PHILRICE®

A quarterly publication of the Philippine Rice Research Institute

MAGAZINE

Creating a farm of abundance

ABOUT THE COVER

Before farmers harvest tons of produce, the crop starts with a little thing- the seed. The seed passes through a tedious process before it reaches the feld and the plate. This issue will try to enlighten you on how varieties are bred, eventually used as seeds, and adopted by farmers. It will also help farmers decide on which varieties to plant and encourage them to use high-quality seeds.

VOLUME 27 NO. III
JUL-SEPT 2014

Contents

Editor's Note

There was lukewarm response on the news article we put up online on the Philippines as Asia's fastest-growing rice producer.

News

Features

The life of a plant breeder is flled with daily semantics and pragmatism. Challenged by tedious processes, scorched by natural and artifcial heat, teemed with solitary moments in the laboratory .

Like a voter, a variety has an identity, too. It possesses certain characteristics that make it unique from other rice cultivars. And like politicians, some rices perform better than the others.

Kuru-Saka

Managing Editors: Charisma Love B. Gado • Mervalyn O. Tomas • **Contributors:** Andrei B. Lanuza • Ashlee P. Canilang • Charisma Love B. Gado • Christina A. Frediles • Jayson C. Berto • Joybeth N. Lisondra • Jungie Q. Amacanin • Mary Grace M. Nidoy • Mervalyn O. Tomas • Marlon M. Prado • Myriam G. Layaoen • Samantha M. Hautea • **Design, Layout, and Cover:** Carlo G. Dacumos • **Illustration:** Andrei B. Lanuza • **Circulation:** Ashlee P. Canilang • **Administrative Support:** Michael S. Reyes • **Consulting Editor:** Constante T. Briones • **Editorial Advisers:** Eufemio T. Rasco Jr. • Jaime A. Manalo IV

Editor's NOTE

VOLUME 27 NO. III
JUL-SEPT 2014

Obsessed with rice seeds

There was lukewarm response on the news article we put up online on the Philippines as Asia's fastest-growing rice producer where we cited data from the World Market and Trade of the US Department of Agriculture (see related story on page 3).

There was, on the other hand, deafening noise on the PDAF scam and Kris Aquino having a new hair style.

This is not to say that the last two issues are not newsworthy. They are. They actually sell like pancakes. PH's achievement as Asia's fastest-growing rice producer, however, is far more important especially if one were to think of feeding the poor, the rich, and the middle class of this country.

The achievement is one defning moment for PH rice agriculture. It is something that is largely achieved by having the right technologies, which are products of years of research. Among these technologies are high-quality seeds. Never mind if rice is at times vainly called "poor man's crop."

The Pinoy Rice Knowledge Bank cites that in the 1970s, rice yields were low with national production at only 5.32 million tons. Adaptability to different ecosystems was poor. Some 40 years later, the country enjoys remarkable rice yield, up to 16.82 million tons in 2008. We have rices that are adaptable to all ecosystems known in the country.

At present, the country has over 200 rice varieties; more choices for the Filipino farmers, improved chances of getting higher rice yields.

Additionally, our inbreds now are better-performing than decades ago. Their yields are not far inferior to the hybrids'. Data from the National Seed Industry Council indicate that many inbreds can yield more than 10 t/ha; NSIC Rc302 (10.9 t/ha), for instance. Highest yield for a public hybrid is 11.7 t/ha, Mestiso 20.

These did not happen in an instant. They are products of tedious years of research using biotechnology or conventional means. Scientists, researchers, and feld laborers have matured with the varieties they are developing.

In this issue of the PhilRice Magazine, we invite you to take this journey with our rice breeders. We will show you the science, the hardwork, and the meticulous process of producing rice. Leaf through the pages and peek on the work we do in producing the next big thing in the Philippine rice felds.

VOLUME 27 NO. III
JUL-SEPT 2014

News

PhilRice studies win in scientific convention

A study on providing timely and accurate information on rice production bested eight finalists under the downstream research category during the Crop Science Society of the Philippines Scientific Convention in Cebu City on May 12-16.

Titled *Rice Area Mapping and Yield Estimation for Crop Insurance in Leyte Province*, the study, authored by PhilRice's Mary Rose Mabalay, Eduardo Jimmy Quilang, and researchers from IRRI, Deutsche Gesellschaf fur Internationale Zusammenarbeit, and sarmap, had produced remote sensing-based information on rice area, production, yield estimates, and production losses.

Using remote sensing imagery to generate reliable rice area maps, the study aims to address food security and minimize losses during calamities.

"A rice extent map is also generated to provide a national-level baseline of the physical rice area," Mabalay said.

She explained that the actual rice area is then generated using high-resolution (3m) COSMO-SkyMed images acquired approximately every 16 days from June to October 2012 in Leyte. This provides a detailed rice area map for the season, start of season, and the crop status on a bi-monthly basis.

The European, Italian Space Agency/e-GEOS, Infoterra GmbH, and the US Geological Survey provided the ENVISAT ASAR and Cosmo-SkyMed data.

Together with co-researchers under the Remote sensing-based information and insurance for crops in emerging economies (RIICE) project, Mabalay estimated rice yield per barangay and municipality using a crop growth simulation model with input data from Synthetic Aperture Radar imagery, weather stations, soil maps, and field works. The yield estimates are then assessed by RIICE partners to develop a yield index.

A rice extent map generated using remote sensing imagery to provide a national-level baseline of the physical rice area.

The project is a joint effort of PhilRice, IRRI, Deutsche Gesellschaf fur Internationale Zusammenarbeit (GIZ), and sarmap, and is funded by the Swiss Development Cooperation.

Meanwhile, PhilRice's Jayvee Cruz and UPLB researchers' paper, titled *Enhancement of Growth and Yield of Upland Rice (Oryza sativa L.) by Actinomycetes,* won as Best Paper in the upstream category.

She found that a group of bacteria called actinomycetes has the potential to promote upland rice growth and grain yield increase.

The isolates were coded as NB1, AVermi3, AVermi7, and NB3. The selected actinomycetes were inoculated to the rhizosphere (soil surrounding the roots) of the rice roots. The researchers observed that they colonized the roots of upland rice, which resulted in root dry weight increase. Actinomycete NB3 isolate population in the rhizosphere increased 100-fold.

NB3 and AVermi7 increased grain yield by 62% and 48%, respectively, compared to the uninoculated treatment.

Another PhilRice research won Best Paper award under the Technology Extension and Education category in the same convention.

The paper on increasing productivity and climate change resiliency discussed the results of disseminating information on climate change adaptation measures to farmers in Aurora province.

Dr. Aurora Corales, one of the researchers, said that adaptation practices such as pest and water management and diversified farming were disseminated to help farmers lessen the damage caused by pests and diseases.

Three consecutive seasons (2012 WS, 2013 DS and WS) of guiding farmers led them to adopting synchronous planting. Aurora farms are continuous habitats for pests and diseases owing to the tillers' practice of planting anytime they want.

The 2011 average yield increased to 3.92 t/ha in 2012 and 4.94 t/ha in 2013.

- MERVALYN O. TOMAS

Rice researchers are regional Gawad Saka awardees

Dr. Manuel Jose C. Regalado, scientist I and acting deputy executive director for research (DED-R) of PhilRice is the DA's 2014 *Gawad Saka* Outstanding Agricultural Scientist for Central Luzon.

Regalado was selected for his commendable and high-impact research in agricultural engineering. *Gawad Saka* Award is an annual search for outstanding achievers in agriculture and fisheries.

Conferred Scientist I in 2009, Regalado has done research studies and projects on renewable energy, farm machine development, and wind-pump system during his now more than 25 years of work at PhilRice.

He has co-developed the bio-ethanol fuel injector for spark-ignition engines, nypa hydrous bio-ethanol fermentation and distillation plant, and the rice hull gasifier stove.

The stove, one of PhilRice's major accomplishments in 2013, was developed as a cheaper alternative to LPG-fueled stoves. It is also environment-friendly as it makes use of farm biomass.

Regalado said that the Kalinga-Apayao State College in Tabuk City, Kalinga, licensed to commercialize the stove, had already sold 26 units. Moreover, 30 units are being manufactured for delivery to a cooperative in Samar.

He also co-developed the no-tillage and reduced tillage systems, laboy tiller, rice hull gasifier for mechanical drying and electric power generation, rotary reaper, panicle thresher, multi-crop four mill, and the Maligaya fatbed dryer.

The laboy tiller, Regalado`s machine for the deep muddy farm environment, was found to be efficient in reducing labor and fuel costs, and helps produce 1-ton yield increase in rice.

Meanwhile, Dr. Mary Ann U. Baradi, supervising science research specialist in PhilRice Batac, also received the regional Gawad Saka outstanding agricultural researcher award in Region I.

She co-authored the paper titled, *Simulation of Paddy Drying in a Low-Cost In-Bin Dryer*, published in the Advanced Crop Science journal. The study used a mathematical model based on heat and mass transfer modeling.

Baradi's study on *Aroma Loss in Rice as Affected by Various Conditions during Postharvest Operations*, investigated

REGALADO

BARADI

the effects of conditions during drying, storage, and milling on the aroma level and concentrations of the principal aroma compound 2-acetyl-1-pyrroline (2AP) of the fragrant rice Maligaya Special 6 (MS 6). - JUNGIE Q. AMACANIN AND MERVALYN O. TOMAS

PH: Asia's fastest-growing rice producer

The Philippines achieved 97% rice self-sufficiency in 2013, and its 4.04% average change improvement in milled rice production from 2010 to 2013 is now Asia's highest.

Data from the US Department of Agriculture show that from 9.77 million metric tons (Mmt) of milled rice recorded in 2011, Philippine production grew to 10.99 Mmt in 2013.

China (1.55%) and India (3.77%) have lower figures. Thailand, a leading rice exporter, only posted a 0.39% change difference in milled rice production. Bangladesh posted a 0.25-change difference in imports from 2012 to 2013, while China registered 0.10 difference.

Relating the world rice production data to regional rice industry integration in Asia, top analysts advise that "increasing private sector efforts in integrating increasingly ASEAN-wide modern farming and modern economic activities along agri-food supply chains and international trading networks could and should be harnessed and leveraged to complement and supplement on-going government efforts."

Meanwhile, PhilRice and IRRI recently renewed for five years their agreement on rice R&D collaboration.

They will share information on their local researches and provide intensive training among collaborators.

In a forum in the Science City of Muñoz, Agriculture Secretary Proceso J. Alcala assured farmers and the public that his department will "work harder so that the rice that we'll serve on our tables will be planted and harvested in the country."- CHARISMA LOVE B. GADO

VOLUME 27 NO. III
JUL-SEPT 2014

News

Agri-engineers recognized in convention

PhilRice won major awards in the 64th Philippine Society of Agricultural Engineers (PSAE) Annual National Convention and 11th International Agricultural Engineering Conference and Exhibition held at the Visayas State University, Baybay City, Leyte, April 21-26.

Five of nine PhilRice technical papers that joined the oral presentation category won awards. Alexis Belonio and co-authors` *Development of a Hydrous Ethanol Fuel Feeding Device for Spark – Ignition Engine* won as Best Paper in the Agricultural Power and Energy Source Category.

Belonio`s study established that hydrous ethanol can fuel spark-ignition engines without blending gasoline. This was conducted to develop a technology for hydrous bioethanol as a cheaper source of fuel opposed to gasoline.

Paulino Ramos and Dr. Manuel Jose Regalado`s *No-Tillage System for Higher Yield and Labor Productivity, Reduced Production Cost, and Higher Energy Efficiency in Rainfed Lowland Rice* won Second Best Paper in the Production Machinery and Mechanization Category. This tested the performance of the no-tillage technique originally developed for irrigated ecosystem under rainfed conditions.

Dr. Caesar Jovent no Tado and co-authors' *Development and Promotion of the Reversible Airflow Flatbed Dryer in the Philippines* (Postharvest Equipment and Machinery Category) won as Third Best Paper.

Another paper that won Third Best Paper is Dr. Ricardo Orge and John Eric Abon's *Cogeneration of Biochar and Heat from Rice Hull: Its Application in the Poultry Industry* (Agricultural Power and Energy Sources Category).

The study showed that CtRH carbonizer, with heat recovery attachment, can substitute the existing LPG heater to provide the needed heat for brooding chicks, saving up to six tanks of LPG for every heater replaced.

Noel Ganotsi, Moises Galera, and Mar Lester Quigao's *Design and Development of a Low-Cost Venturi-Type Fertigation Component of a Gravity-Type Drip Irrigation System* (Soil & Water and Fishery Engineering Category) won Third Best Paper Award.

This showed how "fertigation" helps reduce the cost of fertilizer application. Fertigation is to be incorporated in the Low-Cost Drip Irrigation System (LDIS).

In the poster competition, 3 of 15 PhilRice entries were runners-up. Paulino Ramos and co-authors` *Rice Hull Gasification System for 100-kW Electric Power Generation*, showed that rice hull could be used as fuel for gasifier to produce electricity.

Results had it that 25 bags of rice hull at 10-12 kg per bag can run the 8-cylinder gasoline engine with 100-kW generator for 2.22 hours. The 100-kW electricity is enough to power a 30-kW submersible pump, while excess production may be used for lighting.

Alexis Belonio and co-authors' *Design and Performance Evaluation of a Rice Husk-Fueled Crude Bioethanol Distiller for Fermented Nipa Sap* supports efforts to reduce dependence on fossil fuel for rice farming operations.

Regalado and Ramos' No-tillage poster showed that the system combined with transplanting can also improve labor productivity by 12-17% and energy efficiency by 15-18% in rainfed lowland rice.

PhilRice consultant Dr. Bernardo Tadeo received the Most Outstanding Agricultural Engineer or Felix Maramba Award, and Noel Ganotsi garnered the Outstanding Agricultural Engineer Award for Irrigation, Soil, and Water Management.

- JOYBETH N. LISONDRA

Foundation seeds, El Niño-ready varieties available

PhilRice now sells foundation seeds (FS) only to seed growers endorsed by Directors of DA's Regional Field Offices. This started in May 2014, after the Department of Agriculture issued an advisory rationalizing the distribution or sale of FS.

"This is to ensure that FS are well-distributed in the entire country, even in far-flung areas," Rodjason Cruz of PhilRice said.

DA-RFO directors identify seed growers who qualify to buy FS. The quantity will depend on the land area they use for seed production. Endorsements indicate the amount of seeds to be sold to particular seed growers.

PhilRice also sells El Niño-ready seeds as the institute encourages farmers to plant early-maturing and drought-tolerant rice varieties.

The phenomenon is expected to hit the country within October 2014 through March 2015, based on a recent advisory from the Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA).

PAGASA predicted changes in the normal rainfall pattern generally resulting in varying dryness in most parts of the country. To maximize use of rainfall, PhilRice recommends the use of early-maturing varieties this 2014 wet season.

For irrigated lowland, PSB Rc10 (*Pagsanjan*) is highly recommended. Farmers may also plant NSIC Rc134 (*Tubigan 4*) and Rc160 (*Tubigan 14*).

For rainfed lowland: NSIC Rc192 (*Sahod Ulan 1*); PSB Rc14 (*Rio Grande*); and PSB Rc68 (*Sacobia*). These are drought-tolerant, preferable in areas where El Niño is expected to hit worst.

Based on PAGASA's El Niño vulnerability map for rice, Cagayan, Isabela, Nueva Ecija, Tarlac, Pangasinan, Camarines Sur, Iloilo, Negros Occidental, Bohol, Leyte, and some areas in Mindanao must be prepared.

These drought-tolerant varieties for rainfed lowland are being promoted through the participatory varietal selection (PVS).

NSIC Rc272 (*Sahod Ulan 2*), Rc274 (*Sahod Ulan 3*), Rc276 (*Sahod Ulan 4*), Rc278 (*Sahod Ulan 5*), Rc280 (*Sahod Ulan 6*), Rc282 (*Sahod Ulan 7*), Rc284 (*Sahod Ulan 8*), Rc286 (*Sahod Ulan 9*), Rc288 (*Sahod Ulan 10*), Rc346 (*Sahod Ulan 11*), and Rc348 (*Sahod Ulan 12*). Some of them are early-maturing and have a maximum yield potential of up to 6.7t/ha.

For the upland environment, recommended varieties are PSB Rc80 (*Pasig*), PSB Rc9 (*Apo*), and NSIC Rc23 (*Kathan 1*).

"PhilRice helps mitigate the negative impacts of this extreme climate event on the livelihood of our farmers," Executive Director Eufemio T. Rasco Jr. said.

Seeds of some of the varieties enumerated are available at PhilRice. For more information, please text 0920-911-1398.- MERVALYN O. TOMAS & JUNGIE Q. AMACANIN

Rasco lauds Isabela farmers

Dr. Eufemio T. Rasco Jr, executive director of PhilRice, on May 12 cited farmers in San Mateo, Isabela during the 6th *Balatong Festival* for being resourceful and open-minded.

"Many farmers in the country are yet to adopt the intensified rice-based farming system and crop diversification, which we promote at PhilRice. Here, you amaze me with your productive farm practices and willingness to produce crops other than rice," Rasco said in Filipino.

San Mateo, known as the country's mungbean capital, can generate P350 million income from the 7, 500 ha planted to mungbean in a year. This is equivalent to a farmer's daily income of P500.

"Indeed, San Mateo farmers are model-modern farmers. Your success in planting mungbean after rice shows that farmers can be competitive in the looming ASEAN trade liberalization," he said.

Emphasizing on the benefits of the rice-*munggo* cropping pattern, Rasco said that the carbonized rice hull (CRH) can help increase water productivity and yield of mungbean, particularly in sandy or heavy soil.

Planting *munggo* after rice also restores the natural fertility of the soil as the crop's root system is filled with nitrogen-fixing bacteria, which is useful in rice farming.

Rasco further urged farmers to boost their knowledge in farming through the internet or listening to the *Madiskarteng Pagsasaka* radio program of PhilRice Isabela every Wednesday, 5:00-5:30 am at DWSI Sonshine Radio 864khz and DWPE *Radyo ng Bayan*. - CHARISMA LOVE B. GADO

"I get satisfaction from my work when I see the farmers use the varieties that we developed."

-- NORVIE L. MANIGBAS --

One in the end

MARY GRACE M. NIDOY

The life of a plant breeder is filled with daily semantics and pragmatism. Challenged by tedious processes, scorched by natural and artificial heat, teemed with solitary moments in the laboratory and fueled by patience and persistence – and that's on a regular day. All in the hopes that someday, farmers will be using the variety they developed for 10-12 years.

"It's like bearing a child until the farmers are ready to adopt and take care of him or her," Dr. Norvie L. Manigbas, PhilRice plant breeder, said.

Although he's been a plant breeder for 30 years, he recognizes the fact that the first plant breeders in the world were the farmers themselves. Jack R. Harlan, American botanist and agronomist, claimed that "since the first domestications of wild plant about 12,000 years ago, farmer plant breeders have been responsible for the development of thousands of crop varieties in hundreds of species."

Conceiving

Varieties are born after more or less a decade of study. The idea of having a new variety is conceived by setting up the breeding objective. In the case of Manigbas' current study, his team began in 2007 developing a variety that could adapt to high temperatures or the "heat-tolerant rice."

"We need to keep up with the ever-changing temperature of the environment. My former colleague at IRRI, Dr. Edilberto Redoña, former Deputy Executive Director for Research and Development of PhilRice, and I thought of developing a variety that could withstand heat up to 38-39°. In the literature, 35°C is already critical for rice but nowadays, the temperature gets as high as 37-39°C," Manigbas said. It is expected that rice yields will be reduced by rising temperature.

His team then identified donors or parents where the offspring would come from. Breeders call this process germplasm identification and evaluation. Through journal references and testing, they chose N22, Dular (heat-tolerant genotypes from India) and Nipponbare (Japan). And because these genotypes for potential parents are foreign germplasm, they had to request from the genebank of IRRI and sign the Material Transfer Agreement (MTA) that would allow them to use these genotypes for research.

Testing of parents or parental evaluation began by examining the parents in heat-stressed environments for two seasons. Finding out that the parents are heat-tolerant, they were crossed to different varieties.

Cross-combination methods

Cross-breeding happens when members of a population mate. Manigbas explained that they had to try different strategies and methods for heat tolerance using N22, Dular, and Nipponbare.

Single-cross is a combination of parents A&B. The first filial (family) generation is called F_1. When the F_1 of parents A&B is crossed with the F_1 of parents C&D, the method is called double-cross.

They also used Single Seed Descent (SSD) method through the Rapid Generation Advance Facility at PhilRice where they can obtain four generations in a year compared with only two under field conditions.

He said, "This is very efficient because it saves time, labor, and resources."

The team also used the backcross method where the F_1 is repeatedly crossed to the recurrent parent (a variety that only lacks heat tolerance trait).

He said, "We used the backcross method in NSIC Rc222 (high-yielding) and other varieties with N22 and Dular (heat-tolerant) using Marker-Assisted Selection or MAS (use of DNA markers to improve response to selection in population) to identify the tolerant types. The tolerant types found in the F_1 progeny are backcrossed to the recurrent parent NSIC Rc222 or other varieties until BC_4 (backcross four) where approximately 96% of the tolerant type of N22 is recovered or transferred."

Nursery stage

Plant breeding for Manigbas is 90% selection.

"When you plant the F_1, let's say you have 25 seeds, in a field nursery, you will have at least 25 individual plants ready for harvest. The harvested seeds will comprise the F_2 population. The second generation or F_2 will give you different or segregating plant types – tall, short, intermediate, or probably heat-tolerant and intolerant. In our study we evaluate about 2,000 plants in one cross," he said.

When the plants have reached the flowering stage, they select from the 2,000 plants the ones that are highly fertile. Using visual selection, they consider the following criteria: resistance to major pests and diseases (breeding nurseries are unprotected), semi-dwarf or intermediate height, erect leaves, long flag leaf, more productive tillers, more spikelets per panicle, length of the panicle, without awn, and desirable plant type.

He explained, "From the 2,000 plants, we select about 10% from the population. The 200 selected plants in the F_2 are planted as individual plants in a row with 25 hills in each row in the F_3. From these, we select the best three individual plants in a row and plant again in the next generation until we get uniform lines in the succeeding generations. The process of planting and selection for every generation repeats itself. We call it pedigree method where we record the performance of the breeding lines."

The process is repeated until the breeder gets the elite and advanced line. "Currently, we have representatives of every generation in the field and it took us three and a half years to reach the F_8 stage and generate uniform lines (one generation is equivalent to a season)," Manigbas said.

Field tests

"Next season, the F_8 breeding lines will be subjected to Preliminary Yield Test (PYT). The data will be analyzed to select the high-yielding lines from the heat-tolerant types. The promising lines will be planted into bigger plots for Observational Yield Trial (OYT) or Replicated Yield Trial (RYT)," he said.

The promising line will then be advanced to multi-environment tests (MET) or directly to the National Cooperative Tests (NCT) in high temperature-prone areas using the standard protocol for evaluation. When the line passes the standard criteria for heat tolerance, yield, grain quality parameters, and pest and disease resistance, it is nominated for release as a new variety.

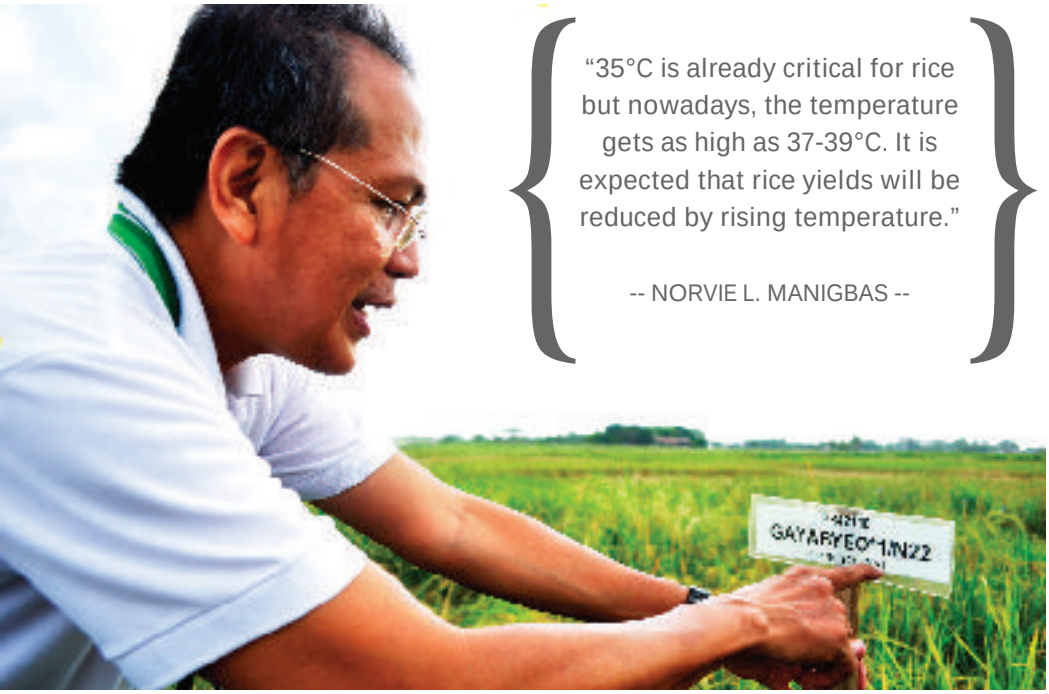
Manigbas targets the promising line to be released as a new heat-tolerant rice variety in 2016-2017.

In sum

When asked what the most challenging work is for a plant breeder, he quipped, "the whole process itself."

"I get satisfaction from my work when I see the farmers use the varieties that we developed," he said.

Much has been said about the arduous process of rice breeding. But to Manigbas and the rest of his team, the process sums up to this: "From thousands of plants, you only get one in the end."



> "35°C is already critical for rice but nowadays, the temperature gets as high as 37-39°C. It is expected that rice yields will be reduced by rising temperature."
>
> -- NORVIE L. MANIGBAS --

Not geek words

It does not take a geek to understand the terms that plant breeders mince. We may have heard of them while we were still children. But yes, as the old joke goes, we may have been sleeping in class. Let's review them then:

Allele

- variant of a gene where the DNA sequence differs between two or more variants.

Backcross

– crossing an individual with one of its parents or with the genetically equivalent organism. The offspring is called backcross generation or progeny.

Chromosome

– a single DNA molecule associated with specific proteins.

F_1

– abbreviation for filial generation or the first hybrid generation resulting from a cross between two parents.

Gene

– heritable unit of phenotypic variation; a sequence of DNA encoding a functional product.

Genome

– the complete set of genetic information of an organism encoded in its DNA.

Germplasm

– an individual, group of individuals, or a clone representing a genotype, variety, species, or culture, held in collection in its original place or elsewhere.

Hybridization

– selfing hybrids to separate large numbers of homozygous types (matching alleles controlling particular traits) with various proportions of genes contributed by the parents.

Pureline Selection

– process of selecting a large number of single plants, comparing their progenies, and saving the most valuable progeny/ies as a new variety/ies.

Phenotype

- all observable characteristics and traits of an organism; the result of the organism's genetic composition, and environmental influences.

Population

– a defined group of interbreeding organisms.

Mass selection

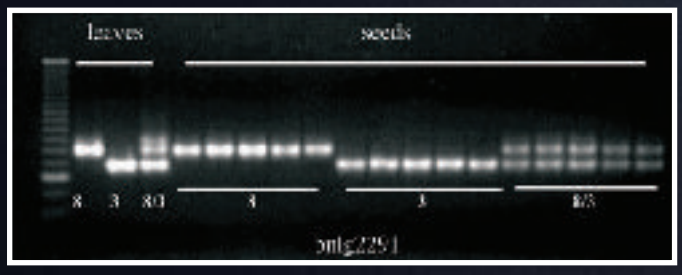
– a number of plants selected to make a new variety.

Marker-assisted selection (MAS)

– the use of DNA markers to improve response to selection in a population. The markers will be closely linked to one or more target loci, which may often be quantitative trait loci.

Molecular/DNA Markers

– DNA sequences that have specific locations on a chromosome.



Of tools, minds, and hearts

It's just the rice, whether in the field or plate, that we see. Only few of us may know that it can take more than 10 years to develop the rice that makes us Filipinos. What's more, only a few of us are familiar with the tools used in breeding, including moisture meter, polymerase chain reaction machine, gel documentation system, pipette, and freeze dryer.

The tools may make breeding technological, but environmental conditions are also vital in breeding. The rices are tested in experimental fields for tolerance, yield, and pest resistance. The breeders are keen in monitoring their field performance as this is where the rice, which took them about four years to select, will either thrive or fail.

But the tools and experimental fields are only the medium. The senses and the heart are the core necessities in breeding. The breeder and farmers' intelligent eyes see the potential in rice; the sensitive tongue decides whether the consumers will prefer its texture; the ears to listen to feedback; and the heart discerns whether all the long years of breeding are worth it for the farmers' generations yet to come.

Polymerase chain reaction machine

allows the production of multiple copies (amplification) of a specific DNA sequence, provided that the base pair sequence of each end of the target is known.

Pipette

Widely used device for accurate dispensing of small volumes of liquids.

Moisture meter

used to measure the percentage of water in a given substance.

Gel documentation system

equipment widely used in molecular biology laboratories for the imaging and documentation of nucleic acid and protein suspended within polyacrylamide or agarose gels.

Freeze dryer

used to measure water content and to preserve samples, particularly seeds.

Breeding what farmers want

► ANDREI B. LANUZA

The process of varietal selection and breeding is long, and optimum variety performance is usually location-specifc. Typically, farmers will not be able to tell what varieties are available until they're approved, released commercially, promoted, and grown under their farming conditions. But what if farmers themselves would have a say on and are directly involved in deciding which varietal characteristics suit their needs and their community best? Through participatory varietal selection (PVS), farmers can!

What is PVS?

PVS is an approach used in choosing new rice varieties that involves and ofers rice farmers the chance to observe and choose varietal traits from many entries that closely match what they want or are appropriate in their location. Farmers partner with rice breeders in identifying desired traits. Aside from high yield, desirable traits are tolerance to specifc pests and diseases common in a certain location, ability of the variety to grow and fourish in distinct conditions, and market demand for aroma, texture, or grain length.

Farmers as partners, farmers as researchers

"Farmers can be involved by encouraging them to do PVS by showing them the benefts through actual farm testing of the rice genotypes or varieties. They become a research partner in variety utilization and improvement. They are taught how to take data and important observations in the feld, and informed about new technologies in rice farming. They manage their farm with many materials to plant and select the best genotypes. A researcher and farmer should be learning from each other, and

obtaining the best results," Dr. Norvie L. Manigbas, PhilRice breeder-scientist said.

In India, Bangladesh, and Nepal, PVS has also been used successfully in sorghum, wheat, corn, legumes, and other similar crops.

PVS works because many farmers prefer to grow varieties that they are very familiar with. This happens because they have experienced that the characteristics expected in some varieties, as breeding institutions intended, are not actually attained in their actual use. These

> "Farmers can be involved by encouraging them to do PVS by showing them the benefits through actual farm testing of the rice genotypes or varieties. They become research partners in variety utilization and improvement."
>
> -- NORVIE L. MANIGBAS --

happen because of certain environment interactions.

In 2008, PhilRice breeders and farmers evaluated direct wet-seeded rice lines and farmer-favored varieties to gauge their preferences.

Together they observed, showed, and selected the rices that best suited the needs of the farmers and the community.

Manigbas explained that the selection environment in research stations is always different from actual farms, which makes PVS an advantageous method in identifying new rice varieties adapted to particular locations. Through PVS, farmers can select traits that are important in their farms so that yield is maximized through their technology.

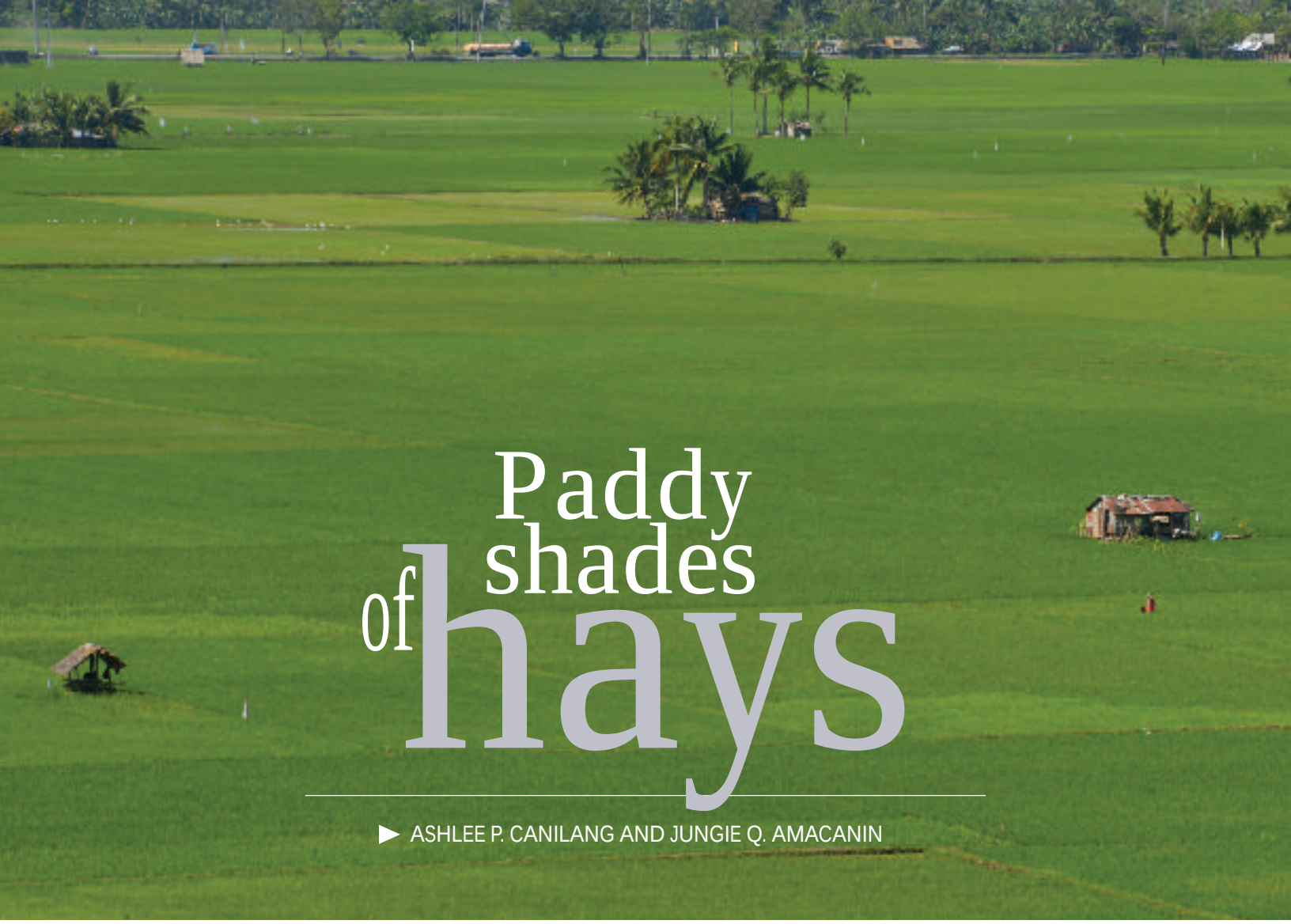
"On the other hand, when a new technology is introduced to farmers, it has to be proven that it works," he said.

Added benefits

PVS activities also create other benefits for farmers. New varieties become more accessible for them and yield performance in a specific farm area is maximized using farmer technologies. Their capacity to maintain and purify varieties that they prefer to plant in succeeding cropping seasons is also built.

Likewise, the community is made aware of seed banking and of preserving seeds that yield high.

As PVS helps empower rice farmers, it may also facilitate the promotion and dissemination of technologies to neighboring farms.



Paddy shades of hays

► ASHLEE P. CANILANG AND JUNGIE Q. AMACANIN

Out of curiosity, Alfonso Reginio of Salvacion, Carmen, Davao del Norte planted hybrid rice on his 30-hectare farm in 2004. An attempt, which the 62-year-old farmer did not regret, as he is now averaging 7.2 t/ha and earning an average of P40,000 net income a hectare.

In a study of PhilRice's Socioeconomics Division (SED), hybrid rice farmers like Reginio considered themselves better providers than inbred rice farmers owing to significant increase in income. They have also acquired more assets after continuous planting of hybrid rice than the non-hybrid farmers.

Commercialization of hybrid rice was revitalized in 2001 to meet the increasing demand for rice and ensure its sustainability in the future. Across the country, technology demonstration farms and adaptability trials were established to test the profitability of hybrid seeds. Dr. Manuel Gaspar, former National Hybrid Rice Seed Coordinator of PhilRice, and his team found in 2007 that earlier on-farm hybrid experiments had a yield advantage of at least 15% over inbred varieties.

Drawing the line

Normally, rice plants are self-pollinating. One rice plant has both male and female organs, allowing it to reproduce on its own through the process called self-pollination or inbreeding.

A different process happens in hybrid rice. Two rice plants with superior qualities are planted side by side and allowed to cross-pollinate by natural or artificial means to produce the seeds. The seed will express the superior characteristics of both parents resulting in a very good trait called "seedling vigor."

This is mainly the reason why hybrid rice yields higher than inbred.

In Nueva Ecija, 2013 SED data show that the average hybrid yield is 8 t/ha, while only 4.6 t/ha and 6 t/ha are harvested by farmers using ordinary inbred and high-quality inbred rices, respectively.

While hybrids yield more than inbreds, they also have their limitations. Unlike inbreds, hybrid rice, just like other hybrid crops, cannot be planted over and over again as hybrid vigor is lost in the process; resulting in lower yield and non-uniform crop stand and maturity.

Hybrids are also more expensive than inbred seeds because of the high cost of seed production inputs. Hybrid seeds are priced from P 195/kg to P500/kg while inbreds only cost P 34/kg to PhP 80/kg.

Tinges from farmers' hands

Even in his early seasons of hybrid seed adoption, Reginio already noted an increase of more than a ton per hectare over his usual inbred harvest.

But not all farmers in the province were convinced. Dario Ibanez, 54, of Tagum City, discontinued his use of hybrid rice owing to insufficient water. Believing that the variety is not suited in his rainfed farm, the idea of using hybrid rice seeds did not again cross his mind.

Ibanez, who owns a 10-ha ricefield, also said that the maintenance of hybrid rice is quite expensive in contrast with inbred. His harvest averaged 5 t/ha, with more than P50,000 operating expenses and a net income of only P12,000/ha from hybrid.

Other than water supply and cost, many farmers also considered farm management of hybrid rice as tedious. In a 2005 SED survey, farmers were discouraged to plant hybrid because of additional labor requirements. Hybrid rice farmers, however, explained that except for seedbed preparation and seedling management, crop management for hybrid and inbred rices is the same.

Despite the predicaments of some farmers, cost-benefit analysis in January-June 2013 showed that Nueva Ecija hybrid rice farmers have an average income of P47,320/ha; only P25,588/ha and P13,372/ha for users of high-quality and ordinary inbred rices, respectively.

Kaleidoscope

For farmers unsure of hybrid rice, Dr. Norvie Manigbas, PhilRice scientist, said that the inbreds, particularly the Tubigan varieties, have a maximum yield potential of 10.6 t/ha, which is comparable with hybrid yields.

Some farmers prefer to plant hybrid during dry season because it is susceptible to diseases during the wet season. However, PhilRice's Mestiso 29 hybrid averages 7 t/ha in both seasons. It has a maximum yield potential of 11 t/ha, 113 maturity days, and resistance to stem borers, brown planthoppers, and green leafhoppers.

Hybrid may be advantageous over inbred, but there is no magic, one-variety-fits-all, in rice production. Only farmers can determine their fate by choosing the best technology suited for them and their respective farming ecosystems.


MESTISO 29

"Mestiso 29, PhilRice's hybrid, demonstrated high yields in dry and wet seasons with an average yield of 7 t/ha. It has a maximum yield potential of 11 t/ha, 113 maturity days, and exhibited resistance to white and yellow stem borers, brown planthoppers, and green leafhoppers."

Why you should not replant hybrid rice seeds

▶ JAYSON C. BERTO

Hybrids yield higher than inbreds by 15-20% owing to heterosis or hybrid vigor, the superiority of hybrids over their parents. This maximizes the combining ability of two different parent lines. It may develop the crop's vigor, fertility, and overall productivity or increase its size.

The first generation after two different lines are cross-pollinated with each other is represented as F_1 (children). The product of self-pollinating F_1s is F_2 (grandchildren); and F_3 (great grandchildren), product of self-pollinating F_2.

Arnel E. Pocsedio, PhilRice plant breeder, said that F_2s are very important in the selection process in rice breeding. While F_1 plants from two inbred rice lines look similar, the plants in the F_2 are different from each other. Breeders can separate desirable plants from those which are not acceptable based on general morphology.

Dr. Dindo A. Tabanao of PhilRice said that F_2 are not good materials for field performance testing owing to segregation in physical characteristics. Plants may vary from each other in terms of maturity, grain shape and color, plant height, and general uniformity. Plants may be tall or short, late-maturing, with few but heavy or many but light panicles; even tall and early-maturing, with several heavy panicles. Replanted F_2 seeds will end up like planting in one farm a mixture of varieties, instead of a uniform crop that farmers expect to see in the field.

> "F_2s are very important in the selection process in rice breeding. They are used to identify good and inferior plants. They could also generate superior plants similar to F_1."
>
> -- ARNEL E. POCSEDIO --

Pocsedio further said that if one parent of the F_1 carries a gene for purple grains and the other has gene for white grains, planting their F_2 seeds will result in purple and white grains.

In terms of maturity, when the F_1 is a cross from late and early-maturing parents, the F_2 plants can mature at different times and will produce ripening and very ripe grains that cannot be harvested all at once. When tall is crossed with short, F_2 plants will be inconsistent in height.

Every plant in an F_2 population is different from the other. Few plants could look alike but actually have different genetic combinations in their DNA.

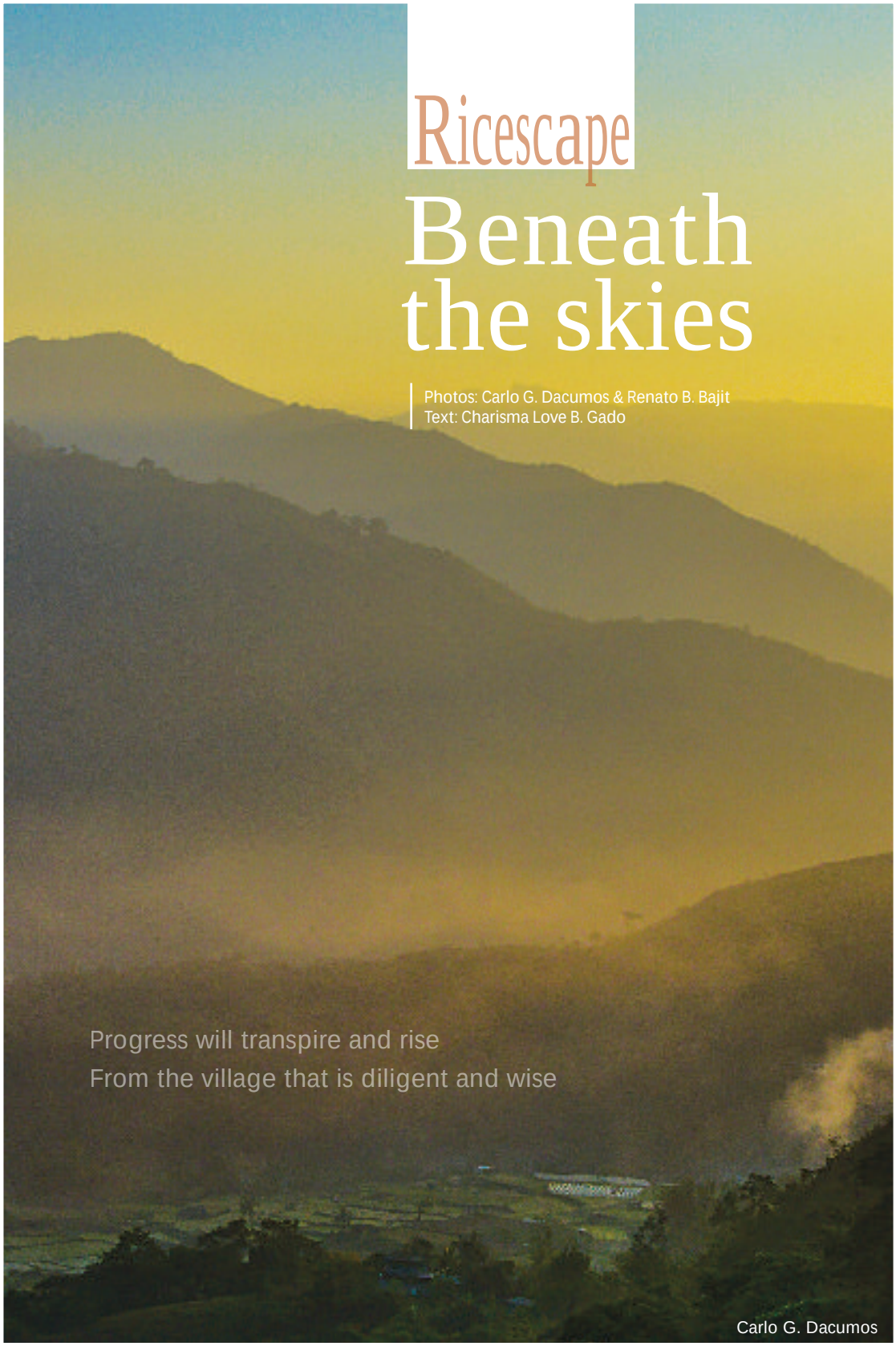
Pocsedio concludes that harvest from F_1 hybrid seeds is best processed into milled rice for eating. After all, the seed industry will continuously supply F_1 seeds for sale to as many farmers as possible.

Ricescape

Beneath the skies

Photos: Carlo G. Dacumos & Renato B. Bajit
Text: Charisma Love B. Gado

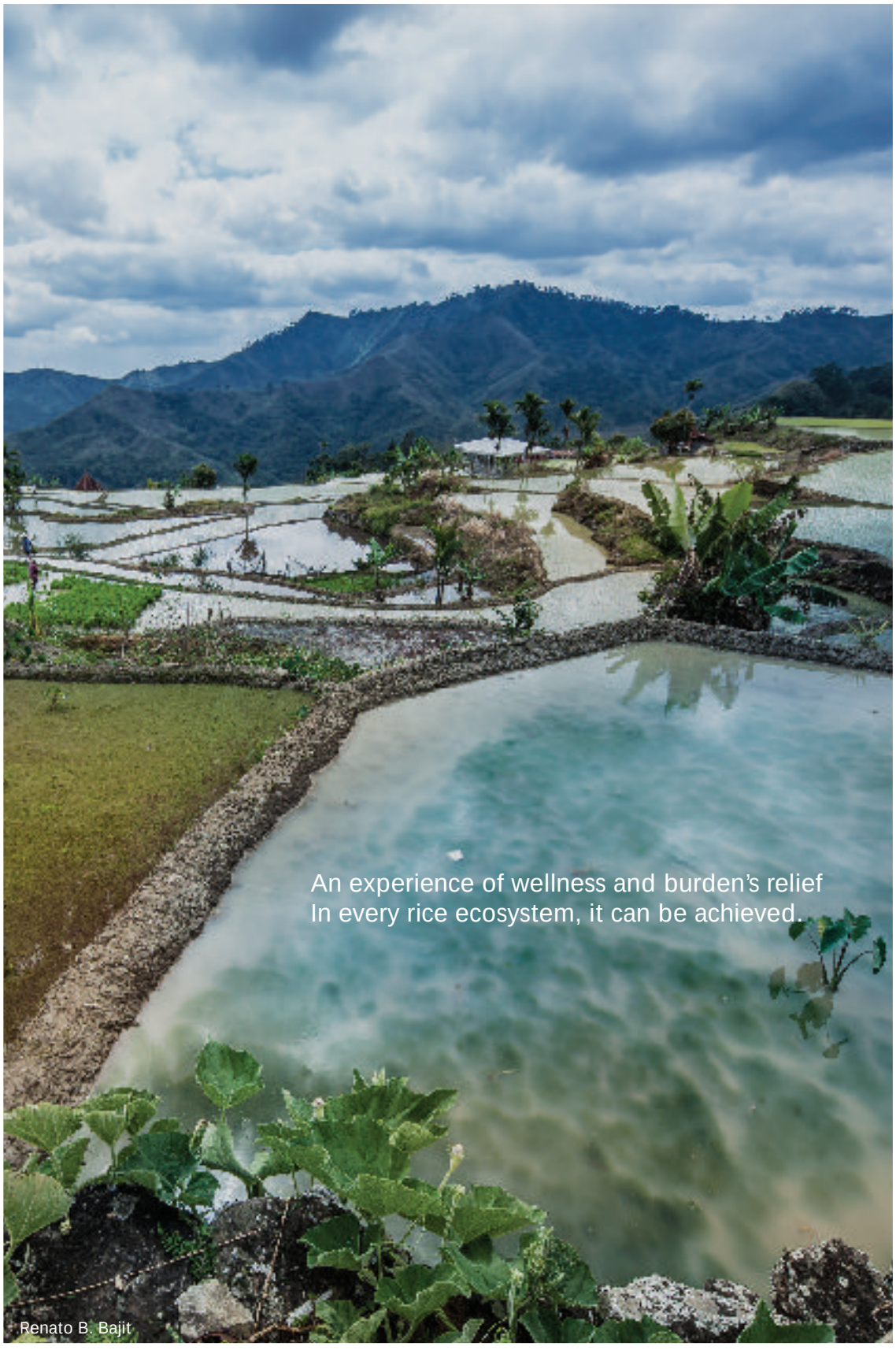
Progress will transpire and rise
From the village that is diligent and wise



Carlo G. Dacumos

(Have your photos published in the Ricescape section of the PhilRice magazine. Please email contributions to prri.mail@philrice.gov.ph.)


Progress from good harvest will transform
An experience that is yet to be known
Renato B. Bajit


An experience of wellness and burden's relief
In every rice ecosystem, it can be achieved.
Renato B. Bajit

An existence of probably forever

► CHARISMA LOVE B. GADO

There's the search for the fountain of youth that we, mortals, can't resist. Even Alexander the Great, who conquered most of the known world before dying at 32, is believed to have been searching for a river that "healed the ravages of age."

The search seems endless with explorers going down springs and cemeteries; philosophers deciphering meanings; and scientists researching on stem cells and their anatomy.

While some humans are expending their energies on the fountain of youth, rice researchers are implementing methods that will ensure that rice will still be life to farmers, consumers, and to the nation that it nourishes. More than 13,000 rice genetic resources or life of the rice industry, are stored in a gene bank housed in PhilRice under the care of the Genetic Resources Division (GRD).

"Gene banks ensure that current and past rice genetic resources are available anytime and can be accessed for use by farmers, researchers, students, and other stakeholders. Farmers can request for traditional or indigenous seeds conserved in the gene bank, and cultivate them in their fields," Loida Perez, GRD head, said.

To conserve the rice varieties including heirloom rices such as *Tinawon*, *Binirhen*, and *Bayag*, researchers at the gene bank regenerate them in the field, characterize, conserve, and store them in cold facilities. In medium-term storage, Perez said that rice seeds are made viable from 25 to 40 years; long-term storage keeps them in healthy condition until 100 years or more with regular monitoring on viability or germination rate of the seeds.

In one of the plots managed by GRD, a so-called "miracle" rice was planted to characterize and verify the claims of locals in Davao who said that drinking its boiled cooking water can cure stomach and headaches.

These seeds are not only kept in the cold facilities and conservation plots, but are also shared to the public.

Dr. Nanette Galang- Gana of the Dr. Gregorio Galang Foundation and pharmacologist at the UP College of Medicine, benefitted from the gene bank when she requested for black rice seeds and planted them in a 100-m^2 plot in Laur, Nueva Ecija.

"I did internet research on black rice and read that it is rich in antioxidants and high in iron. By propagating and increasing these seeds from PhilRice, many of our patients will have access to better rice, and hopefully, their health will improve by consuming this type of rice," she said.

Ricky De Guzman, president of the San Nicolas Farmers' Association in Ilocos Norte, also requested for NSIC Rc218 or Mabango 3 for increased seed production.

Although released in 2009, the variety's seed supply is wanting in the Ilocos region. De Guzman said that farmers in their association want to produce enough supply of the variety because of its good eating quality and aroma.

"Genetic resources are considered as foundation of agriculture and a principal element of breeding and genetic improvement of crops, livestock, and other biological species. They are a must in promoting diversity and improving the quality of our rices," she said.

However, certain sectors raise issues on monopolizing rice seeds, twisting the objective of establishing a public gene bank.

"Gene bank is a state property and is created to serve the Philippine rice industry. Our country is a signatory to the International Treaty on Plant Genetic Resources for Food and Agriculture of FAO. We are mandated to facilitate the utilization of rice germplasm for food and agriculture, to support food security, and not to monopolize ownership over the seeds," Perez stressed.

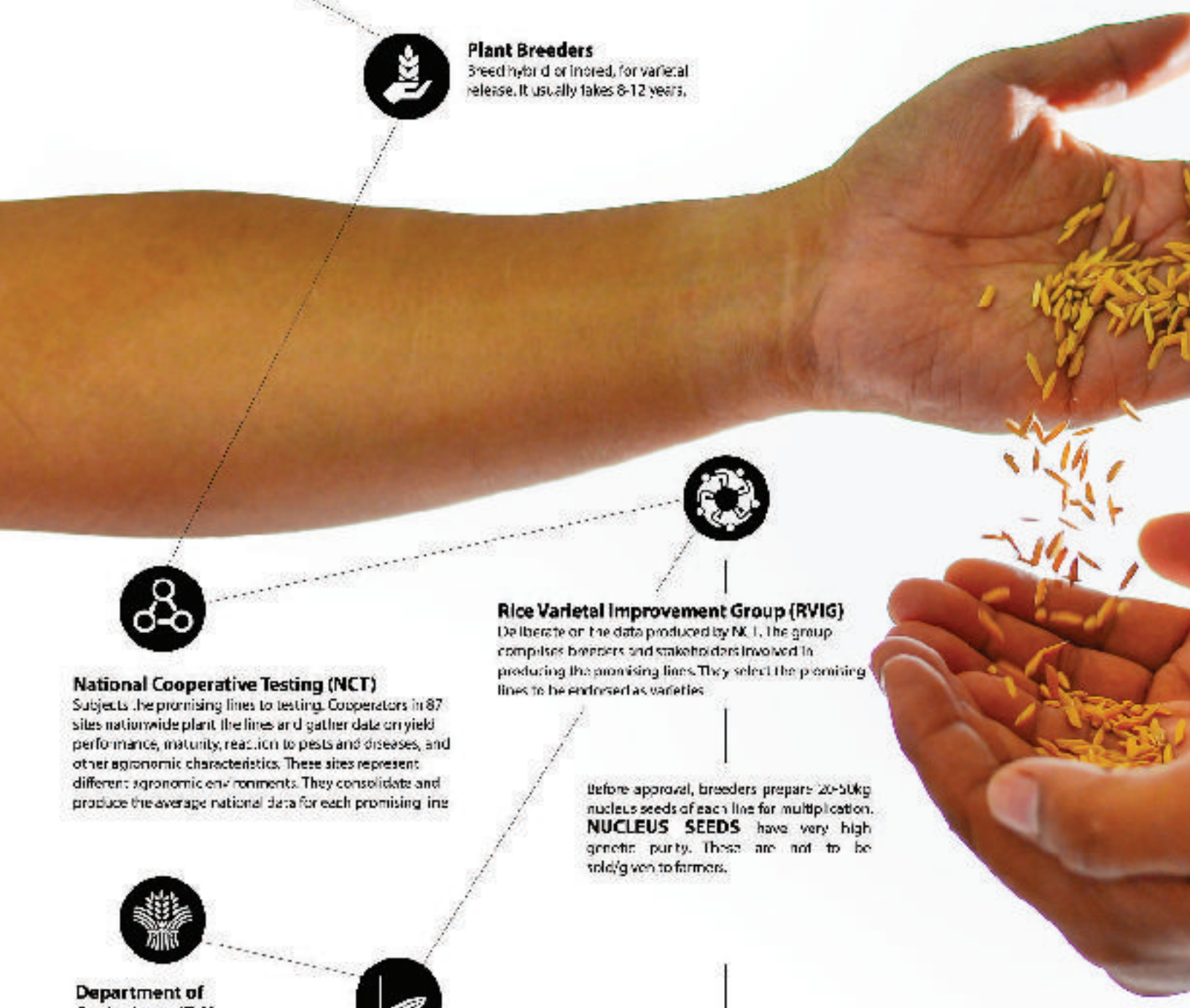
Perez said that material transfer agreements (MTA) in accordance with the FAO Standard MTAs are being implemented to track the transfer and utilization of resources.

Amidst the transfer agreements, utilization rate of rice genetic resources at PhilRice gene bank significantly increased from 57 in 2012 to 647 accessions or collections in 2013 for breeding and genetic studies, and physiology, allelopathy, and phytochemical interests.

"Maintaining a gene bank is not easy. Highly qualified personnel and committed staff are needed to handle the conservation of rice genetic resources because the processes, although simple, need careful attention and see no room for errors... In the seeds and information stored in a gene bank lie the future of rice research, because they are the foundation of genetic information," she said.

As long as there are humans who do not focus much on their own elixir of life, but on creations other than themselves, rice will always be life to nations and traditions.

SEED
From breeders'



Breeding Institutions
Public (PhilRice, UPLB)
Private (Syngenta, Monsanto, Bayer etc.), and
Non-profit (International Rice Research Institute)

Plant Breeders
Breed hybrid or inbred, for varietal release. It usually takes 8-12 years.

Rice Varietal Improvement Group (RVIG)
Deliberate on the data produced by NCT. The group comprises breeders and stakeholders involved in producing the promising lines. They select the promising lines to be endorsed as varieties.

National Cooperative Testing (NCT)
Subjects the promising lines to testing. Cooperators in 87 sites nationwide plant the lines and gather data on yield performance, maturity, reaction to pests and diseases, and other agronomic characteristics. These sites represent different agronomic environments. They consolidate and produce the average national data for each promising line.

Before approval, breeders prepare 20-50kg nucleus seeds of each line for multiplication. **NUCLEUS SEEDS** have very high genetic purity. These are not to be sold/given to farmers.

Department of Agriculture (DA)
DA Secretary approves the promising lines as varieties for commercialization.

National Seed Industry Council
Formerly called Philippine Seed Board (PSB), the council endorses the RVIS selected lines to the Department of Agriculture for release as varieties.

BREEDER SEEDS
Produced from nucleus seeds, they bear the highest purity of the new variety. With BPI- NSQCS certification, the seeds are issued WHITE tags.

CHAIN: hands to farmers' lands

- MARLON M. PRADO

It takes 8-12 years to traditionally breed a rice variety, and a few more years to make it available to farmers. The process is long, rigorous, and takes tons of hard work. But for a plant breeder, there could be nothing more satisfying than seeing a seed initially developed in the lab, then one day planted and harvested in farmers' land.

Seed is the very core of rice farming and therefore it's important to ensure the consistency of seed quality across seed generations before rice varieties are finally commercialized. According to Susan R. Brena, head of the Seed Technology Division at PhilRice, the demand for high-quality seeds have gradually increased over the years as farmers have finally recognized their importance in successful farming.

> "Filipino farmers are now particular when it comes to seeds. In fact, they are now more willing to pay higher amounts for premium-quality seeds."

With the swelling demand for quality seeds, both private and public breeding institutions ensure that farmers get the best seeds to grow.

FOUNDATION SEEDS (FS)
Produced from growing breeder seeds, only two grains of each variety are allowed in the samples. Upon certification, samples are labeled with RED tags.

REGISTERED SEEDS (RS)
Produced from growing FS, only five grains of each variety are allowed in the samples. Upon certification, seeds are issued GREEN tags for accredited seed growers' use.

CERTIFIED SEEDS (CS)
Produced from growing RS, only 20 grains of each variety are allowed in the samples. Upon certification, seeds are issued BLUE tags for farmers' use to produce mostly commercial palay, or so-called "good seeds."

National Seed Quality Control Services (NSQCS) Under the Bureau of Plant Industry (BPI), it is mandated as the regulatory body for seed certification.

DNA fingerprinting:

Cracking rice's identity crisis

► MYRIAM G. LAYAOEN

Like a voter, a variety has an identity, too. It possesses certain characteristics that make it unique from other rice cultivars. And like politicians, some rices perform better than the others. They vary in physical traits (morphology) and production management practices (agronomic). When they look alike and grow in the same manner, how then would it be possible to easily distinguish one from the other?

Deoxyribonucleic acid (DNA) fingerprinting allows breeders and researchers to do that. It is a technique used to see the differences in DNA fragments from one organism to another. DNA is a substance that carries genetic information in the cells of plants and animals. As such, it enables rice breeders to distinguish the fundamental and individual qualities of specific varieties for a certain purpose.

For what purpose, really?

Alec John Jeffreys and team developed techniques for DNA fingerprinting in 1985 mainly for identification of humans. In rice, it works in two ways: for marker-assisted selection (MAS) of target traits, and seed identification or purity analysis.

Molecular marker technology or MAS is a process that uses DNA markers (flanking the target gene) to indirectly select a genetic trait of interest from a certain cultivar. This system is also used to assess the genetic relationships and differentiate varieties from one another.

"Here in PhilRice, DNA fingerprints are most commonly used as a basis to improve the genetic composition and production performance of a rice plant. When a breeder wants to combine a gene of a superior trait from a donor variety to another variety, s/he will use the results of DNA analysis to determine the plants carrying the superior gene. Thus, the selection becomes precise," explained Loida M. Perez, geneticist and head of PhilRice's Genetic Resources Division.

A DNA fingerprint or the clear characteristic pattern of a cultivar is considered the most reliable and precise reference of the identity of the many rice varieties and landraces. It facilitates studies on maintaining seed purity for breeding purposes and consumer satisfaction.

Perez added that the accuracy in selecting the rice cultivar possessing the gene of a desired trait is higher and faster using molecular DNA analysis than by simply relying on its morphological and agronomic characteristics. This is particularly true to traits with simple inheritance and are controlled by major genes with dominant effects.

"Morphological and agronomic traits may change due to efects of the environment, making them fuzzy means of monitoring identity. The genetic makeup, on the other hand, cannot be altered. Thus, it is a stable source of information," said Perez.

Also, DNA analysis provides straightforward projection on the performance of a specifc trait of the rice crop even at an early stage. Perez said the rice breeding process that usually takes 10-12 years can be shortened to 3-5 years with DNA fngerprinting, following the processes of the marker-assisted backcrossing approach.

How they do it

In the past, DNA fngerprinting in rice entailed a very long and tedious toil. With the advent of modern molecular tools, however, the process has become manageable through the help of machines.

At PhilRice, geneticists and laboratory aides handle the process. It starts with the extraction of DNA from a rice plant (usually from a leaf) and ends with a computer-generated plate containing the DNA fngerprint. Without disturbance, the whole process will only take a day to complete.

The process may seem simple but it requires a lot of cautions to ensure the purity of samples as these may be contaminated when inappropriately handled.

"We use at least 10 machines operated by one researcher to work on a hundred of samples from the rice leaf to the DNA fngerprint in two days. The development of molecular marker technology and introduction of the polymerase chain reaction (PCR) technique has signifcantly made it easier for DNA fngerprinting without sacrifcing the quality of results," Perez said.

The PCR is a procedure to exponentially amplify a DNA fragment to generate millions or more copies of DNA. It has various medical and biological applications mainly in gene sequencing and diagnosis of hereditary diseases. It is also used for forensics and paternity testing, detection and diagnosis of infectious diseases, and creation of genetically modifed organisms.

"We extract the DNA samples from a rice leaf and move these from one machine to another. The actual procedures will have to undergo an expert's eye and careful attention to come up with credible results," Perez emphasized.

The fngerprints will then be examined by scientists and researchers for use in the felds of taxonomy, physiology, breeding, genetics, plant genetic resources, and other related felds.

In a laboratory setup, it will cost around P300 to examine a sample from leaf to DNA fngerprint. However, the amount only accounts for all consumable materials. Labor, electricity, and machine maintenance are not included in the computation.

In a 2009 study, Perez and team tried to detect the admixtures of four hybrid varieties from Isabela and Davao using DNA analysis.

"We conducted the study to compare the results of a conventional seed purity test by the National Seed Quality Control Services and DNA fngerprinting of hybrid rice seeds. We noted up to 10% discrepancy in the admixture counts of the two processes. In this case, we can only hope to make DNA fngerprinting a routine in every purity test," Perez said.

Perez envisions a more enlightening future in rice DNA forensics – the use of DNA profling to refect an organism's DNA makeup as its identifer – to establish rice identity for proprietary purposes.

> "Here in PhilRice, DNA fngerprints are most commonly used as a basis to improve the genetic composition and production performance of a rice plant. "
>
> -- LOIDA M. PEREZ --

Practically speaking

The rice R&D sector has always been hounded by issues on varietal identity and rice purity. Scientists resort to DNA fngerprinting or analysis to help them precisely identify varietal distinctiveness and measure purity of rice seeds.

"Rice cultivars have almost identical agronomic features; morphological characteristics alone are insufficient in identifying a true-to-type variety. Thus, it is important to establish molecular diagnostic procedures to ensure identity and maintain genetic purity of these rice cultivars," PhilRice Executive Director Eufemio T. Rasco Jr. said.

With the stringent procedures employed in DNA fngerprinting, Rasco believes it can be an efficient tool to determine the purity and genuine identity of the rice seed. He said scientifc evidence as strong as a DNA fngerprint is enough to protect intellectual property rights against bogus seeds.

"This will be especially useful in hybrid rice as the battle in hybrid breeding heavily depends on the parents. I believe we have enough to work on. Through DNA fngerprinting, we hope to establish the genetic identity of our rice cultivars," Perez said.

Perez is currently conducting a study with a consultant from the DNA Analysis Section of the Philippine National Police Crime Laboratory forensics team for the said purpose.

"Once we establish the parameters we are looking for, we would be very willing to share all information to establish identity of rice for proper identifcation and ownership. By then, our rice farmers can confdently claim their impending right to conveniently access quality rice varieties," Perez said.

The rice DNA will speak for itself – for who it really is.

Diversity for Adversity

Securing the future through rice varieties

► SAMANTHA M. HAUTEA

Plant breeders and researchers are the pioneers in rice production. Their efforts produce new varieties that satisfy the ever-growing demand for rice. But why does their work never seem to end? Why do new rice varieties continue to be developed even when we already have hundreds to choose from?

"We have at present more than 200 commercial inbreds and hybrids released, but improvement must not cease to meet the new demands and challenges of rice breeding," explained Thelma F. Padolina, PhilRice plant breeder.

She said that the environment is dynamic and if breeding slows down, we might be overcome by emerging pests and climate-related problems threatening our rice production system and food security.

"The breeders must ensure that genetic diversity is accounted for as a tool to sustain the gains made in rice production," Padolina emphasized.

"We have at present more than 200 commercial inbreds and hybrids released, but improvement must not cease to meet the new demands and challenges of rice breeding."

-- THELMA F. PADOLINA --

As an archipelago, the Philippines has various types of terrains and ecosystems that are not equally suitable to rice production. Breeders aim to develop varieties that can survive in harsh areas. Flood and drought, high and cold temperatures, salinity in coastal areas, and lack of reliable irrigation are only some of the unfavorable conditions that can affect rice production. Some areas are also more prone to particular kinds of pests or diseases, so plant resistance is another quality that breeders keep in mind.

A single variety cannot possess all the qualities to perform well in varied environments, but it is possible to combine some characteristics to create rice that can flourish even under adverse conditions.

"Location-specific adaptability is the right ingredient in customizing the performance of any variety," Padolina stressed.

"We need more location adaptability testing to fine-tune the performance of these varieties. High yield potential is still the foremost breeding objective and it is a challenge to incorporate multi-stress tolerance, nutrient-use efficiency, and excellent grain quality."

The case of "Super" rice

The Green Super Rice (GSR) Project for the Resources-Poor of Africa and Asia, led by the Chinese Academy of Arts and Sciences,

and supported by the Bill and Melinda Gates Foundation, is an example of how plant breeders are stepping up to the challenge of feeding the world's growing population.

By combining high yield potential with low input, the GSR project aims to produce varieties that can help farmers in areas with poor natural resources achieve sustainable rice production. The Philippines, through PhilRice, is working with an international network to identify promising materials through participatory varietal selection (PVS) trials.

> "We need more location adaptability testing to fine-tune the performance of these varieties. High yield potential is still the foremost breeding objective and it is a challenge to incorporate multi-stress tolerance, nutrient-use efficiency, and excellent grain quality."
>
> -- THELMA F. PADOLINA --

In the trials, farmers plant promising GSR materials in their own farms, using their conventional techniques. The results are documented, incorporating feedback from farmers on their preferred traits.

GSR trial sites have been established in rainfed areas in Ilocos Norte, Tarlac, Leyte, and Sultan Kudarat. Besides providing the materials, farmers are also taught cultivation methods to enhance productivity and maintain seed purity. Dr. Jauhar Ali of IRRI, GSR coordinator for Africa and Asia provide the start-up seeds. In the trials, seeds are made available through the community seed banking system put up by the farmers themselves.

Currently, GSR is not yet available for massive seed production as it is still undergoing further testing. However, under the DA Rice Program, some GSR materials have already been distributed nationally.

Farmers who have planted GSR seeds have reported initial promising results. Padolina cited the example of one farmer from Bohol whose farm was prone to drought, saline, and food, yet got good results.

Breeding continues

As can be gleaned from the GSR experience, having diverse rice varieties offers the assurance that even when drastic and unexpected changes in the environment occur, not all rice farmlands will be affected.

Surviving varieties can be analyzed to determine the traits that make them resistant, or planted in affected areas until the environment stabilizes. For example, in areas afflicted by insect pests or diseases, one solution is for farmers to plant a pest-resistant or commonly called "stopgap" variety for a few seasons until the infestation breaks.

In addition to producing more durable varieties that produce high yield, breeders also look for traits considered desirable by the market. Filipinos prefer soft cooked rice, thus several recent varieties have lower amylose contents. There are also growing markets for varieties suitable for turning into brown (unpolished) rice and other specialty rices (e.g. glutinous, japonica). Depending on how consumer tastes change, other grain types may one day become more popular.

Over the years, many rice varieties have been developed by local and international research organizations. The National Seed Industry Council (NSIC) approves the release of new varieties every year. Advances in modern biotechnology have greatly shortened the development process, allowing more varieties to be released in a shorter period of time. For example, 17 new rice varieties were released in 1966-1975, and 82 in 2006-2011. Private seed companies that engaged in hybrid rice have contributed immensely in this endeavor.

Filipinos can expect the continuing release of more varieties as scientists and breeders work on developing rice that can take on the challenges of ever-changing ecosystems and demanding consumers.

Two strokes to be on high

► CHRISTINA A. FREDILES

Studies show that good-quality seeds can increase yield by 5-10%. Errol Santiago of PhilRice said that even good seeds produce healthy seedlings that grow fast and uniformly and can yield 5 t/ha during the dry season.

Who can produce good-quality seeds?

Two sectors produce seeds – the informal and formal. The informal sector is composed of farmers who use their own-saved seeds or exchange seeds with other farmers for the next planting season. The formal sector comprises cooperatives, rice research institutes/stations, private seed companies, individual private seed growers, and non-government organizations accredited by the Bureau of Plant Industry (BPI) to produce seeds. Under the Seed Industry Development Act of 1992, BPI's main service is to control and supervise field inspection, certification and quality control services, and seed testing laboratories.

Farmers' seed system

A Wageningen University report says that farmer-produced, selected, and stored seed is still the predominant source of seeds in the world, even in European countries.

"Farmers' seed production is based on experimentation and experience that they accumulate over a long period of time. Their practices are often well-adapted to local conditions," the report indicates.

This makes the quality of farmer-saved seed as good as seeds from the formal sector, based on the report.

In the Philippines, farmers like Luciano Coton, 59, of Silang, Cavite produce their own-saved seeds from their harvest and rely on their wisdom in determining healthy grains. Coton gets only 1.25 t/ha in his upland field, which is lower than its 3-t/ha yield potential.

Some farmers in Cavite select seeds based on recommendations by other farmers or seed exchange. *Binerhen, Kinandang, Kire-Kire, Azucena, Dalikit, Pirurutong*, and Miracle rice are their most preferred rices.

In support of the practices of Coton and his fellow farmers, Santiago said that it is fne for farmers to produce their own good seeds especially when certifed seeds are not available in their area.

However, he cautioned that this should be done carefully to ensure quality.

The formal sector

The formal seed sector is organized with the principal goal of difusing quality seeds of improved varieties developed by formal breeding programs.

In the Science City of Muñoz, Nueva Ecija, about 500 seed centers supply quality seeds to farmers across the country.

> "Farmers' seed production is based on experimentation and experience that they accumulate over a long period of time. Their practices are often well-adapted to local conditions."

Based on a focused group discussion with seed producers, the boom in the local seed industry can be partly attributed to PhilRice as source of foundation and registered seeds.

"To be accredited, you have to undergo a fve-day training on seed production. Then, your feld will be inspected by an authorized seed inspector from the local government unit," said Renievoy Undan of Malayantoc, Sto. Domingo, an accredited seed grower.

Field inspection is done at least three times per cropping season. The inspector checks, among other things, for of-types, admixtures and weeds, and incidences of seed-borne diseases and pests.

After harvesting, the seed inspector takes samples and verifes if the seeds hurdle the International Rules of Seed Testing or as prescribed by the National Seed Industry Council.

The seed samples then undergo testing to determine their quality based on the methodologies prescribed by the International Seed Testing Association.

A certifcation tag is issued after laboratory tests: white is for breeder; red, foundation; green, registered; and blue, certifed seeds.

"As a seed grower, the income is quite high but it's a very tedious work. For a hectare, my expenses would reach P50,000 and my yield reaches up to 7.5 t/ha. Selling it at P1,200 or higher per sack of 40 kg, my gross income is P180,000," Undan said.

Bridging the gap

"To respond to the needs of the informal seed sector, the government is providing specialized training courses on producing good seeds," Santiago said. There are also community seed banks (CSB) where farmers are trained on how to produce good seeds of modern rice varieties seen suitable in their areas.

In 2012, the Department of Agriculture (DA) made the CSBs operational to ensure a steady supply of quality seeds. The Agricultural Training Institute, in partnership with PhilRice, IRRI, and DA-Regional Field Ofices and community-based NGOs, leads the project.

Through the CSB, farmers can borrow or barter seeds from other farmers and are assured of the quality of seeds. CSB even promotes biodiversity of plants as genetic diversity is conserved and preserved.

Additionally, supporting the needs of the informal seed sector can help the formal sector concentrate on its mandate, which is to supply seeds of improved varieties from the formal breeding programs.

After all, both sectors share the goal of producing high-quality seeds that obtain higher yields; fulfilling farmers' dreams.

How to multiply healthy own-produced seeds

- Use the Minus-One Element Technique (MOET) to determine soil nutrient defciency or have your soil tested in the laboratory. MOET is a reliable, low-cost, and easy alternative that farmers can do to diagnose soil nutrient status.
- Plow, puddle, and level the feld to control weeds and improve water management. Seedlings should be transplanted at 21-25 days old from a healthy, weed-free nursery or seedbed at two seedlings per hill and with 20 cm x 20 cm-distance.
- Apply sufcient nutrients from tillering to early panicle initiation to ensure good crop growth and panicle development. Keep the crop free from weeds, insect pests, and diseases to avoid yield losses.
- Rogue the feld especially at maximum tillering and fowering. Remove diseased or insect-damaged plants and those with discolored panicles.
- Harvest when 80-85% of the grains are straw-colored. Thresh, clean, dry at 12-14% moisture content, grade, and label the harvested seeds.
- Store the labeled seeds on sealed clean containers in a cool, dry, and clean area.

Sowing the Future: Seed Legislation in the Philippines

► SAMANTHA M. HAUTEA

Rice research primarily focuses on the plant itself, and on developing varieties with desirable characteristics. However, in order for these qualities to be expressed to their full potential, the seeds available to farmers should be of high quality. A well-developed and robust seed industry plays a key role in ensuring stable rice production. Recognizing its importance, Philippine policymakers have crafted a number of policies to support the local seed industry.

R.A. 7308, or the *Seed Industry Development Act of 1992*, was enacted to stimulate plant breeding activities and create a national seed industry program that would allow the Philippines to become self-sufficient in the production of high-quality seeds. This law created the National Seed Industry Council (NSIC) to replace the Philippine Seed Board (PSB), and the National Seed Quality Control Services (NSQCS) which replaced the Seed Certification Section. Both NSIC and NSQCS remain under the authority of the Bureau of Plant Industry (BPI). The NSIC issues directives for the seed industry and registers new varieties. On the other hand, the NSQCS ensures that the seed materials produced in the country conform to established standards. It also accredits seed laboratories.

The Act places a number of restrictions on the sale and use of seeds. It limits the amount of seeds that can be imported into the Philippines; imposes a tarif rate

on imported seeds, and stipulates that rare or indigenous planting materials cannot be exported except for scientific purposes.

Another law relevant to our seed industry is the *Philippine Plant Variety Protection (PVP) Act of 2002*, or R.A. 9168, which created the PVP office (PVPO). According to Dr. Vivencio Mamaril, the designate-executive assistant for NSIC and head PVPO secretariat, PVP is a way of ensuring plant breeders rights over the varieties they develop. Since one cannot patent a plant variety itself in the Philippines, this law gives them rights over the distribution of breeding materials of the varieties they register. This allows them to retain the intellectual property rights over their creations, meaning their permission must be sought before their varieties are propagated.

It is important to distinguish NSIC registration from PVP registration. NSIC registration is based on a variety's characteristics and performance compared to a set standard. If it passes this check, then it is registered, meaning that it is considered fit for reproduction and sale on a commercial scale. However, PVP registration can be granted regardless of whether a variety is NSIC-registered or not.

"In some countries like Germany, seed and PVP registrations are done at the same time. Here, it is optional," Mamaril explained.

However, PVP registration may be the most important way for breeders to protect their work. Breeders with a variety registered under their PVP have a basis for legal action against someone who has taken their work and claimed it as their own, or sold it under a different name.

These policies may be amended in the future, given that there has been a recent congressional initiative to amend the *Seed Industry Development Act of 1992*.

"There is a concern about how to police the proliferation of substandard or adulterated seeds being marketed as quality seeds," Mamaril said, referring to what spurred lawmakers to revisit the Act. "At present, there are no criminal penalties or mentions of police power in the law."

Dr. Flordeliza Bordey, an economist at PhilRice, noted that it may be time to revisit the laws regarding the seed industry given the new economic circumstances not present when RA 7308 was enacted in 1992.

Some sections of RA 7308 need to be revisited, Bordey said. For example, its prohibitive provision on imports and exports of seed for commercial purposes should be clarified particularly in the presence of a growing hybrid seed industry. International trade of seeds may have been unheard of during the time RA 7308 was conceived. But now it is a reality when it comes to hybrid seed. Hence the law needs updating to consider these new developments.

"PVP registration may be the most important way for breeders to protect their work. Breeders with a variety registered under their PVP have a basis for legal action against someone who has taken their work and claimed it as their own, or sold it under a different name."

From his personal experience, Mamaril also had some observations about the seed industry.

"In the past 14 years, I believe we have seen improvements in terms of seed quality, at least if we are speaking of the formal seed sector. In fact, the standard for seed quality of the private sector is even higher than the government standard. Where we are looking at seed germination rate of 80%, they go for 90% or even 95%."

For this reason, he said that he foresees the seed industry eventually moving to a system with less government intervention.

"The role of the NSQCS may and will include accreditation of private seed laboratories. Seed quality analysis of commercial seeds may then be done by these laboratories instead." However, he added that it is unlikely that any changes to the laws would be seen within this session of congress but still hopes that there will be revisions someday.

Good, well-implemented policies play a key part in improving not only the economy, but also the quality of life of every Filipino. Keeping these laws up to date with the developments in the industry and available technology ensures that they continue to be effective and relevant, fulfilling their intended purpose.

Chances

► CHARISMA LOVE B. GADO

Good things are often missed due to chances that are allowed to pass. But no chance will be wasted if the beholder of chance can perceive more than what the eyes see. This gift of discerning may bring out the best in creations, even in rice.

NSIC Rc298 or Tubigan 23, the first direct wet-seeded variety, was left unnoticed for two years in the breeding nursery before it was included in the Participatory Varietal Selection (PVS) in 2006.

"Based on the variety's then designation, PR34159-13-1, the line was sort of overlooked in 2004. I came across the line's fourth generation when I started working at PhilRice in 2006. I nominated it in the National Cooperative Testing in 2007-2008," Dr. Norvie L. Manigbas, former lead of the *Development of Inbred Varieties for Direct Wet-Seeding* (DIRECT) project and one of the variety's breeders, said.

Perceiving its potential, Manigbas tested the line in PVS regional trials for direct and wet seeding in San Antonio, Aliaga, and Rizal, Nueva Ecija; Dingle, Iloilo; and San Jacinto, Pangasinan in 2006-2007.

After four years of testing, NSIC Rc298 was approved in 2012. Multi-location testing showed that it can average 5.3 t/ha and matures in 104 days; has moderate resistance against yellow stem borer in Nueva Ecija and brown leaf hopper.

> "Whenever I dream of a variety and work on it, I ask for God's guidance on the right and specific rice that I have to choose. "
>
> - DR. NORVIE L. MANIGBAS -

"Most of our varieties could be direct-seeded, but they are not tested in this condition. This variety has been tested for its germination capacity when flooded and its genes are targeted to have very good seedling vigor," he said.

Dr. Oliver E. Manangkil of the DIRECT project said that rice varieties are mainly bred for transplanting because of better chances against weeds, lower seeding rate, and controlled plant density.

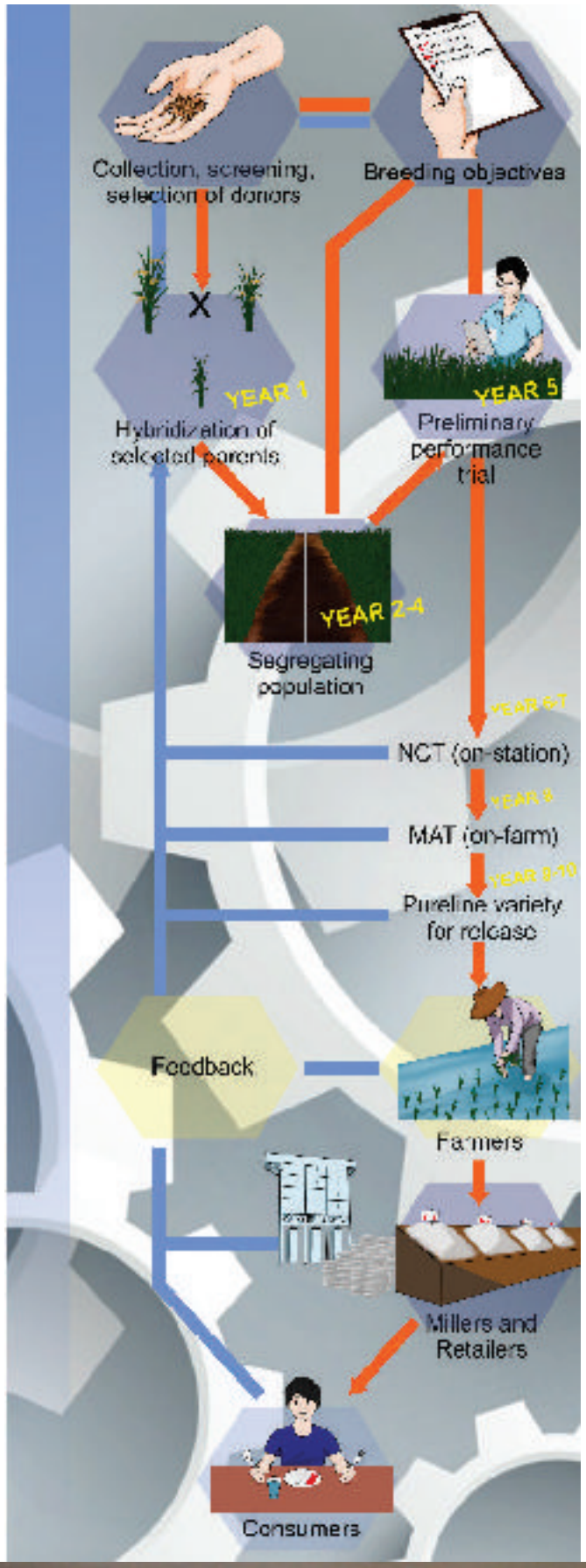
He said that direct seeding is emerging as a preferred method of establishing rice because it addresses labor shortage and high cost of farm inputs and capital without reducing yield.

In their 2011 paper titled, *Direct Seeding of Rice: Recent Developments and Future Needs*, Virender Kumar and Jagdish K. Ladha, said that direct seeding has more potential to reduce water and labor-use than trans-planting. They cited on-farm studies in the Philippines showing that direct seeding can save an average of 11-18% in irrigation water.

Direct seeding can also help solve labor shortage. Labor sources in agriculture, they said, are declining at 0.1 – 0.4% per year in Asia. They said that in Bangladesh, Malaysia, and Thailand, the decline rate is much higher at 0.25-0.40%; followed by India, the Philippines, and Cambodia at 0.18%. Direct seeding reduces labor cost as it does not require nursery raising, seedling uprooting, and transplanting.

"Labor requirement in direct-seeded rice can be 60% lower, with an average savings of 27% than transplanted rice," Kumar and Ladha said.

Conventional Breeding Scheme



In terms of yield, the researchers found that grain yield in Bangladesh and the Philippines from direct wet-seeded rice were higher at 8.6 – 18.5% than from transplanted rice.

"The battle is won in the field. The performance of every generation should be well-monitored. When I tested NSIC Rc298 in the PVS, the farmers liked it so I was encouraged to try it in the multi-location tests. I nominated three lines on direct wet-seeded variety, but only this variety passed the long years of testing," Manigbas said.

Since January this year, about 20,000 kg of NSIC Rc298 seeds had been sold. Buyers were farmers from La Union, Tarlac, Pangasinan, Pampanga, Bulacan, Isabela, and Nueva Vizcaya. Farmers in Nueva Ecija, Bataan, Camarines Sur, and Leyte also planted the variety this wet season.

Chances are not gained by random choices. Even in rice breeding, chances are given by destiny as a vehicle of welfare and prosperity.

"Whenever I dream of a variety and work on it, I ask for God's guidance on the right and specific rice that I have to choose. Two years in the breeding nursery and I was guided to put them out of the nursery and have them tested on farmers' fields across the country. It's more than rational and intuitional," Manigbas said.

Varieties: what fts where?

► MERVALYN O. TOMAS

Farmers and non-farmers alike can now hardly keep track of the number of existing rice varieties.

In fact, over 400,000 varieties of rice currently exist world-wide. In the Philippines alone, 215 varieties were released since 1968 through 2011.

Rice varieties abound as researchers develop rices that suit different ecosystems, while improving their quality and yield.

"Out of a thousand promising lines, a breeder is lucky to successfully breed one or two varieties. However, we still continue breeding because pests and diseases adapt and gradually develop resistance. The existing varieties we use now will have to be changed in the future," Errol V. Santiago, PhilRice breeder, said.

There are different kinds of rice ecosystems where specifc varieties thrive. Every variety is intended for a specifc location.

"The upland, rainfed and irrigated lowland, cool-elevated, food, drought and saline-prone rice farming ecosystems are needed to be considered also in breeding," Santiago said.

Certain varieties are singled out by many farmers in the Philippines, as a recent study done by our Socio-Economics Division shows.

The top rice varieties adopted for all ecosystems during the 2011 wet season are Rc18, 82, 160, 222, 128, 122, 216, 152, and 158.

In irrigated lowland, PSB Rc10, 18, 82; and NSIC Rc122, 128, 152, 160, 214, 216, and 222 topped the list.

For rainfed, PSB Rc12, 14, 36, 38, 40, 98, 100, 102; and NSIC Rc272, 274, 276, 278, 280, 282, 284, 286, and 288 are the preferred varieties.

NSIC Rc192 (*Sahod Ulan 1*) is for drought-prone rainfed lowland. NSIC Rc194 (*Submarino 1*) is the variety for food-prone rainfed lowland.

In rainfed dry-seeded, PSB Rc16 (*Ennano*), 24 (*Cagayan*), 42 (*Baliwag*), 60 (*Tugatog*), 62 (*Naguilian*), 68 (*Sacobia*), and 70 (*Bamban*) are the choicest varieties.

Farmers chose these varieties as they are high-yielding, have good eating quality, accessible, early-maturing, resistant to pest and diseases, tested, sell at premium price, suitable to their farms, have good quality, or grains are fully filled.

For the cool-elevated ecosystem, PSB Rc44 (*Gohang*), 46 (*Sumadel*), 92 (*Sagada*), 94 (*Hungduan*), 96 (*Ibulao*), and NSIC Rc104 (*Balili*) are the choices for farmers.

For saline-prone irrigated lowland, PSB Rc48 (*Hagonoy*), 50 (*Bicol*), 84 (*Sipocot*), 86 (*Matnog*), 88 (*Naga*), 90 (*Buguey*); and NSIC Rc106 (*Sumilao*), 108 (*Anahawan*), 182 (*Salinas 1*), 184 (*Salinas 2*), 186 (*Salinas 3*), 188 (*Salinas 4*), 190 (*Salinas 5*), Rc290, 292, 294, and 296.

For upland, PSB Rc1 (*Makiling*), Rc3 (*Ginilingan Puti*), Rc5 (*Arayat*), Rc7 (*Banahaw*); Rc9 (*Apo*), and Rc11 (*Canlaon*).

These varieties are released for farmers to have options considering their ecosystems.

"One that fts a certain farm does not necessarily ft another even if they are in a similar ecosystem. Farmers need to try which thrives well and yields high in their farms," Santiago said.

The rice retailer nearest you, however, sells what she brands as *Dinorado*, *Sinandomeng*, *Wagwag*, *Angelica*, and so on. This is democratic marketing at work. It's more fun in the Philippines indeed.

KURU SAKA
VOLUME 27 NO. III
JUL-SEPT 2014

Kwento ni **Rodolfo U. Daguio**, 65, ng San Mateo, Isabela
Inilahad kay **Maritha C. Manubay**

"Swertified" vs certified

Tatlumpu't-anim na taon na akong nagsasaka. Kagaya ng maraming istorya ng buhay-magsasaka, ito ang bumuhay sa aking pamilya, tumustos at nakapagpatapos sa pag-aaral ng aking apat na anak na puro babae. 'Yong panganay ko ay isa nang nars at permanent resident sa Ireland, kasama ang kanyang asawa. Ang bunso ay nakatapos ng *Hotel and Restaurant Management*.

Dumaan din ako sa mga nakagisnan nang gawain sa pagbubukid. Darating ang tubig-irigasyon na hudyat ng panahon ng taniman, bibili ng binhi sa kalapit-saka, magpupunla, maglilipat-tanim, at maghihintay ng halos apat na buwan para makapag- ani.

Nakapagbigay naman ng ani ang ganung gawain sa loob ng 10 taon. Ani na sapat para sa pagkain naming mag-anak, at may konting naibebenta.

Hanggang dumating ang panahon na nagkaroon ako ng interes na maging seed grower. Nag-training ako noong 1988 at naging lisensyado akong mag-produce ng binhi.

Doon na ang simula ng pagbabago ng istorya ko bilang magsasaka/magbibinhi.

Nalaman kong ang inaani ko pala sa dalawang ektarya kong bukirin ay mayroon pang itataas. Napagtanto ko na kagaya ng isang bata na tinuturuang magsulat, kailangan muna ng kaalaman sa mga titik at letra. Kung sa pagsasaka, ang ikatataas ng ani ay nakadepende rin sa kalidad ng binhi na itatanim.

Kagaya ng nakararaming magsasaka sa aming lugar, dati'y sinusubaybayan ko ang palay ng mga katabi kong sakahan mula sa pagsibol hanggang sa pagbutil.

Kung maganda ang tindig, malalaki at may laman ang mga butil, nakikipag-unahan akong bilhin ito upang itanim sa aking bukid sa susunod na taniman.

Pagdating ng punlaan, tatlong sako o 120 kilo ng binhi ang aking ipinupunla sa paniniwalang ito ang sapat sa isang ektarya. Mas gusto ko na sobra kaysa sa kulangin ang aking punla. Sa isip ko, 'hindi bale, P15 lang naman bawat kilo ang bili ko ng binhi sa kalapit-saka ko, 'di hamak na mas mura kaysa sa may mga tag na binhi.'

'Yan ang aking gawain sa loob nga ng isang dekada. Walumpung kaban ang inaani ko sa bawat ektarya noon.

Noong nagkaroon na ako ng kaalaman sa pagpo-produce ng magandang binhi, natutuhan ko na ang kahalagahan ng pagpapasertipika ng binhi sa gobyerno. Doon ko rin napansin ang malaking kaibahan ng nakaugalian ko at ang kasalukuyan kong ginagawa.

Pagdating ng tubig, hindi na ako bumibili ng binhi sa kapit-saka ko. Mayroon na akong sariling produce na binhi na sertipikado at may asul na tag. Napansin kong pantay-pantay ang pagkakatubo ng mga punla at kaunti ang halong buto ng damo.

Doble na ang aking ani at kita dahil sa certified seeds! Umaabot na ako sa 200 kaban sa isang ektarya o minsan, depende sa panahon, higit pa ah!

Kung dati, 120 kilo ng binhi ang ipinupunla ko, nung nagbago ako, 40 kilo na lang sa bawat ektarya. At dahil nga pantay-pantay at malulusog ang pagkatubo ng mga punla, hindi ito nagkakaroon ng peste o sakit na kabawasan din sa gastos sa pestisidyo.

Umaani ako ng hindi bababa sa 120 kaban kada ektarya sa aking seed production area at ito ay ibinebenta ko sa mga magsasaka sa aming bayan at kalapit-bayan.

Sinisigurado kong maganda ang kalidad ng mga binhing ibinebenta ko. Sa katunayan, wala akong pwesto o stall. Sa bahay na namin mismo kumukuha ang mga buyers dahil sa kalidad ng aking mga binhing ibinebenta.

Ngunit kagaya pa rin ng bata na natuto nang magbasa dahil nalaman na nito ang mga titik at letra, kailangan pa rin nito ng masusing pagsuporta at paggabay. Kung sa pagsasaka, ang pagtaas ng ani ay hindi lamang nakadepende sa paggamit ng mataas na kalidad na binhi ng rekomendadong barayti.

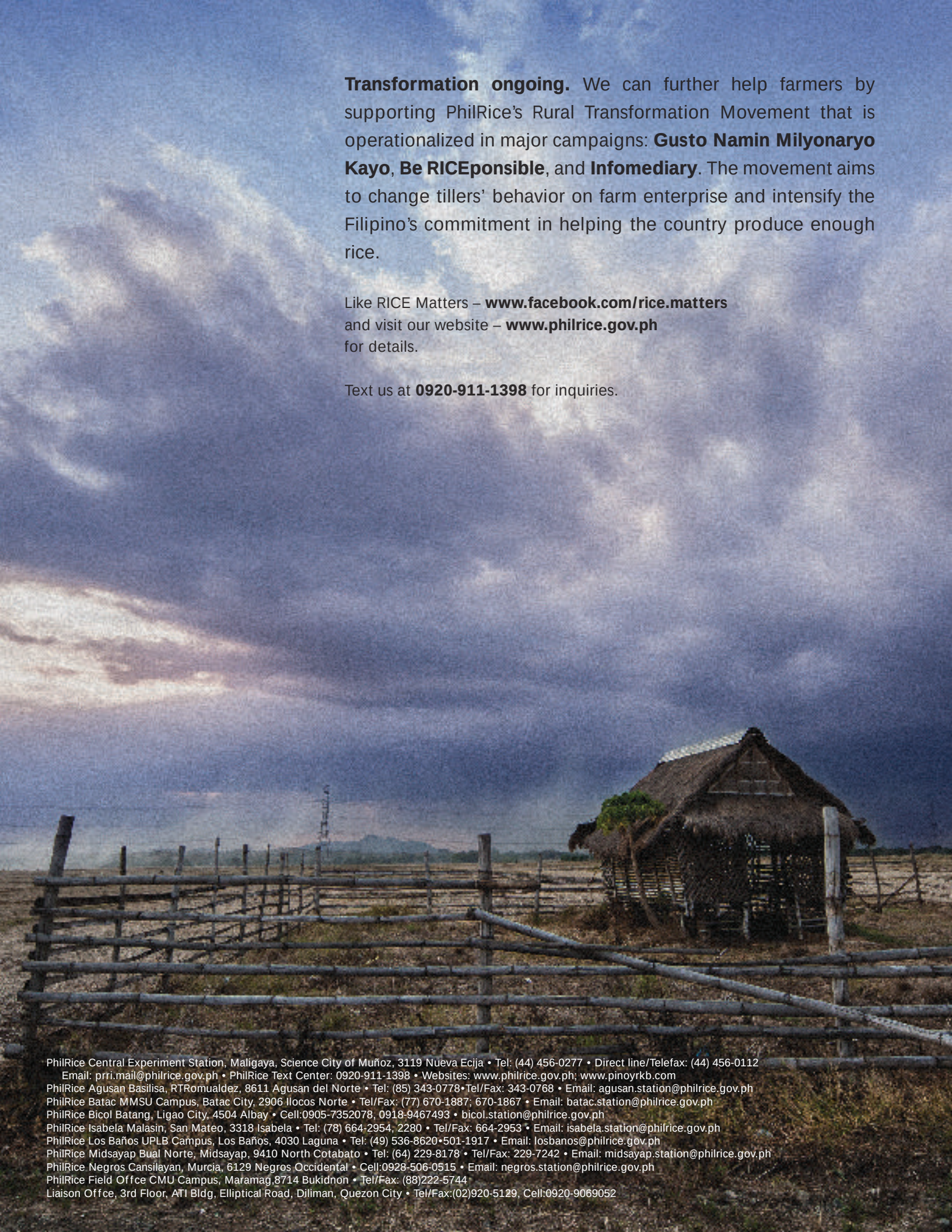
Kailangan na mahusay ang paghahanda ng lupang tatamnan at ang pagsisiguro na pantay ang lebel ng lupa upang mas mainam ang pamamahala ng tubig sa bukid.

Mahalaga rin ang paglalagay ng organikong pataba sa kamang punlaan upang maging malusog ang mga punla. Higit sa lahat, napakahalaga ang araw-araw na pagbisita sa bukid upang obserbahan ang mga organismo na mayroon sa palay tulad ng mga kaaway at kaibigang insekto para naman sa mahusay na pamamahala ng mga peste at sakit ng palay.

Sa pagtaas ng aking ani, tumaas din ang aking kita. Sa dalawang ektaryang aking pinagsimulan, pitong ektarya na! Apat na ektarya dito ay para sa pagbibinhi.

Dalawa sa aking mga anak ay nasa ibang bansa na. Ang aking manugang sa bunso ang katiwala ko sa bukid ngayon. Ang aking bunso ay tumutulong sa nanay niya sa aming palay-buying business. Sila ang nakikita kong magpapatuloy sa mga ginagawa naming mag-asawa.

Sa pamamagitan ng aking pagiging seed grower, naniniwala ako na natutulungan ko ang aking kapwa magsasaka na mapataas pa ang kanilang ani at kita. Kasabay din ang paniniwalang magkakaroon pa ng maraming istorya ng tagumpay ang mga magsasaka.



Transformation ongoing. We can further help farmers by supporting PhilRice's Rural Transformation Movement that is operationalized in major campaigns: **Gusto Namin Milyonaryo Kayo**, **Be RICEponsible**, and **Infomediary**. The movement aims to change tillers' behavior on farm enterprise and intensify the Filipino's commitment in helping the country produce enough rice.

Like RICE Matters – **www.facebook.com/rice.matters**
and visit our website – **www.philrice.gov.ph**
for details.

Text us at **0920-911-1398** for inquiries.

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: 0920-911-1398 • Websites: www.philrice.gov.ph; www.pinoyrkb.com
PhilRice Agusan Basilisa, RTRomualdez, 8611 Agusan del Norte • Tel: (85) 343-0778•Tel/Fax: 343-0768 • Email: agusan.station@philrice.gov.ph
PhilRice Batac MMSU Campus, Batac City, 2906 Ilocos Norte • Tel/Fax: (77) 670-1887; 670-1867 • Email: batac.station@philrice.gov.ph
PhilRice Bicol Batang, Ligao City, 4504 Albay • Cell:0905-7352078, 0918-9467493 • bicol.station@philrice.gov.ph
PhilRice Isabela Malasin, San Mateo, 3318 Isabela • Tel: (78) 664-2954, 2280 • Tel/Fax: 664-2953 • Email: isabela.station@philrice.gov.ph
PhilRice Los Baños UPLB Campus, Los Baños, 4030 Laguna • Tel: (49) 536-8620•501-1917 • Email: losbanos@philrice.gov.ph
PhilRice Midsayap Bual Norte, Midsayap, 9410 North Cotabato • Tel: (64) 229-8178 • Tel/Fax: 229-7242 • Email: midsayap.station@philrice.gov.ph
PhilRice Negros Cansilayan, Murcia, 6129 Negros Occidental • Cell:0928-506-0515 • Email: negros.station@philrice.gov.ph
PhilRice Field Office CMU Campus, Maramag,8714 Bukidnon • Tel/Fax: (88)222-5744
Liaison Office, 3rd Floor, ATI Bldg, Elliptical Road, Diliman, Quezon City • Tel/Fax:(02)920-5129, Cell:0920-9069052