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November 2016

Creating an online catalog of rice genes

Change is coming to Philippine agriculture

Improving the livelihood of Pakistan's basmati rice farmers

Searching for a new Mexican "rice miracle"

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About the cover

The 3K Rice Genome Project demonstrates the power of deep exploration of the International Rice Genebank and offers opportunities to understand the richness of rice diversity. The database derived from the 3,000 genomes, now available online, is being widely used by the global community and enables breeders to search for genes for specific geographic and climatic adaptation not present in the current gene pool of cultivated rice. (Photo by Isagani Serrano)

Rice Today is published by the International Rice Research Institute (IRRI) on behalf of the Global Rice Science Partnership (GRiSP).

IRRI is the world's leading international rice research and training center. Based in the Philippines and with offices located in major rice-growing countries, IRRI is an autonomous, nonprofit institution focused on improving the well-being of present and future generations of rice farmers and consumers, particularly those with low incomes, while preserving natural resources. It is one of the 15 nonprofit international research centers that are members of the CGIAR consortium (www.cgiar.org).

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A cathedral of rice

*A man came upon a construction site where three people were working. He asked the first, "What are you doing?" The man replied, "I am laying bricks." He asked the second, "What are you doing?" The man replied, "I am building a wall." As he approached the third man, he heard him humming a tune as he worked, and asked, "What are you doing?" The man stood, looked up at the sky, and smiled, "I am building a cathedral!" –Author unknown**

It is not difficult to see the bigger picture or a "higher purpose" if one works at the International Rice Research Institute (IRRI). Rice is the staple food for more than 3.5 billion people in the world including around 600 million people living in poverty. Moreover, rice is the fastest growing staple in Latin America and Africa. It is not hard to imagine rice research as a tool for easing poverty and hunger.

To learn more about rice being an entry point in poverty alleviation, see a South Asian map on *Rural poverty and rice* on pages 30-31.

Rice varieties that can withstand drought, flooding, and salinity are not only feeding millions of people in South Asia; it is also improving the livelihood of farmers and their households. Most of all, women farmers are becoming visible as economic contributors in a male-dominated society in which they are often relegated to secondary status within the household and fields. Some have even accomplished what was unthinkable only a few decades ago: becoming entrepreneurs and leaders in their communities. Read about these successful women farmers in *Three great heroes* on pages 37-38 and *Women on the path to progress* on pages 32-33.

Success stories like these have inspired young IRRI scientist Shalabh Dixit to pursue plant breeding. With microscopic genes as his building blocks, Dr. Dixit is constantly developing new rice varieties that he hopes will change the world in a big way. Learn more about him and his work on rice genetics on pages 22-24.

Speaking of genes, read about IRRI's plan to create an online catalog of rice genes from which breeders can choose from hundreds of thousands of genetic materials in the way people shop online (see pages 17-19.)

With the availability of rice farming technologies developed at IRRI plus the political will-of-steel of the newly elected Philippine leader, the new secretary of agriculture Emmanuel Piñol is positive that the country will attain its vision of rice self-sufficiency. (Read *Change is coming to Philippine agriculture* on page 10-13.)

In Mexico, the new rice varieties resulting from a public-private partnership have already started gaining ground. This year, they were sown on more than 3,000 hectares and will enter the Mexican market for the first time. (See *Searching for a new Mexican "rice miracle"* on pages 26-27.)

Similarly in Pakistan, a shining example of a public-private partnership is also making a difference in a program for improving the country's basmati rice not only for local consumption but for the export market. (Read *Improving the livelihood of Pakistan's basmati rice farmers* on pages 14-16.)

In Africa, read about a small dam in M'bé, Côte d'Ivoire, which became an instrument of helping more than 300 farming households survive a difficult time. Read *"Dam" good heroes* on pages 28-29.

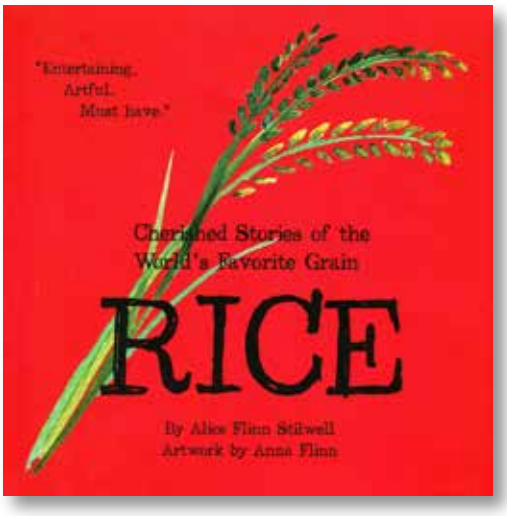
On the cultural aspect of rice, a Chinese rice legend and the great compassion of the goddess Guanyin is said to have created the staple food of half of the world's humanity. (See *Guanyin's gift: White rice, red rice* on pages 8-9.)

Lastly, learn how to cook *Arroz abanda* from Spanish chef Jose Luis "Chele" Gonzalez. Arroz abanda is an inspired combo of two great cultural heritages: a Philippine heirloom rice variety and the iconic Spanish paella.

Enjoy reading!

Lanie Reyes
Rice Today editor-in-chief

*www.storlietelling.com/2013/08/14/bricks-walls-cathedrals-a-story-bite-to-lead-with-vision/



Rice: Cherished stories of the world's favorite grain

by Alice Flinn-Stilwell

Published by Aster Publishing. 159 pages.

This collection of legends puts this cherished simple grain respectfully in the lead role. The 31 legends in this book come from 16 countries. The story covers the origins of rice, why it looks the way it does, and how it is produced, cooked, and eaten.

These rice legends include rich and dramatic tales about gods, miracles, thieves, hunger, and ordinary people. The book narrates in a most interesting way how rice came into being from various points of view inherently unique from the countries the stories are sourced from. The origins of rice are told from 16 countries around the world.

The book has fascinating narratives that depict, in one way or another, the cycle of growing rice. Each story teems with colorful characters culturally unique from each country. Some stories also center on the lives of rice farmers, their traditions and the tools used long ago in growing rice. And, the story-telling process inculcates values of industry, faithfulness, honor, and filial love. Diligence, discipline, and determination are among the lessons that can be derived in these stories.

Another group of stories has rice as food: its flavor and taste from the perspective of a culturally diverse cast of characters. Sweet and sumptuous rice cakes, which are common delicacies in many Asian countries, are among the many dishes that take center stage in this book.

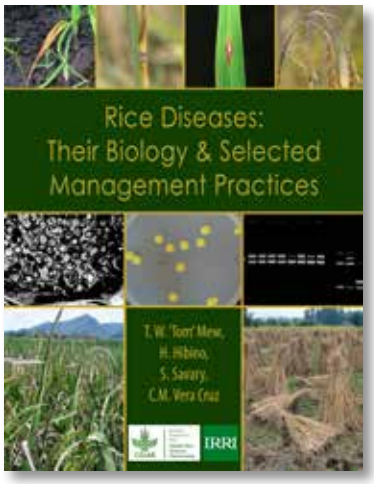
These stories were collected by the author as she traveled with her husband, John Flinn, a former agricultural economist at the International Rice Research Institute. ■

Single copies of the book are available through Amazon at www.amazon.com/Rice-Cherished-Stories-Worlds-Favorite/dp/0994323301. For bulk orders, please contact jflinn@jflinn.com.

Rice diseases: Their biology and selected management practices

by T.W. Mew, H. Hibino, S. Savary, and C.M. Vera Cruz

Published by the Global Rice Science Partnership (GRiSP)



This online resource is authored by 23 global rice disease specialists who are covering the importance of plant diseases in rice production, the biology of rice diseases, and selected rice disease management practices. It is published through GRiSP, the CGIAR research program on rice, with the assistance of partners: including the International Rice Research Institute (IRRI), Africa Rice Center, and the International Center for Tropical Agriculture (CIAT).

Part I covers the importance of rice diseases and their impact on rice crop production in Asia, Africa, and the Americas. Part II focuses on the biology of rice diseases caused by various pathogen groups and recent advances in research. The chapters on the biology of rice diseases provide information on most aspects of individual diseases in a condensed format. Part III covers disease management.

In a textbook format, this resource is not just a literature review of individual diseases, although around 3,500 references are cited throughout. A lot of information has been distilled into—or shown to be related to—plant pathology principles or new knowledge. It is hoped that graduate students—the new generation of rice researchers—will understand where the science in rice disease research is coming from and what progress has been made.

One of the central points in this resource is how the research evolved around "host specificity." This was done because IRRI scientists have been directly involved over the past decades and are still involved in such research. When this research started in the 1960s and 1970s, the question was—and still is—about host specificity, and how the pathogen prepares to invade or infect the host plant and how the host plant is prepared to defend the invasion or infection. This book aims to link the research starting from race-virulence to avirulence with effectors and receptors in recognition and specificity and with downstream signaling to understand how resistance operates at the cellular and molecular levels. ■

Special note:

Many sections and chapters are not available yet because technical editing is still ongoing. However, a soft launch of this online resource was made in time for two conferences on rice blast and bacterial blight held in Manila in October 2016. The launch featured the preface, the introduction (The future impact of rice diseases), and the latest information available on these two important rice diseases. See http://tinyurl.com/blast-blight. Additional sections and chapters covering nearly 70 other rice diseases will be put online as they are released by the technical editors. Watch for notifications *on the Rice Today website* about their availability.

by Chef Luis "Chele" González

Arroz abanda with Dona-al rice

Jose Luis "Chele" González is the only non-Filipino on the roster of "rock star" chefs who contributed to the award-winning 2016 Heirloom Rice Recipe Calendar—but you wouldn't know it from the way he extols heirloom rice.

"I am lucky to work in the Philippines with a new product that I had never seen or used before," said Chef Chele, who hails from Torrelavega, Spain. "When I found the heirloom rice varieties, I was so surprised. They have opened my eyes and make me feel something inside. I call them treasures of the Philippines."

Chef Chele's love for heirloom rice from the Cordilleras is compelling; it goes beyond his restaurants' kitchens. He plans to write a book about the glutinous heirloom rice varieties that he finds especially fascinating. "They have to be really studied and understood because each grain has a different 'personality'."

For now, he promotes heirloom rice through his restaurants, one of which, Gallery Vask, was recently named one of Asia's 50 Best Restaurants. Gallery Vask ranked 39th on the list, a major feat considering it opened just three years ago.

Chef Chele describes Gallery Vask's menu as modern cuisine meets Philippine ingredients. "We're working with local producers and sourcing the ingredients from indigenous communities," he said.

One of these locally sourced ingredients is Dona-al rice from Banaue, Ifugao. With its medium creamy white grains, Dona-al is a luxurious choice for traditional rice cuisines such as paella.

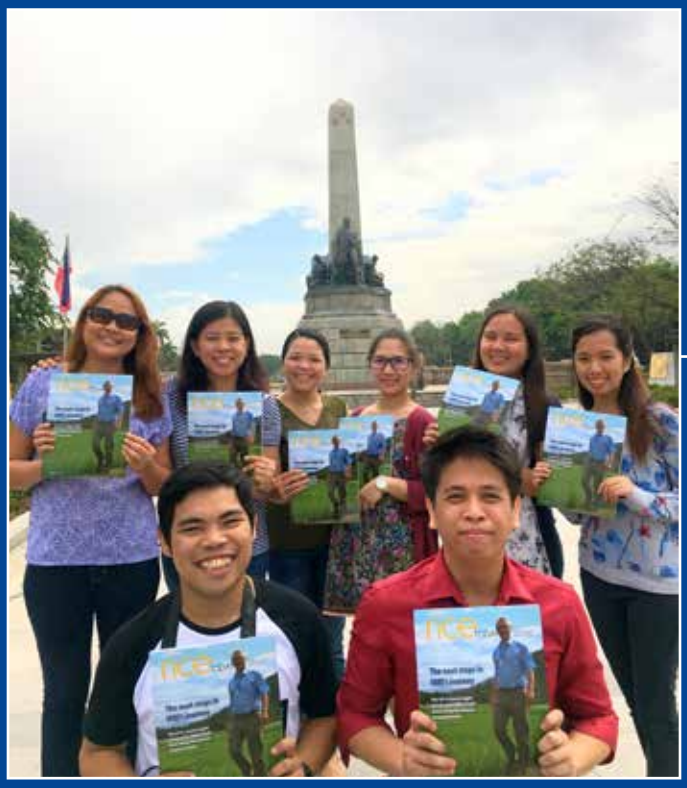
Chef Chele's *Arroz abanda*—one of the recipes he contributed to the calendar—is an inspired marriage of two great cultural heritages: heirloom rice and the iconic Spanish paella. ■

Ingredients (per person)
100 mL extra virgin olive oil
30 grams mussels
25 grams shrimps
30 grams *pusit lumot* (squid)
80 grams *maya-maya* (red snapper) fillet
3 grams garlic
100 grams Dona-al (heirloom rice)
1 gram paprika
3 saffron threads
30 grams tomato sofrito
250 mL fish broth

Preparation
1. Heat paella pan, add some oil, and cook seafoods just halfway. Keep aside.
2. Add more oil and then the garlic and cook for a few seconds.
3. Add the Dona-al rice and toast for 1 minute, then add paprika and saffron. Stir a bit, then add the tomato sofrito. Cook for 1 minute, add fish broth, then season.
4. Cook the rice for 8 minutes at high heat. Turn down heat to low or medium and cook for another 5 minutes.
5. Put all seafood on top. Cook for a bit more.
6. For *socarrat* (caramelized crispy crust on the bottom of the pan), increase the heat until all liquid is absorbed or the consistency is soft and wet, adding a bit more of the broth.

See video in which Chef Chele talks about his experience with heirloom rice: http://bit.ly/28Zq2M8.

rice TODAY around the world



RICE TODAY **honors Rizal. The team of the Philippine Rice Information System (PRISM) poses with *Rice Today* at the Rizal Monument, within which the remains of the Philippines' most celebrated national hero, Dr. Jose Rizal, are interred. The monument lies in the heart of Rizal Park, a historical urban park in Manila. Alice Laborte (*far left, in the background*), who leads the PRISM project at the International Rice Research Institute (IRRI), visited the monument with Neale Paguirigan, Creighton Guevarra, Ruvicyn Bayot, Jeny Raviz, Mary Anne Gutierrez, Ethel Banasihan, and Frances Amanquiton.**

RICE TODAY **with the big leagues. Gene Hettel (*foreground*), former *Rice Today* editor-in-chief, and his former college roommate, Bill Havelec, bring the magazine to the first game of Major League Baseball's American League Division Series in Cleveland, Ohio, with about 10,000 fans cheering in the background.**

SIZING UP deepwater rice. With *Rice Today* in hand, Hon. Melchor Petracorta, vice mayor of Limasawa in Southern Leyte, Philippines, checks the height of a deepwater rice plant during his visit to IRRI's Riceworld Museum and Learning Center. Deepwater rice varieties are grown during the monsoon season when severe flooding occurs and water depth exceeds 100 centimeters for several months. About 100 million people in South and Southeast Asia depend on this rice for sustenance.

Guanyin's gift: White rice, red rice

By Alice Flinn-Stilwell
Artwork by Joanne Flinn

At the beginning of time, there was no rice. There were plants that looked like rice, but they bore no grain. People then ate mostly fruits, which were plentiful. From time to time, they hunted animals for meat.

From high in the heavens, the goddess Guanyin, the Chinese Mother of Mercy, watched the world below. She sometimes visited Earth, the land of mortals, and, when there were problems, she tried to help. She hadn't been to Earth for some time but, checking down below, she saw that, all over China, people were searching patiently and carefully, high and low, on mountainsides and in valleys,everywhere there was land.

"What are they looking for?" she wondered. "And they look so unhappy."

She flew straight down to Earth. To her absolute horror, she found people thin and starving. All were greatly suffering. They were weak from searching vainly for food—especially the children. All were desperate.

Guanyin was terribly upset.

"Ai, yai, yai!" she cried, and compassionate tears dropped from her dark eyes.

"These poor people! How can I help?" she said, looking around for inspiration.

The majestic craggy mountains gave her no clue. The mighty rivers did no better. She looked hopefully at spreading, gnarled trees, and at bamboo thickets, but to no avail. No solution came to mind.

"What can I do for these people?" she asked.

Then, in the open countryside, Guanyin saw grassy reeds growing beside well-trodden paths.

"These are humble, useless weeds," she said to herself. "But they will help."

She picked some of the grasses and gently opened her gown to expose her beautiful pale bosoms. Guanyin pressed her breasts and milk flowed, dropping onto the empty ears of grass. Soon the milk stopped. The grass quivered.

Guanyin was determined to provide food for the starving people. She continued to press until the drops of milk were streaked with blood. When she could really give no more, she finally stopped.

Then Guanyin called over the land so all the people could hear.

"Listen, all people. Your plight has been dreadful and you deserve better. This humble plant, which I give to you all, will grow vigorously. It will bear grain with abundance and will feed every one of you all the time."

Pleased with her efforts, Guanyin floated back to the heavens to join the other goddesses and gods.

And that is how rice came to be and how the food of life came to be colored—some as white as the milk of Guanyin's breasts, and some red where blood streaked her milk of mercy.

Ms. Flinn-Stilwell is a writer based in Hobart, Australia. This story is part of her book, Rice: Cherished stories of the world's favorite grain, a collection of 31 legends about rice and the many customs associated with this amazing grain.

See book review on page 5.

Change is coming to Philippine agriculture

by Paula Bianca Ferrer and Alaric Francis Santiaguel

DR. JACQUELINE Hughes (*in blue blazer*), IRRI's deputy director general for research, briefs Secretary Piñol (*center*), on the institute's research, technologies, rice varieties, and other products during his visit in May. Also in photo is Dr. Tolentino (*extreme right*). (Photos by: Isagani Serrano, IRRI)

In May, the Filipino people elected Rodrigo Duterte as the 16th president of the Philippines. Wildly popular, and often controversial, the tough-talking President ran on the campaign promise of "change is coming" to all aspects of the country's affairs, including the agricultural sector.

Providing support services to small farmers to improve their productivity is part of the Duterte administration's national economic plan to develop the rural areas. The new government aims to achieve rice self-sufficiency "within one to two years" by intensifying domestic production, according to statements made by Peter Laviña, the president's spokesman, to Reuters.

The man President Duterte appointed to do the job is Emmanuel Piñol, the new secretary of the Department of Agriculture (DA). Secretary Piñol, a former provincial governor of Cotabato in Mindanao, calls himself a "hands-on farmer."

"I know how to plow the field using a carabao, how to plant rice, and I breed chicken and goats," he said in a DA media release. "I've been a local government official, I've been aware of the dreams and aspirations of the Filipino farmer.

"The next administration will exert all efforts and use all resources for the country to attain rice self-sufficiency," he added. "It could be during President Duterte's term or maybe the next, but we will lay the foundation of a sustained and well-planned agriculture to attain rice self-sufficiency."

The secretary believes that Filipino farmers could easily fill the 1.18 million tons of rice deficiency if all farms in the country increased their production by 1 ton per cropping season.

To achieve food security, part of Piñol's strategy includes the rapid and effective transfer of technologies to farmers, easy credit schemes for farmers, and efficient marketing of farm products. He stressed that it would be the farmers themselves to decide what they need to improve their production.

"It will always be the farmers' choice," the secretary said. "What variety they want to plant, what fertilizers to use, and what equipment. We are just here to suggest and provide the assistance they need, following a sound assessment and validation."

In July, Secretary Piñol visited the International Rice Research Institute (IRRI) for an overview of its research, technologies, rice varieties, and other products that could help make food available and affordable to all Filipinos and improve the lives of farmers.

Feeding more Filipinos

With a new government in place, the Philippines seeks to ensure that food becomes more widely available and affordable to many families.

No country can realize its full potential—with its citizens being responsible and productive members of society—without having enough affordable and nutritious food. To make food more widely available and affordable, Secretary Piñol laid out his blueprint for achieving food security. The strategy came into fruition after realizing that many Filipino families still struggle to meet their day-to-day food needs.

Filipinos eat rice three times a day. A sharp increase in its price usually leaves most low-income families with little or no money left for meat, fish, or vegetables necessary for a healthy diet. Even with a modest population growth rate of 1.61% in 2015, the mission of feeding millions in the country is not without its challenges, especially considering its limited land area compared with its Asian neighbors.

Focus on farmer

Filipino farmers are not as globally competitive as farmers in other Asian countries because of higher production costs and having longer periods for transplanting and harvesting. But, they have an important role to play in ensuring that food becomes more widely available and affordable to most middle-income and low-income families.

DR. GEORGINA Vergara, Next-Gen Project lead, presents some of the modern varieties developed for the major rice ecosystems in the Philippines.

During his visit to IRRI, Secretary Piñol was interested in bringing advances in rice production developed through IRRI's research to the farmers "so we can focus on food production and poverty alleviation," which is a cornerstone of President Rodrigo Duterte's administration. (See box on page 13.)

"Technologies are useless unless they are in the hands of farmers," said Secretary Piñol.

IRRI Deputy Director General for Communication and Partnerships Bruce Tolentino emphasized this as the reason why other Asian countries such as Thailand and Vietnam have made so much progress in rice production. Although IRRI and the University of the Philippines Los Baños—historically the most advanced agricultural institutions in Asia—are located in the country, the technologies being developed here are either not being used or are used by only a few.

"I can assure our partners in IRRI that your work will not go to waste," said Secretary Piñol. "I would like to make sure that each advancement in technology would be translated into a better life for the Filipino farmer."

(*Left to right*) Secretary Piñol checks out the International Rice Genebank, packed seeds of modern rice varieties, and the flood-tolerant scuba rice.

New hope from heirloom rice

Among other things, Secretary Piñol is zooming in on the problems affecting the country's upland areas (photo at right). His experience as former governor of North Cotabato, one of the food baskets in Mindanao, brought him to the mountainous areas in his province, "where poverty is," according to Secretary Piñol.

Most of the country's uplands suffer from high incidence of poverty. Indigenous people that inhabit the uplands are among the poorest in the country, according to the International Fund for Agricultural Development (IFAD).[1]

The roots of poverty in the uplands are complex. Subsistence-oriented agriculture with low productivity and profitability contributes to the situation. Small farm areas combined with unsustainable practices have led to the degradation of the highly fragile and vulnerable ecosystems of the uplands. IFAD reported that rural areas lag behind in economic growth and they have higher underemployment, partly because of less access to productive assets and business opportunities, and a lack of nonfarm income-generating activities and access to microfinance services and affordable credit. High illiteracy rates among the indigenous people and the encroachment of modern technology and cultures onto their traditional norms and practices aggravate the situation.

Traditional rice returns

In recent years, heirloom rice varieties have made a resurgence in the market. Under the Food Staples Sufficiency Program of the DA, IRRI works with the Philippine Rice Research Institute, the department's regional field offices and local government units in the Cordilleras in northern Luzon and Region XII in Mindanao to help upland farmers conserve traditional rice varieties and link them with local and foreign markets.

"The Heirloom Rice Project not only helps preserve and promote Filipino cultural identity," said Casiana Vera Cruz, the project leader. "It also aims to improve the quality of life of Filipino farmers economically and socially."

The new agriculture chief, a farmer himself, sees the role of traditional rice varieties in helping improve the plight of upland farmers.

"Heirloom rice should be considered as a high-value crop." Secretary Piñol said. "Tinawon is very saleable. They are selling it at four times the price of ordinary rice. If they could produce only a quarter of the production in the lowlands, they would be earning the same. What we intend to do is to develop these (traditional rice varieties) in the upland areas where the beneficiaries would be the indigenous peoples so that they could make more money.

"We need a proposal on how we can expand the production of traditional rice," Secretary Piñol said to Dr. Vera Cruz. "Give me a proposal on how we can expand the seed production in the upland areas and train indigenous people in cultivating these rice varieties and farm management. Then we go marketing." ■

DR. CASIANA Vera Cruz , Dr. Tolentino, and Secretary Piñol discuss the role of traditional varieties (*see photo above*) in easing the poverty in the country's highlands.

Ms. Ferrer is science communication specialist at IRRI. Mr. Santiaguel is managing editor of Rice Today.

[1] http://operations.ifad.org/web/ifad/operations/country/home/tags/philippines

Technology on display: A glimpse of Philippine agriculture's future

Climate-proof rice

Recognizing the threats of La Niña and the recent El Niño, Secretary Piñol stressed the importance of establishing food centers in critical areas of the country with enough supplies to last at least six months. But to do so, farmers need to be equipped with rice varieties that can withstand flooding, drought, and salinity, among other negative effects brought about by climate change.

The NextGen project under the DA-IRRI collaboration aims to breed varieties that not only yield well, but also can adapt to those stresses. Breeding lines are tested in different locations in the country before being officially released as commercial varieties.

Moreover, the farmers are involved in varietal selection, thus giving them a say in determining the cooking quality and other characteristics of rice that are important to them.

Water management

Secretary Piñol noted that the country squanders many of its resources, the most important of which is water. "We are a country with six months of rains, typhoons, and flooding; then there are three months of dry spell when we cry for water," he said. "We need to come up with a good plan to conserve water. We need a program on how to preserve La Niña water for the coming season."

At IRRI, the secretary took notice of a simple perforated plastic pipe that can be used by farmers to conserve the use of water in growing their crops. The contraption is used under the best management practice developed by IRRI water scientists known as alternate wetting and drying (AWD). It can reduce water use in producing rice by as much as 35%. The AWD technology can be used for larger irrigation schemes but it is also just as useful for rice farmers who rely on pump irrigation. AWD use means greater farming incentives as lower water consumption translates right away into savings on fuel cost and higher net income for farmers.

Crop management

Next to water, crop management—especially for fertilizer—is also critical in producing a good rice harvest. In July, Secretary Piñol sought more than USD 12 billion (PHP 62 billion) to fund the improvement of fertilizer, seeds, and crop insurance for four coming planting seasons stretching from September 2016 to April 2017.

In the current DA-IRRI collaboration, rice farmers are not only able to use fertilizers more efficiently, but also can manage their crops better through site-specific recommendations using the Rice Crop Manager (RCM). The RCM can give farmers specific advice on what type type of fertilizer to apply, when to apply it, and how much of it to apply at each growth stage of the crop. In this way, farmers have better chances of getting higher yields.

Satellite technology

Another DA-IRRI collaboration, the Philippine Rice Information System (PRISM), monitors pest and disease outbreaks and damages as well as flood- or drought-damaged fields through a combination of geographic information systems, remote sensing, and appropriate crop modeling tools. PRISM provides potential yield estimates based on crop health assessments or the impact of adverse climatic conditions such as flooding or drought on rice.

Also, PRISM can produce maps of rice growing areas—along with estimated planting dates—often to a degree of reliability supported by official statistics at the municipal level. The images are likewise validated by DA regional officers, who visit the fields to collect data and send the information to a centralized database.

Grain storage

Often, seed producers complain about inadequate storage facilities to ensure that rice seeds can last up to about a year, Secretary Piñol noted.

Engineer Martin Gummert, head of the postharvest unit at IRRI, showed the secretary several postharvest technologies during his visit (photo). These included the Superbag, a durable plastic container designed to keep seeds dry and protected from insects, rats, and molds.

Mr. Gummert also demonstrated the solar bubble dryer (SBD) that dries grains inside a plastic dome to protect them from rain. The SBD can dry grains to a moisture level of 10–13%, depending on the prevailing weather conditions. It can also run on solar power. Other technologies that were shown included a transplanter, a drum seeder for sowing pregerminated rice, a combine harvester, among others, all intended to reduce the labor requirements of rice production.

Foot soldiers of technologies

Confronted by multiple challenges, Secretary Piñol sees the crucial role that extension must play in making food ultimately more available and affordable for most Filipinos.

The IPaD project focuses on building the next generation of Filipino extension officers. The DA plans to expand the project to support increasing rice production to ensure rice self-sufficiency. Under the IPaD project, agricultural extension officers learn both the technology side and the business side of rice production.

"We don't just recommend that farmers plant rice from A to Z, but that they also make money while doing it," said Director Edmund Sana of the National Rice Program. ■

RPL

FROM CROP PRODUCTION TO MARKET: Improving the livelihood of Pakistan's basmati rice farmers

by Gene Hettel

A program for improving Pakistan's basmati rice for the export market is a shining example of how the public and private sectors can work together to make a difference.

An improvement program in Pakistan for aromatic basmati rice has become the most complete contract farmer system that Joe Rickman has seen in his more than two decades of working with the International Rice Research Institute (IRRI) in various capacities. Involved in the program over the last 5 years, Mr. Rickman, currently an IRRI consultant, believes it shows how the public and private sector can work together to make a difference.

"In the program, farmers are being rewarded for growing high-quality basmati rice," he says. "At the same time, the effort is enabling Rice Partners Limited (RPL), an international rice milling company headquartered in Islamabad, to process and sell the product to the European operation of the international food conglomerate Mars, Inc., which is happy to have a robust, high-quality rice supply route in place while supporting small-scale farmers."

Bringing farmers and the market together

The program has brought together hundreds of basmati rice farmers in Punjab Province (see map), RPL with its farmer contacts, Mars with its market knowledge, and IRRI with its technical knowledge and skills. It has resulted in the improved quantity and quality of Pakistan's basmati rice production. Started in 2011 with just 27 contract farmers, the program grew to include 428 farmers in 2015.

"We are on track to have more than 1,000 contract farmers and sell 20,000 tons of brown basmati rice in Europe via Mars' Uncle Ben's® products by 2017," says Mr. Rickman. "After that, we hope to reach out to an additional 15,000 basmati growers in Pakistan."

Public and private sector working together

The program was intensified when IRRI first began working with Mars and RPL. In October 2013, 12 associates from the Mars Ambassador Program came to IRRI to learn firsthand how to grow rice and help farmers improve crop yield and quality. Then, after "having walked in the farmers' shoes" by preparing the land, planting, harvesting, processing, and milling rice at IRRI, they—together with RPL officials and IRRI experts—developed a strategic plan for the improvement program. The aim was to enhance the basmati farmers' productivity and the quality of their crop while, at the same time, increasing their efficiency in input use, especially water and chemicals.

Also in 2013, Bayer Crop Science assisted with financial support and provided farmer training on pest management.

RPL oversees and supports the rice production through a contract grower scheme, procures the paddy from the individual farmers if it meets standards, and then ages and mills the brown rice before selling it to Mars for the European market. Very importantly, farmers receive cash benefits for their quality rice as a premium over the regular market price rate and they enjoy being paid immediately after harvest.

Keeping records setting benchmarks—lynchpin of the program

"RPL currently employs eight quality control officers (QCs), which I trained by helping them to develop a rice check and log book system," says Mr. Rickman. "These QCs, such as Farooq Ahmed and M. Yaqoob (photo), visit farmers every 7-10 days to check on the crop, give advice, and record what is happening in the field. They record all inputs and keep them on a central log book and database at RPL."

Experience has shown that one QC officer can effectively work with up to 50 farmers. "If we increase the number of farmers above 50 per QC then we will decrease the effectiveness of the program and quality will suffer," says Ali Tariq, RPL's CEO. "Obviously, our target is more farmers. But to do this, we will need to increase our existing resources as it is already quite a tough job to monitor the farmers we already have."

IRRI and RPL have developed a rice crop check system, which is used as a benchmark for both farmers and QCs to follow. "The farmers are supported by recommendations on all agronomic and harvesting aspects of rice farming," says Mr. Rickman. "Because aflatoxin and pesticide residues have been the major reasons that grain lots are rejected in Europe, the check system has been introduced to alleviate these problems by providing farmers with information on economic injury levels, withholding period after spraying, and recommendations on harvesting and drying."

Using these quality standards for the paddy, RPL has established the purchase standards for basmati rice. If a contract grower does not meet these standards, the crop is rejected and will then have to be sold on the local markets at a reduced price.

Mutual benefits

"Farmers are developing more sustainable agronomic practices that positively affect productivity and the environment while we are obtaining a high-quality and safe food product delivered to our factories and customers in Europe," says Luc Beerens, European procurement manager at Mars in Rotterdam. "It is also an opportunity to test and audit the Sustainable Rice Platform standards in the real world. With basmati yields in Pakistan being currently half of those in neighboring India, it is a perfect opportunity to make a huge difference."

The success of the program is already evident. "When the program first started, the rejection rate of basmati rice shipments into Europe was as high as 80%," says Mr. Beerens. "In 2013 and 2014, this declined to 25% and 8%, respectively."

Farmers have already benefited financially. "Those who follow the guidelines and sell their crop to RPL receive a 10% premium above local market value, points out Mr. Tariq. "And they are paid within 24-36 hours of delivery with all transportation costs covered by RPL."

Farmers getting in the queue

With this level of support offered by RPL and Mars, it is little wonder that new farmers are lining up on a daily basis to join the program. In 2015, RPL signed up two women farmers and is continuing to look for ways to improve the gender balance of the program.

"Simple things such as counting the number of seedlings established, weed management advice, and understanding the quality traits have all contributed to the farmers' knowledge," says Mr. Rickman. "They also look forward to the security of signing a new contract with RPL each year."

Farmer testimonials

Indeed, local farmers like the program. "I've been an RPL contract farmer for the last 4 years," says Mubasahar Naveed Wagha from Khairpur Mallian Village. "RPL respects us. Their QCs visit us regularly during both the sowing and harvesting seasons. We get very good prices and their method of payment is swift. God bless them all."

"For the 3 years that I have been a contract farmer, the RPL team has guided me on proper farming practices," says Asghar Mujahid also from Khairpur Mallian. "They gave me free seeds. They visited me weekly and gave me fruitful advice through their training programs and

FAROOQ AHMED and M. Yaqoob check the crop of basmati rice farmer Ashiq Hussain. (Photo: RPL)

RPL IS LOOKING to improve the gender balance of participating farmers. Here, the first women farmers, Shadan Bibi (*left*) and Khursheed Bibi (*right*), sign a RPL grower contract. (Photo: RPL)

rice experts. My yield has improved. We are thankful that RPL has liberated us from the middlemen. I am especially thankful to Mr. Tariq who has done a lot for our village."

Next steps

"While we feel that many of the quality issues that we initially faced have been overcome, we now need to start working on getting higher mill outs from the rice in farmers' fields," says Mr. Rickman. "At the moment, RPL is exporting less than 45% of the combined-harvested rice. Our aim is to get this up to 60% by working more closely with the combine operators and farmers during harvest and the RPL rice mill during processing."

One major part of the problem is that the crop is being harvested too early, which increases the number of green and immature grains. Also, many combines are not set up and/or operated correctly, resulting in threshing losses of more than 200 kilograms per hectare and a harvest that contains damaged grains and trash.

RPL will be involving more farmers in its small demonstration and field testing site. Here, comparisons can be made between different production systems such as transplanted and seed-drilled rice, planting rates and land levelling. "In the future, we will introduce variety testing, which will add further to the knowledge available to the farmers," says Mr. Tariq.

By working in this program with the RPL-Mars-IRRI team, farmers have already become keenly aware that quality seed is an important issue. Mars' European market requires that the super basmati rice must be 95% DNA pure, which means that seed must be 98% pure.

In 2016, RPL has looked at ways to begin the production of its own breeder seed to ensure that the 98% purity level can be maintained. And IRRI has been working on introducing disease resistance and submergence tolerance into the existing basmati varieties. ■

Mr. Hettel is an IRRI consultant.

IRRI CONSULTANTS Joe Rickman (*second from right*) and Sarkarung Surapong (*third from right* who came onboard in 2015 to help identify varieties to multiply for distribution to farmers) with RPL team members in Punjab Province. (Photo: RPL)

Digital genes

by Alaric Francis Santiaguel

An ambitious project plans to create an online catalog of rice genes in which breeders can choose from hundreds of thousands of genetic materials in the way people shop on the Internet.

The International Rice Genebank (IRG) is the Fort Knox of rice biodiversity. Established in the early 1960s at the International Rice Research Institute (IRRI) in the Philippines, it holds the largest and most diverse rice germplasm in the world. Currently, the collection houses more than 127,000 rice samples that include generations-old heirloom and obsolete varieties, modern varieties developed during the Green Revolution, breeding lines and special genetic stocks, and wild rice species.

The genebank ensures the long-term preservation of this important diversity as many traditional varieties and wild rice species are being lost as farmers shift to planting modern rice varieties. From 1981 to 1990, IRRI helped Cambodia to restock 766 traditional rice varieties that had been lost from samples in the genebank because of the country's conflict.

"This is such a compelling example why genetic conservation is so critical, particularly for countries such as Cambodia that are so reliant on agriculture and, in this case, so reliant on rice production," said Glenn Denning, a former agronomist at IRRI. (See *Revisiting Cambodia's "Killing Fields" 30 years later* on pages 22-29 on *Rice Today* Vol. 15, No. 1.)

Tip of the genetic iceberg

However, preserving rice biodiversity is just the tip of the IRG iceberg. The real story goes beyond the staggering rice collection it houses. The IRG is a galaxy of uncharted genes. Each variety holds within it genetic materials that could be pivotal to the world's food security in the coming decades of climatic uncertainties.

In the past decades, rice breeders have used less than 5% of the germplasm collection in the IRG in active breeding efforts, according to Ruaraidh Sackville Hamilton, head of IRRI's T.T. Chang Genetic Resources Center. (See *Dawn of a new era in rice improvement* on pages 24-27 on *Rice Today* Vol. 13, No. 3.)

"We have not been more efficient in using more diversity in plant

breeding," said Hei Leung, head of the Genetics and Biotechnology Division at IRRI (photo). "We have been relying on a few major varieties such as the popular IR64."

IR64 and other rice mega-varieties such as IR8, IR36, and NSIC Rc158 are a spectacular success. But, using a limited number of varieties for breeding produces a narrow genetic spectrum that makes many modern rice varieties more vulnerable to pests and diseases, Dr. Leung explained.

"For example, IR64 is extremely sensitive to drought," he said. "IR64 has been good for many years but we have seen the variety succumbing to disease and pest problems in recent years. You really need to bring in genetic diversity in the future development of rice varieties."

A key to the fort

The first step to unlock the full potential of the IRG is the 3K Rice Genome Project (3K RGP)[1], a collaboration between IRRI, BGI in Shenzhen, China, and the Chinese Academy of Agricultural Sciences (CAAS). The project has sequenced 3,000 rice genomes of varieties and lines from the collection in the IRG and CAAS's genebank. In 2014, data from the 3K RGP were released as a global public good and they provide rice breeders and geneticists with a foundation for large-scale discovery of new and important genetic materials for developing tougher and more productive varieties.

The 3K RGP demonstrates the power of deep exploration of the genebank and offers opportunities to understand the depth of rice diversity and the population structure of rice types important in breeding. The SNP-Seek database[2] derived from the 3,000 genomes is being widely used by the global community as shown by the large number of accesses. This enables breeders to find genes for specific geographic and climatic adaptation not present in the current gene pool of cultivated rice.

Although a true milestone in rice breeding, the historic 3K RGP probably reveals less than 29% of the rare alleles in the genebank. Alleles are different versions of the same gene. For example, the famous *SUB1* gene enables rice to survive floods for up to two weeks. It is possible that several alleles of this critically important gene exist and one version could give rice plants the ability to survive floods for a longer duration. A better allele could give rise to newer flood-proof varieties for the 20 million hectares of rice land in Asia. These areas are regularly devastated by floods that are predicted to occur more frequently and that could last longer because of climate change.

The discovery rate from the 3K RGP indicates that breeders have only just begun to mine the opportunities to be uncovered by more comprehensive sequencing.

"We need to sequence additional varieties to capture more rare alleles that are potentially important," Dr.

[1] http://iric.irri.org/resources/3000-genomes-project
[2] http://oryzasnp.org/iric-portal/

Leung said. "If we can sequence all the varieties in the IRG—10,000 genomes to start—we can multiply the capacity to extract new diversity. This is a bold and ambitious objective."

Once the additional 7,000 genomes have been deciphered, it is expected to reveal an additional 15% of the rare alleles in the collection. The information will be added to the existing 3K RGP dataset online, thus creating a virtual counterpart of the IRG that would be available to all breeders via the Internet, free of charge: the Digital Genebank.

The Digital Genebank

The Digital Genebank would be to rice breeders what online shopping sites (such as Amazon, Alibaba, and eBay) are to many consumers today. And, it will offer them the same advantages: accessibility from any location, convenience, and speed.

"When breeders walk into the genebank, they usually ask which line to use," Dr. Leung said. "They don't know what they are getting. Breeders would grow maybe a few hundred to thousands of lines per year to find some new materials for their breeding program."

With the Digital Genebank, breeders can focus on a small portion of the genebank to identify potentially useful genes—such as for tolerance of flooding or drought, or for resistance to pests or diseases—using a computer and study them more thoroughly. The process, called "allele mining," significantly reduces the time and effort in identifying these important traits.

"That's when you can start exploring new genetic diversity to increase the resilience of rice to adverse environments," Dr. Leung said.

"Taming" wild genes

One of the most exciting uses of the Digital Genebank is the mining of the wild rice germplasm.

"No one takes care of wild rice but it is out there," said Flora De Guzman, manager of the genebank. Obviously, wild rice species are genetically wired to thrive in environments free from the features of cultivation: irrigation, fertilizer, and pesticides. Those genes can be useful in developing future rice varieties that can better tolerate future environments.

"For example, right now, we don't have resistance to stem borer in our breeding programs," Dr. Leung added. "Our job is to determine how many lines in the Digital Genebank have that resistance."

Among the important traits of genes of interest found in wild rice that the Digital Genebank could help breeders identify are the sheath blight resistance of *Oryza barthii*, the stem borer resistance of *O. longistaminata*, and the grassy stunt virus resistance of *O. nivara*, along with the yield-enhancing genes of *O. rufipogon*.

Sowing digital genes in Myanmar's rice fields

The Digital Genebank promises enormous potential to help make a more stable world for farmers everywhere.

A major target of this global initiative will be concentrated on Myanmar, where rice production needs sustained support. Over the past 60 years, the country's climate has been experiencing higher mean temperature and increasing frequency of erratic weather patterns such as greater rainfall in most areas and more dry spells in some areas. The late onset and early termination of the southwest monsoon have also been observed. Overall, there has been an increase in extreme weather events and a rise in sea level, according to the Global Climate Change Alliance.[3]

For Myanmar, the tailored combinations of traits conferring tolerance for flooding, salinity, and drought will be particularly important. Armed with the Digital Genebank, rice breeders can then work toward producing new varieties that will directly benefit farmers.

The project will enable Myanmar's national breeding programs to develop new rice varieties with stress tolerance, higher yield, and better grain quality that best suit local needs and conditions. These improved varieties will help alleviate poverty for rice farmers who are battling increasing farming pressures. ■

Mr. Santiaguel is the managing editor of Rice Today.

[3] www.gcca.eu/national-programmes/asia/gcca-myanmar

With a *tirador* (a Filipino word for slingshot) hanging on his neck, a child plays along the bunds of a rice field in the Philippines. Modern agriculture has contributed to the betterment of farming households. Higher productivity and profits translate to better nutrition, education, and lifestyle for farmers and their families. (Photo by Isagani Serrano, IRRI)

Shalabh Dixit:
The link between rice genes and rice farmers

by Alaric Francis Santiaguel

A quantitative trait locus (QTL) is an incredibly small section of DNA that, in the hands of critical-thinking scientists, has the potential to change the world.

DR. DIXIT (*left*) briefs Takehiko Nakao (*right*), president of the Asian Development Bank, on flood-tolerant rice at IRRI's headquarters in Los Baños, Philippines. (Photo by Isagani Serrano, IRRI)

A QTL is a segment of an organism's DNA that contains a gene or genes linked to a particular trait. In the rice plant, for example, it can control height, built-in resistance to a disease, or the ability to produce more grain. It is within this complex inner universe of genes and DNA strands where Shalabh Dixit works in his role as a scientist in the International Rice Research Institute's (IRRI) Plant Breeding Division. He searches for untapped genetic materials to develop new rice varieties that are tougher and more productive.

Dr. Dixit, 32, grew up in Chhattisgarh, also known as the "rice bowl" of India. His home state accounts for more than 9% of India's total rice area and it has more than 20,000 recorded rice varieties. Although he doesn't come from a farming family—his father is an orthopedic surgeon and his mother is a retired school teacher—Dr. Dixit has rice science flowing in his veins. His passion for rice genetics is rooted in his childhood years.

"A large part of Chhattisgarh, more than 80%, is rainfed, and drought is one of the major problems affecting farmers," he points out. "Growing up there, I have seen the impact of environmental stresses. When I started doing rice breeding and drought research, I was able to immediately connect with that time back home when I saw all the problems and crop losses due to drought."

Agriculture was not his first career choice but you wouldn't know it when you see his commitment to his chosen profession. Once he gets into it, there is no stopping him. In an interview, Dr. Dixit talks about his work that links the microscopic

world of rice genes with the farmers who grow one of the world's critically important staple crops.

Why is your work in enabling rice to thrive under various environmental stresses important?

I am a geneticist and a plant breeder. I previously worked on developing drought-tolerant rice and, more recently, started working on flood-tolerant rice. Our work is important in our present-day scenario because incidences of drought and flooding are increasing due to climate change. I believe we need more rice varieties that are not just tolerant of drought but of flood and salinity as well, and at the same time, resistant to diseases. Multiple-stress tolerance in rice varieties is a must to ensure the stability of rice production in increasingly unpredictable weather scenarios. It is time to start thinking about raising the bar and developing varieties that have a minimum set of traits that relate to yield stability and quality.

Why are you focusing on rainfed or unfavorable areas rather than on irrigated or favorable areas?

Large rainfed areas are planted with rice varieties that were not developed strictly for rainfed areas. The first Green Revolution in the 1960s produced IR8 and its successor rice varieties for irrigated fields that were highly responsive to fertilizer and high yielding. These varieties spread rapidly across the rice-growing regions, including rainfed areas. But these varieties break down when stresses occur and don't yield much. That's why stress-tolerant high-yielding rice varieties designed specifically for rainfed areas are so important.

Major breakthroughs are still needed for the favorable irrigated rice environments as well but my interest has been in the rainfed ecosystem. I connect better to it maybe because I have seen the problems firsthand back home. Rice yields are low in these areas. There is a big gap in yield potential between rainfed and irrigated environments, which makes it important to focus on the former. These areas are also home to the poorest farmers. If we can close this gap, even by a ton per hectare, then we can produce a lot more rice to feed future populations and make an impact targeted to the most deprived members of society.

Another new scenario in recent years is the increasing occurrence of environmental stresses in favorable rice areas. These areas need stress-tolerant varieties also because climate change will eventually affect them. For example, irrigation water is becoming scarcer. Flooding and salinity can happen in these areas as well. It looks like it is not going to be about favorable and unfavorable ecosystems individually in the future. Instead, it will be about finding a set of traits that allow the varieties that have them to thrive no matter where farmers grow them.

What is the best thing about your job?

I have mostly worked in identifying and mapping QTLs and genes and developing products that contain them. A mapping population is a specific kind of population you develop by crossing two parents—one tolerant and one susceptible—primarily to identify the QTLs. It's not necessarily to release a variety right away; however, that does happen.

For example, while we were doing the mapping, we saw some lines that looked to be promising. We pulled out some promising lines from my mapping population, continued making selections, and a new line of drought-tolerant rice was released as a variety (IR91648-B-20-B-3-1) in the Philippines in June 2016.

The normal process is to identify a QTL and put it in a recipient variety. Usually, we refine it more by using different breeding procedures before we actually develop a product. But, that one line already had a potential for release; it just needed some selection and purification—a stroke of luck. [See a video featuring former IRRI breeder Peter Jennings who made the cross resulting in IR8, about luck being the residue of design at https://goo.gl/hsebvt.] It doesn't happen very often when working with these complex traits in rice.

The most beautiful thing is when you put a QTL in a variety and it performs the way you want it to and it's something new that you created. Every time I make crosses, and this works when I test the progeny, it gives me the most amazing feeling. It is the feeling of developing something new that connects my genetic work with developing products that could change millions of lives in the real world!

Breeders had no idea how large the impact would be when they developed IR8, the first semidwarf variety that started the Green Revolution in rice, or the recently released flood-tolerant Sub1 lines. Now, the Sub1 lines are planted on millions of hectares around the world. I am working to develop a product with the same potential—this is the most important thing that keeps me going. Whenever I identify a QTL, develop a population or a breeding line, or conduct basic genetic work, that's the one thought always in the back of my mind.

So far, what have been your biggest achievements at IRRI?

Locating the QTLs and developing products with them are my biggest achievements at IRRI so far. I have developed drought-tolerant lines for Nepal using QTLs that we identified. I also helped develop drought-tolerant versions of rice varieties from India, Korea, and Taiwan. I have transferred drought and flood tolerance into IR64, which is still a popular variety in Asia, and Thadokkham1 from Lao PDR under Dr. Arvind Kumar, leader of the South Asia Plant Breeding Group at IRRI. All these lines have the potential to be released as new varieties.

What are you working on now?

I am working on developing rice that can germinate under water or lines tolerant of anaerobic germination,

ISAGANI SERRANO, IRRI

stagnant flooding–tolerant rice, and rice that can survive even longer periods of submergence than we have now.

Hopefully, more high-yielding good-quality rice with adaptability to rainfed areas in Asia and Africa will follow in the coming years. My target is the next two years.

You said agriculture wasn't your first career choice. When did you realize that this was the right career for you?

I realized it soon after starting my bachelor's degree program in agriculture. But one part of it had the most impact on me. In India, there is a 6-month period called the rural agricultural work experience before you can earn your degree in agriculture. You go to a village and stay there for a semester or visit there every day and work with farmers and participate in their day-to-day activities.

I had some technical knowledge from what we studied in school. We tried to apply what we learned in the classroom in the real world during this period. Seeing how things work and learning how farmers see and do things affected my views a lot. If you think about how farmers would react to what you are about to develop, you always make a better decision. When you see the possibility of the impact you can make, it gives you a new perspective.

How important are farmers in your work as a plant breeder?

I'd like to visit the farmers who plant the varieties I helped develop. I have visited some farmers in Nepal, Bangladesh, India, and Vietnam. I still have some more to visit. Last year, I went to Odisha. This is a regular process for looking at flood-tolerant lines that I carry out every year. We visited farmers' fields planted with Swarna-Sub1.

I want to talk with the farmers and listen to what they like and, more importantly, what they dislike in a variety because that will help improve the breeding program. This is the most important feedback.

Participatory varietal selection is the most important point of feedback. You can develop as many varieties as you want, but, if farmers don't like them, they won't use them.

What is your advice to upcoming plant breeders?

You have to move from writing papers to developing actual products. Publishing papers about your work in journals is good. Finding QTLs and genes is even better. But it's mandatory to develop products if you are a plant breeder. It is what we aim for, and this cannot stop in any way. Every plan, every vision, and every experiment should be in this direction. This is what brings the greatest value to all the basic research and genetic work we do. We're doing all this to help change the lives of millions for the better. ■

Mr. Santiaguel is managing editor of Rice Today.

SIMA ASEAN Thailand 2016: the business place for the whole region!

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THE SOUTHEAST ASIAN AGRI-BUSINESS SHOW
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The 2nd edition of SIMA ASEAN, held from 8 to 10 September 2016 at the IMPACT Exhibition & Convention Center, Bangkok, Thailand, proved to be a resounding success. Attracting 13,000 visitors from various countries and covering an exhibition space of nearly 21,000 sqm, including indoor and outdoor areas, the second SIMA ASEAN lived up to its promise as the most international and extensive agri-business event in Southeast Asia.

A USEFUL AND EFFECTIVE PLATFORM

Considered by its exhibitors as a strategic platform to connect and develop their businesses, SIMA ASEAN Thailand 2016 attracted 300 leading brands and companies worldwide including renowned brands such as New Holland, Case IH, CLAAS and Yanmar.

"SIMA ASEAN is the perfect place to get to know our customers and for our customers to discover our products and the New Holland and Case IH quality. We had an opportunity to launch the TT4.90 tractor at the event. This is why the SIMA ASEAN is an important exhibition for us and it's the reason we decided to support the show this year's Platinum Sponsor"

Mr. Mark Brinn,
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SUCCESS FOR THE NEW DEMONSTRATION AREA

For this second edition, SIMA ASEAN presented real-live demonstrations on 2 hectares of outdoor area. The exhibitors such as CNH, Yanmar, Claas, Chokchai Agricultural Machinery Co. or Echo were able to highlight their equipment and machinery in action on the 4 major crops of the region (Rice, Cassava, Sugar Cane and Napier Grass) planted for the event at the Lakeside Mueang Thong Thani.

THAILAND, THE AGRICULTURE HUB OF SOUTHEAST ASIA

"For SIMA ASEAN Thailand, we are focusing on innovation & sustainability which are the key fundamentals to develop agricultural sectors in the region. We need to, not only show new technologies and innovations but also to apply new thinking to build up the new ideas forward for farmers. Only then, can we begin to build a sustainable, positive, and inclusive agri-business industry not only in Thailand but also within the ASEAN Community." said Valérie Lobry-Granger, General Manager of the Agriculture equipment, Food, Construction, and Optics (AFCO) at Comexposium, at the opening ceremony in the presence of Mrs. Jintana Chaiwannakarn, Vice Minister of the Ministry of Agriculture and Cooperatives.

Thus, another success for SIMA ASEAN, whose next edition will take from 7th to 9th September 2017 at the IMPACT Exhibition & Convention Center, Bangkok, Thailand.

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Searching for a new Mexican "rice miracle"

by Adriana Varón Molina

The North American Free Trade Agreement (NAFTA) brought insecurity to the doorsteps of Mexican farmers. Flooding the market with U.S. rice, it drove more than 18,000 rice growers out of business, causing a drastic decline in production. Today, the government and the country's rice growers' association aims to raise national production to 360,000 tons by 2018 (nearly double the amount expected in 2016) and break the dominance of US rice in the Mexican market. It will depend on three things: (1) a strengthened rice sector, (2) support from the federal government, and (3) the success of recently released improved rice varieties.

At sundown, one fateful day, Salvador García was checking to make sure his equipment would be ready for planting the next morning. But then something happened to shatter the routine of this farmer from El Mante, an important rice-growing area in the Mexican state of Tamaulipas. A group of eight men turned up at his farm, beat him unconscious, and took him to a solitary highway—the same one traveled by clandestine vehicles carrying adventurers to the U.S. border in search of the American dream and by feared drug traffickers. He was eventually released after a ransom was paid.

AFTER HIS kidnapping, Salvador García thought about leaving Mexico but decided to stay and keep doing the only thing he likes and knows how to do—cultivating the land. (Photo: CIAT)

That was five years ago, but Salvador still remembers exactly what happened, moment by moment, during his 10 days of captivity. He was lucky enough to get home alive, unlike some other farmers from this region.

Although traumatized psychologically, Mr. García had the fortitude to get back on his feet, just as he did years ago when tons of cheap rice from the U.S. began to flood the Mexican market, causing local production to collapse. Our rice sector was at fault, he says, for not being prepared to cope with NAFTA, the agreement among the U.S., Canada, and Mexico that came into effect during 1994. To make matters worse, the Mexican government lowered subsidies for rice growers. Disease outbreaks took a further toll on production.

According to the Mexican Rice Council (CMA, its acronym in Spanish), which represents 13 private companies and 11 state agricultural councils, Mexico had 25,000 rice growers and 74 related businesses before NAFTA. Afterward, the numbers fell to 6,200 growers and 20 businesses.

Many farmers switched to other crops, such as sorghum, sugarcane, and maize, or to livestock. Some decided to leave the country.

"The most critical year for Mexico's rice sector was 2011, when the country imported 89% of its rice supplies from the United States and Asia," says Luis Bueno, CMA's vice president.

Turning the page

The plan to reinforce Mexico's rice sector included a decision in 2005 to link with the Latin American Fund for Irrigated Rice (FLAR); creation of the Consortium for Rice Research and Development (Cindearroz); and collaboration with the National Institute for Research on Forestry, Agriculture, and Livestock (INIFAP).

Eduardo Graterol, FLAR's executive director, explains that the joint efforts of the Fund's 17 member countries "have led to the development of a new model for high productivity involving improved agronomic practices, which has been replicated in Mexico with encouraging results."

Every year, FLAR sends about 250 improved lines from its headquarters at the International Center for Tropical Agriculture (CIAT), based in Cali, Colombia, for performance testing in Mexico. Since 2012, FLAR has also developed with CMA a program for training technicians and farmers in improved rice agronomy.

IN MEXICO, 90% of the rice consumed is long-grain and is mostly imported, 9% is medium-sized grain of the variety *Milagro Filipino*, and 1% medium-sized grain of the variety Morelos, according to SAGARPA. (Photo: CIAT)

Back from the brink of extinction

In the most difficult period for Mexico's rice production, it became obvious that the country needed a new generation of improved rice varieties to be developed by INIFAP, using germplasm provided by FLAR.

As a result of this collaboration, growers now have two aces up their sleeve for competing with imported rice: INIFLAR Riego and INIFLAR Riego Temporal, new varieties that have long, thin grains like those of rice from the U.S. and Asia but that better match the quality preferences of Mexican consumers.

"We need to restore national production for the benefit of local consumers," says Fernando Flores Lui, director general of INIFAP. "These varieties might be the precursors to a new stage in production, like the revolution created long ago by IR8, which is called *Milagro Filipino* (Filipino Miracle) in Mexico and is still preferred by some consumers."

The new varieties resulting from a public-private partnership have already started gaining ground in Mexico. This year, they were sown on more than 3,000 hectares and will enter the Mexican market for the first time.

Arnulfo Hernández, Edel Chancanul, and Gustavo Romero, farmers in El Junca in the municipality of Palizada, Campeche State, in the Yucatán Peninsula, have planted INIFLAR Riego and INIFLAR Riego Temporal in their fields and are waiting for the first harvest, which they believe could reach 10 tons per hectare.

Like Mr. García, these three producers were thrown off course by NAFTA, rice diseases, and the resulting drop in production. Mr. Hernández had to sell his farm machinery as scrap. Some of it still lies covered with mold and weeds along the roads bordering his field.

For Mr. Chancanul, the lifesaver was to stop growing rice for a time, while Mr. Romero decided to try sorghum and convert part of his 100 hectares into a pasture.

Today, these farmers hope that Mexican-grown rice can make a comeback.

Federal government support

In parts of Campeche, Tabasco, and Chiapas, which once had green rice fields, today stand oil palms. The federal government, through the Secretariat of Agriculture, Livestock, Rural Development, Fisheries, and Food (SAGARPA), will try to entice the farmers back to growing rice through financial incentives: 3,000 Mexican pesos (about USD 162) for each hectare they plant to long-grained rice under irrigation and 1,500 pesos (about USD 81) per hectare of rainfed rice.

"With these agro-incentives, we hope to reach smallscale producers with up to 20 hectares, helping them purchase certified seed of the improved varieties that the rice sector needs, and raise production to 360,000 tons by 2018," says José Homero Melis Cota, director general for agricultural promotion with SAGARPA.

The program will be on offer for three years in the states of Campeche, Jalisco, Michoacán, Nayarit, Tamaulipas, Tabasco, and Veracruz.

The new varieties, according to Mario Torres, director of Cindearroz, are resistant to rice blast and the rice *hoja blanca* (white leaf) virus, which is transmitted by the insect pest *sogata* (*Tagosodes orizicolus*), and show high yield potential. They are early-maturing, in less than 130 days, enabling producers to harvest in less time, save on water, and lower their production costs.

Unlike Mr. Hernández, and Mr. Chancanul, Mr. Romero, Salvador García wasn't able to sow the new varieties this year. For the last eight years, he has grown *Milagro Filipino.* But, he has seen the new varieties and likes them. Next year, he'll try his luck with INIFLAR Riego and INIFLAR Riego Temporal.

Mexico's 6,200 rice growers hope that the rice sector can witness a new miracle, which will not come from the Philippines this time, but from the joint efforts of a sector that believes in the future. ■

Ms. Adriana Varón Molina is a communications coordinator at CIAT in Colombia.

ARNULFO HERNÁNDEZ, Gustavo Romero, and Edel Chancanul, after dedicating much of their lives to farming, suffered the effects of NAFTA. But now they feel confident that Mexico's rice sector will regain its strength. (Photo: CIAT)

"Dam" good heroes

by Savitri Mohapatra

A small dam in M'bé near Bouaké, Côte d'Ivoire, represents the inspiring story of unsung heroes who helped more than 300 farming households survive a difficult time when they had little hope.

THE IRRIGATION system in M'bé has degraded due to wear and tear.

"The M'bé dam was their only lifeline to survival during the decade-long Ivorian political crisis from 2002 to 2011," said Alain N'Zoromi, operations supervisor at the main research station of the Africa Rice Center (AfricaRice) in M'bé. "The farmers in M'bé were able to grow rice even at the height of the crisis as the irrigation system continued to run and ensure water supply.

"In fact, we did not stop the supply of irrigation water even for a day when the farmers required it," Mr. N'Zoromi added. "But today the dam is in desperate need of rehabilitation."

This is in stark contrast to three nearby dams built at the same time, but that are no longer functioning properly because of poor management, Mr. N'Zoromi explained.

A shining example of cooperation

Irrigation is a community enterprise and, to make it work, all user groups must join to maintain the system together. The goal is to assure a strong sense of ownership and equity among participating members.

The reservoir, which supplies water to the M'bé irrigation scheme, lies on the main research station of AfricaRice. The center and the village communities in M'bé have been sharing the water of the reservoir for rice research and farming.

As part of an informal agreement with the farmers' cooperative and the village chiefs, AfricaRice has been managing the irrigation system in a transparent and equitable manner. It takes care of its maintenance, responds to the needs of researchers and farmers, determines water allocation in consultation with the cooperative, and monitors water use at the center and on the farms to avoid waste.

The successful management of the M'bé dam, particularly during the crisis when most AfricaRice research activities were suspended, is a shining example of cooperation and trust between the center and the villagers.

"We thank AfricaRice for the efficient management of the reservoir water and are very proud of its work," said Kouassi N'Guessan, traditional head of the Mizron community. Mr. N'Guessan leads the 13 village chiefs in and around M'bé.

Benefits of the M'bé dam

For AfricaRice, the presence of a reservoir in M'bé is a boon for research as it ensures year-round water supply for its experimental plots. This helps the center continue its research activities and seed production throughout the year.

The potential impact of the rice research and development activities in M'bé station is huge as it has all the main rice-growing agroecologies (see Fig.1) and can contribute to the development of the rice sector in Côte d'Ivoire and neighboring countries.

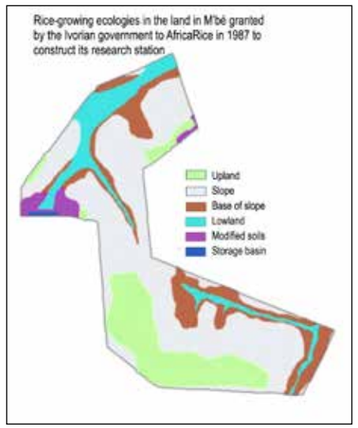

Figure 1. AfricaRice research station in M'bé has all the main rice-growing agro-ecologies.

Similarly, M'bé farmers are assured of two rice crops per year thanks to the stable water supply.

"Our farmers have been able to obtain bumper rice harvests and have become better off," the president of the Rice Farmers' Cooperative (CODERIZ) Coulibaly Issaka said. "They are able to feed their families and send their children to school and pay for medical care."

Life has changed in some of the villages around M'bé, such as in Tabako, where several thatched huts have given way to semi-concrete houses. Also, farmers have been able to acquire tractors and threshers further improving their farming practices.

M'bé farmers also benefit from the new technologies and training from AfricaRice. The region of Bouaké now has a thriving rice industry and traders from Bouaké source their rice from M'bé, according to Mamadou Ouattara, a rice processor and vendor in Bouaké.

Urgent need for M'bé dam rehabilitation

The M'bé dam is now more than 50 years old and has not been rehabilitated in a long time. Sediment has started to build up over the years and the drains and canals are not operating as efficiently as before. Also, since AfricaRice suspended its research operations for more than 12 years beginning in 2002, most of the infrastructure, particularly the drainage system, the canals and canal structures, and the field application system and the pumps, has degraded because of poor maintenance.

The inadequate maintenance of the irrigation system is already affecting the timely supply of irrigation water to the farmers' fields in M'bé.

"We used to get water on our farms within two days," explained Mr. Coulibaly. "Now, it takes more than a week and this delay is a major risk to our crop."

He explained that the canals in farmers' fields need urgent attention and appealed for help to line them to reduce water seepage. In addition, the reservoir is facing challenges of increasing population pressure and climate change.

"It is vital to expand the reservoir so that more farms can be developed," said Mr. Coulibaly. "When it was built, there were only about 60 farmers here with about 4 hectares each. Today, we are 300 farmers and our farm size has been reduced to 0.35 ha for a family of six to seven members. This is unsustainable."

"The canals have become very shallow because of silt and weed growth, making it very difficult for researchers, as we require fields with a proper irrigation and drainage system," said Ampar Vittalaraya Kini, seed systems development coordinator at AfricaRice. "The boom irrigation system that was used for upland research is no longer working and needs to be replaced."

As AfricaRice looks forward to fully resuming its research activities in M'bé, the rehabilitation of the dam is central to its ambitious plans to develop new technologies to boost the rice sector in the country and the Mano River Union.

In view of the strong links between irrigation and agricultural development, the rehabilitation of the M'bé dam will certainly have significant impact on the lives of farming communities.

"For these communities, rice farming is most important as it generates revenue for them," said Amadou Beye, AfricaRice M'bé station head. "Also, different value-chain workers, farmers, mechanics, and millers—are involved in M'bé. So if the dam is improved they will all benefit."

The rehabilitation of the M'bé dam in response to farmers' demand will be a sound and visible investment option to improve the profitability of the dam and boost the food security and socioeconomic status of farmer-beneficiaries in the area, according to Aka Konin, governor of the Bouaké region.

"The rehabilitation will also help generate employment for the village youth, which is a major objective of the local government authorities," Mr. Konin remarked. ■

Ms. Mohapatra is the head of Marketing and Communications at AfricaRice.

CHIEFS OF VILLAGES in and around M'bé show their gratitude to AfricaRice for the management of the M'bé dam water and for the training of the village youth in rice production.

Rural poverty and rice

by Ambica Paliwal, Alice Laborte, and Neale Marvin Paguirigan

More than 65% of the 1.7 billion people in South Asia live in rural areas and rely on agriculture for their livelihood. Nearly, 70% of South Asians, which is one fifth of the world's population, consider rice as their staple food. With 41% arable land, the region produces more than 225 million tons of rice in different ecosystems, which can be categorized into three: irrigated, rainfed lowland, and upland.

We overlaid the map of rice ecosystems (Fig. 1) with population maps to estimate the number of people living at or near rice-growing regions (Fig 2). Based on this assessment, 68% of the South Asians live at or near rice ecosystems: 45% in irrigated, 19% in rainfed lowland, and 4% in upland ecosystems. Nearly 500 million people live on less than USD1.25 a day in South Asia. Many of the poor live in rice-growing areas with the highest density in eastern India and Bangladesh (Fig. 3).

Population maps are important for measuring impacts of population growth, monitoring changes, and planning interventions (Tatem et al 2007). Such information can be used in better targeting of activities such as dissemination of improved rice technologies to benefit more, especially the poor. ■

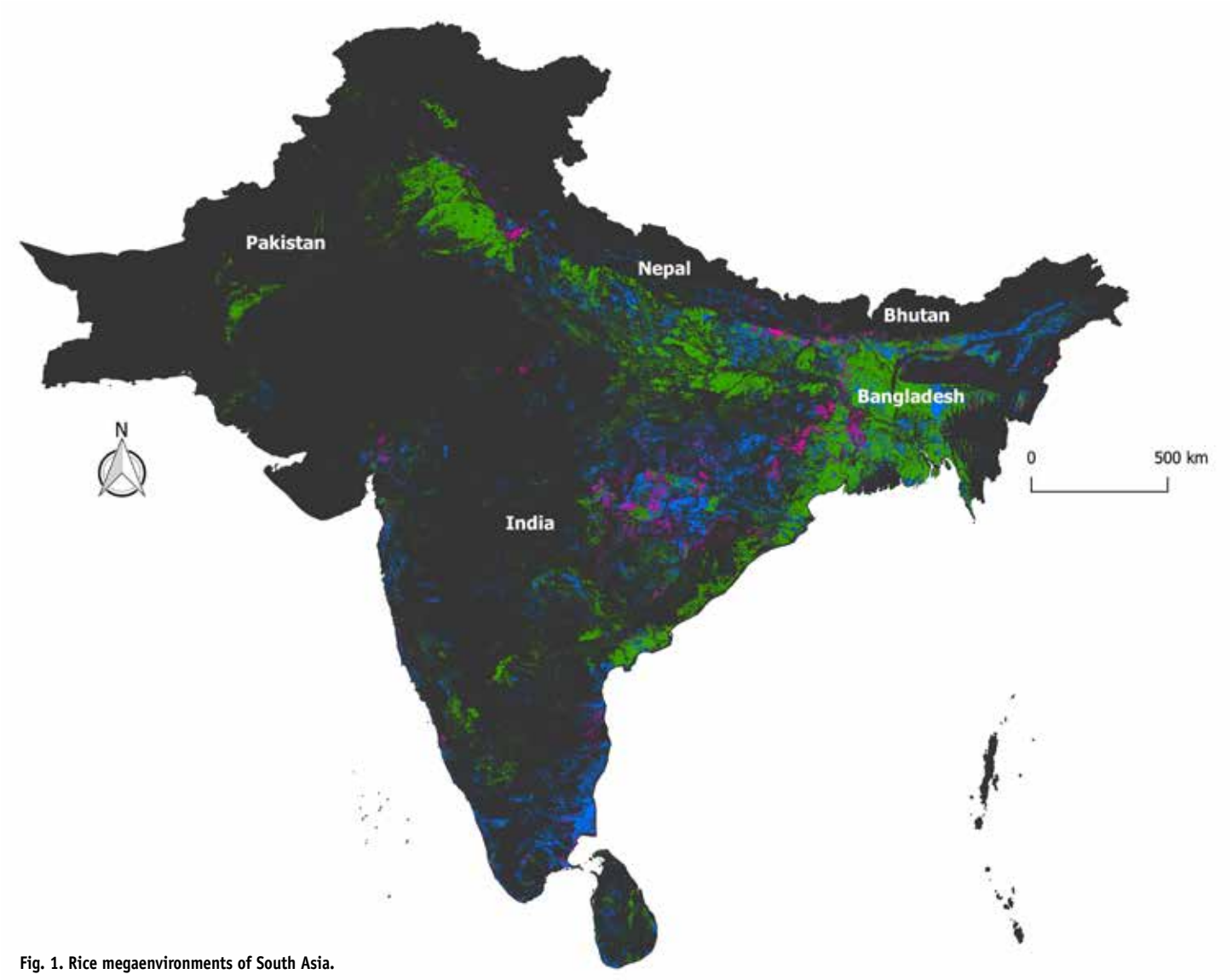

Fig. 1. Rice megaenvironments of South Asia.

Sources:
Center for International Earth Science Information Network (CIESIN), Columbia University, United Nations Food and Agriculture Program, and International Center for Tropical Agriculture. 2005. Gridded Population of the World, Version 3 (GPWv3): Population Count Grid. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). http://dx.doi.org/10.7927/H4639MPP.
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Tatem AJ, Noor AM, von Hagen C, Di Gregorio A, Hay SI. 2007. High resolution population maps for low-income nations: Combining land cover and census in East Africa. PLOS ONE 12, e1298, 1-8.

Dr. Laborte is an IRRI scientist working on geographic information system (GIS) and market research. Dr. Ambica is a postdoctoral fellow on GIS while Mr. Paguirigan is a junior specialist on information system at IRRI.

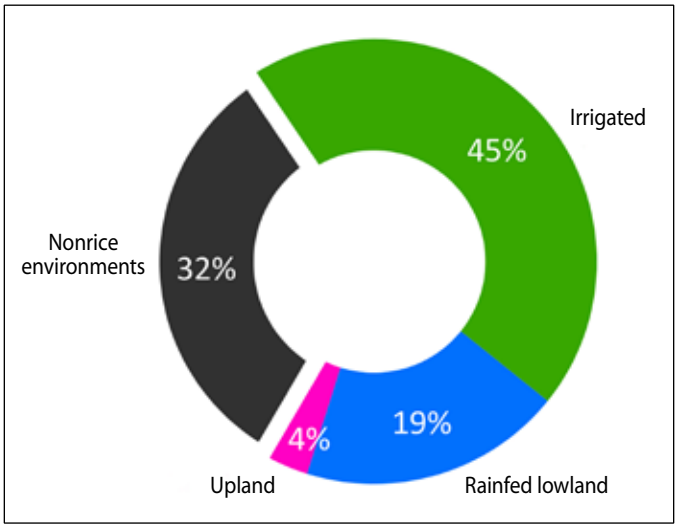

Fig. 2. Population of South Asia in different rice ecosystems.

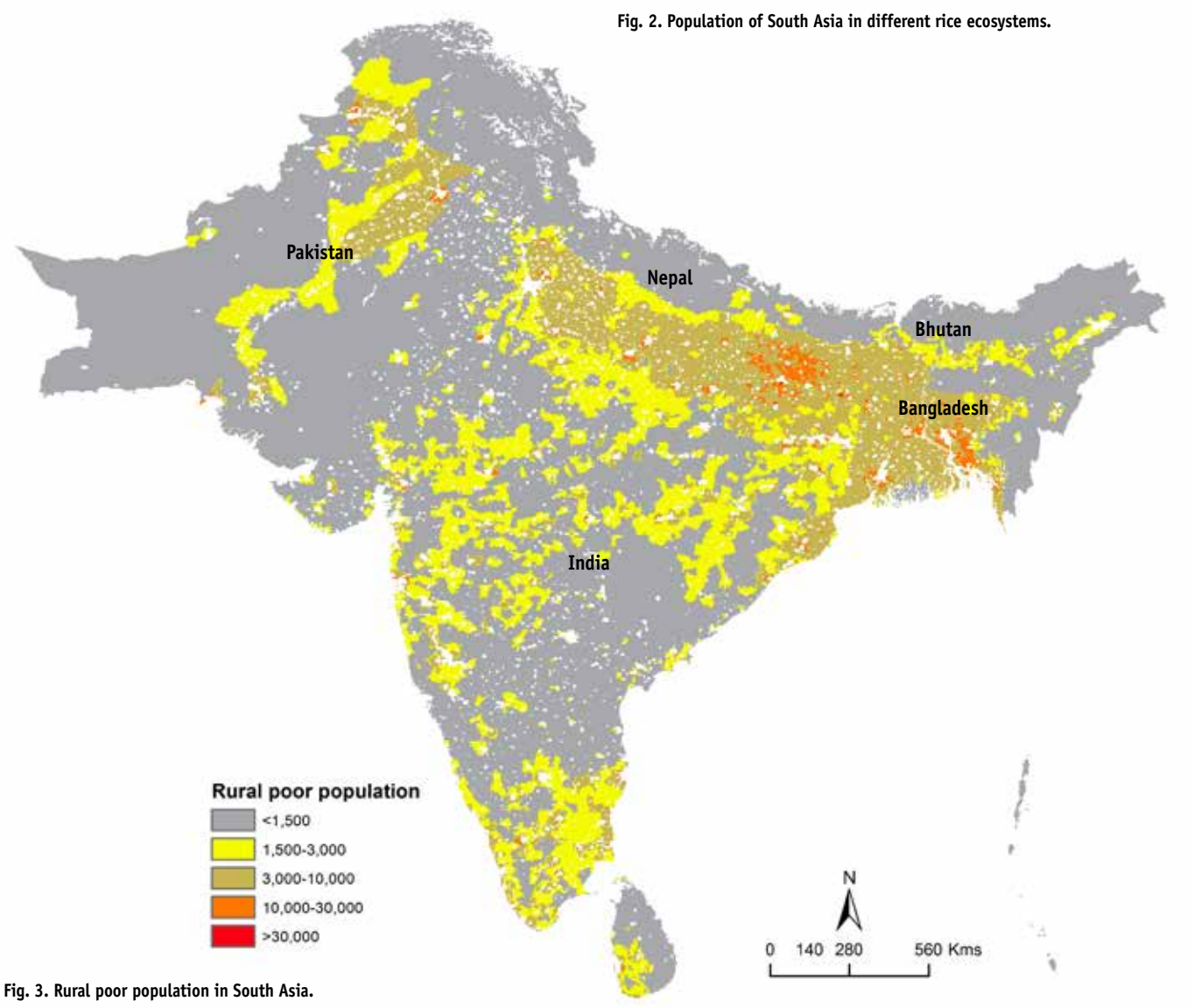

Fig. 3. Rural poor population in South Asia.

Women on the path to progress

by Sujata Ganguly, Sugandha Munshi, and Swati Nayak

In India, self-help groups have made a tremendous impact on the lives of poor women in rural areas and have empowered them at various levels.

SMALL VOLUNTARY associations of poor and marginalized people help the members identify the problems that confront them and seek the solutions that they can and are willing to implement. (Photo: CSISA)

In India, self-help groups (SHGs) have played an important role in changing the lives of women in rural areas. SHGs are considered to be one of the most significant tools in carrying out a participatory approach toward economic empowerment of women and in improving various aspects of the social structure in the country.

These groups are formed and usually supported by nongovernment organizations and, increasingly, by government agencies. These are small voluntary associations of poor and marginalized people—preferably from the same socioeconomic background—whose structures, processes, and activities help the members identify the problems that confront them and seek the solutions that they can and are willing to implement. These groups also provide their members with better access to support services, including credit and government extension services. By empowering rural women, SHGs have become a vehicle of change for poor and marginalized people to be released from the clutches of poverty.

Empowerment through participation

Women's participation in SHGs has made a tremendous impact on the lives of poor women and has empowered them, not only as individuals but also as members of families and communities. Members of an organization come together to solve their shared challenges by helping themselves and each other.

The Cereal Systems Initiative for South Asia (CSISA) project promotes durable change in cereal-based cropping systems in South Asia's most important grain baskets. SHGs have been an important conduit in the states of Odisha and Bihar. Since 2009, some conservation agriculture practices have been supported under CSISA to empower women farmers by ensuring their access to innovative, scale-appropriate agricultural technologies and associated knowledge.

Moreover, SHGs help them acquire entrepreneurial skills to make them become informed and recognized decision-makers in agriculture. The adoption of some technologies by women farmers was targeted so that the interventions help create more revenue and improve the family income along with increasing productivity.

Interventions tailored for women farmers

Women farmer-centric capacity-building programs have been launched in classrooms and through on-field interventions. The programs promoted the adoption of machine-transplanted nonpuddled rice (MTNPR), zero-tillage (ZT) technology, direct-seeded rice (DSR), seed varietal replacement, improved varieties, and mat-type and community nurseries.

These technologies have several benefits such as financial gain among others. The main benefit of introducing these improved varieties is that women farmers have acknowledged that this particular intervention led to higher economic gain, better agricultural option, in adverse climatic conditions, and a better strategy for mitigating the risk of climate change. Moreover, the high-yielding varieties have provided them not only with sufficient food for the family but also with grains with better eating and cooking

BEYOND THE economic gains, new interventions positively affected women's dignity and status in the family because they were the ones who introduced these to their families and communities. (Photo: CSISA)

quality, especially suitable for locally preferred food such as puffed rice.

Women reported that DSR resulted in economic gains by saving resources such as seed usage, amount of fertilizer application, land preparation, and other unnecessary labor done by women such as thinning, gap filling, and multiple weeding operations that followed in the traditional broadcasting system.

MTNPR not only reduces the physical drudgery in transplanting rice and other farming activities done by women but also gives them the choice to use dry nursery preparation and nonpuddled transplanting, thereby avoiding further drudgery and potential health hazards from working regularly in wetland conditions. The technology can help minimize labor shortage, which is a major problem in certain communities and causes delays in operations and poor plant growth, especially during the transplanting season. MTNPR also significantly decreases the total cost of production.

Women farmers have been significantly benefiting from ZT technology by significantly reducing the use of resources such as seeds, fertilizer, and energy for tillage, among other operations, thus, decreasing the cost of cultivation. ZT is also more environment-friendly because the water and soil are used or disturbed minimally during cultivation. A low-cost, resource-conserving cultivation encourages cropping system intensification such as rice-mustard, rice-chickpea, rice-maize, rice-wheat, and rice-green gram that offers a diverse range of crops for the family.

Improved postharvest practices using mechanized threshing have a direct benefit in reducing losses in grain quantity and quality during threshing and storage. This gives more net grain or output as well as higher quality for consumption and sale; hence, having a significant effect on food security as well as possible income enhancement.

The removal of traditional operations from the new package of mechanized practices eventually increases the efficiency of the farmers and farming system and gives them more free time for pursuing alternative sources of income and cultivating other crops. With the significant savings in time, women can invest more in other income-generating activities, backyard kitchen gardens, and attending to family welfare as well as enhancing their social participation in SHGs and village-level activities.

Gaining respect and dignity

Beyond the economic gains, the new interventions positively affected women's dignity and status in the family because they were the ones who introduced these to their families and communities.

In the 21st century, women are gradually obtaining due recognition as farmers. We can see the start of change if not a major transition in the lives of women farmers. In fact, the goal is not to bring a revolutionary change, which is impractical in the present context. However, CSISA's effort in this direction is to start the ball rolling so that the interventions become sustainable.

The formation of SHGs is a stepping stone, and projects such as CSISA act as a catalyst for initiating and allowing change to happen in the lives of women farmers. ■

Dr. Ganguly, Ms. Munshi, and Ms. Nayak are gender specialists at the International Rice Research Institute (IRRI) who are based in India. Dr. Ganguly works at the IRRI-India Office. Ms. Munshi works under the Cereal Systems Intiative for South Asia project while Ms. Nayak works under the Stress-Tolerant Rice for Africa and South Asia project.

This article is based on a study conducted as part of the CSISA project of the International Maize and Wheat Improvement Center, International Rice Research Institute, International Food Policy Research Institute, and International Livestock Research Institute with funding support from the Bill & Melinda Gates Foundation and the United States Agency for International Development.

THROUGH THE support of CSISA, women rice farmers have now access to technologies such as conservation agriculture practices.

Why invest in optimizing water use in rice farming?

ISAGANI SERRANO, IRRI

by Sudhir Yadav and Lanie Reyes

Water use in rice farming needs to be optimized to improve water availability for urban needs.

Expansion of irrigated agriculture over the past half century as well as the recent urbanization and rapid economic growth of Asia have dramatically affected water use in the region. The increasing water demand for domestic, industrial, and instream uses is unbalancing the sectoral share of water, which not only harms the agricultural sector but also has an impact on the environment.

Whenever a region faces water scarcity, the water is generally diverted away from irrigation schemes into urban water systems such as those in Manila (Philippines), Bandung (Indonesia), Bangkok and Chiang Mai (Thailand), and Hanoi (Vietnam).

The complicated business of sharing water

Rice farming is by far the biggest user of developed freshwater resources globally, especially in Asia, where 90% of the world's rice is grown. The way the tensions among users of agricultural, urban, and industrial water play out largely depends on how much water is allocated for rice. The water allocation for agriculture is often seen as economically inefficient and having low return compared with the nonagricultural sector. Reallocation of water for cities and industrial use at the expense of agriculture is seen as a common option. As the share of water surface decreases and as irrigated area expands, farmers start to exploit groundwater to meet the additional need for water.

Withdrawal of water from rivers for irrigation has reduced flows during the dry season. This allows seawater intrusion into lands that were formerly suitable for rice paddies in the Asian deltas. The overexploitation of groundwater, particularly in coastal regions where megacities are commonly located, causes saline groundwater to intrude into freshwater aquifers.

But, substantially reducing irrigated rice farming areas to lessen their share of water is not an option because rice production needs to increase in order to keep up with population growth. In many areas, shortages of irrigation water to ensure future rice harvests in Asia are of growing concern. In Southeast Asia alone, it is estimated that most of the 21 million hectares of dry-season irrigated rice areas will face economic or physical water scarcity by 2025. Thus, there is a nagging concern: to grow *more* rice with *less* water.

Making every drop count

Efficiency has always been the watchword for scientists at the

International Rice Research Institute (IRRI) and its partner research institutes. When it comes to agriculture, particularly in rice production, water-use efficiency is a must for water to be also available for urban use.

"Spending on efficient use of fresh water for rice production, which feeds more than 4 billion people and whose food security depends on it, is undoubtedly a good investment," said Bas Bouman, director of the Global Rice Science Partnership. "And, the good news is that IRRI scientists and their partners are thinking of ways to increase water productivity and efficiency.

"If we can increase water-use efficiency in rice production, it will be huge," added Dr. Bouman. "Rice is grown by 144 million farm families, which is equivalent to 25% of world farmers, and receives 880 cubic kilometers of irrigation water or 35% of the world's total. "If we can save 15% of the water from that amount, we can free up more than 130 cubic kilometers. That is equivalent to more than 50 million Olympic-sized swimming pools. This is enough to provide quarter to a half of the world's population with domestic water in a year."

These numbers inspire scientists to come up with improved water management strategies, with a vision of delivering them to millions of rice farmers threatened by water scarcity.

What can be done?

Identify hotspots to improve water-use efficiency. It is said that halfway to a solution is pinpointing where the problem lies. The institute sees the need to identify specifically the "hotspots," or areas that have a high potential for improving water-use efficiency. To map, determine, and characterize these major hotspots, existing data and local expert knowledge, combined with detailed satellite imagery and ground verification, are the steps in this direction. Thus, policymakers and decision makers could easily identify and estimate the potential of water savings as well as the key factors affecting water availability. In this way, rice research and development can be invested where they are most needed.

Another step forward for water-use efficiency is having blueprints of water management strategies by location instead of a wider regional or national scope. The technological need of one specific location could be starkly different from that of another.

Water-saving technologies. Technology options that can lower by a considerable amount of water use in rice fields are already available to rice farmers. One of these water-saving technologies is alternate wetting and drying (AWD). AWD uses a perforated PVC pipe to measure the amount of water below the soil.

This is a simple device for farmers to determine whether or not it is necessary to flood a rice field. AWD can help farmers save up to 30% of the water with no yield loss and could even attain a small yield increase. The AWD technology is the dominant water management practice in China, and it's spreading in Bangladesh, Vietnam, India, and the Philippines.

Not resting on their laurels, IRRI scientists are looking further into the complexity of water management, especially in Asia, where the problem is linked to poor irrigation system efficiency. More often than not, water is managed by an irrigation association. However, the lack of interface between the irrigation manager and farmers makes it difficult to use water efficiently.

To fill this interface gap, IRRI is working with its partners on automating irrigation scheduling and upgrading the AWD technology with support from the Bureau of Agricultural Research under the Philippine Department of Agriculture. AWD will have a cheap but accurate sensor that not only measures the water level inside the field tube but also improves the decision-making process on irrigation scheduling by transmitting the information via SMS to the farmer and irrigation manager.

Automated AWD can make a farmer's task of monitoring PVC tubes easier. Farmers need not go to their fields every other day just to check the water level in their PVC pipes. The farmers will appreciate this improvement because their fields are usually located at a distance from their homes. This improvement will bring ease to the irrigation manager, who will now have an idea of the water demand scenario of a group of farmers that varies from 3 to 50 members. Thus, automated AWD will link the decision maker (on irrigation) with the water user (farmers).

Improving decision making on water demand and precision farming.

WITH ITS partners, IRRI is working on upgrading the AWD technology. (Photo: IRRI)

The institute is currently working on creating a system to obtain precise information on water demand and schedule, which will result in improving other aspects of crop management such as nutrient application and weed management. One of the ways to achieve this is to use unmanned aerial vehicles or drones for water management. The widespread availability of low-cost drones offers agricultural professionals a more cost-effective way of gathering information at the desired time interval. The use of a plant-based, real-time water demand indicator along with weather forecasting and growth simulation model can help in predicting water demand at different scales.

Reporting reduced carbon footprint

Interest in climate change and water conservation greatly increased after the 21st session of the UN Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP 21) in Paris in 2015 as well as the Water Summit in Doha in 2016.

It was agreed during the COP 21 for all countries to report regularly on their emissions and their progress made in implementing and achieving their nationally determined contributions (NDCs), and to submit new NDCs every 5 years. The agricultural sector features prominently in the intended NDCs. Most countries (94%) include the agricultural sector in their mitigation and/or adaptation contributions, and many countries are targeting improved water management in rice to achieve the mitigation contributions.

With AWD's proven track record in carbon footprint reduction of up to 35%, automated AWD will help gather precise large-scale information on water management and measure how much carbon footprint was reduced nationwide.

What it takes to achieve the goal

Knowing where the water scarcity problem lies, having evidenced-based and appropriate water-saving technologies, along with a comprehensive water management plan that is tailor-made to specific areas, the institute can surely contribute to the food security and improvement of livelihood of rice farmers. From an economic point of view, it is hoped that farmers will reduce their irrigation input and cost while increasing their profits. When it comes to irrigation schemes, it is also a goal to make the distribution of water more equitable within the community.

"For policymakers and decision makers, these strategies will result in better water-investment planning that could result in model projects, on which a program and project developer can build, not only countrywide but in the whole of Southeast and South Asia," said Dr. Bouman.

For Asia to sustain its economic growth, quality of life, and the social stability of its increasingly urban population, it will need to anchor its strategies for food security and a reliable supply of fresh water in the face of an increasing population and changing climate. Surely, it will be easy to gain support for a research and development agenda that addresses three key factors to sustainability: the economic, environmental, and social aspects of water-use efficiency in rice production. ■

Dr. Yadav is a water scientist at IRRI. Ms. Reyes is the editor-in-chief of Rice Today.

OPTIMIZING WATER use in rice farming aims to reduce the irrigation cost and increase the profits of farmers. (Photo by Isagani Serrano, IRRI)

Three real-life HEROES

by Samarendu Mohanty, Bidhan Mohapatra, and Sampriti Baruah

An update on three women farmers in India who were successful in their quest to rewrite their destiny.

In 2013, we wrote about Sukanti Swain, Sanjukta Naik, and Rabi Pradhan in the eastern Indian state of Odisha (See *Breaking the barriers: from housewives to breadwinners* on pages 38-39, Vol. 12, No. 2 of *Rice Today*). They overcame social obstacles and transitioned from being stay-at-home wives and mothers to being successful farmers, entrepreneurs, leaders, motivators and role models. In this piece, we nicknamed Sukanti Swain the "Leader," Sanjukta Naik the "Machine," and Rabi Pradhan the "Fighter."


Sukanti Swain


Rabi Pradhan


Sanjukta Naik

Nearly three years later, we went back to meet our three real-life heroes to get an update on their situation. Our first stop was at Sukanti Swain's house.

The leader's success

The "Leader" greeted us with a big smile. Her house is much improved now with a few new appliances inside. Like before, she owns only 0.3 hectare of farm land and share-crops on an additional 2 hectares. She has been growing paddy in the kharif season and, after paddy harvest, she has been shifting from mungbean to sunflower for the last two years because of the government subsidy for seed and fertilizer and for higher profitability. She also manages a small grocery store in the village and serves as the secretary of a self-help group (SHG) she founded a decade ago. In addition, she serves as the community resource person for 12 other SHGs in the nearby villages.

She continues to help her husband with his *pakhundi* business (making fences using bamboo sticks and using coconut leaves for growing betel plants). In terms of asset creation, she purchased a power tiller using part of a loan from her SHG. She also plans to purchase a mechanical thresher to expand her custom hiring business.

Overall, her economic condition has improved significantly since our last visit. She credits her SHG for giving her a loan for purchasing a power tiller and expanding her husband's *pakhundi* business. She estimated her average monthly income from all sources (farming, SHG involvement for government program implementation, among others) to be around USD 600. Apart from the monetary benefits, she also enjoys the high social status she has earned over the years and she has become a role model for many other young women in the village council, locally known as the *panchayat.*

However, what got our attention was her image and stature as a leader and the value of her services. She has become the go-to person in the *panchayat* for the implementation of any government program. Government agencies keep her on a retainer for rolling out new programs. Using her as reference helps needy villagers successfully obtain loans at the local bank.

She has convinced hundreds of women in the *panchayat* to join an SHG and save money on a weekly basis. In her *panchayat*, the number of SHGs has increased from 70 to 98. All the women in the *panchayat* above 18 years old are members of an SHG, including newly-wed daughters-in-law. This is in stark contrast to the time of her initial involvement in the SHG when women were not allowed to go outside the house and attend meetings, according to Sukanti.

The Machine and the Fighter settle down

After Sukanti, we met our other two heroes: Sanjukta and Rabi. Although both are doing well, we didn't see the same fire and drive they had three years ago.

Sanjukta's work habit had earned her the nickname the "Machine." She still grows paddy but on less than 1 hectare of land compared with the 1.4 hectares three years ago. She does a few other things to earn additional income (garlic processing and livestock). Both her daughters are married and her son, after dropping out of high school, now works in a textile mill in Gujarat. Sanjukta's husband has returned to the village to farm.

She still works as the secretary of an SHG. She has a monthly income of USD 375 from all sources, including her husband and son. She still contributes a large share to the family income pool.

Her shattered dream of making her son, who dropped out of school, become a police officer seems to have affected her work drive. She still wants her son to return to high school and complete his education and become a police officer.

Similarly, Rabi Pradhan, the "Fighter," has also slowed down in her daily struggle of raising three children after her husband abandoned them a few years ago. Her two daughters are now married and her son works as a mechanic in a nearby town. She has given up her betel leaf plantation but she trained her sister-in-law and a few other women in the village in growing betel leaf. She still grows paddy on 0.67 hectare of share cropping, primarily for consumption and she occasionally sells some if they have a surplus.

After the marriage of their daughters, the Machine and the Fighter have slowed down a bit on the work front and their priorities have shifted toward taking care of their respective families and grandchildren. However, all this has been possible only because of the hard work they had put in during the previous years. It was pleasing to see that their financial stability has given them an option of choosing a work-home balance, which was not available to them in the past and is not available to many other women in the village.

Spreading success

Sukanti Swain, Sanjukta Naik, and Rabi Pradhan were married to marginal farmers with less than half a hectare of landholding. They were expected to play the role of traditional housewives in their homes. But, apart from fulfilling their responsibilities as housewives, they have emerged as primary earning members of the family and have become role models for other women and young girls in their villages. Their successes have been so contagious that all the women—old and young—in the *panchayat* have joined SHGs. Thanks to the Leader, the Machine, and the Fighter, many women are now actively managing farms and pursuing other activities for supplemental income. ■

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Empowering women farmers in the polder communities of Bangladesh

by Humanth Bhandari, Anna Minj, Tahmina Begum, and Parul Sarker

Women constitute half of Bangladesh's 160 million human resources. About two-thirds or 53 million of them live in rural areas and eke out livelihoods from agriculture. More than half of the country's agricultural labor force consists of women. They are involved in all agricultural activities, although the most common ones are postharvest operations and livestock and poultry raising.

With growing rural outmigration, women's role in agriculture is increasing. They contribute significantly to the rural economy, and their empowerment is crucial to minimizing poverty and hunger.

Compared with men farmers, women farmers face many more obstacles. Thus, to empower women farmers, we need to understand their constraints and to implement targeted interventions that will help them to overcome these restrictions. These include land ownership and rights, access to improved varieties and technologies, extension and credit services, inputs such as seeds and fertilizers, farm machines and mechanization services, and knowledge and information.

Women farmers also have limited decision-making power and participation in economic opportunities. These obstacles not only limit their productivity but also prevent them from achieving their full potential. As a result, women suffer more from poverty, food insecurity, and malnutrition. Overcoming these obstacles will provide alternatives to improve their livelihoods. Studies have shown that, compared with men, women are more likely to spend their income providing better nutrition, education, and health for their families.

The project, *Unlocking the production potential of polder communities in coastal Bangladesh through improved resource efficiency and diversified cropping systems* (SIIL-Polder) in Bangladesh has a strong gender component. Funded by the Feed the Future Sustainable Intensification Innovation Lab, the project emphasizes gender equality and women empowerment. The goals of the project are to reduce women's workload, raise their agricultural productivity, increase their economic opportunities, and ensure that they have control over resources.

These objectives can be achieved through strategies such as identifying women farmers' constraints and viable options for interventions; carrying out initiatives to enhance women farmers' access to technologies and services; training women on improved crop production, processing, and marketing skills; and establishing and nurturing women producers and marketing groups.

Through a community approach, women farmers can buy high-quality seeds and inputs at lower prices. Collective production, processing, and marketing will allow them to receive higher profit for their produce because they will increase their access to different markets, reduce their transaction cost, and increase their bargaining power.

The SIIL-Polder project will leverage women's groups to educate rural women on improved farming and nutritious diets. In addtion, the robust evidence generated by the project will help design women-inclusive programs and policies. By earning income, women will gain decision-making power and economic autonomy in the family, which will empower them. When women are empowered, their families, children, the next generation, and their communities are empowered, too. ■

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