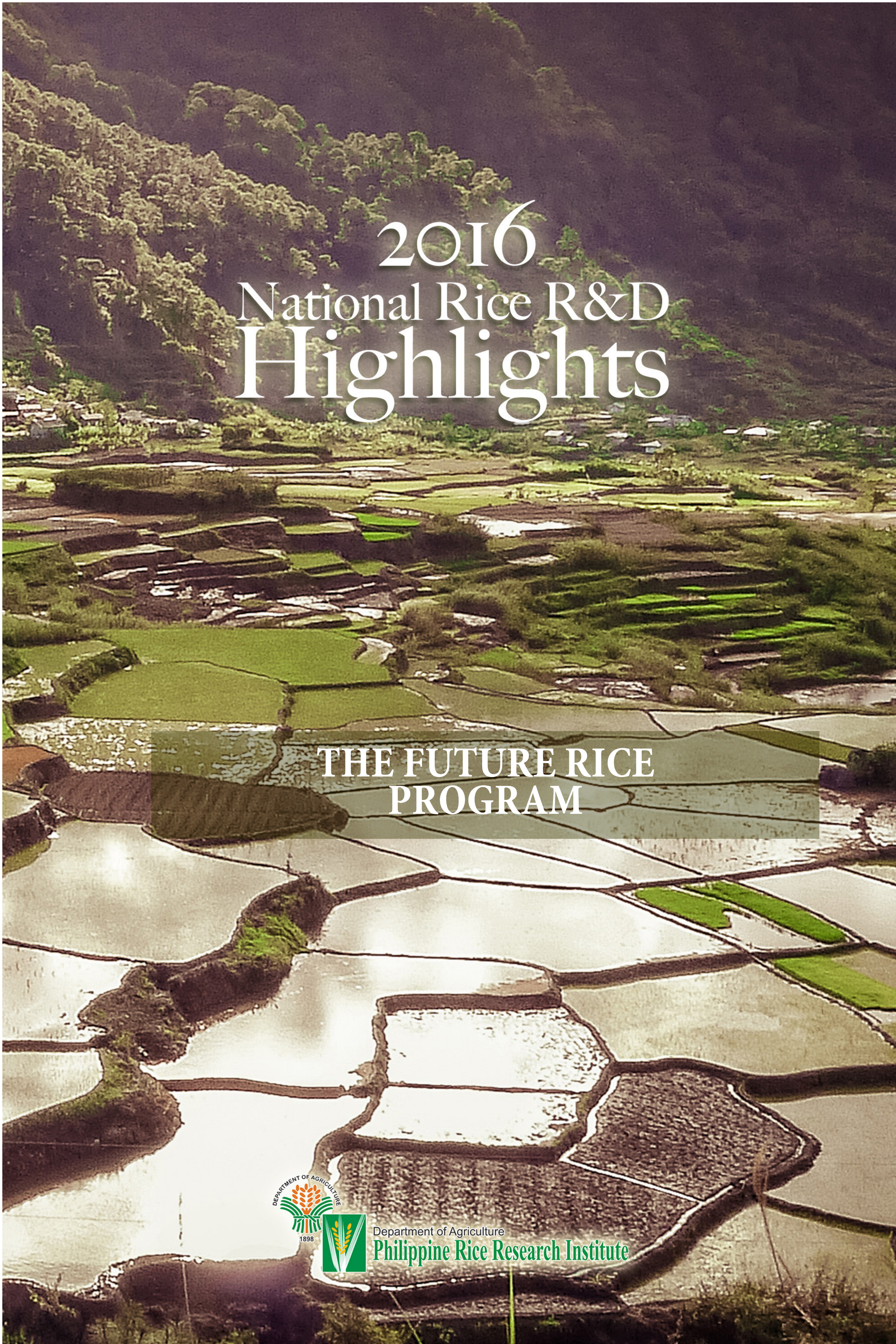

2016 National Rice R&D Highlights

THE FUTURE RICE PROGRAM

Department of Agriculture
Philippine Rice Research Institute

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The FutureRice Program

Program Leader: Roger F. Barroga

Executive Summary

Rice farming in the Philippines will face several challenges in the future. With a very limited irrigated area, it must produce enough rice to feed more than 100 million Filipinos. The impact of climate change has also brought further destruction of remaining irrigation systems, and in some areas, much flooding and landslide due to shift in cyclone path. High population growth rate and rapid urbanization contribute to further reduction of prime agricultural land in the Philippines.

The challenge for R&D is to produce more food output from the same unit of land, and at the same time, protect the soil and the environment from further degradation due to intensive crop cultivation. This challenge is compounded by the dwindling supply and increasing costs of petroleum based products for farm fuel, pesticides, and fertilizers. The increasing production costs at the farm level is eroding potential income and profits of farmers.

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

Thus, the objectives of this program are:

To explore ways to increase current rice output using 21st century and practical cutting edge technologies.

- To prepare farmers for the future of rice farming in the Philippines.
- To inventory, test, and adapt local and global innovations on green, practical and smart farming technologies.
- To train farmers and extension agents on green, practical and smart farming.
- To establish communities that use green, practical and smart farming.
- To establish livelihood opportunities on green, practical and smart farming.

I. Knowledge Management on Clean GPS

Project Leader: RF Barroga

Farming Innovations

RF Barroga and JLZA Libed

So many farming technologies are introduced locally and globally. These technologies were meant to make life easier if only it can reach the intended stakeholders. In the field of science communication, information not communicated is wasted. Knowledge integration of farming technologies, access to these information and adoption of the available technologies are the key elements of a competitive, sustainable and resilient rice industry. Hence, this study aims to collect all these farming technologies and smart innovations to help equip our farmers, students, agri-enthusiasts and stakeholders with these useful information. The goals of this study are: to scan, collect and organize Clean GPS farming technologies; to create a book compilation of organic, mechanized and agro-tourism farms; to write journal articles reflecting high-tech and smart faming that adhere to the Clean GPS for CSR principle.

Activities:

- The first volume of the book "Agritourism Farms of the Philippines" was released in December 2015. It featured nine (9) farms namely: Costales Nature Farms, Herbana Farms, Mangarita Organic Farm, Gourmet Farms, Inc., East West Permaculture Farm, Laur Farm, Duran Farm, Don Bosco Multi-Purpose Cooperative, and ACES Farm Institute. Most of these farms have entered into retailing. They market their own produce in commercial packaging straight to consumers, allowing them to increase their profit significantly. Another common element among these successful farms is their adherence to sustainable agricultural practices such as zero-waste management, efficient maximization of space, organic farming and the use of clean energy facilities. However, it was observed that these farms are lacking in the area of community engagement. Since they already have the know-how and facilities, empowering the local farmers in their area will contribute to inclusive growth in both profit and environmental condition. The book was distributed to stakeholders and agriculture extensionists.

- The second volume of the book is set to be published and distributed in January 2017. It features 10 agritourism farms namely: Penalosa Farms, Leonie Agricorp Farm, Saret Organic Farmville, CLSU Hydroponics and Aquaponics, Allied Botanical Corporation Demo Farm, Rosa Farm, Lomboy Farms, Gapuz Grape Farms, Dole Philippines, and Paradizoo.

Results:

- The technologies and innovations gathered from farm visits are applied at the FutureRice farm such as: effective waste management, vermicomposting, water filtration system, and organic vegetable production.
- The second edition of the book aims to accomplish the same objective of providing inspiration and model for farmers to maximize the productivity of their lands by integrating agritourism components, and at the same time earn added income. It is to be distributed to stakeholders and agriculture extensionists.

II. Establishment of Model Farms for Future Farming Scenarios

Project Leader: MRO Añora

There are plenty of research conducted to address global issues such as climate change, environmental degradation, peak oil scenario and fast depletion of non-renewable resources. Most of the solutions and innovations found were developed and tested independently. Now, the goal of this project is to test and integrate these technologies in real farming scenario. It has three components, namely: demonstration of natural and alternative rice farming technologies, showcasing of high-tech rice farming innovations, and economic assessment of the technologies showcased.

Demonstration of Natural Rice Farming Technologies

EF Javier, XXG StoDomingo, MRO Añora, RF Barroga

Consumers are now gaining awareness in as sessing where and how their food are produced. The effort to find ways of reducing chemical inputs without sacrificing yield productivity is the goal of this study. A demonstration and testing of natural and alternative rice farming technologies may provide sustainable solutions that can be adopted by farmers in their own locality.

Activity I: Organic Rice Demonstration- EF Javier,and XXG StoDomingo

- Two trial sites were established last dry and wet season 2016 to demonstrate the efficacy of two (2) best organic basal nutrient supplement on the yield of pure organically grown rice plants. The plants were subjected to two (2) growing paddy soil condition: one is alternate wetting and drying and the other one is continuously flooded. The two ecosystem differs in their chemical and biological properties due to the presence and absence of oxygen.

- Slightly dried rice straw (not pre-decomposed) plus chicken manure (RSCM) were incorporated during the harrowing stage of land preparation or approximately 14 days before transplanting with a ratio of 10:1. In the other plots, volume vermicast were likewise incorporated a week before transplanting. Azolla microphyla was top-dressed as N supplement at a following rate: fifty (50) kg/ha thirty days (30) after transplanting and five hundred (500) kg/ha during early panicle initiation. In ws2016, the rate of azolla topdress applied at 30 DAT and EPI was 500kg per ha. No chemical fertilizer input was applied.

- Pest and disease management was done using ecological engineering, planted along dikes. Ornamental plants become pest trap crop. A high yielding inbred variety, PSB Rc82 was used as the test plant.

Result: Organic Rice Demonstration

- Results in dry and wet season showed a comparable yield of organic set-ups in well-drained soil condition. Dry season showed that RSCM yielded a 4.4t/ha and vermicast had a 3.7t/ha while in wet season 4.1t/ha was observed in RSCM and 5.1t/ha in vermicast.

- Organic set-ups in continuously flooded condition got a higher yield compared to well-drained soil condition. This might be due to availability of water which is helpful for the reproduction of azolla. In continuously flooded condition, yield result of RSCM had a 6.0t/ha in dry season and 4.5t/ha in wet season. Vermicast had a 5.5t/ha and 5.4t/ha yield in both dry and wet season, respectively.

- In both soil conditions, vermicast application during wet season was observed to have a 1-ton yield increase compared to RSCM.

Activity II: Rice Crop Manager

A field demonstration was used to determine the yield performance of nutrient decision support tool called Rice Crop Manager. RCM based recommendation is adjusted based on different factors which includes the incorporation of organic materials during land preparation. The study aimed at determining whether an incorporation of organic material (vermicast), at a rate of 12 bags per hectare, brings a relative increase in yield or savings in fertilizer application.

Result: Rice Crop Manager

Crop cut results in dry season 2016 showed that incorporation of vermicast yielded a 9.4t/ha compared to control set-up at 8.5t/ha. A yield difference

of .9 t/ha was observed. Similarly, actual harvest in wet season 2016 showed that incorporation of vermicast yields a 4.0tons/ha compared to 3.2tons/ha of the control set-up. The .8tons/ha yield difference is almost same with dry season data. Economic computation is discussed at the latter portion.

Activity III: Others

- Sweet sorghum, SPV 422, was planted last February 2016 at a planting distance of 50cm x 15cm and a depth of 2 to 3cm.

- Aromatic Rice (Basmati) and Burdagol were planted at the FutureRice Farm last dry season 2016 to determine their harvestable yield and demonstrate their crop standing during field visits and lakbay palay.

- Demonstration of Floating Gardens in the flooded areas. Green leafy vegetables such as pechay, mustasa, upland kangkong; and solanaceous crops such as tomato were showcased.

Result: Others

- Sweet sorghum production yielded a 2.1t/ha despite being planted in a clayey soil. The recorded yield might be 1 ton lower compared to the average productivity but it shows that with proper management, sweet sorghum can survive even in soils with high water holding capacity. Harvested grains was used for seed production while the other parts were fermented as feeds for goats.

- Yield results showed that Burdagol had obtained a comparable yield of 7.0t/ha compared to 6.9t/ha of irrigated lowland variety NSIC Rc354 and followed by Basmati with 4.9t/ha. The yield results were quite expected given that Basmati is known for its good eating quality and planted in usually upland areas. Farmers during the field visits had seen the crop standing of both Burdagol and Basmati varieties.

- Planting of green leafy vegetable was a success while deep rooted solanaceous crops were hard to grow. Aside from the planting trials, there are several challenges that the researchers have encountered in this demonstration. Strong winds in open areas is one of them.

Demonstration of High Tech Rice Farming Technologies
MRO Añora

Timely and near accurate assessment of crop's health status is the new face of agriculture. This study aims to demonstrate advances in rice crop management using smart apps to manage rice health. Modern machines were also showcased to minimize high labor cost and crop production loses. Newly released and climate change resilient/adapative varieties were demonstrated.

Activity I: Nutrient Management App

- A randomized complete block design was established for Rice Crop Manager (RCM) and Minus One Element Technique (MOET) App last dry and wet season 2016. A farmer's practice was established for comparison. Yield return was calculated through yield component analysis.

Result: Nutrient Management App

- Using yield component analysis, data last dry season 2016 showed that MOET app had the highest computed yield at 9.43tons/ha followed by RCM at 9.05tons/ha and Farmer's Practice at 7.44 tons/ha. Yield component analysis last dry season 2016 showed no statistically significant difference among treatments but it was observed that MOET and RCM app had higher number of spikelet per panicle, higher percentage of filled spikelet and heavier weight of grains as compared to Farmer's Practice.

- Similarly, wet season 2016 data indicated that MOET app had the highest yield return at 7.26 tons/ha. RCM and Farmer's Practice had a very close yield return of 6.43tons/ha and 6.6tons/ha respectively. Moreover, yield analysis showed no significant difference among its component except tiller count during the vegetative stage.

Activity II: Varietal Trial

- Lowland varieties NSIC Rc354 and NSIC Rc360 were demonstrated last dry and wet season 2016. NSIC Rc352 was only demonstrated in wet season 2016. Average yield for NSIC Rc352 is at 5.1 t/ha, NSIC Rc354 at 5.1 tons/ha and NSIC Rc360 at 5.4t/ha. These three varieties were showcased with controlled irrigation technology. This trial will be demonstrated during field visits and Lakbay Palay.

Result: Varietal Trial

- In dry season 2016, actual yield harvest of NSIC Rc360 was higher at 5.7t/ha compared to NSIC Rc354 at 5.2t/ha. These two varieties, planted with controlled irrigation technology, have a comparable yield with the recorded dry season yield at the National Seed Industry Council.

- On the other hand, results of the wet season data showed that NSIC Rc352 had obtained the highest yield at 5.2t/ha, followed by NSIC Rc360 at 3.72t/ha and NSIC Rc354 at 3.70t/ha. Yield component analysis showed that NSIC Rc352 had a higher plant height and heavier weight of filled panicle but it is not significant compared to the other two varieties.

Activity III: Demonstration of Green Super Rice Lines

- Green Super Rice Line 1 and Line 5 were demonstrated last dry season 2016 to assess their yield performance. However, GSR Line 12 was used in wet season 2016 because of the availability of GSR Line 5. Fertilizer Application rate for DS2016 was 120-60-90 and 90-60-60 for wet season 2016.

Result: Demonstration of Green Super Rice Lines

- Actual yield data showed that GSR line 5 and GSR line 1 had a comparable yield of 7.8t/ha and 7.2t/ha, respectively. The actual harvested yield of green super rice lines in DS 2016 was higher as compared to the demonstrated lowland varieties of NSIC Rc354 & NSIC Rc360. On the other hand, ws2016 results showed that GSR Line 12 had a significantly higher yield return at 6.1t/ha as compared to GSR Line 1 at 3.5t/ha. GSR line 12 had a significantly lower unproductive tiller, higher number of filled spikelet and higher number of grains per panicle.

Activity IV: Field Demonstration of Modern Rice Machinery

- The researchers had conducted three (3) machine demonstrations within the different stages of rice production. Small rotovator was used during land preparation to demonstrate mechanized wet plowing, walk behind and riding transplanter were demonstrated during crop establishment and combine harvester during harvesting period.

- The researchers had conducted a half day Rice Hands-on Experience for new PhilRice staff also. Activities includes the following: short lecture on rice morphology, operate a mechanical seeder and walk behind transplanter, lecture and hands-on training on land preparation, machinery and implements use, operating a tractor, manual transplanting and planting of flowering weeds along the dikes.

Result: Field Demonstration of Modern Rice Machinery

- Over 150 farmers attended the machine demonstrations at FutureRice Farm.

- Over 40 newly hired staff attended the Rice Hands on Experience. Feedback from the participants were positive

Economics of Rice and Rice Based Production Innovations

MRO Añora and RF Barroga

Our goal of increasing farmer's income and uplifting their socio-economic status led us towards technological innovations in rice and rice based farming. A lot of innovations that battle global problems are being demonstrated at the FutureRice Farm. But not all technologies showcased are practical and beneficial to farmers. Researchers need to test the vailidity of a certain technology and if possible localize it in a way that is more doable and replicable to the farmers. An economic analysis of these innovations and every farm operation will be undertaken. This study aims to: provide economic analysis of selected rice farming technologies and establish a small scale crop-fish-livestock integration.

Activity I: Economics of Selected Rice Technologies

- Partial Budgeting Analysis was used in dry and wet season 2016 to determine the nutrient saving and yield assessment of two (2) different apps: RCM and MOET App.

- Partial Budgeting Analysis was used to analyze whether incorporation of organic material (vermicast) brings an economic gain/savings based on RCM recommendation.

Result: Economics of Selected Rice Technologies

- Based on the fertilizer application last dry and wet season 2016, RCM gave a savings of PhP 2,400.00- PhP 3,500.00 per hectare over Farmer's Practice. MOET app had saved around PhP 360.00 to PhP 1,400.00 per hectare over Farmer's Practice. Smaller savings of MOET app against RCM is due to its comparable quantity of fertilizer applied with the Farmer's Practice. In dry season 2016, a potential of Php 27,034 to 35,258 will likely be added to Farmer's income using RCM and MOET App respectively. While a potential income of PhP 2,800.00 to PhP 11,000.00 may materialized in wet season 2016.

- DS and WS 2016 data showed that vermicast incorporation gave a savings of Php 1,508.00 to PhP 4,600.00/ha over the control set-up.

- But if the vermicast applied was purchased, an additional cost of Php 4,200.00 per hectare will be incurred. With its high yield and fertilizer savings, vermicast incoporation offers a possible income of about Php 13,000.00 to PhP 18,000.00 per hectare (@15kg per kilo of palay).

Activity II: Establishment of Small Scale Mixed Crop-Fish-Livestock Production.

- Hot pepper production was initiated last July 2016. Twenty (20) raised-beds were constructed. This set-up was intended for the drip irrigation set-up in dry season 2017.

- Collaborated with Bureau of Fisheries and Aquatic Resources to get 2,000 matured fingerlings. Started fish production last April 2016 in about 800sqm meter area pond. Estimated date of harvest will be at the end of July 2016.

- Technical collaboration for goat raising with the Central Luzon State University- Small Ruminant Center was undertaken. Purchase request and canvassing of goats were completed. Forage production started last October 2016.

- Dragon fruits were planted in 120 linear meter. Cutting materials came from PhilRice Batac. The researcher had planted two (2) cuttings per post and 2.5 meters away between posts.

Results: Establishment of Small Scale Mixed Crop-Fish-Livestock Production

- Hot pepper production was damaged by two (2) weeks of consecutive rain last August 2016. As alternative, the researcher opted to test the viability of planting hot pepper along aqua dike last September 9, 2016. The area planted was about 100 linear meter. Initial cost of production was about PhP 3,557. Harvest was about 4kg per month and the price varies from PhP 200 to 300/kg since November 2016.

- Preliminary cost analysis was conducted to assess the profitability of fish enterprise at FutureRice Farm. Fish production management was an extensive fish culture type with a stocking density of 2 to 3 fish per square meter. Expenses were based on the actual cost incurred. Unfortunately, data on actual harvest is not yet collected since fishes were displaced into big water embankment due to collapsed dikes. Instead, the projected income was based on the average weight of fish collected and estimated farm gate price of PhP 55.00 per kilo. Fixed costs in pond digging and installation of gates are not yet included since most of these operations are still on-going. All data are in nominal value. Results showed that the average weight of fish in the pond was at 278grams. If there is a 10% mortality rate, the estimated variable expense per piece is at PhP 7.58 and the estimated sales is at PhP 15.29. In a 1-hectare area production, the estimated gross income per cycle is at PhP 324,912.50 while the variable cost is PhP 160,988.50. This is comparable to the existing market income and production cost estimates.

III. Advocacy, Capacity Building, and Agritourism

Project Leader: JLZA Libed

The objectives of this project are: to promote the knowledge of Clean GPS farming to new generation of rice stakeholders using conventional and social media; to address social change issues in the community level through seminars, workshops, and farm tours; and to promote a model rice agritourism site that will showcase new farm technologies and innovations.

Public Awareness and Campaigns

RF Barroga and JLZA Libed

The rice industry abounds with many available technologies and techniques that can make the life of every farmer easier, more efficient, and profitable. However, not all these knowledge and information are accessible and are easily adaptable to our farmers. This is where the role of communication comes in. This study aims to identify strategic and efficient approaches in communicating our advocacies to our farmers, students, rice stakeholders and the general public. It is the priority of this study to maximize the use of both conventional and social media to create touchpoints and get our message across by creating venues for positive engagement with our target audience. The goals of this study are: to produce print and online educational materials, create campaign strategies and training materials to promote the program; to generate free TV, radio, and print exposures for the promotion of FutureRice advocacies, technologies, and innovations; and to increase audience engagement in social media accounts.

Activities:

- Different media outlets and platforms were scanned and studied particularly according which will be more strategic in getting across resonating messages to farmers, students and rice stakeholders. Interested media parties partnered with the program in creating stories and news features on TV, radio and print. Production meetings, briefings, and shootings were conducted to document and discuss the technologies and advocacies of the FutureRice Program.

- Taking advantage of the wide reach that social media allows, audiences were segmented according to groups. The FutureRice page uploaded posts that targeted the members of groups that are interested in rice farming, agriculture, agriculture technologies, and agripreneurship. The posts that were uploaded were aligned with the advocacies, campaigns and technologies that the program promotes and are perceived to be beneficial information to the target audiences.

- Serving as a one-stop demo farm for different high-tech innovations and natural farming techniques, important information on crop management were put as technology and field labels as well as brochures and flyers. Precautionary and directional placards and promotional billboards were also designed.

- Participated in a mall exhibit on Farm Tourism and Wellness in Robinsons Starmills, San Fernando Pampanga hosted by the Department of Tourism Region 3. FutureRice rice straw art figures were displayed, PhilRice publications, and merchandise were sold while educational materials were distributed for free.

Results:

- FutureRice has partnered with media outlets in promoting technologies, innovations and events at the farm. A total of 24.6 minutes of television air time in 7 different programs, radio program features in 3 different stations, 6 published news and feature articles in 4 different broadsheets from January to December 2016. All media exposures are free of charge.

- The social media presence of the program significantly increased by 150%. The highest post attained 87,342 people for the rice paddy art announcement while a third party post on the same subject generated 62,000 likes (GMA Network). The social media sites like Twitter, YouTube, and Instagram were also penetrated through the rice paddy art exhibit and promotion. There was also more than 50 blog and social media site features primarily by major news organizations for rice paddy art for both dry and wet season. A major online promotion was achieved this year when the news about the Rice Up Pilipinas paddy art was featured on the homepage of Yahoo!. The FutureRice Facebook page has 3,185 likes as of December 2016.

- On site billboards, field and technology labels, directional, safety, and promotional placards were installed for dry season and wet season 2016. Program brochures, and flyers were also distributed to visitors and Lakbay Palay participants.

Communication and social change research
RF Barroga and JLZA Libed

The level of resonance a message generates from its target audience heavily depends upon the relevance of the message, and the suitability of the approach and medium used. To share new knowledge about clean, green, practical and smart farming entails an effective participatory communication among rice stakeholders and farming communities. The key messages must be as effective as the communication medium used to gain significant impact to the intended participants. The objectives of this study are: to conduct perception analysis research in farming communities concerning important social change issues; to create promotional materials showcasing the model farm technologies, practices and green products that can reach the farming villages and communities; to conduct consultation events/workshop in farming communities to address social change issues.

Activities:

- A perception analysis was conducted to determine the demographics and insights of visitors and tourists during the 'Aldub Rice' paddy art exhibit from March to May 2016. This study was based on the visitors' feedback form accomplished by random visitors during the exhibit.

- A rice straw art contest was held at the FutureRice farm to enjoin the nearby farming communities in the productive use of rice straw and to promote the institute's campaign against the burning of rice straw.

Results:

- The results of the perception analysis will be used to improve the agritourism management in the farm particularly during rice paddy art exhibit.

- There were seven (7) rice straw art figures that were produced from the contest which were exhibited in the farm. The figures were based on the images of beneficial insects to rice fields such as: butterfly, grasshopper, spider, and lady bug, and a frog. Popular-themed structures were also made: Captain America and Iron Man – these two were exhibited at the event in SM Cabanatuan and Robinsons Starmills Pampanga, respectively in October 2016.

- The contest participants were able to encourage other nearby farming community members to visit the farm and check out the rice straw art structures. They appreciated how rice straw can also be used productively instead of burning it. The mallgoers who saw the rice straw art figures during the exhibit were also appreciative of the work, and they were also educated about the creative use of rice straw or more popularly known to most as "dayami".

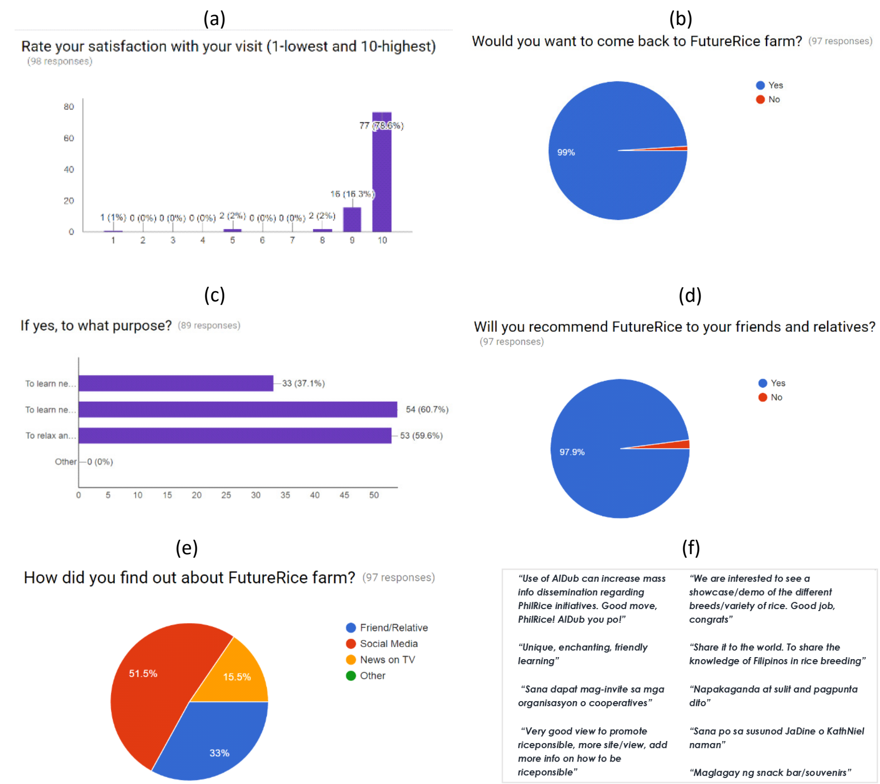

Figure 1. Feedback results from random visitors of AlDub Rice: (a) 79% satisfied with their visit; (b & c) 99% would want to return to learn new information on rice and technologies (54), relax and have fun (53), learn new skill in farming (33); (d) 99% will recommend visiting the rice paddy art to their friends and family; (e) 52% learned about the rice paddy art through social media; and (f) some of the visitors' comments and suggestions for the rice paddy art.

Figure 2. The rice straw art figures which were exhibited in mall events and at the FutureRice farm.

Agritourism Development
RF Barroga, MRO Anora, JLZA Libed and NL Caballong

The role of a rice agritourism site is to create a conducive environment for learning, showcasing and engaging the public in advanced farming technologies, innovations and agribusiness opportunities. The FutureRice farm, which also provides recreational facilities, aims to promote agritourism as a route for reviving the rural farming economies, in adherence to the provisions of the newly legislated Farm Tourism Act (RA 10816).

The objectives of this study are: to build a rice agritourism site with learning and recreational facilities; to create agritourism attractions and draw visits from tourists, farmers, students and farming enthusiasts; to conduct farm tours and events to promote smart farming technologies and innovations; to create an ideal model agritourism farm from which guests, particularly farmers and land owners, can adopt or implement on their own; to acquire certification from Department of Tourism as an accredited agritourism destination.

Activities:

- The FutureRice farm was formally opened last April 1 through a ribbon cutting ceremony led by former DA Secretary Proceso Alcala and PhilRice Executive Director Calixto M. Protacio.

- FutureRice exhibited its second rice paddy art featuring the image of a popular love team, Maine Mendoza and Alden Richards. The image was converted into a two-tone photo

using the software Photoshop. Two varieties used were NSIC Rc360 and Purple Rice to correspond to the green and violet pixels. The art was planted manually per hill to get the exact corresponding color per area. The principle of anamorphosis was applied to achieve the desired angle for best viewing. This project was in collaboration with Genetic Resources Division. It was opened to public on March 15 until May 6.

- A one-day hands-on training and experience activity participated by new PhilRice staff were conducted to give them a background on the major farm processes, machinery, technologies and other important information on rice farming. Hands-on training on manual and mechanical rice transplanting, land preparation, manual and mechanical harvesting, will be offered to the public as agritourism experience.

- In wet season of 2016, FutureRice Program launched another rice paddy art featuring the newly elected President Rodrigo Duterte and Vice President Leni Robredo. The art was called Rice Up Pilipinas. Its aim was to serve as a call to unity among Filipinos to stand together with the new administration in uplifting our rice industry, especially the lives of our Filipino farmers.

Results:

- The rice paddy art exhibit gathered approximately 3,000 visitors from March 15 to May 2016. The visitors were able to see the art, as well as the different technologies and crop experiments showcased at the farm. This project paved the way for more people to learn about the different advanced technology developments and opportunities in rice farming especially among the youth.

- A partnership with the Department of Tourism will help promote the farm as an agritourism destination.

- FutureRice won the 1st and 3rd best poster awards during the 46th Scientific Conference of Crop Science Society of the Philippines in June 2015 at General Santos City. The poster titles were: “Building a Rice Agritourism: Challenges and Opportunities” and “Farmer’s Toolbox of the Future: The RCM and MOET Apps” respectively.

- The Rice Up Pilipinas paddy art was able to attract students and tourists from all over the country. During its viewing period, the farm served as an educational tour destination for students from preschool to college.

Figure 3. The 'AlDub Rice' paddy art planted at the FutureRice farm in collaboration with the Genetics Resources Division of PhilRice

Figure 4. DA Secretary Alcala leading the ribbon cutting ceremony of the FutureRice Farm with PhilRice officials.

Figure 5. The wet season rice paddy art featuring President Duterte and Vice President Leni Robredo called Rice Up Pilipinas.

IV. Farm Automation thru ICTs

Project Leader: NL Caballong
Co-project Leader: RF Barroga

The main objective of this project is to showcase different forms of ICTs applicable to rice-based farming systems. Specifically, it intends to (a) promote and deploy existing ICT products and services ready for farmer use; (b) customize industry-based ICTs to fit in the agriculture system; and (c) develop emerging ICTs for agriculture research and product model development. All these activities intends to reach out to the new generation of farmers, agricultural workers, and agricultural innovators.

Development of farm and crop management apps

NL Caballong and PAA Alday

Smartphones and tablets are versatile tools capable of processing and storing data and information, and connecting to the internet. Because of the availability and affordability of smartphones and tablets, sooner or later the use of these handheld computers will be widespread among Filipinos even to farmers. Thus, agriculture apps must be already available when that time comes. This study targets development of 3 apps – an electronic farm management app, a fertilizer calculator, and a rice pest identification app. Each app will undergo the same 4-milestone development process derived from agile development methodology, namely: baseline designing; baseline prototyping; testing, evaluation, and iteration planning; and iterations development (designing, prototyping, and testing cycle).

Activities:

- Last year, the electronic farm management app also known as AgRiDOC App has gone with the first two milestones of its development – baseline designing and prototyping. For the first half of 2016, it was scheduled for testing and evaluation and actual use at the FutureRice farm. The process resulted an iteration plan to improve usability and usefulness to target users.

Results:

- The initial concept of AgRiDOC App in 2015 targeted progressive farmers with high familiarity in using computers and the internet. It is a browser-based app based on Enterprise Resource Planning (ERP), a software suite used in business enterprise management which features basic accounting, supply inventory, personnel, and equipment management. It adapted the activity orientation of rice crop production.

- As a result of testing and evaluation, several specifics has been taken into consideration on AgRiDOC App for its first iteration cycle. First, the targeted users are entry-level to the proposed concept of the app even if they are already familiar with computers. The interface must be simplified and must be similar to their current method (i.e. record book). Second, string inputting must be minimized by incorporating pre-defined libraries. Third, report generation and printing must be improved. Fourth, PalayCheck provide schematic guide to crop management based on crop age. It can be incorporated to the system. Fifth, common information about crop production must be easily seen, as well as links to other useful information. Lastly, integrate farm map features based on last year's output prototype of farm land management geo-interface.

- The current web-based AgRiDOC app targets progressive farmers as primary users. A different version of the app compatible for offline use and smartphone platform has been designed and prototyped. This new version will be used by farmers and extension workers. The above given considerations were implemented in this version but in a more simplified manner.

Figure 6. Interface design of AgRiDOC App Android Version: (a) crop record page imitating a record book used by farmers; (b) farm entrance page with links to active crops, useful information, and geo-location of the farm; (c) notes page with crop management recommendation notification based on crop age; (d) login page; (e) a pop-up panel containing a crop management key check.

Development of UAV-based remote sensing platform for rice R&D

NL Caballong, ER Tiongco, JG Tallada, M Ramos and RF Barroga

Unmanned Aerial Vehicles (UAVs) are lightweight aircrafts that can carry different kinds of sensing payloads. These sensing devices can be programmed to gather data and images from above while the UAV flies over rice fields. Then, the data and images collected will be processed using dedicated software into different forms of digital maps. They present a whole new way of looking at a phenomenon. This system is very helpful for researchers in gathering and monitoring precise data for a wide range of experiment setups, community wide observations, and technology impact evaluation among others. The objectives of this study are: (1) to establish the FutureRice UAV service; and (2) to use UAV technology in rice nutrient and pest management.

Activities:

- Three units of UAV arrived on December, 2015 – a quadcopter, a trainer plane, and a sensor-carrier fixed-wing aircraft.
- Trials were conducted using the DJI Phantom 3 Professional quadcopter with built-in RGB camera for different applications. DroneDeploy App was used to set the waypoints of the aircraft flight while DroneDeploy Cloud Processing was used for generating map outputs. Quantum GIS application was used for processing vegetation index.
- The Civil Aviation Authority of the Philippines (CAAP) provides guidelines on legal operation of UAVs whether for hobby, commercial, or research purposes. FutureRice applied for licenses and authorizations.

Results:

- The DJI Phantom 3 Professional quadcopter was tested for the following methods: photography and videography; field mapping and photogrammetry; and image processing for vegetation indexes. Photography and videography are its basic functionality. The attached camera provided researchers with high resolution top view angle shots of their experiment plots. Field mapping was applied mainly for site development planning of FutureRice farm. Through photogrammetry, measurements such as area and distance were rapidly conveyed. Moreover, the maps generated were post-processed to provide raster images of vegetation index. There different image processing algorithm to get the numerical value of the greenness of the crop canopy. Normalized Green Red Difference Index (NGRDI) was used in the technology trial (M.M. Saberioon, et.al. (October 2014). Assessment of rice leaf chlorophyll content using visible bands at different growth stages at both the leaf and canopy scale. International Journal of Applied Earth Observation and Geoinformation Volume 32, 35–45).
- FutureRice is on the process of consolidating requirements of CAAP on UAV licenses. These include certificate of training for UAV pilots, comprehensive insurance of the UAV aircrafts, and proof of safety standards of the organization among others.

Figure 7. Drone-based aerial imagery applications using DJI Phantom 3 Professional quadcopter: (1) Aerial photography and videography; (2) Photogrammetry; (3) Time lapse monitoring; (4) Location mapping; (5) Visual aide; and (6) Vegetation index calculation.

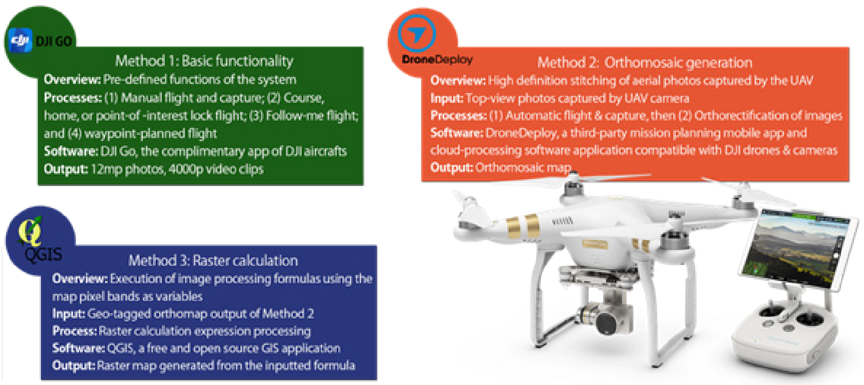

Figure 8. The methods tested using the ready-to-fly quadcopter DJI Phantom 3 Professional.

Setting up the ICT backbone of FutureRice Farm
NL Caballong, VJA Taylan, DG Cargamento and RT Apuada

ICT has become essential among businesses nowadays. FutureRice Farm as an agritourism site will not only showcase ICT's applicability in agriculture but will also utilize ICT to support its operations. This study will lay down a local area network (LAN) to be able to connect different ICT components on the farm – CCTV cameras, computer terminals for RCM and MOET App services, WiFi connectivity, personnel workstation, as well as farm automation prototypes. A website of the farm will also be created. The online portal will feature information about the farm and the program, the technologies being showcased, and a visit reservation page.

Activities:

- Specification and procurement of materials for LAN.
- Installation of CCTV system.
- Development of FutureRice website.

Results:

- FutureRice farm is located more than a kilometer from the main campus. A point-to-point antenna was installed at the farm that connects to another antenna at the main building. This set up links the components in the farm to the internet and network service managed by the Information Systems Division (ISD). One of the components now working and being managed is the CCTV surveillance system. The E-center which will cater RCM and MOET App services will soon be connected to the PhilRice system.

Development of Advanced ICTs for Agriculture
JG Tallada, NL Caballong, PJS Quierra, MJPS Ancheta and PAA Alday

Wireless sensor network consists of a mesh network of sensors, microcontrollers, transducers and actuators that collect, transmit, process, and control data. The mesh is deployed in a field to automate monitoring and control of relevant parameters. For example, a crop farm can have weather monitoring, irrigation control and pest and disease monitoring so that yields are maximized and the risks of adverse weather such as drought or excess water are minimized. There is a need to acquire and demonstrate this technology especially to enhance the adaptive capacity of future farms to climate change impacts. Two system prototypes will be the output of this study – (1) wireless sensing network that collects environmental parameters, and (2) wireless sensing and actuator network for an automated watering system implementation.

Activities:

- Specification and procurement of materials for the wireless sensing network.
- Hardware assembly, firmware programming, and testing of three sensing nodes platform. Temperature and humidity sensors were installed as initial environment parameters.

Results:

- Two wireless sensor node and the sink node prototypes were assembled and programmed. The wireless sensor nodes autonomously collect environmental temperature and relative humidity. Data are transmitted to the sink node first before being organized at the data server. Additional environment parameters such as soil moisture and solar radiation will be added in the future. The main backbone of the system is based on the ZigBee technology. ZigBee is an established protocol that defines system components, data transmission methods and error control. Its network self-healing capability allow automated reconfiguration of the network whenever a new node is added or removed to achieve maximum system availability. Solar panel system modules provide power to the independent nodes. The prototypes were built using an open source electronic platform.

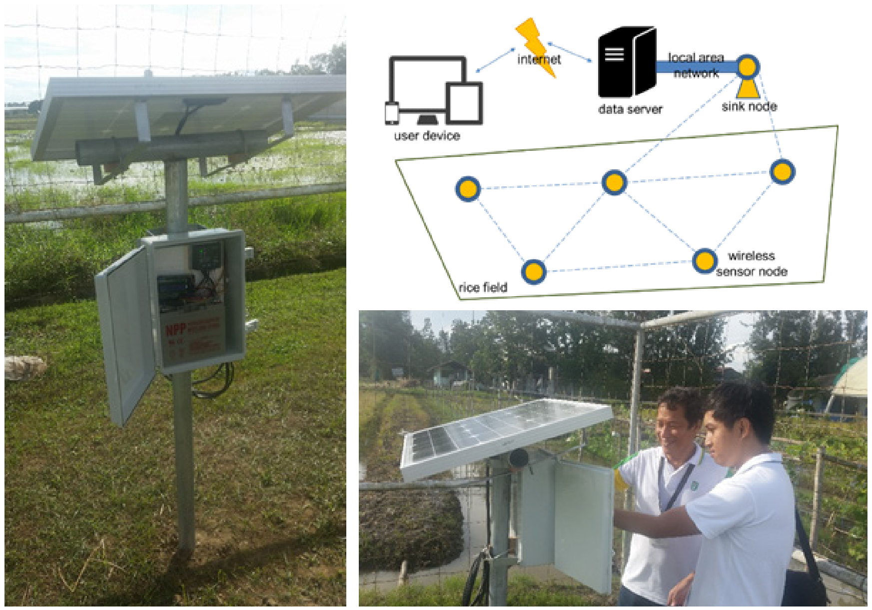

Figure 9. (a) A wireless sensing node prototype being tested at the field; (b) the implementation plan diagram of the wireless sensing network system; and (c) Dr. Jasper G. Tallada (left) and Peter John S. Quierra (right) updating the firmware of the sink node.

Deployment and Promotion of ICT for Agriculture
NL Caballong, RF Barroga and VJA Taylan

New forms and models of ICT services for farmers and other agriculture stakeholders are being developed by different government agencies including PhilRice. Some of them include the Rice Crop Manager, and the Philippine Rice Information System (PRISM) which were funded by Department of Agriculture in collaboration with International Rice Research Institute. Another one is the MOET (Minus One Element Technique) App which complements the soil fertilizer recommendation testing method of the same name developed by PhilRice and University of the Philippines-Los Baños. There is a great need to intensify promotion of these services to the target agriculture stakeholders. Thus, an E-center will be established at FutureRice farm for this purpose.

Meanwhile, although it is important to focus in deploying ICT services for farmers of today and the future, it is equally important to equip the ICT innovators that will support them. Another target audience of this study is the ICT community. Sharing technological and economic opportunities to them will open up perspective to venture in businesses that provides ICT-innovations for agriculture. Hence, conferences and competitions as well as thesis or project assistance will be handled under this study.

Activities:

- FutureRice is customizing a microbus which will be used for campaign caravans especially in rural areas. It will be tapped with a wireless network infrastructure and servers which will enable remote processing of RCM recommendation. It will also carry UAVs for low altitude remote sensing services.

- AgRiHackathon, a yearly event hosted by PhilRice that calls on to the university students to develop innovative ICT products and services for farmers and agriculture stakeholders, was planned.

Results:

- AgRiHackathon Symposium was conducted on November 15, 2016. A total of 168 students and teachers of IT related courses attended the event. Four state universities joined the event – Central Luzon State University, Pampanga State Agricultural State University, and Nueva Ecija University of Science and Technology. Delegates from College for Research and Technology San Jose City, a private school was also present during the event. The main objective is to inspire them become ICT-agrinovators. It intends to inform them about the trends in agriculture and encourage them to consider venturing in providing innovative ICT services for farmers when they graduate by building startup companies. Thus, two keynote speakers were invited. Dr. Jasper G. Tallada, one of PhilRice's senior researchers talked about the direction of agriculture and some technical opportunities for growth. Engr. Franch Maverick Lorilla, a young techno-entrepreneur from Davao City shared his experiences in making their way into the digital startup culture. In the afternoon, six ICT tools for rice knowledge topics were presented to the audience.

Figure 10. (a) Dr. Flordeliza H. Bordey delivering her welcome message; (b) 168 students and teachers from 4 SUCs and 1 private college; (c) the Agri-Hackathon working committee; (d) Engr. Franch Maverick Lorilla sharing the journey of the company he co-founded, Cloudfarm Innovations in Davao; and (e) Dr. Jasper G. Tallada talking about the future opportunities of ICT in the agriculture sector.

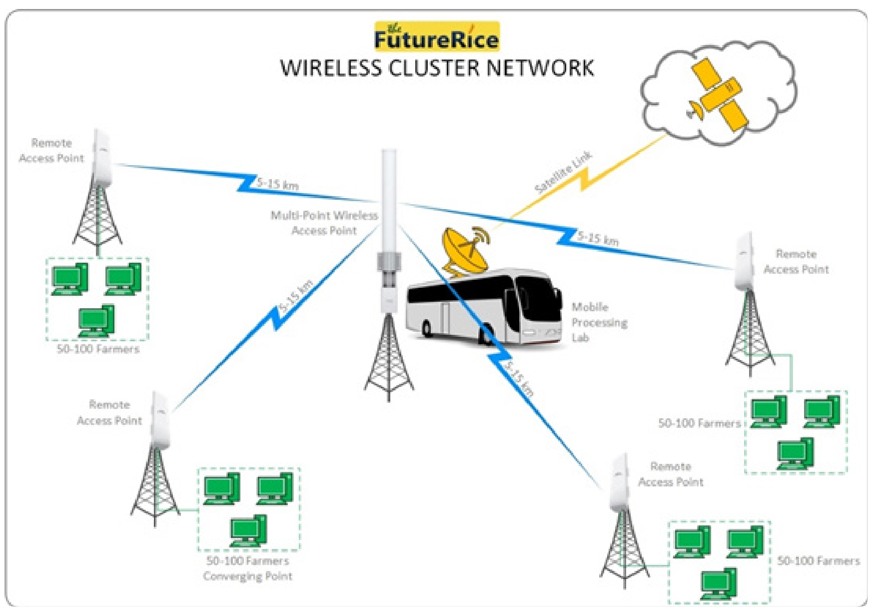

Figure 11. The mobile wireless cluster network plan for the FutureRice Bus to be used for different mobile and remote services such as Rice Crop Management processing, and field mapping.

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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