rice TODAY

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Rice: The pulse of life in Myanmar

Future rice climates in Africa

The global market post-2008 rice crisis era

Helping Cambodia reap a more bountiful harvest

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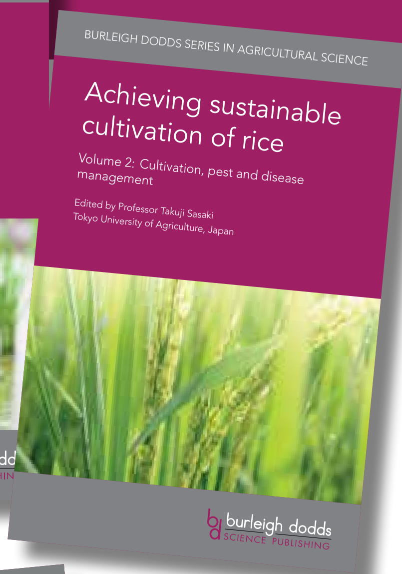

Achieving sustainable cultivation of rice - Volumes 1 & 2

Edited by: Takuji Sasaki, Tokyo University of Agriculture, Japan

KEY FEATURES

- Reviews advances in breeding, exploiting the genetic diversity of rice and enhancing properties such as yield, nutritional value and drought tolerance
- Summarises advances in cultivation practices to close yield gaps and methods of 'climate-smart' cultivation such as SRI
- Reviews the latest research on insect pests, integrated pest and weed management

Rice insect pests and their management

E.A. Heinrichs, Francis E. Nwilene, Michael J. Stout, Buying A. R. Hadi and Thais Freitas

KEY FEATURES

- Covers almost 100 species of the most important insect pests affecting rice cultivation
- Brings together the key research on each pest, including description and biology and effects on rice plants
- Written by a team of leading entomologists with experience of rice pests in Asia, Africa, the United States and Latin America
- Includes over 150 photographs and images

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CONTENTS

rice TODAY Vol. 16, No. 2

About the cover

Women farmers are the unsung heroes in Myanmar's agriculture. According to the FAO, women produce more than half of the world's food and they comprise about 43% of the agricultural labor force globally. Despite their contribution, they face limited access to improved crop varieties, training, information, and marketing services. In Myanmar, however, a partnership between researchers and smallholder farmers is giving equal opportunity and increased capacity to both men and women. (*See Rice: The pulse of life in Myanmar.*) (Photo by Grant Singleton, IRRI.)

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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Farewell editorial

It is with mixed emotions that I write my final editorial as the editor-in-chief of *Rice Today*. I feel a sense of pride to be part of its success and its evolution from an IRRI-centric magazine to a truly global magazine on rice and, at the same time, sadness for parting with close colleagues.

I look back at the past eight years and it has been a pleasure to have worked with a great team of writers, editors, graphic designers, and photographers within and outside International Rice Research Institute headquarters. I should not fail to mention Bill Hardy, former IRRI senior science editor, and Gene Hettel, former editor-in-chief of the magazine, whom I consider my mentors.

It was also a privilege to work with our communication partners from the Africa Rice Center (AfricaRice), through Savitri Mohapatra, and the International Center for Tropical Agriculture (CIAT), through Nathan Russell, former Latin America editor, and now with Neil Palmer. Together, we've gathered stories from genetic discovery to rice markets around the world.

This issue is no different—we have a good mix of stories from evidence-based information on the rice sector to working collaborations, and the cultural aspects of rice.

Our cover story is about a partnership between researchers and smallholder farmers in lower Myanmar that is reviving the profitability and productivity of the country's once-mighty rice sector. (Read *Rice: The Pulse of Myanmar* on pages 14-17.)

Meanwhile, Cambodia is on its way to developing a market for its rice by making its value chain stronger. The country is now taking advantage of farm machinery and enhancing the skills of future agricultural engineers as part of its strategy to reap a more bountiful harvest. (See story on pages 18-19.)

In the Philippines, increases in rice production in the country can now be predicted by its government through PRISM. PRISM is an online system that consolidates and presents accurate and timely on the status of rice crops and it is now preparing to be part of the Philippine Department of Agriculture. (Read *PRISM in perspective* on pages 28-29.)

On the science front, *Resistance from within* is a story about how a recent technology and a combination of genes are helping rice scientists come up with a more resistant plant to counteract insidious brown planthoppers, the scourge of Asian rice farmers. (See story on pages 10-12.)

We also focus on the importance of targeted investment in further research and development in Africa to respond to the problems with weeds that are infesting more than a million hectares in at least 31 countries. (Read *Africa's rice farmers lose millions of dollars to parasitic weeds* on pages 30-31.) In *RiceAdvice: An app tailor-made for Africa farmers* (see pages 5-7), a smart mobile crop management tool is helping farmers on the continent optimize their production and profits and reduce waste. And, in our maps section, AfricaRice scientists lucidly show the changes in temperature and rainfall patterns across the continent in 2030. (Read *Future rice climates in Africa* on pages 22-23.)

Our rice facts column provides an in-depth analysis of the current global rice market, factoring in key players such as China and India, policy changes in some Asian countries, and the increasing popularity of rice in sub-Saharan Africa and the Middle East. (Read *The global market post-2008 rice crisis era on* pages 36-37.)

Rice Today has also featured some of the most influential rice scientists in history. One of them, Peter Jennings, who led the team that developed the legendary high-yielding IR8, shares his thoughts on how to increase national rice yield to 6 tons per hectare in the Philippines and elsewhere. (See the *Grain of truth* column on page 38.)

Also, we highlight the journey of two women rice scientists whose experiences and points of view would surely inspire the next generation of researchers. (Read *Bold and beautiful minds: The journey of scientists Fiona Hay and Maricar Alberto* on pages 32-35.)

Speaking of the next generation of scientists, the article on *Reimagining agricultural education* (pages 24-25) will walk you through the transition of IRRI's training program to IRRI Education to cater more to the needs of the rice scientists of the future.

On the cultural aspects of rice, follow the *Arroz con pollo* recipe by a celebrity chef who uses an heirloom rice variety from the Cordillera Region of the Philippines as the main ingredient. (See recipe on pages 26-27.) And, how the inhabitants of that region came to be rice eaters is explained in the fable *Immortal's gift* on pages 8-9.

Rice Today will be in good hands so expect more fascinating stories to come!

All the best!

Lanie Reyes

RiceAdvice:

An app tailor-made for African farmers

by Savitri Mohapatra

A smart mobile crop management tool is helping farmers in Africa optimize their production and profits.

Farming is often a risky venture and involves a lot of uncertainty. It is no wonder, therefore, that the 17th century writer Jonathan Swift spoke so highly of farmers:

> "Whoever could make two ears of corn, or two blades of grass, to grow upon a spot of ground where only one grew before, would deserve better of mankind, and do more essential service to his country, than the whole race of politicians put together."

Traditionally, farmers have made decisions on the farm based on their own experience and knowledge. To enable them to be more efficient and reduce risks in farming, the recent revolution in information and communication technology has made it possible to develop decision-support tools that can guide them to make informed decisions to improve their production and increase their productivity.

One such smart mobile app is *RiceAdvice*, a science-backed crop management decision-support tool developed by the Africa Rice Center (AfricaRice), which can be downloaded for free on on Android smartphone or a tablet device through Google Play Store.

This app generates tailor-made recommendations—based on field-specific information—that help African farmers in irrigated and relatively favorable rainfed lowland areas apply mineral fertilizer more efficiently so that they can optimize production and profits.

Customized prescriptions

In Africa, rice production has not been able to keep up with the continent's rapidly growing appetite for rice.

Rice cultivation must significantly increase its efficiency in the continent so that it can lead to improved food security and reduced poverty. The average rice yield in sub-Saharan Africa is around 2 tons per hectare, which is about half the global average.

Farmers' efficient use of mineral fertilizer coupled with good agricultural practices is a key to enhancing rice production in the region.

Many rice farmers are not aware of the right combination, dosage, and timing of fertilizer application. Insufficient fertilizer can result in

IN NIGERIA, a RiceAdvice service provider (*right*) collects information to generate customized recommendations on fertilizer options. (Photo by Kokou Ahouanton, AfricaRice.)

A FARMER in Nigeria has greatly benefited from RiceAdvice. (Photo by Phillip Onimisi Obosi, GIZ-CARI)

loss of yield, whereas too much can reduce profit and may harm the environment.

Thus, tools that can eliminate guesswork and increase yields and profits through optimal fertilizer application are valuable for farmers. The *RiceAdvice* decision-support tool helps farmers identify the best option for fertilizer to buy, based on nutrient requirement and fertilizer prices.

Moreover, *RiceAdvice* helps farmers make better-informed decisions based on return-on-investment calculations. They can select their own target yield based on their budget. In fact, this feature of *RiceAdvice* has been commended by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)-Competitive African Rice Initiative (CARI), which is helping in the deployment of *RiceAdvice* in sub-Saharan Africa.

*RiceAdvic*e does not need an internet connection to generate the guidelines in villages or fields, except for updating the app. Expected users are farmers, extension workers, input dealers, traders, agricultural entrepreneurs, and development agencies in Africa interested in receiving expert advice for rice production.

AfricaRice studies have shown that the adoption of *RiceAdvice* recommendations can increase rice yield by 0.6 to 1.8 tons per hectare in farmers' fields.

"However, it is important to remember that *RiceAdvice* should be disseminated along with other good agricultural practices," emphasized Dr. Kazuki Saito, AfricaRice agronomist, who has spearheaded the development and dissemination of the tool.

Backed by science

Explaining the importance of data from basic research that underpin *RiceAdvice,* Dr. Saito said that the decision-support system was built on decades of work by AfricaRice scientists and their partners since the late 1990s developing improved crop management options in irrigated and rainfed ecosystems.

Farmers were closely involved in the development of such crop management options. Care was taken to propose prototype technologies and good agronomic principles and decision tools rather than fixed technologies or blanket fertilizer recommendations, as the nutrient requirements of the crop can change, even across short distances in fields.

Thus, *RiceAdvice* is essentially based on databases from research repackaged into a format that is useful and accessible. The tool has been extensively fine-tuned and validated on the ground in consultation with farmers. More than 90% of the farmers who used the tool in Senegal and Nigeria during its validation phase are willing to continue using it.

RiceAdvice deployment

In April 2016, a one-year project was launched by AfricaRice, with support from the government of Japan, to disseminate *RiceAdvice* in Nigeria and Mali to improve rice productivity, maximize rice farmers' investment potential, and catalyze youth employment. The project's overarching goal is to contribute to food security and social stability in the two countries.

The project's strategy was to train 200 people, including youth and women, in these countries in the use of *RiceAdvice* and good agricultural practices in rice farming. The trained people, in turn, served as advisory service providers and gave recommendations generated by *RiceAdvice* to 12,000 farming households.

The project aimed to increase rice yield in the target areas in Mali and Nigeria by 20%.

For the rollout in the two countries, the project benefited from the help of key development partners GIZ-CARI and Syngenta Foundation for Sustainable Agriculture as well as national agricultural research and extension systems such as the Institut d'economie rurale in Mali, the National Cereals Research Institute, and Ahmadu Bello University in Nigeria.

At the project closing meeting held at the AfricaRice-Cotonou research station in February 2017, it was reported that, thanks to the Japan-funded project, 200 trained service providers have helped more than 16,000 rice farmers in Mali and Nigeria benefit from *RiceAdvice*, leading to increased productivity, efficiency, and profits.

"Farmers are happy with the significant improvement in yield and income that *RiceAdvice* has brought to them and are eager to continue with the service," observed GIZ-CARI, which is helping deploy the *RiceAdvice* technology to more than 9,000 farmers in the Nigerian states of Kogi, Niger, Jigawa, and Kebbi through 97 trained service providers.

Mr. Murtala Aliyu, a farmer from Kebbi with 0.2 hectare of land, said, "Before, I used to apply four bags of fertilizer and harvest only six bags of paddy. But now, with *RiceAdvice*, I applied just two bags of fertilizer and I harvested 18 bags of paddy on the same farm."

After seeing the increase in yield on his farm because of *RiceAdvice*, Mr. Abdullahi Mahari from Jigawa expressed his willingness to pay NGN 20,000 (USD 65) for *RiceAdvice* service because it was so profitable to him.

Syngenta Foundation for Sustainable Agriculture recounted a similar experience from Kouroumari area in Office du Niger, Mali. Of the 600 farmers who benefited from *RiceAdvice*, 99% wish to reuse the service in 2017 and 44% of them are ready to pay between 250 F CFA (about USD 0.50) and 10,000 F CFA (about USD 16) for *RiceAdvice* recommendations.

"We are pleased that nearly all the project targets have been achieved or even surpassed in some cases," said Dr. Saito, *RiceAdvice* project coordinator, at a meeting to review the progress and achievements, share experiences, and develop a follow-up plan for after the project ends in March 2017.

Thanking the government of Japan and the various partners for their strong support, Dr. Saito reported that various media tools have been developed for promoting *RiceAdvic*e, such as a promotional video, social media, and a dedicated website.

The way forward

The meeting participants discussed opportunities for and constraints to outscaling and upscaling *RiceAdvice* in a sustainable manner so that the tool could serve more people and achieve broad impact.

"AfricaRice and its partners agree that we need appropriate business models, coordination mechanisms, and new partners, particularly from the private sector," said Dr. Saito. "We are quite lucky as a wide range of partners is interested in this tool."

AfricaRice and its partners are analyzing the data from the project and are making follow-up field visits to assess the initial impact and identify mechanisms for the effective rollout of *RiceAdvice* in sub-Saharan Africa after the end of the project. GIZ-CARI is actively supporting the dissemination and validation of RiceAdvice in Burkina Faso and Ghana, in addition to Nigeria. Syngenta Foundation for Sustainable Agriculture is also disseminating RiceAdvice to farmers in Mali and Senegal. GIZ is supporting an AfricaRice project to develop and validate RiceAdvice for Eastern Africa. All these efforts will ensure that many more farmers can make two rice plants grow where only one grew before. ■

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

A RICE farmer (*second from left*) in Burkina Faso followed RiceAdvice recommendations and is happy with the result. (Photo by Kokou Ahouanton, AfricaRice.)

KOKOU AHOUANTON, AfricaRice research assistant (*third from right*), demonstrates how to use the RiceAdvice in Nigeria. (Photo by Phillip Onimisi Obosi, GIZ-CARI.)

The immortals' gift

by Alice Flinn-Stilwell

A tale of how rice became the staple food of the tribes in the northern Philippines

Malakas and Masipag were tribesmen and hunters. They journeyed many days through the rugged Cordillera mountains, struggling through dense forest—the trees so tall they could not see the tops, and the trunks so large it would take eight men holding hands to stretch around the base. Between these giants, rattan lianas festooned like giant spider webs hung high overhead, grass and moss filled every cranny and crevasse, and streams and waterfalls rushed headlong out of sight among the undergrowth.

The terrain was steep and their way long, so Masipag and Malakas had little time to forage for food. Evening approached. Light from the sun disappears fast in the forest, and night comes quickly—they knew from experience.

“The light is almost gone we must find something to eat,” said Malakas, putting down the small bundle from his back.

They foraged among the rocks and ferns for a few roots, but soon realized they would have to sleep with their stomachs aching from hunger. Their only luck was that, in their search for food, they had found a dry cave.

“At least we have shelter for the night,” they agreed. “Maybe tomorrow we’ll find food.”

They were just settling down for the night when they heard small noises—but not the usual forest noises. They peered cautiously from the cave, hoping it was an animal that they could catch and eat.

They were surprised, and a little afraid, to see people.

“Don’t be afraid,” one of the strangers called out. “We are friends.”

“You look hungry,” said another. “Have you eaten?” Without waiting for a reply, he offered them food. “Please eat now.”

The food looked like white worms. Malakas and Masipag had never seen anything like it before, and, although they were very hungry, they did not want to eat such things.

“We don’t eat worms,” they murmured.

The immortals insisted that these worms were grains and good to eat. They told the hunters that they had been cut from the stalk of a plant, dried in the sun, and then boiled.

“These are delicious,” the immortals insisted.

Hunger finally got the better of them, and Malakas and Masipag cautiously tasted a few “worms.”

“Very good indeed,” they chorused and ate more.

Soon they had eaten well and their hunger was satisfied.

“What you have eaten is called rice,” said the immortals. “And now, we must be on our way.”

“But wait,” called Masipag hastily. “This rice you gave us was very good ... but tomorrow we will reach our homes and our families have not tasted it.”

The immortals vanished without a word but where they had stood were two sacks. Peering inside, the hunters found they were filled with rice. So, Malakas and Masipag returned home laden. They used some of the rice for eating and sowed the remainder in the most fertile soil they could find. From then on, rice became their staple food.

Indeed, it was food from the gods. ■

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.*

Resistance from within

by Alaric Francis Santiaguel

A recent technology is giving rice scientists a new weapon for fighting the notorious brown planthoppers: a combination of genes.

PHOTO BY ISAGANI SERRANO, IRRI

Brown planthopper (*Nilaparvata lugens*) is an insidious insect with a massive appetite for destruction. These insects, also called BPH, attack in frighteningly large numbers and commence a feeding frenzy at the base of the rice plant. Hundreds of thousands of stylets—mouthparts designed for piercing tissues—suck out the sap that nourishes the plant.

Like wildfire

In their wake, the BPH leave their trademark "hopperburn," so called because the rice leaves initially turn orange-yellow before the plants die. "It's like wildfire has ravaged the rice field," said Kshirod Jena, a plant breeder at the International Rice Research Institute (IRRI). "There's no escape."

BPH can also transmit the viruses that cause rice ragged stunt and rice grassy stunt, two incurable diseases that can finish off what the insects started. If any plants survive the initial onslaught, the plants infected by either virus are no longer productive.

These insects affect both tropical and temperate rice productions, causing severe yield losses worth hundreds of millions of dollars. Although these insects originate in the warm tropical zones of South and Southeast Asia, great swarms of BPH are carried by wind currents to great distances as far north as Japan and Korean peninsula.

"Many insects attack rice but the damage they cause is minor," Dr. Jena said. "BPH can destroy whole fields. That's why they are the number one enemy of rice farmers in Asian countries."

The most extensive damage from the pest has occurred in India, Indonesia, the Philippines, Thailand, Vietnam, Japan, South Korea, and Taiwan, with estimated annual losses of 2–3 million tons across the region. When rice farmers lose their entire crops to BPH, this sets off a domino effect that could quickly lead to farmers sinking deeper in debt, followed by lean months and food insecurity, and foregoing healthcare and educational needs of family members. In a real sense, BPH can put the entire farming household in peril as well.

Plants vs. vampires

BPH have been aptly nicknamed "vampire insects" for their manner of feeding. And, because the battle between the insects and their host plants has been going on for millions of years, their feeding mechanism has evolved into something that's quite intricate.

"The insect uses its stylet to navigate through the spaces between cell layers until it reaches the phloem cells," said Dr. Jena. "Then it injects a vector effector protein. It's like a killer protein. It dissolves the cell wall enabling the insect to suck the sap or phloem fluid, which transports the nutrients within the plant."

The phloem fluid is analogous to blood in other organisms, hence the insect's nickname.

But, the plants have developed their own elaborate protection system against insect attacks. Through the process of natural mutation, some plants have acquired the genetic component that enables them to secrete a substance called the receptor protein. The receptor protein neutralizes the harmful effect of the vector protein injected by the insects on the phloem cell wall. Thus, the receptor protein blocks the ability of BPH to feed, forcing them to find their meals elsewhere or starve to death.

Things became more complicated when farmers joined the "war" against BPH using pesticides as their weapons. The insects have an uncanny ability to quickly become resistant to chemicals. Farmers invested heavily in pesticides that offered only short-term protection. To keep up with the insects, farmers started spraying more often and used higher concentrations. But, the BPH kept bouncing back, flaunting their immunity and destroying rice fields.

The clone wars

Since the extensive use of pesticides is proving to be more harmful to the well-being of farmers and the environment than the actual target, IRRI has been working on host-plant resistance as an effective, environment-friendly approach to reducing insect damage and increasing rice yield.

"In the 1970s, IRRI was using the natural resistance of landraces and some wild rice to BPH in developing new varieties," Dr. Jena said. "IRRI pioneered the research protecting rice against BPH. It's called host-plant resistance breeding."

Back then, scientists knew that resistance genes existed. But they didn't have the technology to definitively identify them. They discovered 30 genes linked to the plants' resistance to the insects and labeled them *Bph1*, *Bph2*, *Bph3*, and so on.

It was only recently that researchers such as Dr. Jena were able to isolate the actual genes and pinpoint their location on the rice chromosome.

Through recently developed process known as gene cloning (not to be confused with creating carbon copies of whole organisms), they were able to study how these genes interact with the insects and fully understand the previously mentioned vector protein—receptor-protein interaction.

"In gene cloning, we identified the resistance gene derived from a wild rice, *Oryza australiensis*," Dr. Jena explained. "We transferred the gene into a cultivated rice variety. Then we located the introduced gene on the rice chromosome 12 of the cultivated

HOPPERBURN, where rice fields appear to have been scorched by fire, is one of the signs of a BPH infestation. (Photo: IRRI)

variety through gene mapping and confirmed that the gene is working."

Gene cloning is a process that can take up to five years to complete.

Over the past six years, Chinese researchers have cloned four resistance genes while Japanese scientists have pinpointed a fifth gene found in cultivated rice. Researchers at IRRI have also identified new sources of resistance to recently evolved BPH populations in the Philippines.

The new resistance genes will be transferred into IRRI varieties to protect rice against aggressive BPH populations.

An "international" gene

In 2006, Dr. Jena discovered the *Bph18* gene with scientists from the Rural Development Administration (RDA), a government organization responsible for agricultural research services in South Korea. Five years later, the collaborative team from RDA and IRRI released a new high-yielding and delicious variety, ANMI, in South Korea. ANMI carries the Bph18 gene making it highly resistant to BPH and is now commercially cultivated in South Korea. *Bph18* is proving to be a more formidable gene. Until now, ANMI is still resistant to BPH.

In 2016, Dr. Jena and his team at IRRI successfully cloned Bph18, from a wild species of rice.[1]

"IRRI is the only one using the wild rice germplasm," said Dr. Jena. "Some wild rice cannot be crossed with cultivated rice. But we have a mechanism to overcome this incompatibility barrier and move the gene from the wild rice into cultivated rice."

In recent years, BPH infestations have intensified in many countries as the insects developed resistance to widely used pesticides to overcome genetic resistance in plants. The *Bph1* and *Bph2* genes introduced into IRRI varieties IR26 and IR42 have succumbed to new strains (or biotypes) of the insect.[2]

The genes cloned by Chinese and Japanese researchers proved to be effective against BPH biotypes found only in the two countries, respectively. The *Bph18,* on the other hand, is effective against BPH populations in different Asian countries giving rice crops a broad-spectrum protection.

"This gene confers resistance to BPH populations in the Philippines, Korea, Vietnam, Indonesia, India, Thailand, and China," Dr. Jena said. "It also provides a very stable resistance."

A package of resistance

Genetic resistance to BPH can last from 5 to 10 years before it is breached again, according to Dr. Jena. But, thanks to advances in gene cloning, scientists are now doing something to make it last even longer. At, IRRI, Dr. Jena's team is combining different resistance genes that have been identified through gene cloning.

"We are combining *Bph18, Bph3,* and *Bph20,*" Dr. Jena explained. "We're making a package of resistance genes and developing BPH-resistant IRRI breeding lines using IR24."

Released in 1973 in China, IR24 is one of the most popular rice varieties developed at IRRI. But IR24 is susceptible to BPH. "We are putting the three resistance genes in IR24," said Dr. Jena. "Instead of producing one kind of receptor protein, the plant will be able to produce three types of receptor protein to fight off the vector protein."

This gives the plant durable or longer resistance, up to 15 years or so, compared with single-gene resistance. Once ready, the resistant lines will be sent to different locations in Asia that are affected by BPH problems for field testing.

However, this is not a silver bullet against the BPH problem. Because natural selection is a constant process, BPH is expected to overcome even triple-gene protection. This process could be hastened by the improper use of pesticides and even climate change that could spurn genetic mutations in the insects.

"Once insects mutate, they become more virulent," said Dr. Jena. "What we can do is continue making new gene packages and put them into rice plants. It is crucial to identify more genes and understand their mechanism of resistance to develop rice varieties with long-term BPH resistance as well as resistance to different variations of the insects."

Gene cloning is a long, tedious, and expensive process. But, for Dr. Jena, it is worth the time and investment that IRRI pours into it.

"I feel very happy when we discover a new gene," he said. "Because that discovery could be beneficial to rice farmers all over the world." ■

Mr. Santiaguel is the managing editor of Rice Today.

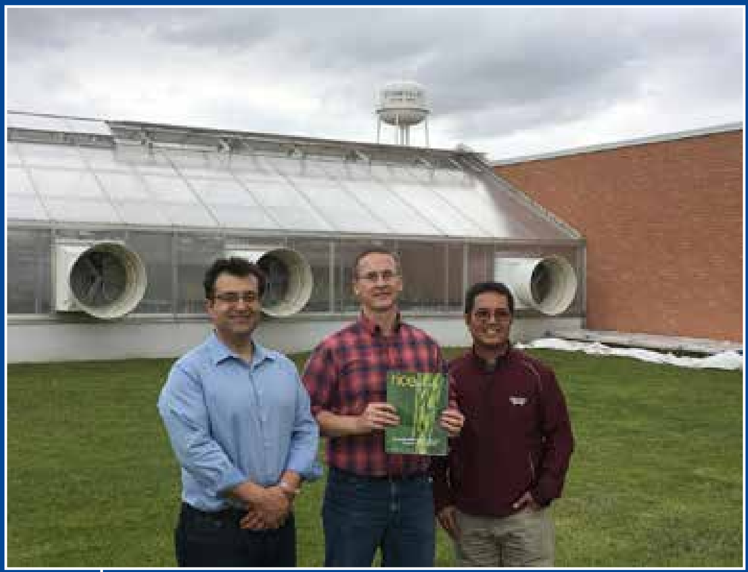
[1] Ji H. et al. 2016. Map-based cloning and characterization of the *BPH18* gene from wild rice conferring resistance to brown planthopper (BPH) insect pest. Sci. Rep. 6, 3476.
[2] Tamura Y. et al. 2014. Map-based cloning and characterization of a brown planthopper resistance gene *BPH26* from *Oryza sativa L. ssp. indica* cultivar ADR52. Sci. Rep. 4, 5872.

rice TODAY around the world

RICE IN the heart of the Corn Belt. Darlene Sanchez takes a selfie at the Iowa State University. Although Iowa produces the most corn in the US, it is also home to wild rice, often called the oldest agricultural crop in the nation. Much of the wild rice has disappeared from its traditional range but efforts to reintroduce it are underway.

RICE TODAY in a climate-smart village. Ou Thi Thanh (*left*), a farmer in Ma Village, and Hoang Thi Yen, an agricultural extension officer in Vinh Kien commune pose with the magazine. Ma, which is located in Yen Bai Province, Hanoi, Vietnam, is a village under the Vinh Kien commune. It is one of the climate-smart villages under the CGIAR Research Program on Climate Change, Agriculture and Food Security in Southeast Asia.

RICE IN the land of Kiwis. Cirila Lagala, a care assistant at Mitchell Court Resthome, poses with *Rice Today* at Fergusson Park in New Zealand. The mountain in the background is Mt. Maunganui, a large lava dome formed about three million years ago.



THREE SCIENTISTS and a rice magazine. Ehsan Shakiba, Bryce Blackman, and Ed Redoña are at Delta Research and Extension Center, the largest of Mississippi State University's (MSU) off-campus agricultural research site. The center focuses on solving crop and aquaculture production problems and transfer new information and technology to area producers.

Dr. Shakiba is an assistant professor of rice breeding and genetics with the University of Arkansas. Dr. Blackman is a research entomologist with the Southern Insect Management Research Group in Stoneville while Dr. Redoña is a professor of rice breeding and genetics at MSU.

A partnership between researchers and smallholder farmers in lower Myanmar is improving agricultural profitability and productivity through rice-rice and rice-pulse cropping systems.

RICE: THE PULSE OF LIFE IN MYANMAR

by Rona Niña Mae Rojas-Azucena and Grant Singleton

In the 1960s, Myanmar was a leading rice exporter in the global rice market. Political developments in the country, however, closed off the nation from neighboring trade and international activities and dampened its once-illustrious rice sector.

With the democratic reforms in recent years, Myanmar has slowly reopened its doors to global trade and other countries as it strives to transform its economy. Myanmar's economic growth hinges on the development of its agriculture, particularly the rice sector.

The role of rice

Rice is very important in Myanmar. It is cultivated on 64% of the country's arable land—more than 8 million hectares. At least 5 million rural households are involved in rice farming. People living in rural Myanmar have a large per capita consumption of rice—up to 154 kilograms per year. Rice provided 70% of their daily calorie intake in 2016. At the moment, most of the rice produced in Myanmar is used to feed the local population of more than 52 million.

Despite Myanmar's rich land and water resources, its rice farmers are far behind their Asian neighbors. Rice yields along the country's fertile Ayeyarwady Delta are only half of those along Vietnam's Mekong Delta. Farmers grow rice in the monsoon season. But, during the dry season, only about a third of them grow rice while the rest grow pulses.

A new dawn for farmers

The Ministry of Agriculture, Livestock, and Irrigation (MOALI) is keen to regain the country's status as a major rice exporter and increase the income of its rice farmers. Increasing production will help Myanmar be more competitive in regional and global rice markets. To do so, it is essential to increase the efficiency of production and quality of its rice by allowing its farmers to avail of new crop varieties and agricultural expertise.

The Australian Centre for International Agricultural Research (ACIAR), in partnership with MOALI, is working to improve agricultural productivity and sustainability and food system resilience in Myanmar through the MyRice project. Formally known as *Diversification and intensification of rice-based systems in lower Myanmar*, the project aims to diversify and intensify rice-based systems in lower Myanmar and assist smallholder farmers in the mid- and upper Ayeyarwady Delta. The Department of Agriculture (DOA), Department of Agricultural Research (DAR), and Yezin Agricultural University (YAU)—all under MOALI—and the International Rice Research Institute (IRRI) are the main partners in the ACIAR MyRice project.

Under the project, IRRI works closely with its local partners to improve farm productivity and the profitability of smallholder farmers. Meanwhile, in addition to rice, MOALI is looking at the production of pulses and other high-value crops that are often grown immediately after the harvest of the monsoon rice.

SMALLHOLDER FARMERS in lower Myanmar have struggled with low yield and income from rice farming. ACIAR's MYRice program has brought these farmers together to become partners in agricultural development. (Photo: Grant Singleton, IRRI)

Solutions through farmer participation

With partners from DAR and DOA, the MyRice project identified Maubin in the Ayeyarwady region and Daik Oo in the Bago region for its initiatives. Forty-four trials were undertaken from the 2012-13 dry season to the 2016 wet season. These were on-farm participatory adaptive research trials, implemented with 2,990 farmer-partners. The trials focused on short-duration and new high-yielding varieties of rice and pulses, best management practices, community rodent management, and improved postharvest management. A participatory varietal selection (PVS) approach was used to obtain immediate feedback from farmers—their reasons for their preferences and constraints to adoption.

"The PVS approach helped Myanmar's agricultural technicians and farmers to obtain a variety that suits their tastes and preferences," says Dr. Daw Tin Tin Myint, former deputy director general of DAR and MyRice collaborating scientist. "It's a leading technique for all participants to be involved in making decisions."

The close collaboration among farmers and national partners resulted in the release of two flood-tolerant varieties for the wet season (rice-rice systems), drought-tolerant varieties for the dry season (rice-rice systems), and one variety suited for both the wet and dry seasons.

U Maung Maung Aye, a 52-year-old farmer from Phaung Wae Village in Daik Oo, joined the trials on varietal selection for new green gram varieties. He also participated in the trial for best management practices in rice during the 2015 monsoon season.

"We were taught new ways of planting pulses such as line sowing," U Maung Maung Aye says. "I prefer it over our traditional practice of broadcasting seeds because seed rates are lower using line sowing." He uses 8 kilograms per hectare with broadcast seeding compared with only 3.2 kg with line sowing.

During the same season, husband and wife U San Pwint and Daw Aye Maw participated in the best management practice trials for rice using two new varieties, Pyi Taw Yin and Sin Thwe Latt.

"We were planting traditional varieties such as Sin Thu Kha that yielded 4 tons per hectare and sold for 4,500 kyat (USD 3.38) per basket as grain," U San Pwint says. "We also incurred more losses in the field than when we tried growing Pyi Taw Yin, which yielded 4.75 tons per hectare and sold for 7,500 kyat (USD 5.64) per basket as seed."

The new and improved crop varieties enable farmers to obtain higher yield and income, and to cope with the effects of climate change. Dr. Aye Min, DOA assistant director and MyRice collaborating scientist, says: "Farmers feel more secure and are able to save on input costs."

Trials on drum seeding and integrated weed management in the rice-pulse system in Maubin indicated a benefit of USD 15 per hectare for the monsoon crop compared with the farmers' practice of transplanting. Row seeding using a drum seeder provided farmers with an extra USD 100 per hectare for the summer crop.

In the 2014, 2015, and 2016 wet seasons, 8,148 kg of seed for monsoon rice varieties was distributed to 352 farmers in the Ayeyarwady and Bago regions. In the 2015, 2016, and 2017 dry seasons, 5,124 kg of seed for summer rice varieties was distributed to 204 farmers. For the first time in 20 years, pulse farmers in Myanmar have had access to new pulse varieties and more than 340 pulse farmers have adopted them. The combined benefit from new varieties and new best management practices (pre- and postharvest) indicate that productivity benefits will surpass 40%.

Postharvest gains

An assessment conducted by IRRI in 2013 revealed that farmers in rice-pulse areas practice manual harvesting and then pile up the harvested crops for as long as three weeks while they prepare their land for pulses. Farmers rely on outdated local threshers that are unable to thresh wet rice and are not mobile. This means that quality deteriorates and the harvest sells for a low price.

The MyRice team measured the losses from the traditional

LEARNING ALLIANCE members collectively assess technologies that will help improve their current postharvest systems. (Photo: Christopher Cabardo, IRRI)

postproduction process and compared these with the best management practices introduced by IRRI. Rice grain losses from traditional practices—piling, use of heavy threshers, sun drying, and storing—can reach 13%. Rodents also cause significant damage and farmers lose about 100 kilograms of rice every six months. This is enough to feed a family for more than a month.

The farmers who adopted best management practices reduced their losses to 3–7%. The grains processed using best practices also had higher milling recovery than the grains processed through traditional farmers' methods.

Best practice techniques include threshing crops immediately after harvest using a lightweight thresher or a combine harvester, systematic drying using a flatbed dryer, and storing the paddy and pulses in hermetic (airtight) bags.

"I am mostly impressed with the combine harvester, which I used to harvest rice last summer," says U Shwe Toe, one of the cooperators. Women involved in farming activities reported that they had more social and community activities when they began renting combine harvesters.

Since 2013, the use of combine harvesters in the village has significantly increased. Farmers have also tried using hermetic bags and 1- or 5-ton GrainSafes to store their pulses.

Daw Tin Yee, a rice farmer for 25 years, stored her pulse seeds for nine months in a hermetic IRRI Super Bag. "After storage in the Super Bag, I noticed that the color of the seed is better, the germination rate is higher, and there was no insect infestation," she recalls.

The following season, Daw Tin Yee planted stored Yezin 2 seeds and harvested 12 baskets per acre. "The trader also preferred Yezin 2 so I was able to sell it at 48,000 kyat (USD 36) per basket," she says. "I used the profit to renovate my house."

The MyRice group also introduced community-level rodent management and reduced rodent losses by 25%. Farmers benefited by up to USD 81 per household. Another benefit was decreased contamination by feces, thus improving human health.

Building networks for change

The MyRice team established a multiple-stakeholder platform called a Learning Alliance (LA) to engage with different groups across the rice value chain. Farmers, traders, millers, DOA staff, and IRRI shared their knowledge and experience of technologies to optimize rice and pulse production.

The LA became an avenue for these groups to collectively assess their experiences from the best management practice trials and to identify opportunities to maximize the benefits. They visited the main wholesale market for rice, and the seed farms, where they learned about quality, different varieties, and the process of selling in markets.

Alliance members also participated in a lightweight thresher demonstration on U Shwe Toe's farm to show how immediate threshing can reduce postharvest losses.

At the LA meetings, farmers from the best management practice trials also shared their experiences in using Sin Thwe Latt (rice) and Yezin (pulse) varieties with improved crop production management.

Recently, members organized farmer groups to develop postharvest services for the community in threshing, drying, and storage. From the best management practice technologies used during the postharvest loss assessment trials, members chose the technologies they preferred to rent out and generate profit.

Equal opportunity and increased capacity

Collecting data on gender is part of the MyRice project. Gender equality outcomes are measured via large household surveys at the beginning and end of a project, and seasonal farmer diaries.

Gender equity was examined in one of the project's townships using the framework of the Women's Empowerment in Agriculture Index (WEAI).

Participatory varietal selection trials recorded the preferences of men and women farmers based on agronomic characteristics and cooking and eating quality of rice varieties tested on-farm. Feedback identified the most preferred rice varieties and their seed multiplication and distribution in the community.

Women farmers, such as Daw Aye Nyein, not only became active cooperators but also successful seed growers. "I was able to pay off my loans because of the profit I earned," she says.

The MyRice project raised awareness among the project partners of the benefits of research and development on gender equity for agricultural smallholder communities.

MyRice is supporting two PhD students and Master of Science thesis grants for 17 DOA and DAR staff. The DOA partners who were mentored on farmer participatory research have gained project implementation skills and are now taking the lead during farmer meetings and field days.

Sustainable adoption pathways

The MyRice team is ramping up plans to further scale out best management practices and high-yielding varieties of rice and pulses. The project is also collaborating with other ACIAR initiatives in the country, such as MyPulse (legumes), MyFish (fisheries), and MyLife (livelihoods).

"The support for, and appreciation of, the project's benefits to smallholder farmers from the government of Myanmar has strengthened because of the impressive results of field demonstrations and the process of participatory engagement with farmer groups," says Dr. Grant Singleton, IRRI scientist and MyRice program manager.

"We are very pleased with the results of our collaborative research in Daik Oo," says U Hla Myint, DOA regional director of Bago. "It is now time to expand the project in 2017." He and his counterpart in the Ayeyarwady region, U Tun Aung Kyaw, met with their staff to identify outreach priorities for the next year.

During the MyRice project meeting in October 2016, U Hla Myint said: "In 2017, we will expand MyRice to 63 new villages from four districts. This will require a large investment of resources—my extension staff's time and operating funds. The regional government is willing to provide the main investment in this outreach."

A similar commitment was made by U Tun Aung Kyaw. Initiatives from the MyRice project are a great contribution to Myanmar's goal to regain its position as a significant contributor to regional and global food security through rice. Strong collaboration and engagement among MOALI, IRRI, nongovernment organizations, and private-sector partners are also highly important.

Boosting competitiveness in the domestic and international rice markets is critical. Methods learned in the MyRice project and access to new rice varieties will assist and will help pave the way toward the sustainable development of Myanmar's agricultural sector. ■

Ms. Rojas-Azucena is a communication specialist at IRRI. Dr. Singleton is a principal scientist and MyRice program manager at IRRI.

This article is reprinted from the second issue of ACIAR's Partners *magazine in 2017. (See http://aciar.gov.au/files/part_1703_myanmar_hr.pdf.)*

DAW TIN Yee, a farmer from Maubin, joined the MYRice on-farm research activities and benefited from her learning. (Photo: ACIAR)

After achieving rice self-sufficiency in the 1990s, Cambodia strives to be a global rice producer.

Helping Cambodia reap a more bountiful harvest

by Reianne Quilloy

As the global food plate continues to demand more rice, more rice-producing countries, including Cambodia, are setting their sights on becoming major players in the market. The country aims to export 1 million tons of milled rice per year, which means ramping up several initiatives to increase its rice competitiveness. The government of Cambodia invested in developing a portfolio of strategies aimed at helping the country reach 50% of its target. These include overcoming the labor shortage in rice production through mechanization, improving infrastructure, and providing interventions to improve its postharvest systems.

"But, there's still a lot more work to do," says Dr. Meas Pyseth from the Ministry of Agriculture, Forestry, and Fisheries. "We could not optimally reach our target because there is no market for Cambodian rice. Farmers largely depend on traders buying and processing their paddy in Vietnam instead of processing their own, which makes our rice value chain weak."

To tackle this problem, farm machinery, such as two-wheel tractors and combine harvesters, was rapidly introduced to the rice landscapes. But, the anticipated impact of mechanization was encumbered by the lack of value chain support services.

"Farmers are keen innovators. But, without a clear understanding of these machines and how to operate and troubleshoot them, they cannot be optimally used," shares Lor Lytour, dean of the Faculty of Agricultural Engineering at the Royal University of Agriculture (RUA), a leading public agricultural university based in Phnom Penh. "Aside from these, the farmers who can afford to buy the machines do not have the mechanisms to recover their cost. Cambodia also lacks agricultural engineers who can adapt existing technologies to local conditions and skilled agricultural machinery mechanics who can provide repair and maintenance services."

Building the capacity of future agricultural engineers

The International Rice Research Institute (IRRI) is a strong partner of Cambodia in looking for solutions to optimize rice productivity through mechanization and improved postharvest. In 2013, IRRI appointed Gerald Hitzler, IRRI-Centre for International Migration and Development expert, to lay the groundwork for developing initiatives to improve the country's capacity to strengthen its rice value chain support services.

Mr. Hitzler works with the RUA to revitalize its agricultural engineering curriculum. Formerly known as Agricultural Technology and Management, the program focused on technologies in general and lacked courses that will improve the operational skills and business component of the technologies.

"The new agricultural engineering curriculum emphasizes the technical aspects of mechanization," Dr. Lytour says. "Recently, we've been teaching business management skills so our graduates will have the chance to become entrepreneurs in the future. Gerald was on top of this to make it possible."

Mr. Hitzler also collaborates with the Department of Agricultural Machinery (DAM) and took the initiative to send some senior students to assess technologies developed by the institute. Some of them chose the improvement of machinery for their thesis topic.

Kroesna, a senior agricultural engineering student at RUA, is one of those students. She elected to work on improving the seed cleaner developed by DAM for her thesis.

"I like the practical teaching approach," Kroesna says, sharing her experience studying under the new program. "We were taught how to drive a tractor and repair machines. I'm very interested in machinery, so I find it fun to spend time in the workshop repairing machines, welding, and troubleshooting. I can even make my own machines in the future."

"This helps the department's efforts to improve the country's postharvest and mechanization activities," Dr. Lytour says. "We also engage in discussions on how to improve other machinery. I wish he will continue to help us more in our research and development efforts to help improve the rice mechanization in Cambodia."

Fostering synergies among various actors

IRRI, through Mr. Hitzler's active involvement, also works with other partners such as the Don Bosco Agricultural Vocational School (DBAVS) in Battambang Province.

"Gerald has been helpful in providing opportunities for our students to have hands-on experience in operating and maintaining machines," says Walter Zwick, a senior expert service consultant at DBAVS. "We have been sending our students to different institutions such as CLAAS Harvest Center and Agricultural Systems Research-Cambodia in Battambang as interns to get hands-on training in tractor repair and other jobs that can't be done in DBAVS's workshop."

Mr. Hitzler also fostered a strong and informal partnership with the French Agricultural Research Center (Cirad) and DBAVS.

"We hosted about 10 students from the DBAVS to work on field operations at our project sites," says Florent Tivet, a scientist at Cirad. "It was good for us, and good for them because they can learn much from field operations. At the same time, the students get hands-on experience in maintaining and fixing agricultural machines. We also borrow the equipment they have at DBAVS, such as a straw baling machine. Without this great partnership, we won't have this kind of synergy."

A business management module is also being considered by DBAVS to reinforce the knowledge and skills of students who want to run their own business someday.

Recently, an IRRI-led rice straw management project, launched in 2015, introduced the rice straw baler to help solve the country's increasing problem in handling rice straw after harvesting. The project held demonstrations of straw baling in Battambang Province. The project is also expanding its activities to Svay Rieng. Baling machines entered that province from Vietnam and they made an impression.

"Rapid adoption of the rice straw baler is slowly reaching neighboring provinces," says Mr. Hitzler. "Because farmers can now efficiently collect rice straw, cattle raising in Svay Rieng has increased by 20%."

He is scheduled to train farmers and government agriculture staff on the operation, maintenance, and repair of balers and other machines. "This way, we can improve the efficiency of providing after-sales service to ensure sustained use of equipment."

The rise of RICE in Cambodia

There are more things to do to help Cambodia meet its rice production goals. But, more importantly, the country now has the means to accomplish them.

With the inception of the Rice agri-food Systems CGIAR Research Program or RICE, IRRI and its partners will continue working together toward strengthening rice value chain services under the Flagship Project 2 (Upgrading rice value chains) of RICE. The Flagship Project enables Cambodia to produce rice sustainably and be responsive to market opportunities.

"We look forward to contributing to the improvement of Cambodia's rice sector by building on what we started years before," says Martin Gummert, one of the Flagship Project 2 activity cluster leaders of RICE. "RICE will help continue our initiatives and do a lot more."

With IRRI's continued strong commitment to being a global leader in rice science initiatives and the country's efforts to ramp up such initiatives, the transformation of Cambodia's rice industry from a local to a global provider is within its reach. ■

KIM DARA (*center*), 19, is a student at DBAVS Battambang and intern at CLAAS Harvest Center Phnom Penh. He plans to have his own machine repair shop someday. (Photo by Reianne Quilloy, IRRI)

Ms. Quilloy is a communication and outreach specialist at IRRI.

Drying rice is an art and a skill. Parboiling, a task largely done by women in parts of Africa involves partially boiling rice in the husk and drying it well before it is milled.

Taken by R. Raman© from the Africa Rice Center, the photo is the first runner-up in *A rice farmer's life*, a competition celebrating the 50th year of IR8. The "miracle rice" was developed by IRRI scientists in the early 1960s is believed to have saved many countries in Asia from famine.

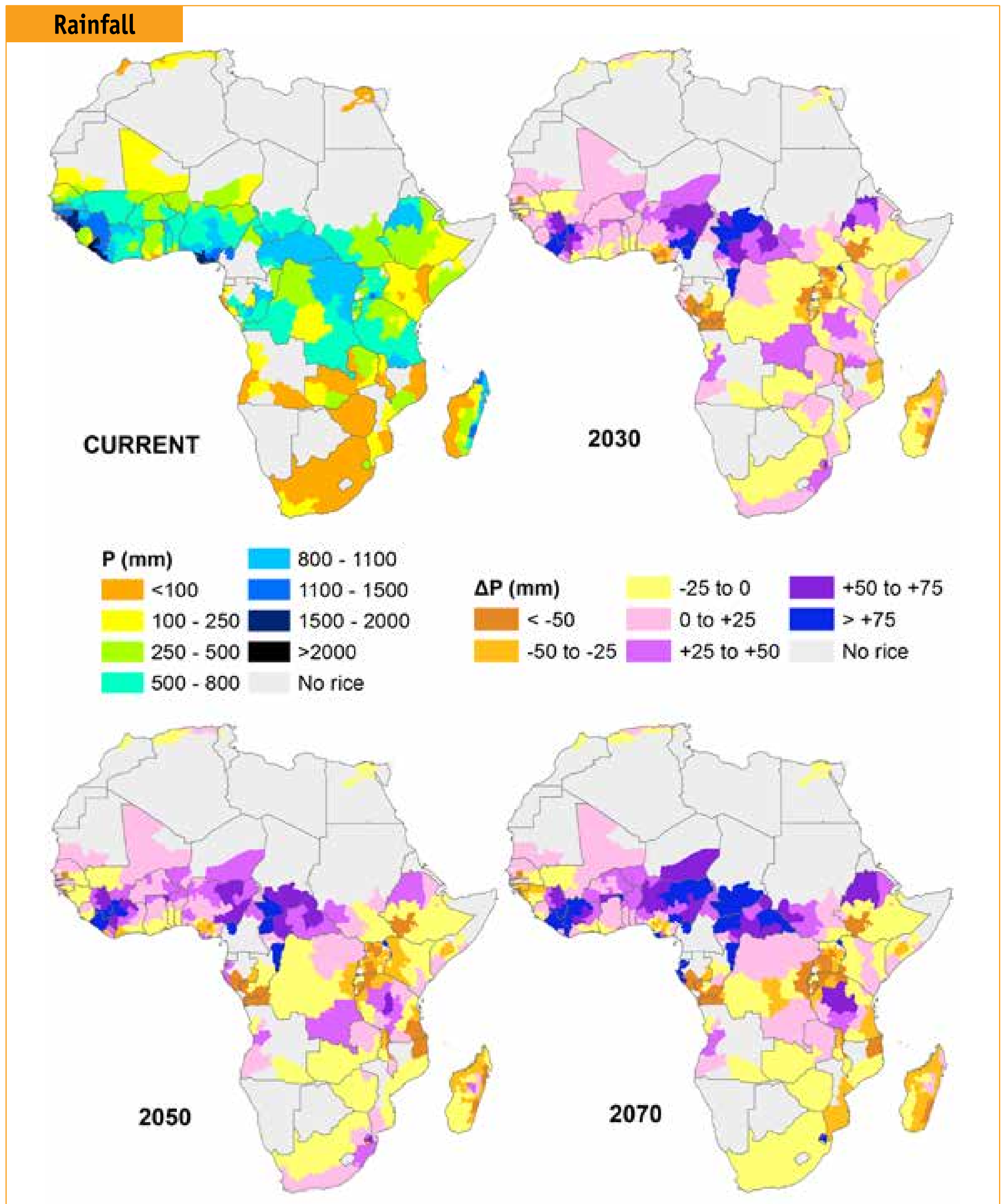
Future rice climates in Africa

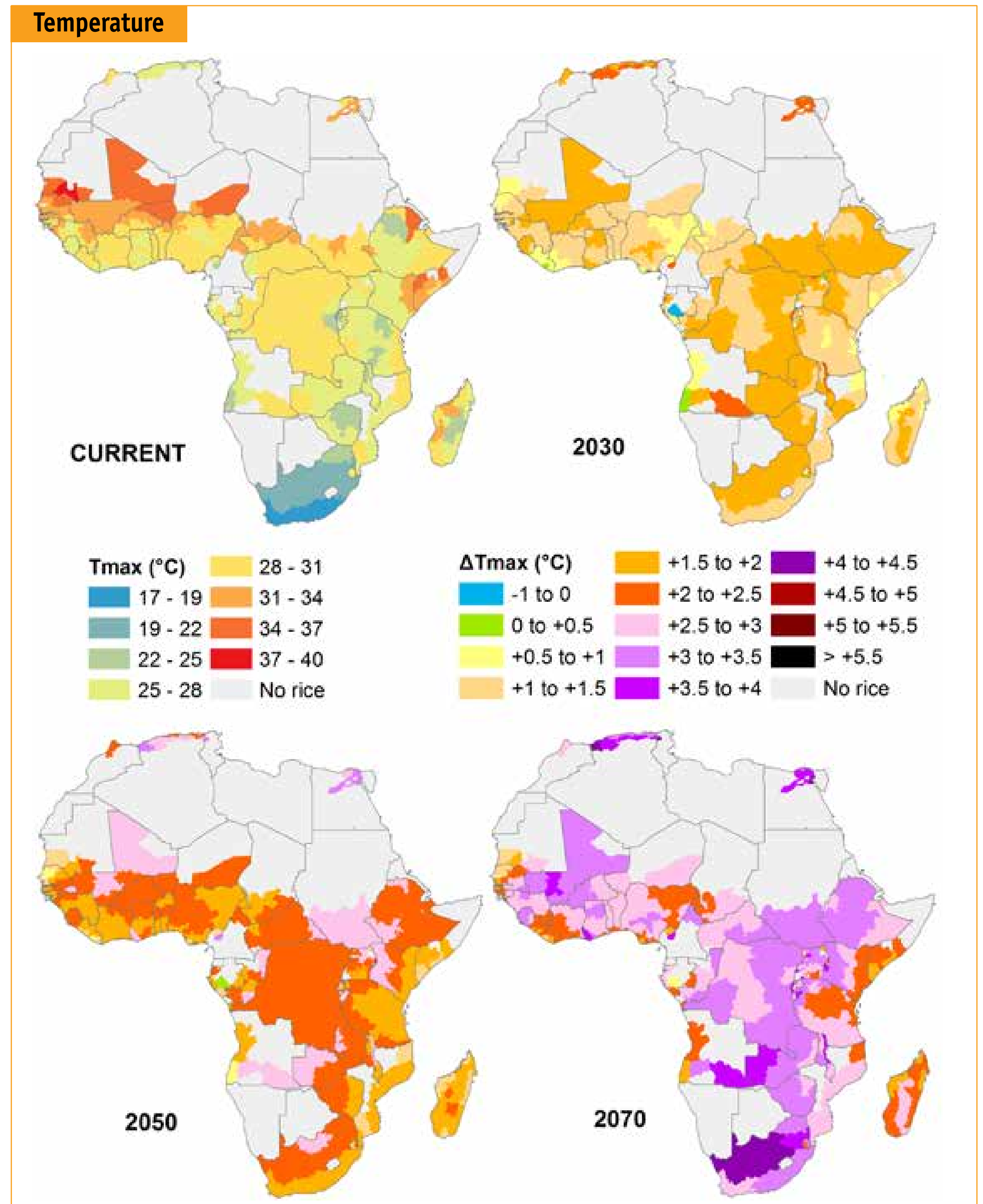
by Sander Zwart, Moctar Dembélé, and Pepijn van Oort

Rice is grown in a wide range of climates across Africa, from cold conditions in the highlands of Madagascar, Ethiopia, and Rwanda to extremely hot conditions in the Sahel zone and Egypt. Future rice production and food security are under pressure as a result of climate change-induced increases in heat, drought, salinity, and floods.

As a first step in understanding future climate changes and the impact on rice production, spatial analysts from the Africa Rice Center (AfricaRice) have quantified projected changes in average maximum and minimum temperature (ΔT) and total rainfall (ΔP) during the rice-growing season. Downscaled climate change scenarios were overlaid with rice maps and rice phenology from *RiceAtlas* of the International Rice Research Institute. The analysis was performed for three time periods (2030s, 2050s, and 2070s), four scenarios developed by the Intergovernmental Panel on Climate Change, Representative Concentration Pathways (2.6, 4.5, 6.0, and 8.5), and two agricultural seasons (wet and dry).

The projected rainfall patterns are diverse; increase in seasonal rainfall is predicted in Central Africa (Nigeria, Niger, Chad, and South Sudan) and northern Ethiopia. Reduction in rainfall is predicted in eastern Africa and Madagascar in all Representative Concentration Pathways (RCPs). Maximum temperature is projected to increase in almost all countries under the different RCPs but at different rates. The strongest temperature increases are predicted for Mali and the bordering administrative units in Burkina Faso where the average maximum temperature are already high, ranging from 30°C to 41°C, during current growing seasons. The second zone where strong temperature increases are predicted is the currently relatively cool belt stretching from Ethiopia to Zimbabwe. Temperature increases in the highland areas in these countries may offer new opportunities for rice farmers. ■





Dr. Zwart is a GIS and remote-sensing specialist, Mr. Dembélé is a postmaster fellow, and Dr. van Oort is crop modeler. All the authors are working in the Sustainable Productivity Enhancement Group at AfricaRice.

For a full explanation of the methodology, reference is made to the citation and link below. All maps are provided as supplementary information and can be downloaded and visualized using GIS software or Google Earth.

Zwart SJ. 2016. Projected climate conditions for rice production systems in Africa. *AfricaRice GIS Report – 1. Africa Rice Center, Cotonou, Benin. (See http://dx.doi.org/10.13140/RG.2.2.13172.14728.)*

Reimagining agricultural education

by Sherwin Pineda

Even though the International Rice Research Institute (IRRI) has made a name for itself as a research institute, it has always provided a venue to train scientists, extension agents, and farmers. Over the past five decades, IRRI boasts of having trained more than 15,000 scientists in rice research. Scholars from IRRI Education, then the Training Center, have become ministers, secretaries, and leaders within national agricultural research and extension systems around the world.

"Given IRRI's history, knowledge base, and technology, it is in a unique position of being able to leverage its expertise in rice science to teach skills and educate those in the agricultural sector within the context of rice," Peter Brothers, head of IRRI Education, said.

These days, the M.S. Swaminathan Hall, where IRRI Education holds office, is buzzing with activity. Aside from the usual comings and goings of rice research scholars who attend the lectures inside, the IRRI Education staff busy with the active marketing of their courses.

Refocusing training

"IRRI Education is the next evolutionary step for IRRI's training program," Dr. Brothers said. "We are proactively reaching out to organizations that have a vested interest in agriculture and making them see IRRI Education as the solution to beefing up their capacity development needs."

IRRI Deputy Director General for Research Jackie Hughes added, "The global environment, the agricultural landscape, and technology—these are all changing and farmers can't keep up. IRRI Education is the capacity development entity that we have that will bring all the cutting-edge technologies to the farmers and students to help them meet the challenges of this rapidly changing world."

"We think about the mechanization issues that are really significant in India," said reflective Jason Beebout, an extension agronomist, when asked about the need to ramp up capacity development in the agricultural sector. Mr. Beebout is a member of the IRRI Education team. "We also need to be able to train women—we need to be able to give them the skills that they need."

Previously, the IRRI Training Center undertook training work in terms of grants received by IRRI that had a training component. This meant that students invited to attend courses were fully funded by the IRRI grant. Now, in addition to maintaining such activities, IRRI Education is devising a full portfolio of courses that will be offered for students who are self-

PETER BROTHERS, head of IRRI Education, is hopeful for the future of education in the agricultural sector. (Photo by Rene Guevarra, IRRI)

funded, that is, they will need to find the costs of attendance from their own funding sources.

In addition, what makes IRRI Education different from its previous version is that it provides more flexibility in terms of developing courses that people are interested in attending, according to Mr. Beebout. "I'm really excited that people will walk away with a high quality experience, walk away with specific skills that they can take back to their work."

The emphasis on flexibility makes IRRI Education attractive to students and organizations because they are able to design courses that target specific needs.

The courses may be for self-study (using a variety of distance-learning technologies), face-to-face classroom and fieldwork experiences, workplace learning with mentoring by more experienced scientists, or a combination of these three.

In addition, the offerings may be delivered as one-off block courses, as regularly scheduled experiences over a period of time, or self-paced. They may be delivered at the IRRI headquarters in Los Baños, at other IRRI locations around the world, or at any site convenient for a particular group of students.

IRRI Education also designs and creates courses for organizations to use in their own work.

Renee Lorica, a scholar from the Philippines, couldn't be happier with the program she's currently following. "The system is really useful because people here are very helpful and, research-wise, you have all the facilities you need," she said.

"It's an excellent program," Hein Zaw from Myanmar said. He stated that the time he spent at IRRI helped him become a leader in his work back in his country.

Mohammad Chhiddikur Rahman, a PhD scholar from Bangladesh, added, "I'm learning a lot here because I get to interact with scientists whose expertise and experience cover a wide range of specializations from different regions."

Training the next generation of scientists

One of the mandates of IRRI Education is to train the next generation of rice scientists, a mandate that Dr. Brothers takes seriously.

"IRRI Education's portfolio focuses on three crucial areas: technical, scientific, leadership," he said.

The portfolio contains course offerings in science (aimed at emerging scientists), technical areas (best practice in farming, aimed at people who work directly supporting farmers, such as agriculture extension agents), and leadership (aimed at policymakers and those who undertake analysis in support of policymakers.

For Sampriti Baruah, the courses she is taking at IRRI have clear real-world applications for her work. "I'm trying to understand how IRRI's science can be taken to the field," she said.

"I am involved in research and also in training future students who are going to study in my field," Côte d'Ivoire student Amani Kouassi said.

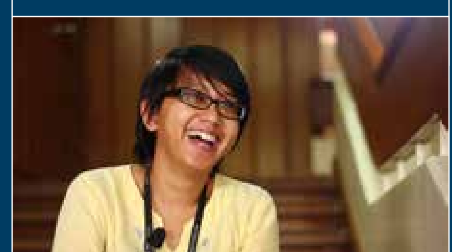
"IRRI is the best platform to interact with different people from the scientific community, young and trained," Nitika Sandhu, a student from India, reiterated. "IRRI is the premier institute in the world where you have access to the newest technology and resources."

It is important that training future rice scientists be unified with a purpose, according to Dr. Hughes.

"If we give a lot of random training courses, which are not consolidated, there is a risk that (a) we won't target their needs and (b) the quality control may lag," she added. "In IRRI Education, we will pool it as one entity for the students. The big plus is they will have access to our network of other trainees and all the contacts and collaborators that we have to help them build their future." ■

Mr. Pineda is a communication associate at the International Rice Research Institute.

AMANI KOUASSI, a student from Côte d'Ivoire, is looking forward to returning to his country and sharing the knowledge he has learned at IRRI. (Photo by Isagani Serrano, IRRI)



RENEE LORICA, a scholar from the Philippines, thinks that IRRI Education is providing her with the tools and resources she needs to become a significant member of the next generation of rice scientists. (Photo by Isagani Serrano, IRRI)

MOHAMMAD CHHIDDIKUR Rahman, a PhD scholar from Bangladesh, says his interaction with IRRI scientists is helping him become a stronger researcher in his field. (Photo by Isagani Serrano, IRRI)

Arroz con pollo

by Robby Goco

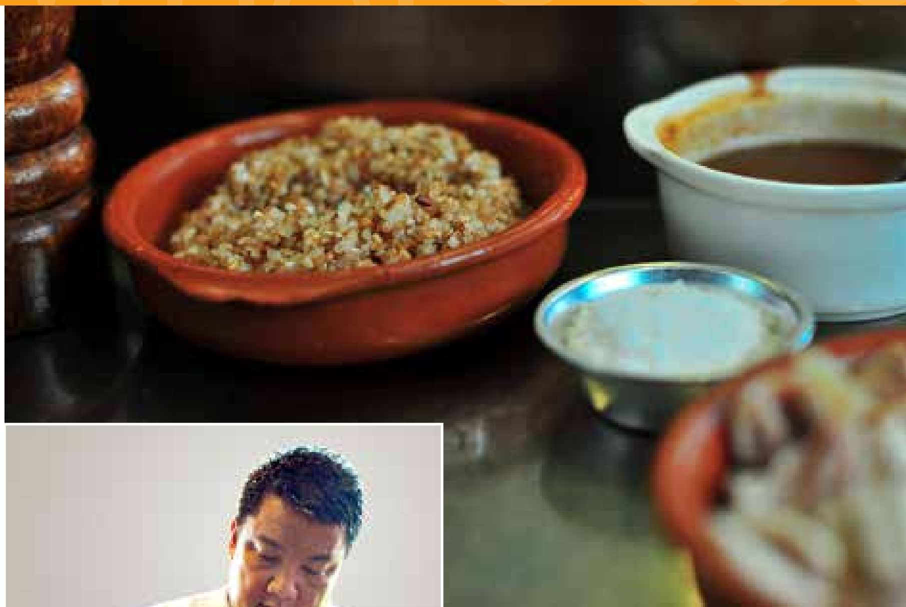
PHOTOS BY ISAGANI SERRANO, IRRI

Chef Robby has more than 20 years of professional cooking and kitchen management experience, with a scope that knows no geographical boundaries. A graduate of the California Culinary Academy, he is renowned for his classic Mexican, Greek, American, and, of course, Filipino restaurants that constantly obtain rave reviews and have won numerous prestigious awards.

But, Chef Robby is more than a culinary artist. He is a respected entrepreneur, having been named one of the country's 10 Outstanding Entrepreneurs in 2008. His talent for cooking and business has been a key to the development of iconic restaurants such as Cyma Greek Taverna, Ristras Mexican Grill, Mati Greek Taverna, Triple V Group, Tequila Joe's, and Alfredo's Steak House in the Philippines.

Chef Robby's latest restaurant, Green Pastures, is the perfect stage to display his devotion to local and sustainable ingredients. The restaurant's concept is "farm-to-table" with "back-to-basics preparation," focusing on organic and locally sourced ingredients. Green Pastures is a member of the Slow Food movement, an international nonprofit, ecogastronomic organization that strives to preserve traditional and regional cuisine and protect cultures and the environment.

In this recipe, Chef Robby uses *Imbuucan,* an heirloom rice variety cultivated by in the Cordillera Region in the Philippines. *Imbuucan* has splendid brown grains that seamlessly match its flavor and aroma. The round grains are firm to the bite, making *Imbuucan* ideal for dishes such as Arroz con pollo, in which rice must be served al dente. ■



Ingredients

½ cup dark brown roux (see recipe)
3 cups *Imbuucan* (heirloom rice)
4 cups kombu (kelp) stock (see recipe)
250 grams roasted chicken (can be store-bought), chopped
salt and pepper to taste
50 grams crispy chicken skin (can be store-bought)
micro greens, as needed

Preparation

1. On a sauté pan, heat the dark brown roux.
2. Add cooked *Imbuucan* rice. Mix rice and roux until well combined.
3. Add kombu stock and chopped roasted chicken in the mixture and let the mixture boil. Reduce to a simmer for 8 minutes or until the rice absorbs all the kombu stock. Season with salt and pepper to taste.
4. When the rice has absorbed all the liquid, turn off heat.
5. Garnish with crispy chicken skin and micro greens.

Dark brown roux

Ingredients

1 cup butter, unsalted
½ cup all-purpose flour

Preparation

1. Place sauté pan on low heat. Melt butter in the pan.
2. Add flour when butter is melted and gently mix until it turns chocolate brown. This will take 30–45 minutes. Make sure the heat setting is very low to prevent the mixture from burning.
3. When the mixture turns into the desired color, remove from heat and transfer to a container. Set aside.

Kombu stock

Ingredients

1 whole sheet Kombu seaweed
5 sprigs fresh rosemary
5 sprigs fresh thyme
1 liter water

Preparation

1. Place kombu, fresh rosemary, and fresh thyme in a mixing bowl.
2. Heat water to a rolling boil.
3. Pour boiling water in the mixing bowl with kombu and herbs.
4. Steep mixture for 30 minutes before use.

PRISM in perspective

by Paula Bianca Ferrer

Information has the power to help policymakers make better decisions.

Information is power and, when it is in the hands of policymakers, better decisions can be made. Nowhere is this statement truer than in the collaborative monitoring and information system for rice production project of the Philippine Department of Agriculture (DA) and the International Rice Research Institute (IRRI).

Indeed, the power of accurate information is important, especially for a country that experiences an average of about 20 typhoons a year. In January 2017, the Philippine Rice Information System (PRISM) was tasked with assessing the extent of damage due to flooding and torrential rains that hammered Davao City in Mindanao in the southern part of the Philippines.

"We received a request from the DA for an assessment of flooded rice areas in Davao in January this year," said PRISM project leader Alice Laborte. "We mapped all the flooded areas—not just the rice areas—in Davao and other parts of Mindanao where many locations were placed under a state of calamity.

"The beauty of this technology, which makes use of satellite imagery, is that we can quickly provide an assessment and estimate the extent of damages over a large area," Dr. Laborte added. "One needs also to consider that, when there's a calamity such as this, mobility for government workers is limited and accurate and timely assessments of damage are particularly challenging."

System in shape

PRISM is an online system that consolidates and presents accurate, timely, and location-specific information on the status of rice crops. This includes rice area estimates, planting dates, yield estimates, and crop health assessments. PRISM provides vital information that can support the DA in strategic and policy decision-making, technology deployment, disaster preparedness, and rapid response to emergency situations during natural calamities.

Dr. Laborte shared that, initially, rice areas in seven out of the country's 18 regions were mapped during the wet season of 2014. By 2015, the project was already mapping rice areas in the entire country with an accuracy of more than 85%. Validation was done using field data collected by DA regional field officers with the aid of smartphones.

"The turnaround time for estimating rice areas is also quicker because we don't have to wait to obtain data until the end of the season," Dr. Laborte said. "We can also estimate rice area and yield at the municipal level, so the data are more specific than official statistics."

She explained that the maps can even be more granular—at the barangay level (the smallest local government unit in the Philippines). However, we need accurate barangay maps to release reliable estimates at this level, according to Dr. Laborte.

Ready to go

At the end of this year, the entire operation of PRISM will be turned over to the DA through the Philippine Rice Research Institute (PhilRice) to ensure the continued operation of its system.

"The PRISM project will be owned and operated by the Department of Agriculture," said Dr. Eduardo Jimmy Quilang, deputy executive director for research of PhilRice and PRISM project leader of PhilRice. "This year, we are in a transition period. We are now institutionalizing PRISM at PhilRice."

"We have been working hand in hand with PhilRice during the research project phase of PRISM," said Dr. Laborte. "PhilRice has been beefing up its infrastructure and setting up a separate PRISM unit with dedicated staff. This year, we are handing over the entire operation and moving from research to an operation mode."

Laborte reported that they have invested a lot in building the capacity of their regional partners. Last year, the DA regional field officers participated in several training courses, including research data management, GIS, and crop health. Meanwhile, local government units joined a crop health training activity. This year, the field officers will be participating in an intermediate GIS training, which will allow them to use PRISM products in identifying problem areas and targeting possible interventions to increase rice yields.

We are seeing a growing interest in PRISM products and we would like planners and policymakers to use the information generated by PRISM when and where needed to make informed decisions, according to Dr. Laborte.

"Besides assessing damage caused by flooding and drought, we receive other queries from the DA on whether we can estimate irrigated and rainfed rice areas, and also map other crops, such as maize and other high-value crops, across the country," said Dr. Laborte. "We have to build the system incrementally. Now that we have developed and have gained confidence in our estimates for rice area, we can explore protocols for mapping other areas as a next step."

Primed with a new purpose

Farmers, on average, lose about 37% of their rice crop to pests and diseases annually. In severe cases, pests and diseases can even wipe out crops completely, leaving farmers with nothing.

"The DA also wanted us to assess the damage caused by pests and diseases on rice," explained Dr. Nancy Castilla, PRISM crop health specialist. "We proposed to focus on five pests and diseases initially for the Pest and Disease Risk Identification and Management (PRIME) project. These pests and diseases, such as blast, bacterial blight, rice tungro disease and its vector green leafhopper, brown planthopper, and rats, cause major losses in the Philippines. Like PRISM, PRIME will be funded by the DA-Bureau of Agricultural Research."

"PRIME will build on the existing platform of PRISM and will integrate field-based pest surveillance and information derived from satellite and drone images to identify risk factors of pest and disease outbreaks, map potential outbreak risks, and identify appropriate management strategies and tactics to reduce crop losses," Dr. Laborte said. "PRIME is expected to enhance the DA's ability to reduce yield losses due to pests and diseases through better management and targeting of risk areas. The more data there are in both PRISM and PRIME, the more powerful our rice-based monitoring system becomes." ■

Ms. Ferrer is a science communication specialist at IRRI.

DR. LABORTE says PRISM can provide an accurate and timely estimate of damages over a large area when making assessments on the ground.

DA REGIONAL STAFF discuss their collective vision of how PRISM outputs will be used when it becomes operational under the department.

IRRI INFORMATION System Specialist Abel Callejo presents the PRISM website to agriculture executives and other government officials.

AGRICULTURAL EXTENSION workers undergo crop health training for the expansion of the coverage of PRISM monitoring fields.

AGRICULTURAL FIELD officers undergo training in basic geographic information system, which enables the visualization of rice area and yield, GPS-based field observations, and other data generated by PRISM.

Africa's rice farmers lose millions of dollars to parasitic weeds

by Savitri Mohapatra

Striga hermonthica

Striga asiatica

PHOTOS BY JONNE RODENBURG, AFRICARICE

An international team of researchers representing the Africa Rice Center (AfricaRice), the International Rice Research Institute (IRRI), and Wageningen University, has raised the alarm over the enormous economic impact of parasitic weeds on rice production in Africa, threatening the food security and livelihoods of millions of resource-poor rice farmers and consumers in the region.

Rice is the second most important source of calories in Africa. It is also critical for smallholder incomes. Demand for rice is growing at more than 6% per year—faster than for any other food staple in sub-Saharan Africa (SSA), because of changes in consumer preferences and urbanization. Rice production is increasing across SSA, but the continent still imports some 40% of its rice.

Smallholder farmers in the continent are losing half a million tons of rice worth about USD200 million because of parasitic weeds every year. This is roughly equivalent to the annual rice consumption of Liberia, a low-income country, which heavily relies on rice imports. If the rice lost due to the parasitic weeds had been saved, it would have been enough to feed 4.5 million people, the total population of Liberia, for a year.

Parasitic weeds are among the most destructive and problematic weeds to control.

"When these plants invade food crops, they turn into ferocious weeds," said Jonne Rodenburg, an agronomist at AfricaRice.

The most important parasitic weed species in rice are *Striga asiatica*, *S. aspera*, *S. hermonthica*, and *Rhamphicarpa fistulosa*. They are all endemic to Africa and can also parasitize other cereal crops such as maize, sorghum, and millet.

The team of researchers reveals that these parasitic weeds, which survive by siphoning off water and nutrients from host crops, have invaded 1.34 million hectares of rainfed rice in Africa, affecting an estimated 950,000 rural households. The infestations are increasingly becoming severe due to an intensification of agricultural production and climate changes.

The areas affected by parasitic weeds are home to some of the world's poorest farmers. Studies by AfricaRice and partners have shown that parasitic weeds seem to predominantly affect women farmers in Africa as they are often forced to grow rice on the most marginal and parasitic weed-infested plots.

Parasitic weeds threaten rice production in at least 28 countries in Africa that have rainfed rice systems. The most affected countries are Burkina Faso, Cameroon, Côte d'Ivoire, Guinea, Madagascar, Mali, Nigeria, Sierra Leone, Tanzania, and Uganda.

The researchers warn that these parasites are spreading fast in the rainfed rice areas. If nothing is done to stop them in their tracks, the damage will increase by about USD30 million a year.

These findings were revealed in *Parasitic weed incidence and related economic losses in rice in Africa* published in *Agriculture, Ecosystems and Environment* 235 (306-317). It is published as open access (www.sciencedirect.com/science/article/pii/S016788091630528X).

Until now, there has been little information on the regional spread and economic importance of parasitic weeds in rice in Africa. "We have presented in this article best-bet estimates on the distribution as well as the agronomic and economic impact of parasitic weeds in rice in Africa," explained Dr. Rodenburg. "In fact, this is the first multi-species, multi-country impact assessment of parasitic weeds in Africa."

MORE THAN a million hectares of rainfed rice are infested with parasitic weeds in Africa, says Dr. Rodenburg, an agronomist at AfricaRice. (Photo by Mamadaou Cissoko, AfricaRice.)

RICE FARMERS select their preferred Striga-resistant varieties during a participatory varietal selection activity in Uganda conducted by AfricaRice, University of Sheffield, Makerere University, and Africa2000. (Photo by Dr. Rodenburg, AfricaRice.)

The article focuses on the four most important parasitic weeds in rice. *Striga* species— commonly known as witchweed—occur in at least 31 countries with rainfed upland rice systems. *Rhamphicarpa fistulosa*, or the "rice vampireweed" threatens rice production in at least 28 countries with rainfed lowland rice systems.

Dr. Sander Zwart, AfricaRice remote sensing and geographic information systems specialist, explained that, for this study, a map of rainfed rice production areas, compiled from different databases was overlapped with parasitic weed observation data retrieved from public herbaria to visualize the regional distribution of these four important parasitic weeds.

From this overlap, probabilities of actual infestation were estimated. "These estimates together with secondary data on parasite-inflicted crop losses and efficacy of weed control were combined into a stochastic impact assessment model," explained Dr. Matty Demont, an agricultural economist at IRRI and one of the contributors to the impact paper.

TWO RICE farmers show Rhamphicarpa, a parasitic weed that has infested their rice fields in Madagascar. (Photo by Mamadaou Cissoko, AfricaRice.)

Rhamphicarpa fistulosa **affects the yield of a woman rice farmer in Casamance, Senegal. (Photo by Jonne Rodenburg, AfricaRice.)**

The knowledge acquired on the distribution as well as the agronomic and economic impact of parasitic weeds in rice in Africa underlines the importance of finding effective measures to control these pests through research.

AfricaRice and its partners have been investigating and developing efficient parasitic weed management strategies that are affordable and feasible for resource-poor rice farmers.

"A range of high-yielding, short-cycle, farmer-preferred rice varieties have been identified with resistance or tolerance to different species and ecotypes of *Striga*, as well as varieties with good defense against *R. fistulosa*," said Dr. Rodenburg.

Lammert Bastiaans of Wageningen University, a research partner and co-author of the impact paper, explained that such varieties can be combined with different agronomic measures, such as late sowing (against *Striga*) or early sowing (against *R. fistulosa*), and the use of organic soil fertility amendments. Growing a leguminous cover crop such as *Stylosanthes guianensis* and following a zero-tillage approach also contribute to the effective control of *Striga*, as demonstrated by agronomic experiments conducted by AfricaRice and its partners in Madagascar, the French Agricultural Research Centre for International Development (Cirad), the University of Antananarivo, and the National Center for Applied Research and Rural Development (FOFIFA).

To study institutional and socioeconomic constraints underlying the challenge posed by the parasitic weeds, and raise awareness and improve communication on efficient management strategies, AfricaRice, Wageningen University, and national agricultural research systems in Benin, Côte d'Ivoire, and Tanzania have brought together stakeholders, including national research institutes, extension services, crop protection services, and private sector representatives in workshops in East and West Africa.

At a time when public sector investments in agricultural research decreases, efficient targeting of resources is becoming increasingly important.

"Our studies show that targeted investments are important in further research, the development and dissemination of control technologies, and capacity building of farmers, extension agents, among other stakeholders, to reverse the trend of increasing parasitic weeds in rice," stated Dr. Rodenburg. In this regard, we are grateful for the funding support received from the Department for International Development through its Biotechnology and Biological Sciences Research Council (DFID-BBSRC), the science division of the Netherlands Organizations for Scientific Research (NWO-WOTRO), the CGIAR Research Program (CRP) on Climate Change, Agriculture and Food Security (CCAFS), and the Global Rice Science Partnership (GRiSP). ■

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

Bold and beautiful minds:

The journey of scientists FIONA **HAY** and MARICAR **ALBERTO**

by Elemarie Lamigo-Rosellon

International Women's Day is a global celebration of the social, economic, cultural, and political achievements of women. This year, the theme for the International Women's Day is, *Be bold for change.* It highlights confidence during challenging times.

On 8 March, the International Rice Research Institute (IRRI) proudly joined the world in honoring the women in its workforce, their important roles, and positive impact on advancing the institute's mission of ending global hunger and improving the lives of farmers.

Fiona Hay, a seed physiologist, and Maricar Alberto, a climate change expert, shared their scientific journeys, which began when they were school girls, Dr. Hay in the UK and Dr. Alberto in the Philippines. Dr. Hay (**FH**) and Dr. Alberto (**MA**) also revealed their most significant achievements to date as rice scientists at IRRI—and the challenges they faced along the way.

PHOTO BY ISAGANI SERRANO, IRRI

Have you always known that you would be a scientist?

FH: No. I think, when you're a child, the idea of being "a scientist" is quite abstract; it's not clear what a scientist really does. What I did like when I was a child was collecting seeds from the garden. I collected the seeds and liked to store them in little packets. I had an interest in seeds at an early age.

As a teenager, I liked the plant science side of the biology that we were studying in school. I remember reading my Mom's and Dad's newspaper about a new journal coming out, *Plants Today*. I asked them if they could get it for me. It was quite a random thing but they subscribed to this journal for me! It covered a range of topics but was easy to read and understand. An article on seedbanking talked about modeling seed longevity. Since I had an interest in math, I found it amazing that one could describe populations of seeds according to mathematical equations. That's where the interest came in—and that led to understanding more about seedbanking.

I also wanted to go seed collecting. I liked the idea of seed collecting before I knew that some people actually did that for their work. I went on to do a plant science degree at Manchester University and, when I had an industrial placement year, I said I wanted to work at a seedbank. That's how it all happened. I worked in a seedbank and stayed on and did my PhD. During my PhD, I went to the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), in Niger, and went seed collecting and I thought, oh, this is what I wanted to do.

MA: Yes. I think I've always known I would be a scientist. Since grade school, my favorite subject was science. Even in high school, all science-related subjects interested me. I was, and still am, always curious to know the why and how of things around me. I can say that I had an inclination toward science since I was a little girl.

Why did you choose to work at IRRI? Why rice?

FH: My interest was more to do with the specific work of the genebank. The seedbank that I worked at in the UK was a wild species seedbank for conserving species. I knew about crop genebanks, the parallels, but it was really seeing a job advertisement that mentioned seed longevity that attracted me to IRRI. It was a matching of interest. It was great coming here and seeing the differences between the wild species seedbank and a major crop genebank. Last year, a list of top genebanks to visit came out. In the top 10 of about 1,750 genebanks were the IRRI genebank and the Millennium Seedbank that I worked at in the UK. Not many people have a background that includes working in both a wild species seedbank and a crop genebank. It's quite useful having them both.

MA: For me, it was not a long journey to work at IRRI because I graduated from the University of Sto. Tomas (UST) in Manila in 1982 with a degree in chemistry. At that time, IRRI was already popular among university graduates. Everyone talked about IRRI as a nice place to work. In fact, several chemistry graduates from UST had already worked here in the soil microbiology, soil chemistry, and agronomy departments. In addition, I wanted to work far from home as I had always been with my parents. So, when I saw the newspaper ad that IRRI was in need of a chemist, I immediately applied for the position. Fortunately, I was hired as a research assistant in the soil chemistry department in January 1983. I was fresh out of college. I don't know whether I was inclined to rice but I know that as a young graduate I was attracted to IRRI. I was also drawn to the beauty of Los Baños. This is where I have built my home with my husband and raised our children.

What is your work's focus at IRRI?

FH: When I came in 2009, the first thing I had to do was to build up a team to research ways in which we could optimize genebank processes. My task was to gather evidence and, when necessary, make changes in how we did things in the genebank.

MA: I've been involved in several projects since I joined IRRI. Right now, I am working with the Rice and Climate Change group, which covers various aspects of adaptation and mitigation strategies in rice-based production systems against the changing climate.

What do you like best about what you do?

FH: There are two things I like best about my job. One is seeing my staff grow and having students go through a PhD program and seeing them succeed in becoming a scientist. The other thing that really excites me is discovering something new, knowing it's new scientific knowledge being generated and then (I hope) published, and knowing that it's contributing to the whole understanding of how things work.

MA: I like writing research articles for publication in international journals the most. This means so much to me because I believe that I am leaving something that others could build on. Another exciting task is the opportunity to represent IRRI during media interviews, international conferences, and meetings. I know this is a good way to share IRRI's work with the broader community.

PHOTO BY ISAGANI SERRANO, IRRI

What are the best things and the challenges of being a woman scientist?

FH: I don't really like the question because it implies that I understand what it's like to be a male scientist! Also, different character types exist, regardless of gender. But, I can think of an instance when somebody came to my office to talk with me who was totally flabbergasted that I was a woman. The person was really taken aback. I guess some cultures are not yet used to having women scientists and that can be a challenge. But, in general, it's not really an issue. The most obvious difference is when you become a mom—when there are practical issues, such as having to express milk at work, and you don't think about research so much since your mind goes to the child—but I'm sure that's true of men, too.

MA: Based on my experience as a soil chemist, the best things about women scientists are that they are systematic, well-organized, hard-working, articulate, and scholarly, and women can balance life with work.

Can you name your biggest achievement and the biggest challenge at IRRI?

FH: The biggest challenge at the start would be to just get things going! You have to find out how things work in a different place, building a team, training. Working on a new species and learning about that species was a bit of a challenge. There's just a lot of learning. In terms of achievement, in the new seed facility for the genebank, we have a new machine, a seed sorter. It is custom-built for IRRI and represents a significant step in introducing automation.

MA: For almost 23 years of working at IRRI, I have been conducting research in the field, greenhouse, and laboratory. All this time, I have kept a low profile although I have published research articles in international journals and presented our findings in both local and international conferences. My biggest challenge was balancing my time between my work and raising my family.

In 2006, Dr. Achim Dobermann (then IRRI deputy director general for research) sent me to the AsiaFlux training course on micrometeorology in Tsukuba, Japan. Although the training was far from my field of expertise, right after the training, I was able to set up the different sensors of the eddy covariance system (ECS) at IRRI. Dr. Reiner Wassmann (IRRI climate change specialist) suggested that I make my first flux measurements over flooded and nonflooded rice fields to make a comparative analysis of their microclimates and ecosystem exchange of CO_2 and energy fluxes.

FIONA HAY checks seed packets at the International Rice Genebank, as featured in the Farm Tales section of the F&B Report Yearender Issue 2016. (Photo: RG Medestomas, F&B Report magazine)


FARM TALES 25

THIS PAGE: FIONA HAY INSIDE ONE OF THE GENEBANKS WHERE SEEDS ARE STORED IN TEMPERATURES OF 2-8 DEGREES CELSIUS. OPPOSITE PAGE: GRAINS ARE CAREFULLY AND MANUALLY EVALUATED TO ENSURE QUALITY. PREVIOUS PAGE: ONE OF THE INNOVATIONS IRRI IMPLEMENTS IS ALTERNATE TESTING

F&B REPORT

MARICAR ALBERTO discusses climate change management on Sa Ganang Mamamayan-Pulse of the People, a Philippine television show. (Photo: IRRI)

I realized then that setting up and running the ECS was not enough. I needed more guidance to interpret all the data generated. The scholarship I got, through the Japan Society for the Promotion of Science Ronpaku PhD research program, from 2008 to 2013 gave me an opportunity to interact with experts on flux measurements such as Dr. Akira Miyata (National Institute for Agro-Environmental Sciences, Japan) and Prof. Takashi Hirano (Hokkaido University), who served as my advisers and mentors. I was also given a chance to present the outcomes of our research in several international AsiaFlux workshops through funding assistance from the Asia-Pacific Network for Global Change Research and AsiaFlux. To date, I have published seven flux papers in international peer-reviewed journals.

How important is it to be bold in your work as a scientist?

FH: To be bold is to be open to opportunities. I think that's especially important when working on a crop like rice. There's so much opportunity to build on what is already known, for instance, in using the 3K genome data. In the past, the thought of working with hundreds of accessions of one species was unthinkable. But, at IRRI, it's possible to work on a large number of accessions. For example, my team is working to better understand the genetic basis of seed longevity, among other things.

MA: As a scientist, it is important that we are bold enough to strengthen our technical skills, broaden our knowledge, exchange ideas with senior scientists, write papers for publication, and present our findings to the international community.

What is your advice to young women who want to become scientists like you?

FH: The best thing is to be there. Acknowledge that there are knocks somewhere along the way but keep pushing forward.

MA: If you are aspiring for something, don't be afraid to give it a try! I have been a working mother for almost 30 years and all my three sons are now professionals. My journey may be long and slow but I have enjoyed every step of the way because I was not alone. I have shared it with my loved ones.

Ms. Lamigo-Rosellon is a communication specialist at IRRI.

rice facts

The global market post-2008 rice crisis era

by Samarendu Mohanty

The 2007-08 rice price spike seems like a distant dream now considering the calmness in the rice market in the past few years despite El Niño and other weather-related scares. Rice prices in the international market have been very stable after a steep decline in 2013 (Fig. 1). The record production in 2016-17, which is expected to reach 480 million tons (milled rice equivalent) as compared with 472 million tons last year has kept the prices stable (Fig. 2).

The normal monsoon in many Asian rice-growing countries contributed to this bumper crop. As shown in Fig. 2, this is the sixth record crop in the past seven years. The leftover rice stocks in Thailand to the tune of 18 million tons from the rice mortgage scheme that was abandoned in 2014 have also kept the market stable in the past few years. According to a published report, the government plans to sell the last batch of 8 million tons of mortgage stock this year. Of the 8 million tons of stocks, 3 million tons have been reported to be food grade whereas the rest are for industrial use.

This will also be the sixth year in a row in which India will be exporting 10 million tons or more of rice since removing the export ban on nonbasmati rice in 2011. India's entry into nonbasmati market coincided with the Thai mortgage scheme, neutralizing the unilateral action of Thailand to increase rice prices through its mortgage scheme. Thailand was unable to sell rice in the market and ended up stock-piling mortgage stocks. These mortgage stocks, in turn, helped keep the market stable during El Niño years.

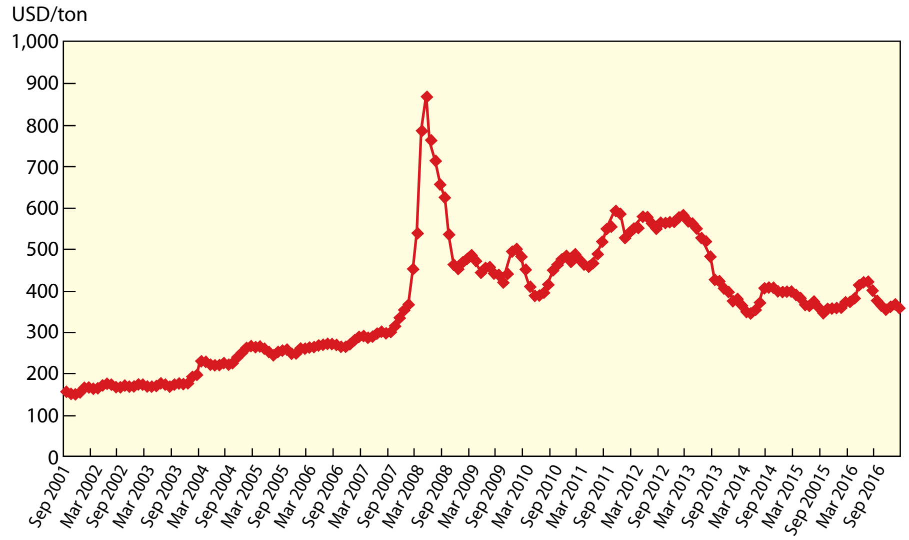


Fig. 1. Thai 25% broken rice price (September 2001-February 2017).
Source: FAO Rice Market Monitor & World Bank.

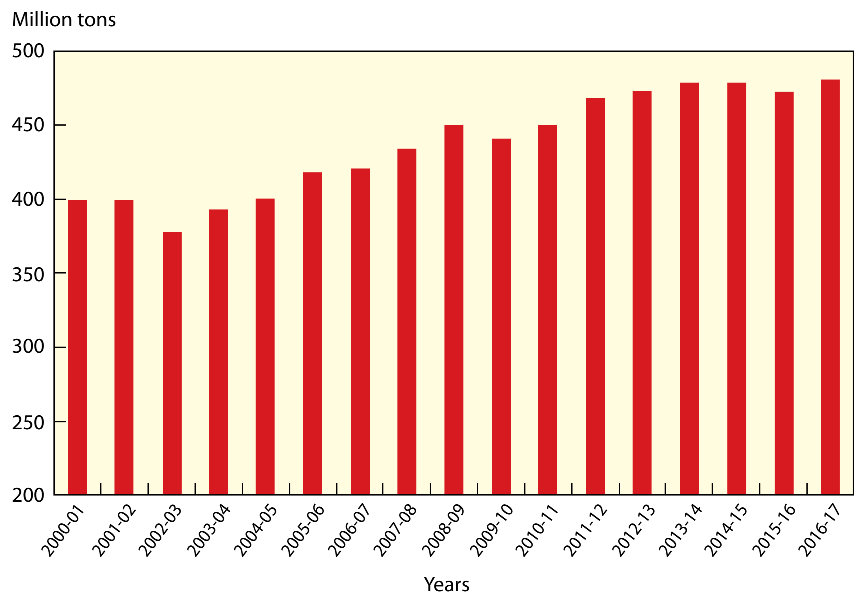


Fig. 2. Global rice production.
Source: PSD online database, USDA.

Both India and Thailand have helped this market to remain calm even in time of uncertainties. It is also sheer coincidence that, in the same year, India took everyone by surprise by taking the top spot in the export market, and China stormed into the rice market as the second-largest importer with 2.9 million tons of imports. Since then, China has overtaken Nigeria as the largest importer with imports reaching 5 million tons in 2016-17. This does not even include the additional 2 million tons of rice that enters China through cross-border trade from Vietnam and Myanmar. Other major Asian importers such as Indonesia, the Philippines, and Malaysia continue to import 3 to 5 million tons of rice together depending on their domestic production.

Outside Asia, many countries in sub-Saharan Africa (SSA) continue to remain the biggest clients for Asian rice. In the past two decades, SSA rice imports have increased nearly three times from 4 million tons in 1997 to 11.6 million tons in 2017. This has happened despite the more than doubling of domestic production from 6.7 to 15.5 million tons during the same period. Both India and Thailand account for the bulk of SSA rice imports from Asia.

The overall upward trend of the volume of the global rice trade that was set in motion in the early 1990s continues to stay on track even after a change in sentiment of the importing countries during the post-2008 crisis to purse self-sufficiency and reduce reliance on foreign rice. The current trade volume now accounts for nearly 9% of global production as compared with less than 7% during the 2008 rice crisis and 3.5% in 1990.

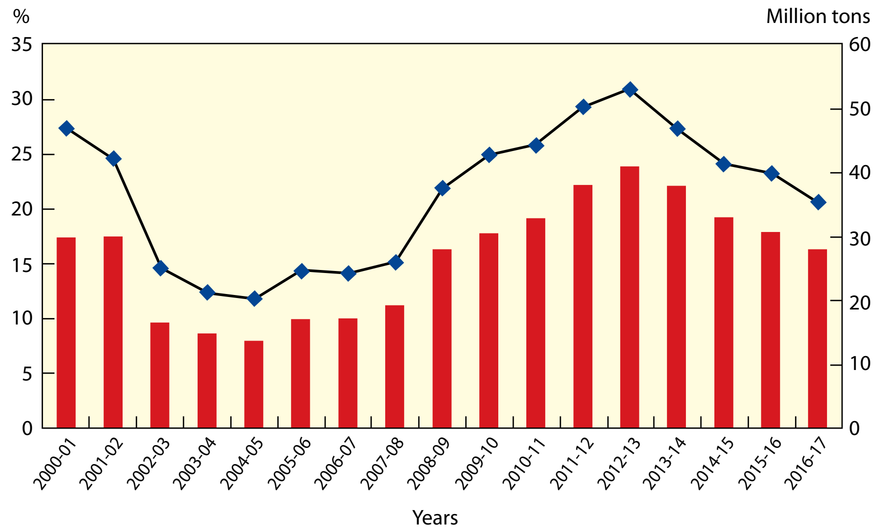


Fig. 3. Top 5 exporters rice stocks vs stock-to-use ratio.*
Source: PSD Online Database, USDA.
*India, Thailand, Vietnam, Pakistan, and the United States.

What does this mean for now and the future?

The record production in the past several years has kept a lid on the price but the rice stocks of the top five exporters (India, Thailand, Vietnam, Pakistan, and the United States) have steadily declined in these record production years from 41 million tons in 2012-13 to 28 million tons in 2016-17 in the face of strong demand growth (Fig. 3). In the past decade, rice consumption has increased by nearly 14% from 418.5 million tons in 2006-07 to 475.5 million tons in 2016-17. In terms of inventory as a proportion of total demand (the stock-to-use ratio), a convenient measure of supply and demand interrelationships, the ratio has declined from 30% to 20% during this period. But the good news is that this is still 5% greater than what it was during the rice crisis in 2007.

As we move into the main rice-growing season in 2017, the low stock-to-use ratio, which acts as a buffer against any weather-induced supply uncertainties, is likely to be in the mind of market makers. If the monsoon is disrupted in a few rice-growing countries, the market should be able to absorb these shocks and remain stable. But, large-scale disruption in supply due to extreme weather events such as flood and drought could create anxiety in the market. It is also important to note that without Thai rice mortgage stocks, which supported the market in the past few years, there will be added pressure on price if monsoon falters in key rice-growing countries.

Looking into the future, the uptrend in rice trade is likely to continue despite some protectionism feeling among importing countries after the rice crisis. But, the rising popularity of rice in many non-Asian countries, including Sub-Saharan Africa and the Middle East is likely to support the uptrend in rice trade in the future. Both India and China are also likely to play key roles, although on different sides of the global rice market. Ideally, one would like to see the global rice market to grow to 15–20% of total production for market stability and future food security.

On the flip side, the active participation of India and China in global rice trade may bring a degree of uncertainty to the market because of their sheer size and their focus on domestic food security. Politicians will continue to fiddle with domestic and trade policies to support farmers and achieve greater domestic price stability and in the process may bring greater volatility to the international market.

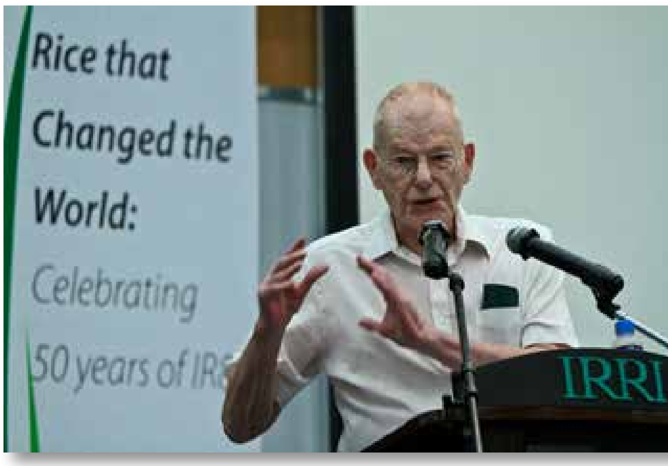
The other traditional exporters in Asia namely Thailand, Vietnam, and Pakistan will continue to remain stable suppliers of rice to the international market. The emergence of Myanmar as a growing exporter should also help the stability of rice prices in the future. ■

Dr. Mohanty is a principal scientist, head of IRRI's Social Sciences Division (SSD), and Flagship Project leader (Accelerating impact and equity) under the Rice Agri-Food System, the CGIAR Research Program on rice.

Increasing national rice yield to 6 tons per hectare in the Philippines and elsewhere

by Peter Jennings

Although these remarks are specific to the Philippines, they apply equally to all countries currently mired in an average rice yield of 4 tons per hectare. Whereas high-yielding varieties emanating from the International Rice Research Institute (IRRI) had a sudden and large impact beginning in the mid-1960s, yield improvement in subsequent decades has come largely from farmer initiatives with little contribution from research. The increase in yield to something over 2 tons per hectare attributed to IR8 (see *IR8—a rice variety for the ages*, *Rice Today* special supplement, November 2016, pages 4-5) and subsequent semidwarf varieties is well known.



Less appreciated is the investment of extra income from these varieties by farmers in water control from low-yield, high-risk ecosystem to higher-yield, lower-risk irrigated rice from the 1970s to the present. This slow transition to roughly 50% of irrigated farms today is the major contributor to the increase in yield from about 2 to 4 tons per hectare today.

Farmers' appreciation that water control is essential for profitable rice farming clearly defines future needs. The shift to water control can be accelerated to reach a goal of 80–90% irrigated farming. That alone would guarantee a national yield of 6 tons per hectare. The strategy proposed to achieve this implies that progress will come more from farmers' initiatives than from researchers.

> **"Self-financed farmer cooperatives are a viable strategy to increase irrigated rice area to attain a national yield average of six tons."**

To reach an average of 6 tons per hectare, farmers require many improvements, including better farm-to-market roads, modernized rice mills, earthen dams to capture rainwater where topography permits, credit for tube wells and low-lift pumps, subsidies to reduce electricity costs to run the pumps, and a massive increase in extension agents trained to simultaneously reduce the multiple deficiencies in crop management that constrain yield.

These extremely expensive requirements are unlikely to be met from government coffers. Capital from farmers and millers is a better alternative. To generate this, the Philippine secretary of ariculture would identify one or two rice areas easiest to impact. His staff would select in each area a highly respected farm leader competent in the management of people and finance.

The selected farmer would visit all the barrios in his or her area to convince farmers and millers to join a cooperative and accept obligatory taxes of a few centavos on each kilo of grain harvested and milled output. Money collected at the mills would create the capital for investment in irrigation and other farm requirements. Matching funds would be sought from international banks, foundations, and other sources. The cooperative would invest in farm needs with the guidance of a board of elected farmers and millers. Success in the pilot areas would be extended to the rest of the country through the creation of additional farmer organizations.

This proposal will be difficult to implement, opposed by vested interests, and subject to financial mismanagement. Yet, self-financed farmer cooperatives are a viable strategy to increase irrigated rice area to attain a national yield average of 6 tons per hectare. ■

Dr. Jennings is senior scientist emeritus at IRRI, who led the team that bred IR8 in the early 1960s.

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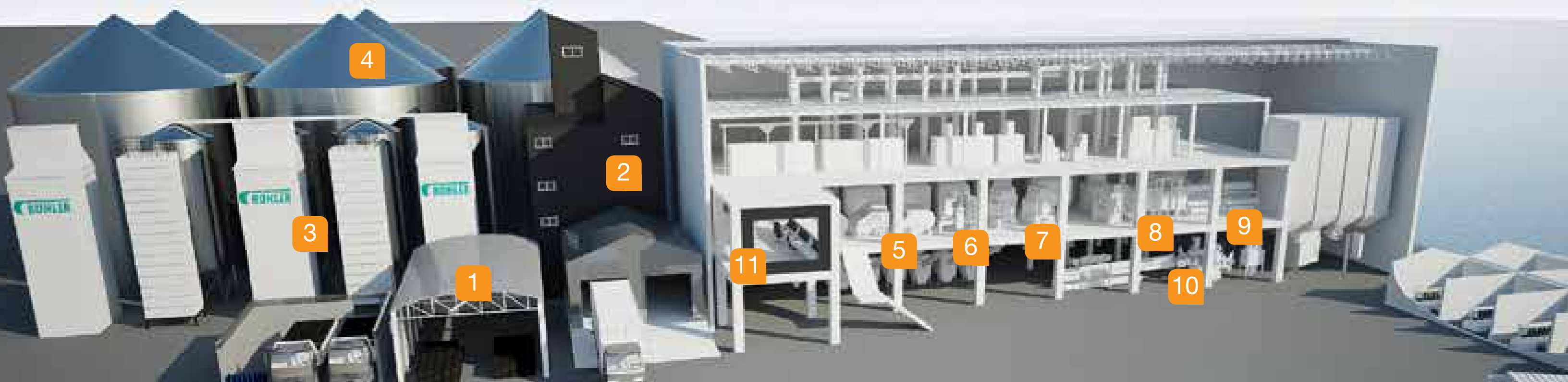

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