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Helping Indonesia keep its rice bowl full

Senegal's quiet rice revolution

The "crown jewels" of Chile

Water management is key

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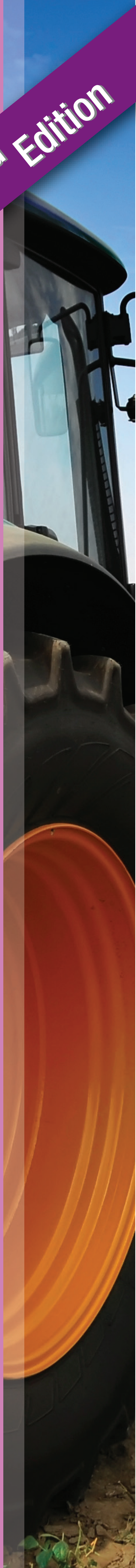

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About the cover

Fiipino artist Erick Dator© finds inspiration in the traditional method of transplanting rice by hand in *Magtanim ay di biro* (Planting rice is hard work). An experimental folk artist, Mr. Dator depicts rustic sceneries from his hometown of Lucban in Quezon Province. A unique aspect of his work is his custom-made canvass layered with board cutouts in the shape of kiping, giving his paintings a distinctive texture. Kiping is vividly colored leaf-shaped wafer made of rice flour used as decorations during the *Pahiyas* Festival, one of the cultural highlights of Lucban.

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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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Pressing on

Rice R&D has shown much progress since the Green Revolution started 50 years ago. Now, farmers in Asia, Africa, and Latin America are benefiting from the fruits of decades of research. Come flood, they have flood-tolerant rice. Come drought, they have drought-tolerant rice. Many technology options have since become available for rice production problems such as salinity, pests, diseases, diminishing resources, and labor shortage, among others.

I still remember the first issue of *Rice Today* that I worked on as an editor. In 2009, the cover story was about "Scuba rice," a flood-tolerant variety that made a successful impact in farmers' fields in India and Bangladesh. Years later, stress-tolerant rice—varieties that can withstand drought, flood, and salinity—had reached around 10 million farmers.

Those are the inspiring stories featured in the magazine.

This first issue of 2017, like many other editions, continues to narrate the outcomes and impact of rice science. Our goal is to inform and inspire both scientists and laypersons alike.

In this issue, Bas Bouman, the director of the CGIAR Research Program (CRP) on rice, gives an overview of the blueprint and the direction of the next CRP on rice. (Read *Continuing global partnership through rice* on pages 37-39.)

Speaking of partnerships, nongovernment organizations have always been dependable partners of the International Rice Research Institute (IRRI). This is highlighted in our coverage of Bangladesh. Read how a strategic alliance with BRAC is improving lives in the coastal areas of Bangladesh (on pages 18-19). An essential part of that, particularly in the polder areas that are beset with challenges to rice productivity, is water management. *Water management is key* explains how it is an important entry point in changing lives in these areas. (See pages 5-6.)

Working together with national partners is one way to fast-track national goals. In Indonesia, IRRI's collaboration with the national government is helping the country increase its rice production by intensifying rice production on the outer islands, including South Sumatra. (See *Helping Indonesia keep its rice bowl full* on pages 14-16.)

Women are also helping to improve the lives of other farmers. The women farmers of Bihar in India are not just becoming more productive as a result of rice technologies, but are also becoming powerful agents of change and partners in development (see pages 10-11). In relation to this positive development, Dr. Ranjitha Puskur, lead of IRRI's gender research, explains what it takes to truly integrate gender in agricultural research. (See story on pages 12-13.)

Also in India, *Small Farmers, Large Field*, which has been a successful scheme to improve the productivity of smallholder rice farmers in Vietnam, is now being piloted in eastern India. So far, the results are overwhelmingly positive. (See story on pages 35-36.)

Outside of Asia, we have a story about *The "crown jewels"of Chile*—rice varieties, all named after precious stones, developed to tolerate the country's very cold temperatures. (See pages 30-32.)

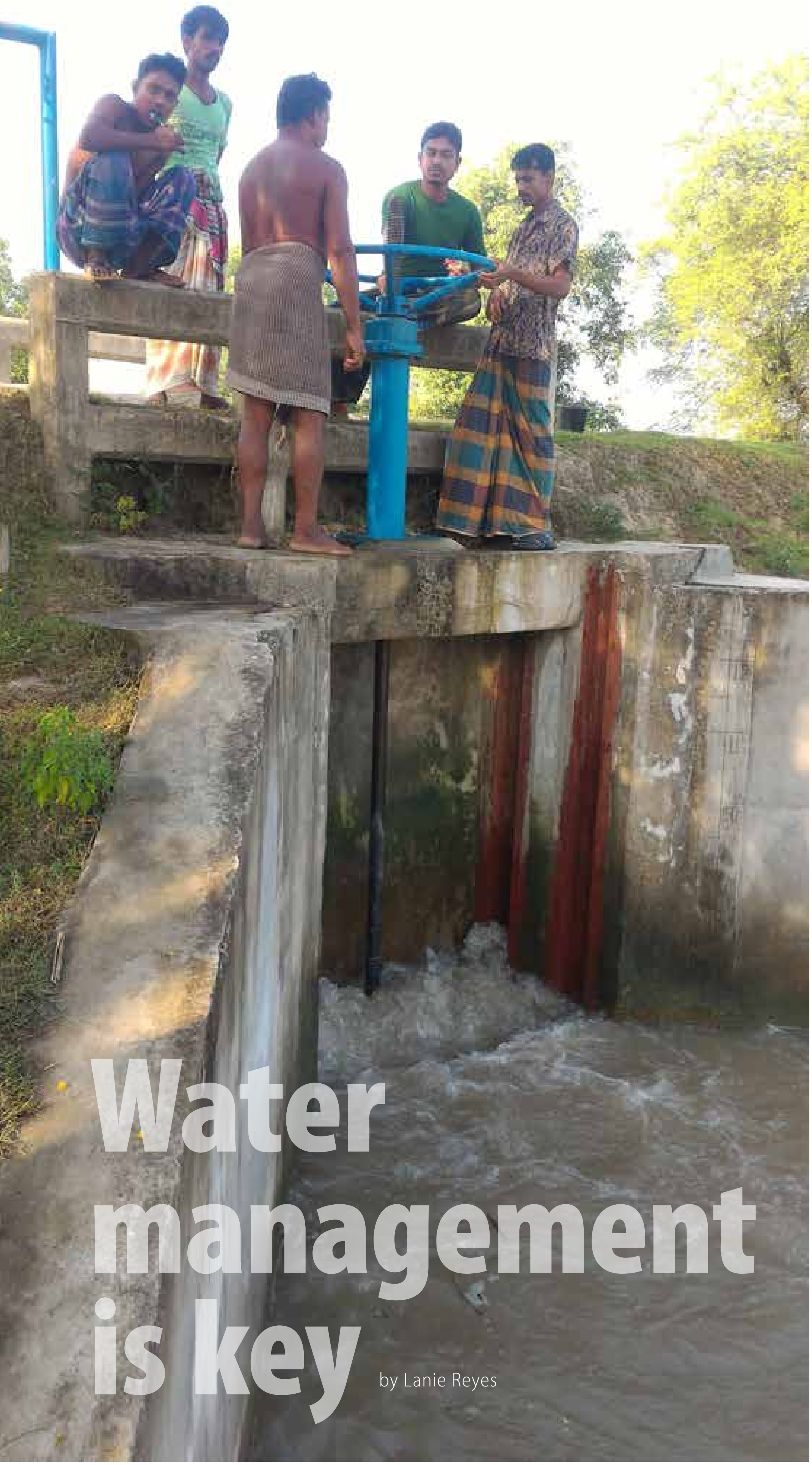
From the African continent, we have an article about *Senegal's quiet rice revolution* (on pages 28-29) that is helping turn the Kolda Region into a profitable hub for upland rice seed production. This transformation is helping the country move faster toward rice self-sufficiency.

This issue also features young scientist Tobias Kretzschmar. Although he is not from a rice-growing country, he finds bridging discovery work with applied rice science highly rewarding. Read his story and advice to aspiring scientists on pages 24-27.

And finally, *Heavenly rice*, a tale from Indonesia, tells us how rice, once grown only in heaven, found its way to Earth (see pages 8-9). It's a good read, made better with a glass of *Chicha de arroz*, a beloved Ecuadorian beverage made from rice (recipe on page 33)!

Enjoy reading!

Lanie Reyes
Rice Today editor-in-chief



Water management is key

by Lanie Reyes

The monsoon season that comes once a year is part of the ecosystem in Bangladesh and an important source of water. It goes without saying that water is a vital need for humans, livestock, and crops. However, in Bangladesh, especially in its coastal areas, the problem is that there is too much of it—resulting in flooding. The water comes from the tributaries of the Ganges River. It flows to the southwestern coastal region where many farmers are affected. Moreover, storm surges from the Bay of Bengal aggravate the problem.

The coastal areas of the country have more than one million hectares enclosed by polders to control tidal flooding so that farmers can increase their productivity. Polder zones are mostly susceptible to climate change-related problems such as rising sea level and flooding. These problems put farmers in polder areas at a disadvantage, allowing them to plant only a single traditional rice crop per year. Thus, poverty is common in these areas.

Although the central and northern parts of the country benefited from the first Green Revolution, the polder areas were left behind because no varieties existed then that could tolerate salinity and flooding. The polder areas could not profit much from the ongoing second Green Revolution because of long-standing flooding that even modern flood-tolerant and salinity-tolerant rice could not withstand.

The problem is not the absence of modern high-yielding rice varieties because the farmers now have a number of choices. Some early-maturing rice varieties allow farmers to plant more than two crops per year. These high-yielding varieties give farmers an edge toward food security. Most of all, some of these varieties can withstand flood, salinity, and even drought to some extent.

The problem lies in water governance—or the lack of it—in timing the opening and closing of sluice gates, which requires the involvement of the community.

Even if some farmers cultivate an early-maturing high-yielding variety, they cannot benefit from planting another crop because they have no control over the sluice gates, which determine the water coming into and going out of the farms," explained Manoranjan Mondal, an IRRI water management expert based in Bangladesh. "This is where the water management group comes into play.

"Farmers can come together to talk about many things, including when to open or close the sluice gates," said Dr. Mondal. "They need to agree among themselves when to plant their crops and what kind of variety to plant. If some cultivate early-maturing rice but others do not, then those who harvest earlier will have to wait for other farmers to harvest their late-maturing traditional crop before they can plant another crop."

The water management groups (WMGs) allow the coastal communities in the country to manage floodwaters and deal with poverty and food and income insecurities on their own.

"Water management has become the key entry point in changing people's lives and has triggered socioeconomic development in coastal Bangladesh," said Sudhir Yadav, a water scientist at IRRI.

One example is the Fultala Water Management Group. Registered in 2014, the Fultala WMG covers 146 hectares and 262 households. It has 152 members, 85 of which are women. With a growing cash capital of BDT 61,000 or around USD 700, they already own some farm machines, including a power tiller, a power pump, and a thresher. They hope to be able to join a microfinance program once their capital reaches BDT 100,000 (USD 1,260).

But, they have a long way to go when it comes to water management. Since the political division is not the same as the hydrological management unit, the Fultala WMG will need to coordinate with other water management groups to attain synchronous rice farming. Even if Fultala WMG members agree on sluice gate operations, they will still be affected by the WMGs near them.

According to Dr. Yadav, scope exists to create a program based on information and communication technology (ICT) that will send and receive data from areas in a hydrological unit. In this way, coordination from one water management group to another will be easier.

"Truly, participation from the local community through the water management group affords people a sense of control over their own lives and livelihoods," said Dr. Mondal. "With a simple change in water management, the road toward the project goal for people to increase their productivity and food security can be realized."

Moreover, the prerequisite of women representing at least 30% of the membership in creating WMGs empowers women in molding the future of their community. Having the voices of women heard will have a positive influence on the cultural aspects of their lives. As women leaders start to rise to the occasion, other women and girls will view this as the "new normal." This could trigger a ripple effect of empowered women ready to play more significant roles in the community. ■

Ms. Reyes is the editor-in-chief of Rice Today.

This article is reprinted from Vol. 1, No. 2 of Polder Tidings *newsletter.*

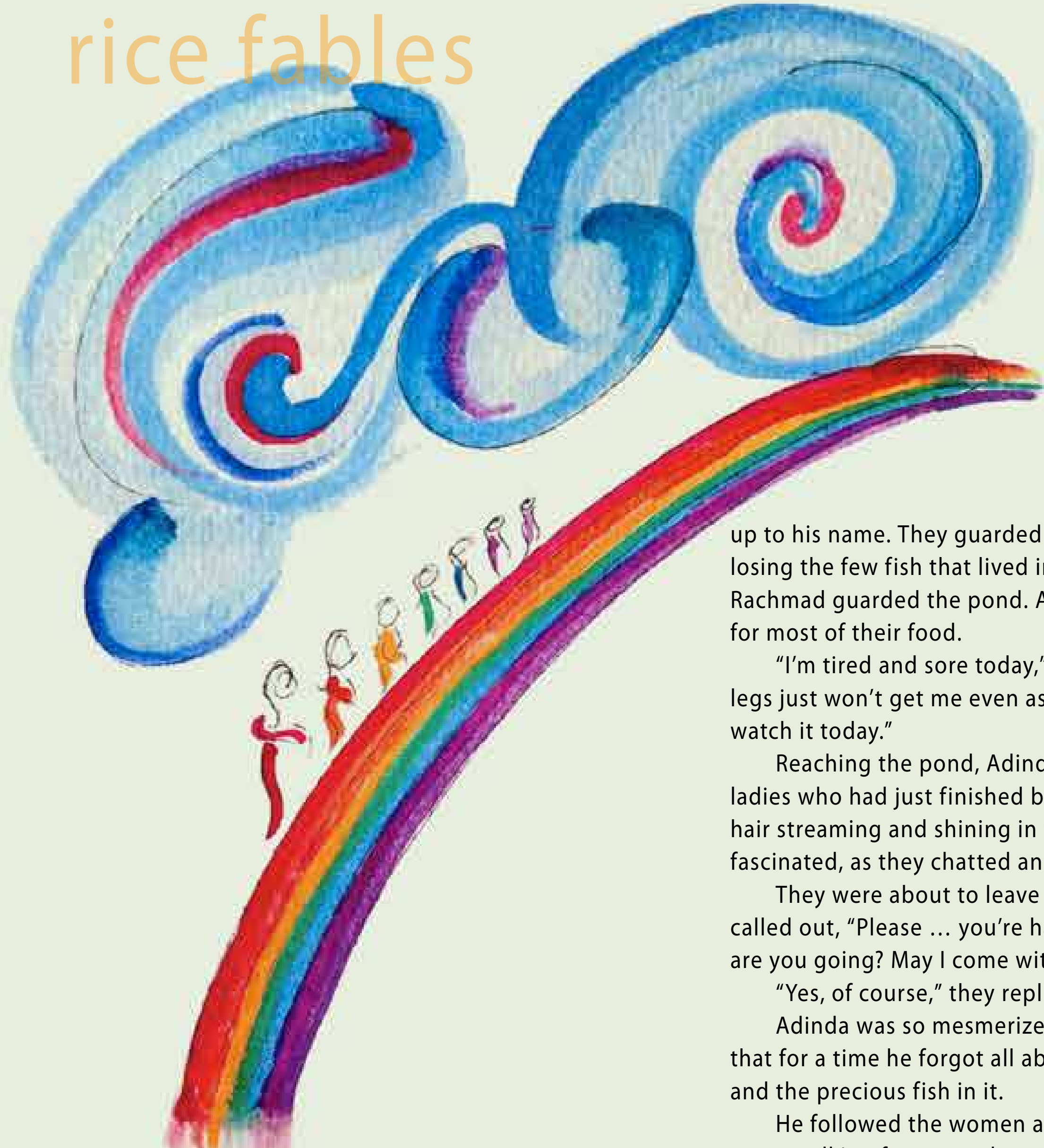
MANORANJAN MONDAL discusses water governance with WMGs to introduce an improved production system in the region. (Photo: IRRI)

rice TODAY around the world

SEE *RICE TODAY* in Zierekzee. IRRI scientist Matty Demont and partner Ana Reynoso, who also works at IRRI, pose with *Rice Today* and their son Alonso Mateo in front of a canal in the small city of Zierikzee in the Netherlands. The canals, used for irrigation and water removal, were also designed with transportation in mind.

RICE ON an island paradise. Chris and Adriel, sons of *Rice Today* editor-in-chief Lanie Reyes, pose with the magazine on Boracay Island in the Philippines, one of the major tourist destinations in the world. Boracay is known for its barefoot-friendly, powdery white sand, which extends for kilometers. Artists use the sand to create sculptures along the beach.

RICE-POWERED MACHINES. Rice-and-bike enthusiasts from IRRI take a break from their Century Ride at the Lipa City Hall in Batangas, Philippines. Starting from the institute's headquarters in Los Baños, Laguna, (*left to right*) Eric Clutario, Jose Luis, Glenn Enriquez, and *Rice Today* designer and production manager Grant Leceta traversed a 100-km bike route through the neighboring provinces of Batangas and Quezon, and back to IRRI.



Heavenly rice

by Alice Flinn-Stilwell
artwork by Joanne Flinn

A tale from Indonesia tells us how rice, once grown only in heaven, found its way to Earth

Many long years ago, two young orphan boys, Rachmad and Adinda, struggled to survive. Their parents had been well-off. But, when they died, the defenseless boys were soon robbed of most of their inheritance. After a time, a fishpond was almost their only possession.

Rachmad's name meant "blessed," but he seldom felt that way. He was crippled and that made life difficult. Adinda meant "dear young brother," and he tried to live up to his name. They guarded the pond carefully, fearful of losing the few fish that lived in its fresh waters. Being lame, Rachmad guarded the pond. Adinda had to go out begging for most of their food.

"I'm tired and sore today," Rachmad said one day. "My legs just won't get me even as far as the pond. You'll have to watch it today."

Reaching the pond, Adinda found seven lovely young ladies who had just finished bathing. Their long, clean hair streaming and shining in the breeze. Adinda watched, fascinated, as they chatted and laughed with each other.

They were about to leave when on impulse Adinda called out, "Please … you're happy. It's wonderful. Where are you going? May I come with you?"

"Yes, of course," they replied. "Join us if you like."

Adinda was so mesmerized by these beautiful women that for a time he forgot all about looking after the pond and the precious fish in it.

He followed the women across the rainbow and into the stars, walking for seven days and seven nights, until they reached Heaven. Then, the women suddenly disappeared. Adinda was left wondering what to do. After so long with no sleep, he lay down.

Waking later, he looked around and, seeing a road, he wandered along it. He hoped it might lead to a village. He soon saw a man working in the sun, spreading something golden yellow on a woven mat. In the bright sun, it sparkled like gold.

"My, what a treasure trove you have there," he called. "You were lucky to come by so much gold."

"Luck … you must be joking," said the man. "It was hard work. But, you don't really think it's gold, do you?"

"I can't imagine what else it could be," said Adinda.

"It's rice. Grains from a plant," said the man. "And very good to eat. I guess it's better than gold, because you can't eat gold!"

"I've not seen it before," said Adinda. "Maybe it doesn't grow on Earth."

"It grows only here in heaven. It's food for the gods and very nourishing. Here, try some," he said, handing him a little cooked rice from a bag.

"Mmm, it's delicious … filling too. I'd love to take some back to Earth to my crippled brother. Maybe we could grow some there. He might become stronger."

At this, the man became furious.

"Don't ever take any rice, not any, not so much as one grain," he thundered.

Seeing how crestfallen Adinda was, he softened a little.

"Eat as much as you like while you are here, but taking rice from heaven is not allowed under any circumstances."

So, Adinda ate his fill and enjoyed the subtle taste of every mouthful. His stomach had not felt so full for a long time. He secretly determined that he must take some back to Rachmad.

"Surely just a handful of grain would not be missed," he thought.

When the man was not looking, Adinda hid some rice grains in his mouth. Then, he headed toward the rainbow to walk back to Earth. But, the farmer knew what he was up to. He shouted angrily and dashed after the young fellow. He shook him so much that Adinda lost his balance and cut his foot. Undeterred, the farmer did not stop until he discovered the rice grains in Adinda's mouth.

"Thief! Thief!" he screamed, forcing Adinda to spit out every last grain. "I warned you not to take the rice. If I catch you taking rice again, I'll throw you back to Earth."

That was a threat indeed, and certainly to be avoided, Adinda thought.

"My foot is hurting. The cut seems deep," he said. "May I just stay here with you awhile?"

He stayed quietly with the farmer.

Some days later, his foot was healing well and he began to think of returning to Earth to Rachmad. He still wanted to take some rice grains, but he also did not want to be thrown out of Heaven.

Adinda had a bright idea. He decided to hide a few grains in his healing foot. The wound would mend enough for him to return to Earth, where he could retrieve and plant the grains.

He carefully pushed several into the wound. In a few days, the cut was healing well.

Adinda told the farmer he was very grateful for his hospitality. But, as his foot was nearly better, he would return to Earth to find his brother.

The farmer was suspicious that the boy would try to take some rice with him. So, he thoroughly searched the boy, even checking in his ears and under his toenails. When the farmer was quite satisfied that the boy was hiding no rice, he took him to the end of the rainbow. Here, they bade each other farewell.

Pleased with his cleverness, Adinda sped back to Earth and found Rachmad. They planted the grains and carefully tended their tiny plot. The rice grew green and strong. But, back in Heaven, the rice began to wither and die. Nothing the farmer did helped the crop. Now, the farmer knew that the rice could grow either in Heaven or on Earth, but not in both places at the same time. He began to suspect that Adinda had tricked him and managed to take some rice back to Earth. The farmer determined to find out and called a messenger.

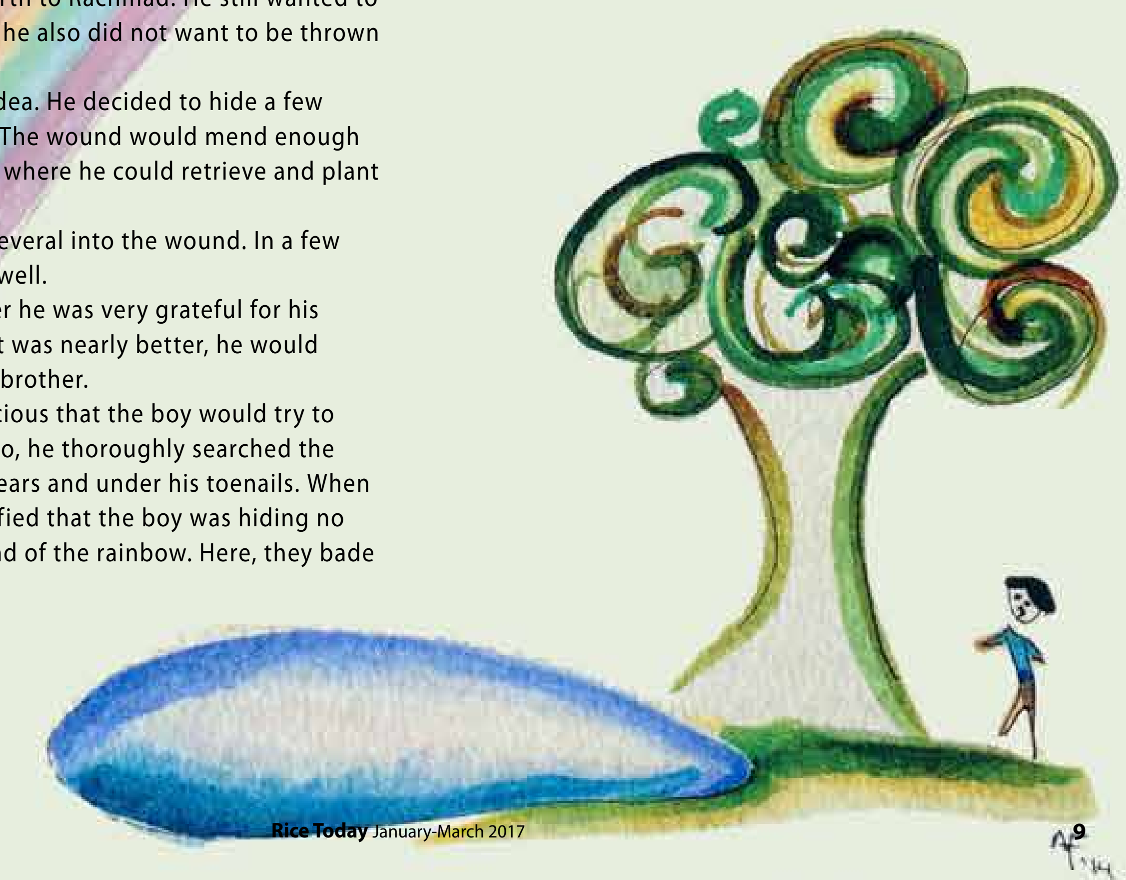
"Go down to Earth and find out if any rice grows there," he said. "However small, I must know. Return here when you have found out."

It did not take the messenger long to find the little rice plot the boys were tending. He hurried back to Heaven to tell the farmer.

Furious that he had been deceived, the farmer determined to wreak havoc on the earthly crop. He called to the birds. "Fly down to Earth at once and find the rice crop tended by two young boys. Eat every morsel. Don't leave as much as a single grain. From now on, you will eat whenever you can."

So, how does rice still grow on Earth? Did the boys valiantly protect their crop? Or did the birds take pity on the boys? That is something we'll never know. ■

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.*



Bihar women farmers: powerful agents of change

by Alaric Francis Santiaguel

Women are increasingly establishing their identity as efficient and knowledgeable farmers in their community, thus increasing the scope of inclusion and equity in India's society.

Women play a crucial role in rice farming in India. They provide a high proportion of the labor in the country's rice cultivation. They contribute significantly to production and postharvest operations. However, because of social and cultural barriers, women farmers often lack access to information and modern agricultural technology.

Bihar, one of the eastern Indian states, has low agricultural productivity and high incidence of poverty. Male outmigration in pursuit of better economic opportunities is high, leaving the responsibility of farming, child-rearing, and household work to women.

In India's patriarchal society, farming has been considered a "man's world" for centuries. The men have ownership of the land. "Women's contributions to the farm economy remain invisible and unrecognized," said Ranjitha Puskur, leader of IRRI's gender research at the International Rice Research Institute (IRRI). "Being a part of the informal sector and their work unpaid and characterized as family labor, women have no identity as farmers."

Although only 1% of the women in Bihar own land—and they are mostly small and marginal farmers—they represent untapped human resources for producing food. Women farmers could substantially increase the yields on their farms by 20% to

PHOTO BY SUGANDHA MUNSHI

PHOTO BY SUGANDHA MUNSHI

30% if they had the same access as male farmers to agricultural inputs and services, according to the FAO State of Food and Agriculture 2010-11 report.

Sugandha Munshi, a gender specialist at IRRI, shared this inspiring grass-roots gender revolution at the Third International Conference on Social Sciences 2016 in Bali, Indonesia.

In her presentation, which she co-authored with Dr. Puskur, Ms. Munshi portrayed the challenges and the solutions that are enabling women farmers in Bihar to redefine their roles.

The women in Bihar are not a homogeneous group, according to Ms. Munshi. Some women are landless, some are marginalized smallholders, and some are landowners. But, they have one thing in common.

"They do not have access to knowledge and technology," she stated. "Agricultural knowledge and technologies do not reach them effectively. They are often left behind in agricultural innovation."

This is where women's self-help groups come in. Through a pilot project under the Cereal Systems Initiative for South Asia (CSISA) hub in Bihar, CGIAR, the State Department of Agriculture, Jyoti Mahila Samakhya Federation, and other nongovernment organizations joined hands to introduce mechanized rice farming and better agronomic practices to the women farmers in the state.

CSISA has been working closely with these village-level organizations through partners that bring women together to support one another and obtain access to improved technology, microcredit, and other services. These efforts have proven to be highly effective at creating change in the women's communities.

"In groups, women were willing to experiment and take risks," said Ms. Munshi. "They perceive that the risks are shared within the group and that their voices are being heard in the decision-making process.

"With their newly found voice and negotiating power, the women, or *Kisan Sakhi* as they are now known, were able to articulate their preferences and needs," Ms. Munshi added. "They wanted to increase the productivity of their farms and lower the cost of production and labor, and they wanted relief from the drudgery of plowing, transplanting, weeding, irrigating, and harvesting. They also wanted other income-earning opportunities."

CSISA introduced the community nursery for healthy seedlings, mechanical transplanting, and improved threshing. With fewer hours spent on labor, the women farmers had more opportunities for other activities such as education, selling vegetables, and livestock. CSISA's focused interventions have led to nearly 4,500 women farmers adopting new climate-resilient and sustainable agricultural practices and technologies.

"Access to knowledge, information, social capital, and services increases their confidence and, in turn, their decision-making at household and community levels," Dr. Puskur reported. "Women are increasingly establishing their identity as efficient and knowledgeable farmers in their community, thus increasing the scope of inclusion and equity."

Despite gaining some ground, women farmers still contend with some challenges.

"There is a need for making technology more women-friendly," shared Ms. Munshi. "The women expressed interest in value addition and having better links to markets. But, because of the existing social norms and patriarchal setup, the women farmers' mobility and interaction with people outside their families are restricted. There is a need to design strategies to bring the market closer to them and further explore the use of information and communication technology. Self-help groups need more capital to become viable. Women-friendly financial services and products need to be developed."

The women farmers of Bihar have the potential to transform agricultural production and help to eradicate hunger. But, the power of *Kisan Sakhis* can be harnessed only if they are given access to resources, knowledge, and services. ■

Mr. Santiaguel is the managing editor of Rice Today.

PHOTO BY SUGANDHA MUNSHI

Integrating gender in agricultural research:

more than counting the women farmers

by Ranjitha Puskur

Agricultural research paradigms have shifted over the years in response to demands to make research more efficient and effective. It has been widely acknowledged that closing the gender gap to help women gain access to resources, technologies, and markets is critical to tackling the challenges of poverty and hunger, particularly in the face of increasing vulnerability to climate change. Integrating gender in agricultural research is no longer a debate. It is about doing it effectively.

Some initiatives and projects seem to be content with recording and reporting the number of women farmers engaged in research for development efforts. However, gender research is a lot more than that!

"Gender" is a social construct associated with being masculine and feminine. It defines what is acceptable for women and men and girls and boys to be, to do, to own, and to control. It is linked to a time and place but it is changing and changeable. It is important to note that women and men are not homogeneous groups. Their identities are influenced by social and economic classes, race, ethnicity, caste, age, and location, among other factors. Gender research does not just focus on women and men. It also focuses on social relationships and how they influence their different roles, responsibilities, opportunities, and needs. These relationships are governed by the power relations underpinning gender roles and norms, human behaviors and practices, and social systems and structures.


RATNA ROKHSANA (in blue), BRAC gender specialist, discusses with women on their involvement in agriculture. (Photo: IRRI)

Gender integration in agricultural research and development is about understanding and taking into account both the differences and inequalities between women and men in program planning, implementation, and evaluation. Frontloading research for development projects with a rigorous social and gender analysis to understand the social systems and contexts is critical in designing and implementing socioculturally appropriate and relevant interventions that would have larger and longer-lasting impacts.

Using a social relations framework can reveal the gendered power relations that cause and sustain inequities. The analysis should involve not just the household but also the community, markets, and institutions. Unpacking gender relations and their associated dynamics in different social and institutional contexts helps in identifying women's bargaining position and design strategies to improve this.

According to the Global gender gap report 2016, although Bangladesh is leading in narrowing the gender gap in South Asia, it has recorded a widening of the gap in women's labor force participation and estimated earned income. Globally, the premise is that social norms and lack of care infrastructure are holding women back from accessing economic opportunities.

So, although we would like to engage women in alternative income-generating enterprises, it is important to understand how the social norms and structures would affect that and with what consequences for the men and women farmers. Although increasing income is good, it is control over income that is empowering. We need to also ensure that these new activities expand the remunerative choices available to women. In the polder zones of Bangladesh, the increased vulnerability due to ecological collapse is leading to widespread male outmigration. Thus, the number of women becoming heads of male-absent households is increasing. These situations might lead to relaxing certain social norms allowing women to move into new roles and have a more decision-making power. However, we do not know whether these women are able to command resources in this situation and develop social capital. Husbands and mothers-in-law are gatekeepers of women's mobility and their permissions are necessary to obtain participation in program activities.[1] The introduction of microcredit, however, has contributed to increased women's mobility.

In 2014, the Feed the Future (FtF) assessment of the Women's Empowerment in Agriculture Index (WEAI) in Bangladesh revealed that, despite gains in some areas, women are still quite disempowered in Bangladesh. Female employment is much more concentrated in low-wage jobs and women's wages for equivalent work are much lower than those for men. Women's access to and control over inputs are severely limited, including credit. They face considerable mobility constraints and extension services fail to reach them. The family income is controlled by male family members as are decisions related to agricultural production.

A survey in Barisal District showed that purchasing of daily household necessities is the only area in which a significant portion of women report having autonomy in decision-making. The leadership roles for women in the community are limited: 46% of husbands, 33% of wives, and 60% of mothers-in-law do not think women can be capable leaders.[2]

Understanding and tackling these challenges must become an integral part of the research and intervention design for women to be empowered. It is important to engage men as equal partners in this effort because evidence shows that failing to involve men in such interventions can lead to resentment and a worsening of gender attitudes and relations.[3]

The project, *Unlocking the production potential of polder communities in coastal Bangladesh through improved resource-use efficiency and diversified cropping systems,* will focus on understanding how poor men and women are differently affected by the climatic stresses and trends; how their responses are shaped by their respective access to and control of resources and assets which, in turn, are shaped by the prevailing social norms, attitudes, behaviors, and structures. These factors will influence and determine their technological choices around cropping system options, drainage management, and engagement in new income-generating opportunities. We need a shift in paradigms and beliefs and, an effective evaluation and learning culture in tackling gender issues to have the impact we seek.

The project was initiated under the flagship of USAID's FtF, the Sustainable Intensification Innovation Lab (SIIL) of Kansas State University (KSU), and the International Rice Research Institute (IRRI) in partnership with BRAC. ■

Dr. Puskur leads gender research at the International Rice Research Institute.

This article is reprinted from Vol. 1, No. 2 of Polder Tidings *newsletter.*

WOMEN AND MEN farmers learning to treat rice seed in Odisha. (Photo: IRRI)

1 Sethuraman K, Kishore Kannuri N, and Prasad N. 2006. Report of the gender analysis of the Jibon-o-Jibika Program in Barisal, Bangladesh. Dhaka: Save the Children.
2 HKI [Helen Keller International]. 2011. Gender attitudes and practices survey: Nobo Jibon gender baseline. Dhaka: HKI.
3 Ahmed, F.E. (2008). Microcredit, men and masculinity. Feminist Formations 20(2): 122–155.

Helping Indonesia keep its rice bowl full

by Grant Singleton and Reianne Quilloy

One of the biggest rice consumers in the world aims to develop a long-term strategy for rice self-sufficiency to meet the continuing increase in population.

PAK SUBARJO proudly shares his field, which harvested its third cropping in January 2017. (Photo by Budi Raharjo, Assessment Institute for Agricultural Technology, Indonesia)

Indonesia is the world's fourth most populous country and one of the largest rice consumers. To feed the country, its present rice production of 75 million tons must increase by 2.3% per year through 2019. As the demand to produce more grains increases, the country has always depended on Java—where nearly 60% of the total rice production comes from—to fill the country's rice bowls. Although the yields in Java are relatively high compared with those of other areas of Indonesia, the rice productions areas on the island are under pressure from urban and industrial development.

Efforts to increase national production have led the government of Indonesia to craft a long-term strategy for rice self-sufficiency. A key pillar of this strategy is intensifying rice production on the outer islands, including South Sumatra. The government also developed a policy of GP-PTT (*Gerakan Penerapan Pengelolaan Tanaman Terpadu* or Implementation Action of Integrated Crop Management) to deploy best management practices in rice-farming communities. This created an opportunity in South Sumatra to forge collaboration between the International Rice Research Institute (IRRI) and the Assessment Institute of Agricultural Technologies (AIAT) through the Closing rice yield gaps with reduced environmental footprints (CORIGAP), a project funded by the Swiss Agency for Development and Cooperation (SDC). In the tidal deltas of South Sumatra, the two institutes are conducting validation of yield gaps to establish solutions that will help farmers sustainably intensify their rice production.

"CORIGAP is fully in line with Indonesia's national program," says Dr. Hasil Sembiring, director general of the Directorate of Food Crops in Indonesia. "Due to increasing population and demand for rice, innovation in CORIGAP is needed to increase rice productivity in Indonesia. Thus, we appreciate any innovation introduced to increase our rice production. This year, South Sumatra contributes about 1 million tons of rice."

Before, a majority of the deltas produced one rice crop per year. After successful demonstration trials of best management practices by IRRI scientists and collaborators, planting area for rice rapidly increased from 30 hectares to 93,000 hectares. The combination of effective extension and strong promotion of the CORIGAP project nationally and provincially was one of the factors that contributed to the success.

Expanding the rice granary to the outer islands

Of the 780,000 hectares of land in South Sumatra, 260,000 hectares situated in the coastal plain and deltas are seen as potential rice-growing areas. However, productivity in these areas is relatively low because most farmers plant rice only once a year.

"I used to harvest only 2–3 tons of rice per year, and was able to plant only during the wet season," said Pak Subarjo, who has been farming for 35 years. Their rice productivity is impeded by expensive labor and severe pest problems during the dry season when weeds and rodents cause huge losses, he added.

In 2012, more than 250,000 hectares were planted for monsoon rice in the tidal deltas but dry-season rice was planted on only 30 hectares. In 2013, IRRI scientists and AIAT staff worked together through to develop and demonstrate best crop and pest management practices. This approach helped farmers in the tidal deltas increase their rice production in 2014 as double cropping expanded to 300 hectares.

Based on this strong evidence of progress, a large-scale rollout of crop management recommendations from the CORIGAP project was conducted in selected rice-farming villages in South Sumatra. A range of technical options were introduced to farmers that helped them close their rice yield gaps: water-saving techniques, *legowo* drum seeders to optimize labor productivity, ecologically based rodent and weed management, and improved postharvest management of rice. IRRI scientists and AIAT worked hand-in-hand with about 50 farmer groups to promote the adoption of these technologies.

"The AIAT staff and IRRI scientists conducted regular meetings with the farmers," said Director Harmanto, former director of AIAT, who contributed significantly to the program. "We worked closely with the farmers. We regularly monitored the fields and the farmers and they could easily reach us if they encountered problems. Others, such as university staff members and army personnel, helped expand our reach."

The hard work paid off. In 2015, the package of CORIGAP best practices was promoted in the villages of South Sumatra. This approach was instrumental in helping farmers implement crop and pest management for rice intensification. Using the CORIGAP approach, around 1,500 hectares of rice fields were planted in the project's villages. Also, the total dry-season rice crop covered 17,000 hectares in South Sumatra.

This includes Mr. Subarjo's 2-hectare rice field. Mr. Subarjo said that the training on good rice cultivation practices conducted by AIAT enabled him to grow two crops in one year: producing more than 7 tons per hectare in the wet season and 4 tons per hectare in the dry season.

"Now that I've seen the benefits of the technologies introduced to me, I reduced the amount of pesticide in my field and used the correct herbicide," said Pak Subarjo. "I also found the drum seeder very useful.

"After attending training activities from AIAT, I immediately shared my learnings with my son, who helps me tend our rice field," he added. "I also share my learnings with my fellow farmers here in Sumber Mulyo Village. I also feel confident about planting rice thrice a year."

Building on this confidence, he participated in the third cropping of the rice-cropping program of three crops a year, locally called IP 300. His demonstration plot will soon be ready for harvesting. Mr. Subarjo is willing to talk to farmers, extension workers, researchers, and local government staff about his experience.

"The rapid increase in planting area was a combination of innovative extension strategies of AIAT and the promotion of CORIGAP nationally and provincially under the banner of GP-PTT," said Dr. Harmanto.

According to Dr. Harmanto, the strong progress of the CORIGAP approach in South Sumatra can be traced from evidence drawn from the

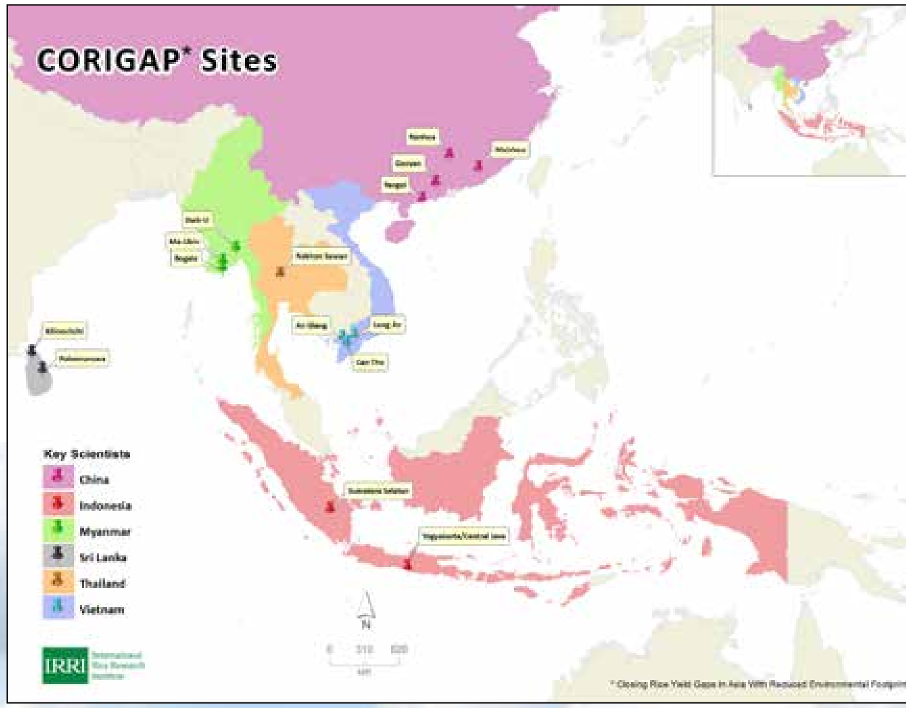
CORIGAP farmer-participatory field trials, its alignment with Indonesia's national policy for food security, and the innovative approaches in disseminating the crop management recommendations. These encouraged more farmers to increase their cropping intensity, such that the planting area for rice in the dry season expanded impressively to 93,000 hectares in 2016.

The next step: CORIGAP-PRO

Based on the impressive progress of the project, the team aims to reach half a million farmers in six major rice-growing countries, including Indonesia. Through the ongoing support of SDC, IRRI scientists and its national partners in Asia (China, Indonesia, Myanmar, Sri Lanka, Thailand, and Vietnam) are gearing up for the next phase of the project, CORIGAP-PRO.

Building on the success of CORIGAP, CORIGAP-PRO will continue to chart the pathways to increase farmers' profitability using best management practices for lowland rice production. In the next four years, CORIGAP-PRO will focus on the effective and widespread dissemination of best management practices, which in turn will increase the profitability of rice production and improve the livelihoods of smallholder farmers. ■

Dr. Singleton is a principal scientist and project leader of Closing rice yield gaps in Asia with reduced environmental footprints (CORIGAP) at the International Rice Research Institute (IRRI). Ms. Quilloy is a communication and outreach specialist at IRRI.



SOUTH SUMATRA, which predominantly consists of marshlands and coastal areas, historically produced rice once a year. (Photo: IRRI)

SIIL-Polder Scholarship

The International Rice Research Institute (IRRI) invites qualified students from Bangladesh (who are enrolled in a university in Bangladesh), to apply for MS or PhD research scholarship positions to work on agricultural production systems and water management in the coastal zone of Bangladesh.

AVAILABLE RESEARCH AREAS

Agronomy/water management

- Technologies for intensification and diversification of agricultural production systems
- Water management (supplementary irrigation, drainage, models of water management)
- Climate and cropping system modeling

Human nutrition

- Baseline situation—status, gaps, awareness
- Devising solutions to improve nutrition in households, with particular emphasis on children and women
- Quantifying the impacts of project interventions on nutrition

Socioeconomics/economics

- Adoption of improved technologies—quantifying adoption, perceptions, and the impacts of adoption on rural livelihoods
- Investment on infrastructure
- Community cooperation and coordination—enabling conditions

Gender in agriculture

- Quantifying the impacts of project interventions on women, youth, and other marginalized groups
- Models to attract youth into agriculture

Environment

- Soil fertility dynamics with improved production system
- Salinity

Visit www.training.irri.org

For more information, email: scholarship@irri.org

Strategic alliance with BRAC

by Lanie Reyes

SIRAJUL ISLAM and his team visit a sunflower demonstration supported by BRAC. (Photo: BRAC)

"BRAC has a long history of development work and commitment to food security and reduction of hunger and malnutrition through improved agricultural productivity," said Sudhir Yadav, co-leader of the SIIL-Polder project that focuses on the coastal area of the country. "This makes the organization a good ally in improving the lives in polder communities in coastal Bangladesh."

From ruins to hope

When the Bangladesh War of Independence broke out in 1971, many people fled to neighboring India. When they came back after the war, they found that their houses were decimated. With no livelihood, the people were helpless.

But, Sir Fazle Hasan Abed, a man from a wealthy family, had a vision of reaching out to his countrymen. He sold his house in London and he and his like-minded friends raised funds to buy building materials for their homeless countrymen. His work, which he started with his colleagues in a remote region of northeastern Bangladesh, led to the nongovernment organization known today as BRAC.

Although the building materials were intended for the poor, they eventually ended up in the hands of the rich as these were sold for food and other needs. Thus, BRAC (formerly known as the Bangladesh Rehabilitation Assistance Committee and then as the Bangladesh Rural Advancement Committee) saw the need for providing the poor with economic empowerment through livelihood activities. In terms of the scale and diversity of its interventions, BRAC is now the largest development organization in the world.

BRAC counts 45 years of fruitful existence. Dr. Abed never imagined that BRAC would be this big. The impact of the organization is so huge that Dr. Abed received the World Food Prize in 2015.

Sustainable giant

Because the country's economy is agriculture-based, BRAC's entry point of intervention came through the agricultural sector such as crop-based livelihood, fishery, poultry, and livestock. In each aspect of agriculture, the end goal has always been enterprise development.

"The strategy is to reach sustainability," said Dr. Md. Sirajul Islam, head of the Agriculture and Food Security Program of BRAC. "Donors may not always be there to finance the organization."

One example of its viable activities is in the seed industry. "At first, we produced seeds and gave them to the farmers," said Dr. Islam. "Since this was not sustainable, we ended up marketing the seeds, which eventually helped the seed sector. As one of the largest producers of quality seeds, we control the market to some extent. As a result, private seed producers could not unjustifiably increase the price because we have the biggest share. The revenue earned is fed back to the organization's development activities."

BRAC-IRRI connection

Dr. Abed has been a formidable ally of agriculture, particularly the rice sector. He served as a member of the Board of Trustees of the International Rice Research Institute (IRRI) from 2005 to 2010.

Moreover, the connection between IRRI and BRAC does not end there. The late Dr. Mahabub Hossain, former head of IRRI's Social Sciences Division, retired from the institute in 2007 to serve as the executive director of BRAC. He addressed the challenge of the reemergence of food insecurity in the country and established BRAC's Agriculture and Food Security Program.

BRAC focuses on three components in attaining food security through agriculture, according to Dr. Islam. The first is research and development.

(*Foreground, left to right*) Dr. Hossain and Sir Abed visit a field in Bangladesh. (Photo: BRAC)

"We validate varieties developed by international institutions such as IRRI, and national institutions such as the Bangladesh Rice Research Institute (BRRI), before making them available to farmers," he said. "We rigorously test any promising technology in our fields first. If we find the technology to be good, then we can go to the second component—taking the mature technology to the farmers.

"Submergence-tolerant rice varieties such as BRRI dhan51 and BRRI dhan52 are some of the varieties for which BRAC helped fast-track the diffusion of the technology in coordination with the Department of Agriculture and Extension (DAE) of the country," he added.

SIR FAZLE Hasan Abed received the World Food Prize in 2015. (Photo: BRAC)

"Our third focus is on climate-vulnerable areas," stated Dr. Islam. "Coastal zones are highly vulnerable to climate change. These areas have problems such as saline intrusion and flooding."

Dr. Islam explained that fish is also a very big component in the south where the coastal zones are located. The country became the fourth-largest inland freshwater fish producer in the world, for which BRAC fisheries activities also significantly contributed along with the government and other partners.

A worthy partnership

"BRAC is a worthy partner of the project, *Unlocking the production potential of polder communities in coastal Bangladesh through improved resource-use efficiency and diversified cropping systems,* because of its expertise in technology dissemination," Dr. Islam said. The project, also known as "SIIL-Polder," was initiated under the flagship of USAID's Feed the Future (FtF), the Sustainable Intensification Innovation Lab (SIIL) of Kansas State University (KSU), and IRRI in partnership with BRAC.

"Aside from IRRI, BRAC has been routinely partnering with other international institutions to improve the livelihood of the community in the south, particularly after the cyclones Sidr and Aila devastated the country," Dr. Islam added.

Moreover, BRAC has a good infrastructure of 2,500 branch offices spread all over the country. Its infrastructural capacity makes it easy for the organization to implement project activities.

BRAC is not new to projects similar to SIIL-Polder. The organization was a partner under the CGIAR Challenge Program on Water and Food (CPWF), in which one of the components was led by IRRI. In fact, the SIIL-Polder project is the continuation of the CPWF and CGIAR Research Program on Water, Land, and Ecosystems when it comes to improving the productivity of the coastal zones of Bangladesh.

The SIIL-Polder project targets 600 households in Polder 30. Although this may not seem many, the real count starts "beyond the project." BRAC will ultimately target 100,000 farmers in two years, according to Dr. Islam.

"This may sound ambitious," stated Dr. Islam. "But, we will be promoting the technologies together with DAE, especially when the technologies are technically sound, economically viable, and socially acceptable."

"With its success in its value-chain approach to agricultural development, BRAC, as a strategic partner, will play a key role in attaining food security through improved agricultural productivity in coastal Bangladesh," said Krishna Jagadish, leader of the SIIL-Polder project and associate professor at Kansas State University. ■

Ms. Reyes is the editor-in-chief of Rice Today.

This article is reprinted from Vol. 1, No. 2 of Polder Tidings *newsletter.*

A rice farmer in the field quenches his thirst with water brought by his son.

This photo by Nimai Chandra Ghosh© was chosen as the winning entry in *A rice farmer's life,* a photo competition sponsored by IRRI. Mr. Ghosh's image was selected—among 72 impressive submissions by photographers from different countries—for capturing the gritty essence of the noble work of farmers. Here, Mr. Ghosh shows a man toiling under the scorching sun to give the people that depend on him, like his young son, a better future.

A rice farmer's life was held in celebration of the 50th year of IR8, the "miracle rice" developed by IRRI scientists in the early 1960s and is believed to have saved many countries in Asia from famine. Released in 1966, the first modern rice variety became popular with farmers because it had a short growth duration and a high-yield capacity related to its response to nitrogen fertilizer.

The 50th anniversary of IR8 was an opportune time for IRRI to host celebratory events in the Philippines and India and to share the milestone with other regional constituencies. IRRI would like to thank everyone who participated in *A rice farmer's life* for sharing their inspiring images and adding a rich visual tapestry to the 50th anniversary of IR8.

by Jonne Rodenburg, Matty Demont, Sander J. Zwart, and Lammert Bastiaans

Food security under attack: Africa's struggle against parasitic weeds

Parasitic plants infest other plants to extract water, nutrients, and metabolites, causing great damage to their hosts. When these plants invade food crops, they turn into ferocious weeds. We overlaid a map of rainfed rice production areas with parasitic weed observation data retrieved from public herbaria to visualize the regional distribution in Africa of the four most important species: *Striga hermonthica*, *S. asiatica*, *S. aspera*, and *Rhamphicarpa fistulosa*.

Striga species occur in at least 31 countries, whereas *Rhamphicarpa fistulosa* threatens rice production in at least 28 countries with rainfed rice systems. Together, they invade an estimated 1.34 million hectares of rainfed rice area in Africa. The total economic loss inflicted by parasitic weeds in rice in Africa is estimated at USD 200 million, with an annual increase of USD 30 million.

Targeted investments in research, development, and capacity building are needed to reverse this trend. The countries where such investments would yield the highest payoff are Nigeria, Guinea, Mali, Côte d'Ivoire, Cameroon, Tanzania, Madagascar, Uganda, Sierra Leone, and Burkina Faso. ■

Dr. Rodenburg is an agronomist in the Sustainable Productivity Enhancement Program at Africa Rice Center (AfricaRice) in Côte d'Ivoire. Dr. Demont is an agricultural economist in the Social Sciences Division at the International Rice Research Institute in the Philippines, Dr. Zwart is a remote sensing and GIS specialist in the Sustainable Productivity Enhancement Program at AfricaRice in Benin, and Dr. Bastiaans is an associate professor at the Centre for Crop Systems Analysis at Wageningen University in The Netherlands.

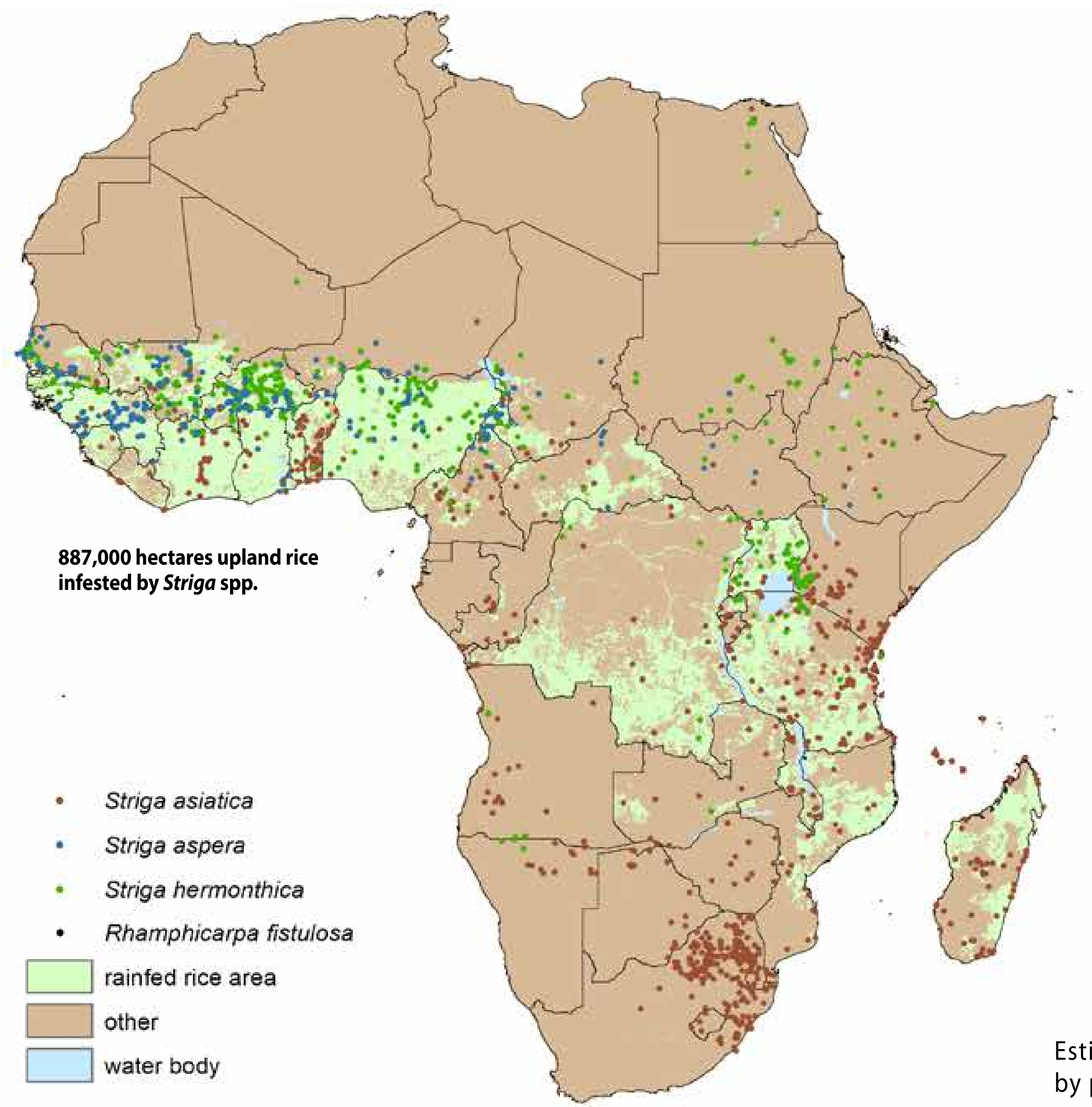
This article is an excerpt from Parasitic Weed Incidence and Related Economic Losses in Rice in Africa published in Agriculture, Ecosystems and Environment. 235:306-317. *The article is freely available at https://goo.gl/kWqpYP.*

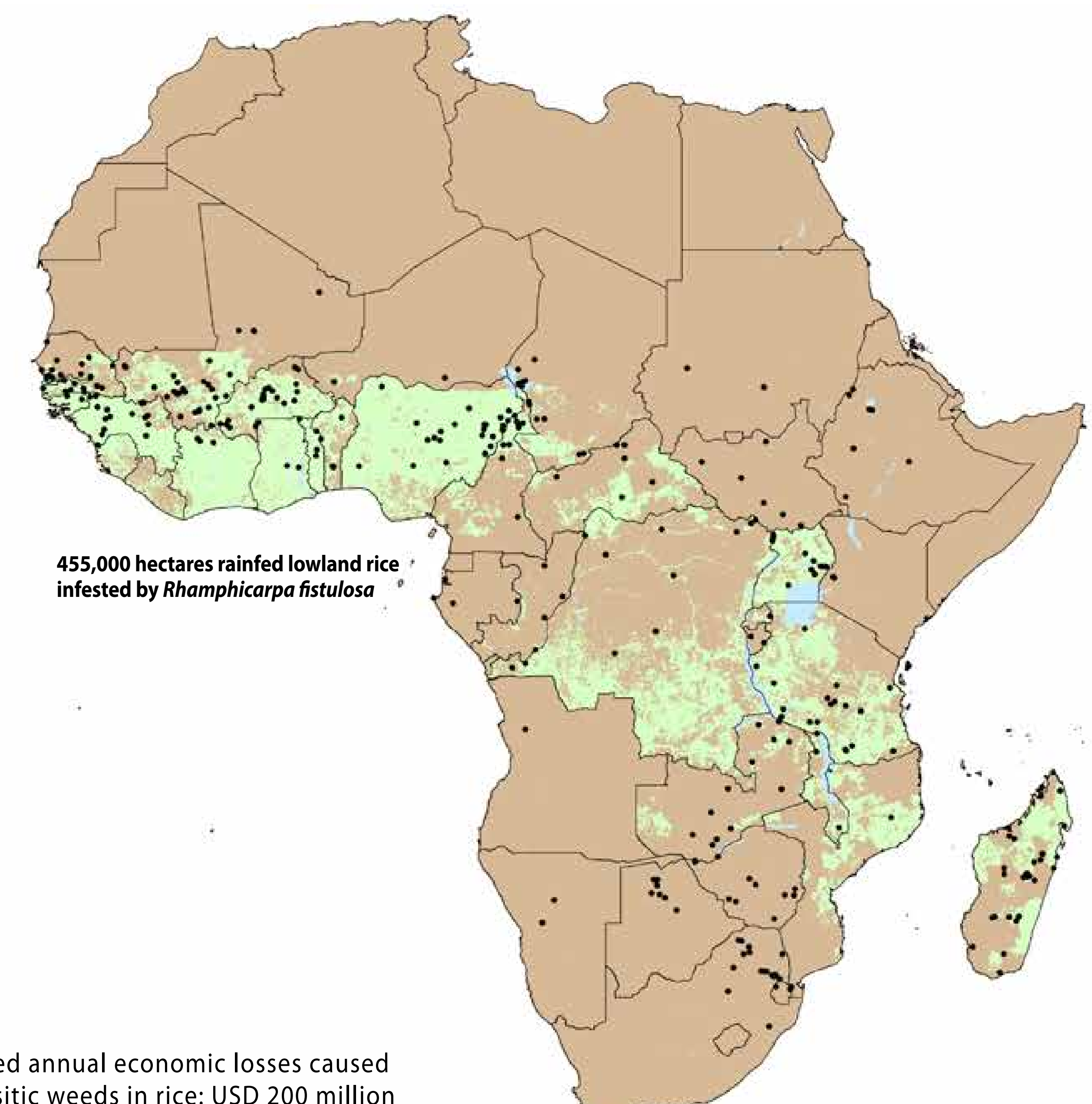
Striga aspera

Striga hermonthica

Striga asiatica

Rhamphicarpa fistulosa





Estimated annual economic losses caused by parasitic weeds in rice: USD 200 million

PHOTO BY TAMAMI KRETZSCHMAR

Tobias Kretzschmar: Bridging discovery work with applied science

by Elemarie Lamigo-Rosellon

Hailing from Germany, Tobias Kretzschmar heads the Genotyping Services Laboratory (GSL) in the Plant Breeding Division of the International Rice Research Institute (IRRI). As a scientist early in his career, Dr. Kretzschmar has already established a strong record of success. But then again, he has a history of achieving success at a young age.

A mere three years after receiving his PhD in molecular plant physiology from the University of Zurich in Switzerland, Dr. Kretzschmar authored a paper on the discovery of a plant hormone transporter in *Nature* magazine (2012). In the same year, he won the Best Paper Competition in IRRI's International Young Scientists Conference for his work on genes that enable rice seeds to germinate underwater. He authored a paper about this key trait for direct-seeded rice in *Nature Plants* in 2015, which made the cover of the magazine (see photo of cover). Apart from the service team that Dr. Kretzschmar leads, the GSL has an R&D team developing molecular markers and genotyping platforms. He also leads a gene discovery team that identifies genes associated with traits that enable plants to adapt to harsh environmental conditions.

His impressive credentials and expertise in botany, molecular genetics, and functional genomics may give him the appearance of being a "sciencehead" who is out of touch with the real world. But, that's the other thing about Dr. Kretzschmar. He considers his work, which is fundamental science, as directly applicable for alleviating poverty and ensuring food security. (See *The future faces of rice science* on page 42 of *Rice Today* Vol. 12, No. 1.) He describes this as a "rare privilege."

In this interview, Dr. Kretzschmar shares his brief but impressive scientific journey and offers tips to aspiring scientists.

Have you always known that you would be a scientist?

I always wanted to do plant science. But, I started my career on the academic side. I envisioned an academic pathway of getting my PhD and a postdoctorate degree, becoming an assistant professor, and having a permanent position at some small or big university, depending on how well I did.

When I was starting my career, I did not see myself going into applied science. But now, I find it more rewarding than basic science. Being able to publish and contribute on the discovery side is important. However, what I can do here at IRRI at the moment is bridge discovery work or basic science with applied science. Seeing products coming out of my work makes me feel that I am doing the right job.

Germany is not a rice-growing country. What made you choose rice?

I had not worked with rice before I came to IRRI, but knowing that rice is the world's major staple crop struck a chord with me. My wife is Japanese, so rice is important for her as well. Looking at where I can have the most impact as a scientist, the CGIAR centers came up, and I think IRRI was the most appealing in terms of its vision and mission. I also considered what's possible in the organization. In terms of the location of IRRI headquarters, I think the Philippines is a great country in which to live.

Can you tell us more about what you are doing in the GSL?

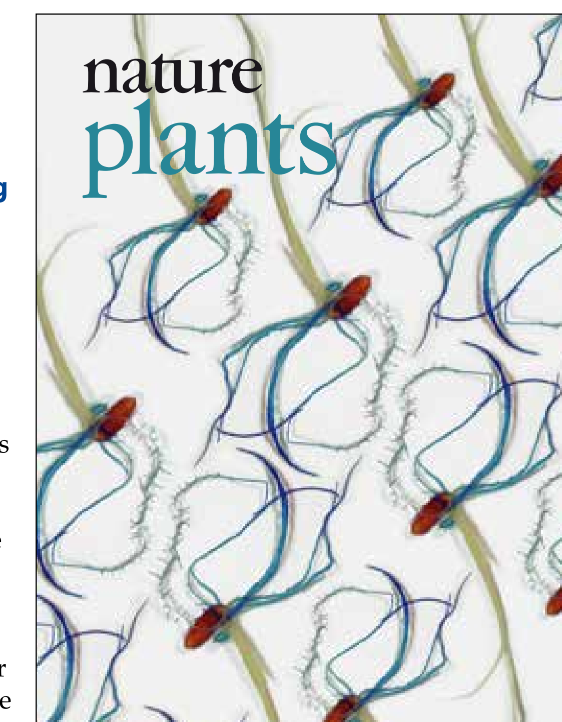
The GSL offers tissue sampling and sample tracking, DNA extraction, and a variety of low- to high-density genotyping assays. These range from tracking single traits such as *Sub1* to establishing genetic fingerprints of several thousand markers. We have several ongoing projects developing new platforms and creating collaborations and partnerships with other companies that will do some of the genotyping for us.

One of our projects is the Genomic Open Source Breeding Informatics Initiative (GOBII). It is a 5-year project funded by the Bill & Melinda Gates Foundation. The project will create a platform for breeders to access, use, and analyze genotyping data. It's a big database project across three CGIAR centers and five crops that will allow breeders to have easy access to the genotyping data, and provide tools for their analysis. Building that database takes time, particularly since it has to be well integrated with breeding management systems.

There is a core database now but it's going to take another year before it becomes a tool that's accessible to and easy to use by breeders. Breeders who are well versed may not require informatics to do it, but we want to make it easy to use, almost like an iPhone, so that breeders can choose the apps for analysis and do the downstream analysis.

What are your goals as the head of the GSL?

Since I came on board a year ago, we've made a lot of changes in the GSL. Interacting with our clients is very vital: making sure the product we deliver is fully understood. We



also help with downstream analysis. Our motto is to do things better, cheaper, and faster, and provide friendlier services.

Our first goal is to make genotyping cheaper. We are trying to make it cheaper because the cost of genotyping is the key restraint for breeders to fully adopt it across their programs. That is the challenge at IRRI because the equipment and the maintenance of the equipment are expensive here in the Philippines.

Our second goal is to make it faster. Making it faster is difficult for in-house service because we are constrained by logistics. For outsourced service, we are constrained by regulations for sending materials out.

In terms of making things better, I think our data quality is on a par with international standards and we are constantly adding new markers and panels to our portfolio and running state-of-the-art chemistry.

About the friendlier service that I touched on, we try to be demand driven. Rather than just having an off-the-shelf service, we try to create a service that meets breeders' demand by knowing their needs. We are trying to make genotyping data a direct decision support tool for them. Our goal is to integrate genotyping into the general breeding workflow. That is a function of cost but it's also a function of how fast the breeders can obtain the data and how easy it is for the breeders to analyze the data and make decisions based on the data. That is the GSL workflow in a nutshell.

TOBIAS KRETZSCHMAR (*center*) and members of Genotyping Services Laboratory at IRRI Headquarters. (Photo by Isagani Serrano, IRRI)

Among your projects, which one are you most passionate about?

For the bigger picture, there's the Transforming Rice Breeding (TRB) project. Here, we are mostly involved in developing innovative genotyping platforms and workflows to make genotyping accessible for breeders. Precision breeding, that's our component in the TRB. GOBII feeds into the same idea as TRB so these projects work synergistically. Both are large projects in which we play a small but important role. In terms of having impact on rice breeding, both are going to be tremendous because they will not only improve rice breeding but also transform it into something more modern, more streamlined, more integrated, and more effective. Also, we are working on genome editing in collaboration with C_4 Rice and the Genomics group at IRRI. It's a kind of consortium to get genome editing off the ground at the institute so as not to miss out on its future potential.

From a scientific aspect, I might be the most passionate about Nutrient Rice. It's a very small project in collaboration with the Philippine Rice Research Institute (PhilRice) and the National Institute of Agricultural Botany (NIAB) in Cambridge. It targets Philippine heirloom rice from the Cordillera Region. The idea is to assess the rice from a health perspective. PhilRice has collected 800 accessions of colored heirloom rice: pink, purple, black, red, brown, and speckled. There are antioxidants, polyphenolics, and secondary compounds in these varieties. We are going to investigate these for their health benefits. We're hoping to obtain a lot of useful information and find out which ones are the healthiest varieties that would help in promoting the consumption of heirloom rice.

From a breeding perspective, we want to be able to use genes associated with their health benefits and incorporate them into major breeding programs at IRRI. This way, we can bring the health benefits from the colorful rice that is grown on a very small scale up in the mountains to more people through IRRI-developed varieties. PhilRice is in direct contact with the indigenous tribes that grow heirloom rice and the benefits will also trickle down to them. It's the project I am most passionate about, even if it is my smallest project.

What is the secret to being a successful young scientist?

I don't know the secret! But, in terms of being successful, it comes down to a few components. Clear communication with your team is one. Making sure that everyone on your team knows their role and the bigger picture where the team wants to go. Communication and clarity are probably the most important.

The second most important is collaboration. Nobody can do everything by themselves so building strong partnerships within IRRI and also with external partners drives the science because everyone has their area of expertise. Collaboration works best if you communicate well, if everyone in the collaboration has a clear vision of where we're going and everyone is clear on what their objectives are. Communication, collaboration, and clarity, that's the 3Cs.

What is your advice to aspiring scientists?

Be curious. That's another C! Don't be afraid to fail. Failing is always a part of the job. If you are too cautious, you will never get anywhere. Build partnerships and collaborations as early as possible. Having a strong network is very important in becoming a successful scientist.

Be open and be creative. Don't tie yourself down too much and don't focus only on what your boss tells you to focus on. Keep an open mind and a broad vision because you never know where that will lead you. Focus is important but, if you focus too early and too much, you will never get out of your comfort zone.

And finally, balance. One thing that IRRI does well is balancing between being publication-focus and product-focus. As a young scientist, you have to publish. But, if you want to make a real impact, it's the product that matters, so try to balance that out. That is more difficult for some people. If you're very much on the breeding side, you're not going to be able to publish but you will have stronger impact. If you are on the discovery side, it's going to be easier to publish but it will be more difficult to translate that knowledge into an actual product, so always be aware of both worlds.

What can you say about making science sexy for the general public?

It is very difficult to educate or make the broad audience have a sexy view of science. Communicating science to the general public for the sake of science is not going to work. If you want the public to be interested in science, you need to have a sexy product, something that is convincing. Then, you communicate the science behind it and how many scientists were involved. Most people don't know how much work there is in breeding. Most people think that whatever is grown in the field has been there forever. They are not aware how much cutting-edge science was involved.

It's difficult even if you're good in communication. Communicating with small teams is easy but communicating on a national level trying to convince countries that this is the right strategy is difficult. My approach is linking into young scholars to get them interested and excited about the work. We engage a lot of interns rather than tackling a broad audience. We also try to do some master's work and, as much as possible, that goes all the way up to the PhD level. If you can convince one or two individuals every year that science is sexy, that will trickle down. Linking with other young scientists is probably the best way to get them excited about plant science.

In terms of the lines of communication, I think it's important to start high. IRRI can't reach all farmers, so IRRI has to be involved in the higher policy-making level. To convince policymakers of the usefulness of the science we do and the amount of science and hard work that goes into the development of new products. That would be my approach. ■

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

Senegal's quiet rice revolution

by Savitri Mohapatra

Seed growers turn Anambé into a valley of prosperity

RICE FARMERS in Anambé Valley in Kolda Region, Senegal, have discovered that seed production can be a lucrative business. Within two years they have been able to buy tractors and build new houses for their families with the cash from selling seed of upland rice. (Photo by R. Raman, AfricaRice)

Unknown to many, rice seed growers are quietly turning Anambé, Kolda Region in southern Senegal, into a valley of prosperity.

Thanks to an amazing synergy among all the stakeholders, subsistence farmers in Kolda have become prosperous in less than two years doing a booming business in quality seed. Kolda has also become for the first time a major hub for upland rice seed production in Senegal. This transformation is helping the country move faster toward the goal set by the government to achieve rice self-sufficiency by 2017.

Anambé success story

"With the profits I recently made selling rice seed, I have bought two tractors, and I am thinking of acquiring a third one," said Mr. Issa Baldé, chairman of the Anambé valley farmers' federation (FEPROBA) in sector 5, Dialakégné. He proudly announced that he has enrolled his son in a football (soccer) training school in Dakar, whose fees are 2.6 million FCFA (USD 4,315).

Many other members of FEPROBA, which has about 4,600 farmers, have similar success stories to tell. Some of them are building new houses with the cash from seed sales. They are benefiting from the government's subsidy scheme for buying agricultural machinery and are able to obtain bank loans because of the profits they are making from seed production.

"I had never seen 1 million FCFA (USD 1,659) in my life until now," remarked Souleymane Gano. "By selling rice seeds, I made 1.3 million FCFA (USD 2,157) after paying all my loans." Mamadou Dian Diallo, another seed grower, built a two-story house with storerooms and bought two tractors and one four-by-four vehicle.

FEPROBA chairman El-Hadj Gano made enough money from selling seeds to buy a tractor, build a house, buy cattle, and enroll his children in a private school. Mrs. Fatoumata Sabaly from Soutouré Village in Anambé has produced 77 tons of rice seed in 2016. She also bought a tractor and has 60 head of cattle.

Reasons behind the success

The Anambé success story started in July 2014 when FEPROBA received 60 tons of seed of rice varieties NERICA 4 and NERICA 6 for the upland ecosystem and WITA 9 for the lowland ecosystem. The seeds were distributed by the Africa Rice Center (AfricaRice) and the Senegal Ministry of Agriculture and Rural Equipment as part of the Japan-funded Emergency Rice Initiative implemented by AfricaRice.

Anambé was identified by the National Rice Self-Sufficiency Program (PNAR) as a hub for upland rice seed production because the valley has good water control facilities and also the possibility of supplemental irrigation, if necessary, during the off-season. The government is also keen to improve the livelihoods of farming communities in Kolda, one of the poorest regions of Senegal.

PNAR coordinates the various efforts relating to the development of the national rice sector and seeks to help the country achieve rice sufficiency by 2017 by producing 1.6 million tons of paddy (1.08 million tons of milled rice). Although earlier the government had determined that 80% of this would come from irrigated rice and 20% from upland rice, it decided to increase the share of upland rice production to 40% in 2014.

This change in strategy was largely thanks to a program supported by the United States Agency for International Development (USAID) in southern Senegal, which demonstrated that the productivity of the upland rice system could be significantly improved using high-yielding varieties such as NERICAs with good agricultural practices, mechanization, and an efficient seed system.

"However, as upland rice was seen as a poor relative in Senegal, no quality seed was practically available for farmers," explained Dr. Waly Diouf, PNAR coordinator. "Therefore, AfricaRice's offer of seeds came at an opportune moment. We decided to distribute them to FEPROBA farmers, in collaboration with the Society for Agricultural and Industrial Development in Senegal (SODAGRI), so that the farmers could multiply the seeds for large-scale distribution."

The seed growers were supported through advisory and extension services. Since the beginning of the initiative, AfricaRice has been an active partner of the government in the training of trainers, including extension agents, in improved rice production practices. According to Dr. Karim Traoré, AfricaRice grain quality and seed system expert, one of the main resource persons in the training program, good-quality seed is essential for farmers to have good harvests.

Improving the seed system

Anambé seed growers have been following government procedures to produce certified seed. Quality control of the seeds is done by the National Seed Division (DISEM) starting from the field. Seed samples are tested for germination, physical purity, and moisture content in the government seed testing laboratory in Tambacounda.

In January 2015, a seed treatment center with a sorting capacity of 40 tons per day was established in Kolda with support from USAID. The center, which is run by a private company, certifies the seeds after cleaning, grading, and treating them at 20,000 FCFA (about USD 33) per ton, paid by the seed growers.

PHOTO BY R. RAMAN, AFRICARICE

"We ensure that our center sends out certified seeds that farmers can count on for increasing their production," said Mr. Baila Diop, manager of the Kolda center.

Tangible results

Within a couple of years, the Anambé valley had truly become one of the biggest suppliers of certified seed for upland rice in Senegal. "In 2015, it supplied more than 1,000 tons of upland rice seed and in 2016 nearly 2,000 tons are expected," stated Moussa Baldé, director general of SODAGRI.

"The initiative has brought hope to FEPROBA farmers, who have understood that seed production can be a profitable business," he added. "Our target is to supply at least 50% of the certified seed needed for upland rice cultivation in Senegal by 2017."

Kolda is feeding Kolda

According to FAO, Senegal reaped a record 906,000 tons of paddy (634,000 tons of milled rice) in 2015, which is 62% higher than the production in 2014. It projects that, in 2016, the country will collect at least 950,000 tons of paddy (665,000 tons of milled rice), up 5% from the 2015 record.

The Anambé seed growers have certainly contributed to the growing success of the government's new strategy and are fulfilling the promise of the slogan "Kolda is feeding Kolda" in rice. They are eager to do more. "We have now the supporting policies from the government. Farmers can feed Senegal without going outside for help," said Mr. Baldé.

He and the other FEPROBA members requested the government to increase the irrigated area as high demand exists from a growing number of farmers who are coming to Anambé after witnessing the seed boom. They would also like to have a seed treatment center nearer the production sites and a rice processing factory.

For Dr. Diouf, the Anambé success story is a vision of the government that has come true thanks to all the research and development partners, including AfricaRice. "We were able to ensure rice self-sufficiency in Kolda within two years. We are now no longer speaking of self-sufficiency here but of prosperity. This means we have moved to a higher level of development." ■

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

The "crown jewels" of Chile

by Adriana Varón Molina

INIA-QUILAMAPU hosts the national Rice Breeding Program, which has released more than ten rice varieties with great impact on Chilean rice producers. (Photo: CIAT)

Diamond, Amber, Quartz, and Sapphire: this collection of "jewels" is not kept in a bank vault, but sown in the cold soils of Chile, the country hugging the southwestern coast of South America. These are some of the rice varieties (named after precious stones) that are grown in the country.

With fields at 36.5 degrees south of the Equator, rice growing in Chile is considered to be one of the most southerly in the world. These varieties are able to resist temperatures as low as 5 degrees Celsius at planting time and wait patiently in the soil to germinate when the temperature rises to 12 degrees Celsius.

But what characteristics make these varieties the jewels in the crown?

The type of grain that these temperate japonica varieties produce is long, wide, and adapted to the taste of most Chileans, who consume up to nine kilos of rice per person annually. Chileans prefer their local product even though the market has cheaper imported rice with long, narrow grains.

Timing is everything

In addition to a germplasm tolerant of low temperatures and using certified seed, the farmers have another ace up their sleeve to ensure successful production of up to nine tons of rice per hectare: the planting time.

Abel Concha is a 73-year-old veteran farmer. In the 50 years that he has been growing this cereal grain, he has witnessed the difficult work involved in producing rice so far south. He knows the ideal time to plant is from 1 to 19 October so that the crop has optimal meteorological conditions to develop and for the grain to mature.

It is possible to plant as late as 6 November, but the risks are greater. What Mr. Concha definitely avoids is planting after 7 November when the likelihood of crop failure is very high because temperatures can drop to less than 2 degrees Celcius, cold enough to kill the flowering rice plants.

Chilean rice producers have found that water can be an ally for reducing the impact of low temperatures. Those who plant late maintain an almost permanent layer of water in the field during the early stages of development of the crop to create a buffer effect so that the ground does not become as cold as the air.

"The thermal variation facilitates rice production because the cold nights are compensated for by the hot days and high daytime solar radiation with temperatures that can soar to nearly 28 degrees Celcius," said Rodrigo Avilés, director of Quilamapu Regional Research Center under the country's Institute of Agricultural Research (INIA). INIA Quilamapu is home to the Program for Genetic Improvement of Rice, which has released other varieties—such as Shiny, Gold, and Platinum—that have had a big impact on Chile's rice production.

Smaller area, higher production

In Chile, the area planted to rice has decreased by 50% in the past 30 years with an estimated 25,000–27,000 hectares under cultivation. Despite this, production has increased by 37% over the same period to an average of 160,000 tons per year.

Karla Cordero, the coordinator of INIA's Rice Program, attributes this increase in production to the use of adapted varieties and improvements in agronomic management. The only significant problem has been weeds, particularly those that are resistant to herbicides. Because of this, INIA is investigating alternative crop management methods to reduce the effect of weeds in the field.

The guardian of the Maule

Majestic and protective is the description of the snow-capped peak of Longaví of the Andes mountain range. At 3,240 meters above sea level, in addition to giving water to the Maule region, the main rice-growing zone of Chile, it provides a protective shield. Longaví, together with the snow-capped peaks of Chillán, block the passage of pests. As a result, rice production in Chile is very "clean" because of the low application of agricultural chemicals.

According to Mario Concha Urra, president of Fedearroz, Chile's federation of rice producers, some 80% of the country's rice comes from the Maule region.

"In the past 10 years, we have grown from an average production of 4.5 tons per hectare to 6.9 tons, with some farms producing as much as 9 tons," said Mr. Urra. "This is due to the implementation of appropriate agricultural practices that take advantage of the genetic potential of certified seeds."

By adopting new technologies, Chile has boosted its rice production. A significant number of producers have participated in technical tours, training, and field days thanks to

SEVENTY-TWO percent of Chilean rice producers sow less than 50 hectares. Twenty-six percent of them cultivate rice on 50 to 500 hectares, while 1.6% are large-scale producers with more than 500 hectares. (Photo: CIAT)

THE USE of horses for rice production is a common practice among Chilean smallholder farmers. José Moreno helps with the sowing activities of the Membrillo farm, in the Maule region. (Photo: CIAT)

the country's link with the Latin American Fund for Irrigated Rice (FLAR), a public-private alliance whose aim is to improve the competitiveness and sustainability of the rice production systems in the region.

But not all is well among the farmers. Climate change and climate variability are affecting rice productivity. In fact, Longaví and its neighboring mountains are not receiving enough snow that provides the water to irrigate the rice fields in the spring and summer. The rains are failing as well.

The reservoir that provides water to the nearly 1,400 producers in the zone is currently working at half capacity, according to Rafael Campos, head of the Embalse Digua Association in Parral in Linares Province of the Maule region.

In the more than 40 years that the reservoir has been operating, it has failed to fill to capacity only three times. The year 2016 was one of them; two of the rivers that feed the reservoir had a reduced flow.

"The reservoir has a storage capacity of 220 million cubic meters of water," said Campos. "Last year, we made it to 178 million cubic meters. This will have repercussions on the next harvest because the farmers did not risk planting for fear of running out of water halfway through the season. Because of the water shortage, some 5,000 hectares were not planted."

INIA has worked closely with researchers at the International Center for Tropical Agriculture (CIAT) and, more recently, with FLAR, from which they have obtained genetic materials that are evaluated for developing new varieties for the country. Furthermore, there are already experiments in direct planting and early soil preparation (recently, as early as right after the harvest of the previous season), which allow producers to plant earlier, use up to a third less water during the crop cycle, and increase yields.

"These practices can transform rice into a more productive crop with a lower environmental impact," says Ramón Henríquez, who leads the technical assistance enterprise Agroparral that works with the country's Ministry of Agriculture.

For Karla Cordero, the development of new varieties will also be indispensable for the sustainability of Chile's rice production. In order to do that, INIA is proposing projects with the International Rice Research Institute (IRRI), and also with Japan, parts of which have comparably low temperatures.

The development of varieties and the management of rice growing in Chile show how both research and the empirical knowledge that passes from generation to generation of farmers can serve as a model of adaptation for other rice-growing regions that experience low temperatures.

In Chile, producers, technicians, researchers, and industrialists have learned how to promote the rice that is born in the country's cold soils, along with the development of seeds that deserve to be considered the "jewels in the crown" of the kingdom of temperate rice. ■

Ms. Varón Molina is communications coordinator for Latin America and the Caribbean at CIAT.

Chicha de arroz

by Margarita Pérez

Chicha is one of the most popular drinks in South America and is loved by people of all ages. However, each country boasts of its own version of chicha. In some countries, this refreshing drink is made from maize or cassava.

Chicha de arroz, an Ecuadorian recipe of Margarita Pérez, is a sweet and thick drink made from uncooked rice with tropical fruits and spices. Served chilled, it is the perfect pick-me-up for hot tropical summer days. ■

PHOTOS BY ISAGANI SERRANO, IRRI

Ingredients (for 8 glasses):

- 3 heaping tablespoons uncooked rice
- 3 cups chopped pineapple
- 1 cup chopped jackfruit (or passion fruit)
- 1 liter cinnamon- and clove-infused water
- 1 liter lemongrass- and lemon leaf-infused water
- 2 tablespoons lemon juice (one lemon)
- 3 tablespoons sugar

Preparation

1. Soak the uncooked rice for 24 hours (change the water three times in a span of 24 hours).
2. Marinate pineapple and jackfruit in lemon juice and 3 tablespoons of sugar.
3. Drain the uncooked rice and grind it in a blender without water until it becomes powdery.
4. Add fruits and infusions and blend well.
5. Strain the mixture and add sugar to taste.
6. Serve cold.

HOW TO MAKE

- *Cinnamon- and clove-infused water*
  Boil a liter of water and add a 2-inch piece of cinnamon and five cloves. Boil for some time. Strain.
- *Lemongrass-infused water*
  Boil a liter of water and add three leaves of lemongrass and three leaves of lemon. Boil for some time. Strain.

Mrs. Pérez is the mother of Ricardo Oliva, a plant pathologist at the International Rice Research institute (IRRI) and works on host plant resistance against major diseases of rice. Living in Ecuador, she shared this rice recipe when she visited Ricardo at IRRI in Los Baños, Philippines.

COURSES OFFERED BY IRRI EDUCATION

IRRI education offers science and technical courses aimed at developing the global agriculture sector. The center has a core set of offerings separated into three types: Science, Technical, and Leadership. These are offered each year at scheduled times. However, additional offerings of existing courses can be made available based on client's request. In addition, IRRI Education designs and develops new courses tailored to client's specifications.

IRRI Education courses are delivered through a variety of distance-learning technologies, face-to-face classroom and fieldwork experiences, workplace learning and mentoring, or a combination of all three. Classes can be held at IRRI locations around the world or at any site that is most convenient for a group of students.

Moreover, IRRI hosts a large number of graduate and postgraduate students undertaking research in cooperation with IRRI scientists.

Course title	**Date**
Effective Presentation Skills	1-3 February
Basics of Rice Production (BASF) (by invitation)	13-17 February
Basics of Rice Production	20-24 February
Basic Experimental Designs and Data Analysis	6-10 March
Quality Seed Production for Extension Agronomist (JICA and PhilRice) (by invitation)	6 March- 28 April
Quality Breeder and Foundation Seed Course (JICA) (by invitation)	13-31 March
RDM 101: Basic Research Data Management	15-17 March
Rice: Post-production to Market	17-28 April
Basic Scientific Writing	17-21 April
ORYZA Training Program for Basic Applications	17-21 April
Laser Leveling Course	8-12 May
Design and Analysis of Breeding Trials	9-12 May
Results-Based Monitoring, Evaluation, and Learning Course	15-19 May
Rice Production and Research (by invitation)	15-18 May
Regional Training Course on Integrated Good Agricultural Practices/Technology Packages Based on Innovative Soil, Water, and Nutrient Management (by invitation)	22-26 May
RDM 101: Basic Research Data Management	21-23 June
Training Workshop on Rice Technology Transfer Systems in Asia (by invitation, venue: Jeonju, South Korea)	26 June-7 July
Scientific Writing Workshop	17-21 July
Rice: Research to Production	7-25 August
Communication Skills Course	29-31 August
RDM 101: Basic Research Data Management	20-22 September
Research Proposal Writing	16-20 October
RDM 101: Basic Research Data Management (PRISM)	17-19 October
Advanced Applications of ORYZA in Rice Research	06-10 November
RDM 101: Basic Research Data Management	15-17 November
Rice Breeding Course	TBA*
SNP Data Analysis	TBA*

**To be arranged*

Unless noted, all courses are conducted at the IRRI headquarters, Los Baños, Philippines.

For more information, please visit http://training.irri.org or send an email to IRRITraining@irri.org

Piloting the Vietnamese "Small Farmers, Large Field" scheme in eastern India

by Samarendu Mohanty, Bidhan Mohapatra, Sampriti Baruah, and Prakashan Challatan Veettil

Smallholder rice farmers are finding strength in numbers through a scheme that helps them lower their production costs and increase their productivity.

In the past few years, Small Farmers, Large Field (SFLF) schemes have received significant attention in Vietnam as a solution to smallholders' problems of mechanization and lack of bargaining power in both input and output markets. Under the scheme, the participating farmers organize themselves into groups and synchronize their operations by adopting a single rice variety to plant, group nursery, and transplanting and harvesting around the same time, thus essentially converting their small landholdings into a large field. The SFLF schemes in Vietnam range from formal arrangements, in which farmers set up a company structure and become shareholders, to informal synchronization of activities.

Similarly in Thailand, farmers grow one rice variety with synchronized planting and harvesting time on around 400 hectares through a scheme introduced by the Suphanburi Rice Millers' Association in collaboration with the Suphanburi Rice Research Center. The bottom-line objective of all these models is to lower production costs and obtain a higher selling price for paddy. The rising wage rates due to rural outmigration and acute labor shortage are also forcing farmers to become part of some form of land aggregation scheme to make mechanization viable at the smallholder level.

PHOTO: IRRI

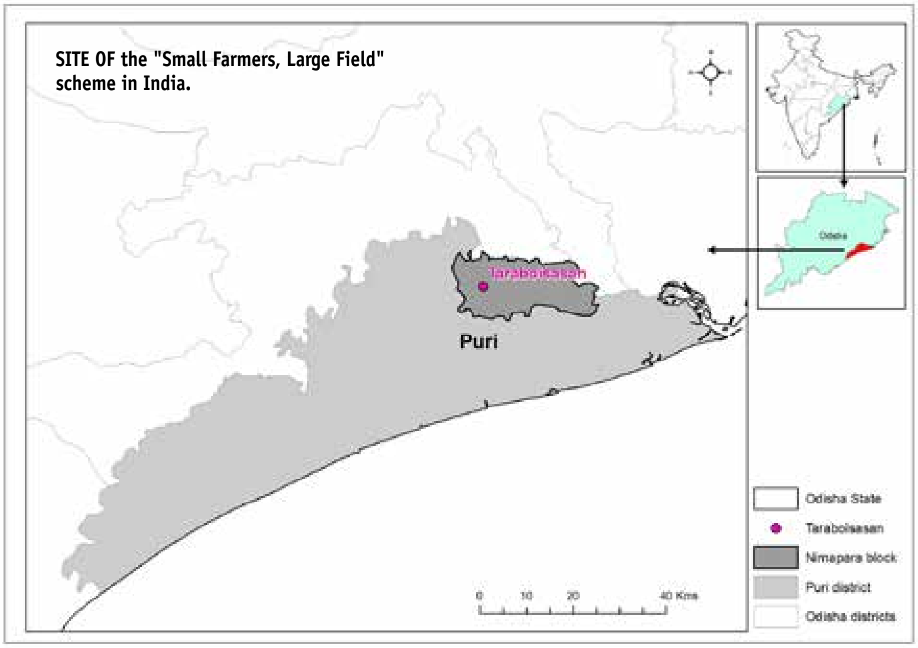
The pilot SFLF model in Odisha

For the 2017 dry-season crop, the International Rice Research Institute is piloting a customized version of the SFLF model in Taraboisasan Village near Bhubaneswar, the capital of the eastern state of Odisha in India. Initially, many farmers in the village were not convinced of the benefits of integration and synchronization and giving up their freedom to do farming on their own. But, eventually, they realized the benefits of working together.

We explained the concept to the farmers and then customized the scheme based on their suggestions, preferences, and needs. We now have 54 out of 70 farmers in the village with 38 hectares participating in the project. The participating farmers have selected an eight-member committee to take on the role of facilitator between the farmers and implementing agencies, such as the International Rice Research Institute and Madhyam Foundation. The committee facilitates discussions among participating farmers and communicates decisions to us.

During our meeting with the participating farmers on 4 January 2017, they decided to name the committee the Laxminrusingha SFLF Committee, after their village deity Laxmi Nrusingha, as a sign of gaining their trust and confidence. So far, the committee has been quite active in implementing project activities in coordination and consultation with both the member farmers and us.

The participating farmers unanimously decided to grow flood-tolerant BINA Dhan 11, a new variety from Bangladesh recently released in the state by the Stress-Tolerant Rice for Africa and South Asia (STRASA) project. Apart from its higher yield



and higher grain quality, the farmers strongly favored growing this variety so that they would have quality seed for the upcoming wet season.

The first joint activity was organized on 21-25 December 2016 to set up a mat nursery in nine patches, with the largest patch serving 12 hectares. It took some effort to assemble the farmers into nine groups based on their field location, irrigation tube well and relationship with their fellow farmers.

"Without the scheme, each of the 54 participating farmers would have raised their nursery individually on a very small piece of land," said Bimbadhar Biswal, the secretary of the Laxminrusingha SFLF Committee. "It used to be extremely difficult for a tractor to move around within a small piece of land and it consumed additional fuel. It took time to visit different field locations at different times. The participating farmers are already benefiting in terms of saving time, energy, labor, water, and money through the group method of nursery raising."

We have worked with the committee closely in lining up input suppliers and service providers and negotiated cheaper prices for the farmers. The Indian Farmers' Fertilizer Cooperative Limited (IFFCO) agreed to supply fertilizer at its wholesale price, usually 10–15% lower than the retail price, and also suggested conducting soil testing for each field free of cost. On 9 January 2017, the IFFCO mobile soil testing lab was in the village and provided soil analysis and some recommendations for each farmer. We have also roped in our scientists from the STRASA and Cereal Systems Initiative for South Asia (CSISA) projects to provide necessary support on crop management. The STRASA scientists have been extremely helpful in procuring high-quality BINA Dhan 11 seed at lower prices. CSISA scientists will be called in to resolve crop establishment and after-care problems.

We have also invited a few local millers to visit our site and explained our pilot project to them. The response has been quite positive and they fully assured us that they would buy all the paddy at a higher than market price. They are willing to pay more because of the single rice variety planted on the entire 36-hectare patch with synchronized planting and harvesting. They even asked whether we would be expanding our pilot to other villages next season so that they could purchase all paddy at a higher price as long as the grains were uniform in shape and size and not mixed with other varieties.

Based on our back-of-the-envelope calculation, on average, farmers in the group earned a profit of INR 9,500 (USD 139) per acre in the 2016 dry season. The group farming is expected to increase their profit to INR 21,000 (USD 308) per acre this season because of lower production costs, higher paddy selling price, and 25% higher yield from 5 to 6 tons per acre. The assumption of a 25% yield increase is our conservative estimate since the use of quality seed, proper nursery management and timely transplanting, recommended fertilizer application based on soil testing, proper crop care, and timely harvesting can increase group yield by much more than one ton per acre.

What's next?

Depending on the success of the scheme this season, we plan to expand our pilot demonstration to other villages in the state. We are in the process of identifying villages where we would like to expand our demonstrations. Farmers from those villages are expected to visit the SFLF model pilot site in Taraboisasan to obtain first-hand experience with the program and its benefits from their fellow farmers. We hope that convincing the farmers will be much easier in the future with participating farmers acting as a brand ambassador for the scheme. The extent of our expansion will depend on the availability of funding from donors. ■

Dr. Mohanty is a principal scientist, head of the Social Sciences Division (SSD), and program leader (targeting and policy) at IRRI. Mr. Mohapatra is an assistant scientist and Ms. Baruah is a PhD scholar in SSD. Dr. Veettil is an agricultural economist in SSD.

CONTINUING GLOBAL PARTNERSHIP THROUGH RICE

by Bas Bouman and Lanie Reyes

CECILE GRENIER, a Cirad breeder working at CIAT, and Jaime Borrero, a CIAT research associate, inspect a rice field in Bolivia. (Photo: CIAT)

Rice is the world's most important staple food and will continue to be so in the coming decades. A staple for some 4 billion people worldwide, rice provides 27% of the calories in developing countries. With expected population growth, income growth, and decline in rice area, global demand for rice will continue to increase, from 479 million tons of milled rice in 2014 to 536–551 million tons in 2030.

Rice farming is associated with poverty. About 900 million of the world's poor depend on rice as producers or consumers. Of these, some 400 million poor and undernourished people are engaged in growing rice. (See infographics on the importance of rice on page 38.)

In the future, rice will have to be produced, processed, and marketed in more sustainable and environment-friendly ways, despite the diminishing resources (land, water, labor, and energy) and the problems brought about by climate change. And, we need to produce more per unit of land and water.

Moreover, we still need to improve the nutritional quality of rice-based diets through biofortification, optimizing processing, and dietary diversification.

Women play a significant role in rice farming, processing, marketing, and buying rice for food. Yet, they still have less access to and control over resources such as information and inputs. These inequalities reduce the productivity of women-managed farms. But, with appropriate technological, institutional, and policy support, rice farming, processing, and marketing could offer equal opportunities for employment for both women and men.

Moreover, more youths in some parts of the world are becoming unemployed, especially in sub-Saharan Africa. The rural population is aging particularly in Asian countries where structural transformation is rapid. Thus, it is imperative for the rice sector to develop attractive job opportunities for young people.

Clear targets

RICE, the CGIAR research program (CRP) on rice agri-food systems, will tackle these concerns with crystal-clear targets. RICE aims to reduce poverty and hunger, improve human health and nutrition, adapt rice-based farming systems to climate change, promote women's empowerment and youth mobilization, and reduce rice's environmental footprint.

Through R&D in collaboration with its many partners, RICE expects to

- help at least 13 million rice consumers and producers, half of them female, to exit poverty by 2022, and another 5 million by 2030;
- assist at least 17 million people, half of them female, out of hunger by 2022, rising to 24 million by 2030; and
- assist at least 8 million people, half of them female, to meet their daily zinc requirements from rice by 2022, rising to 18 million by 2030.

These outcomes will become possible by:

- helping at least 17 million more households to adopt improved rice

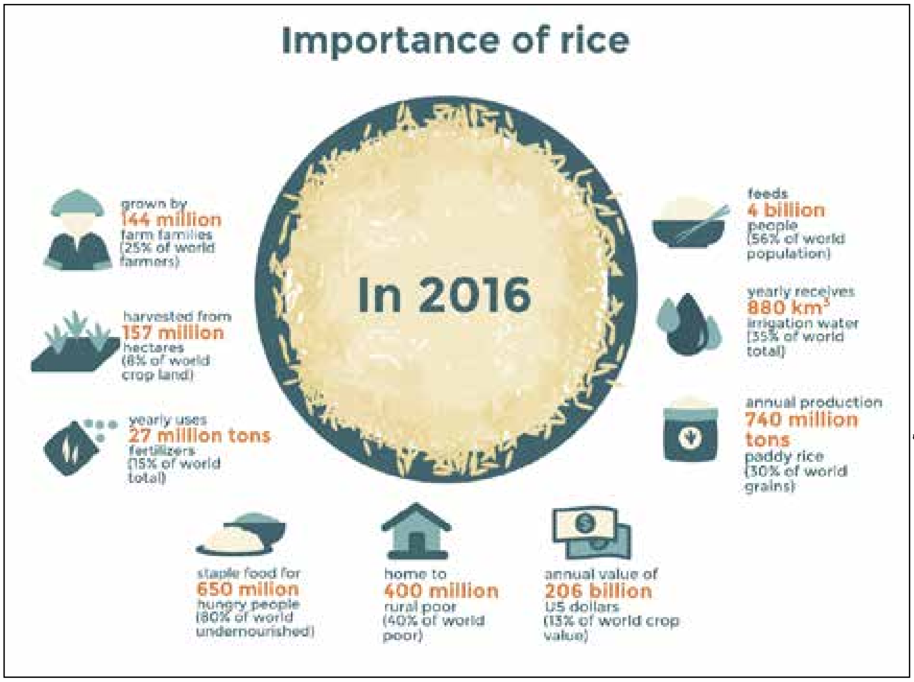


ILLUSTRATION BY MARIA ANGELA PEÑAFIEL, IRRI

varieties and farming practices by 2022 and a further 19 million by 2030;

- improving the annual genetic gain in rice (as measured in breeders' trials) to at least 1.3% by 2022, rising to 1.7% by 2030;
- helping increase annual global milled rice production of 479 million tons in 2014 to at least 536 million tons by 2022 and to 544 million tons by 2030;
- increasing water- and nutrient-use efficiency in rice-based farming systems by at least 5% by 2022, rising to 11% by 2030; and
- helping reduce agriculture-related greenhouse gas emissions in rice-based farming systems by at least 28.4 of megatons carbon dioxide (CO_2) equivalent/year by 2022 and by a further 28.4 megatons of CO_2 equivalent/year by 2030, compared to business-as-usual scenarios.

The way to the target

These outcomes will be achieved through many interventions along the rice value chain from farmer to consumer. These interventions involve intensification and diversification of farms, genetic improvement and improved crop and natural resource management, reduced pesticide use and development of pest- and disease-resistant varieties, integrated pest management and ecological engineering, increasing the marketability and value of products and by-products, increasing participation in the value chain, increasing the content of minerals and micronutrients in rice grains, and improving the glycemic index of rice.

And, to increase the sustainability of production, the pathways are to reduce the use of precious resources, increase ecosystem services, and reduce negative environmental externalities such as greenhouse gas emissions and loading of agrochemicals in rice production. Increasing the productivity of inputs reduces their amounts used per unit of production. This can be done by making the use or uptake of these inputs effective, and reducing their loss to the environment.

RICE will deliver international public goods as well as locally tailored solutions. These include genes and markers, breeding lines, improved varieties, improved crop management and postharvest technologies, publicly accessible data and information systems, capacity development, training and dissemination materials, and policy briefs and other knowledge products.

Gender

RICE R&D products will focus on contributing to gender equity and women's empowerment. One of the ways is to improve women's access to resources (seed, inputs, technologies, and technical knowledge), which will increase their labor productivity aside from increasing their rice productivity and production.

Youth

Despite agriculture being the core sector of these economies, youth employment in agriculture has remained very low—mainly as family labor—because of the lack of mechanization, high production risks, and low agricultural productivity. Thus, RICE will engage in strategic research on youth issues and develop business models and opportunities for young people to be actively involved in rice value chains.

Program structure and flagship projects

RICE is designed to have five highly interconnected flagship projects (FPs):

- Accelerating impact and equity (FP1),
- Upgrading rice value chains (FP2),
- Sustainable farming systems (FP3),
- Global Rice Array (FP4), and
- New rice varieties (FP5).

FP1 will engage in foresight, policy analyses, gender and youth studies, monitoring and evaluation of progress, and ex-ante and ex-post impact assessments across the research program portfolio. It will help the other flagship projects develop well-targeted and demand-driven products and delivery approaches to have impact at scale.

FP2 will analyze rice value chains and identify entry points for upgrading. This flagship program will conduct market research, assess rice value chains, and identify opportunities for improved processes, reduced postharvest losses, novel and value-adding products, strengthened value-chain linkages, and improved market access. It will provide guidance for specific product development and connect novel farming systems with markets.

FPs 3–5 focus on the production part of the rice value chain and will develop new rice technologies and rice-based farming systems.

FP3 will develop and deliver sustainable intensification and diversification options for rice-based farming systems to improve farm livelihoods and rural diets, while minimizing their environmental footprint.

FP4 will establish a global network of field laboratories that will discover new genes and traits of rice, develop and test rice ideotypes, assess the suitability and robustness of novel genotype × environment × management options, and use the rice plant itself to characterize climate change.

FP5 will develop and deliver new varieties adapted to current and future climates and have improved traits such as increased yield potential, resistance to biotic stresses (pests, diseases, and weeds) and tolerance of abiotic stresses (drought, submergence, salinity, heat and cold, problem soils, and low light). Seed distribution systems will be strengthened to ensure that the new varieties are available to millions of farmers.

AFRICA'S RICE sector is now more aware that producing just more rice is not enough and that quality is essential. (Photo by R Raman, AfricaRice)

Research and site integration

The partnerships under RICE extend to link with other CRPs. For example, RICE will collaborate with Policies, Institutions, and Markets on foresight analysis, food supply-demand modeling, and impact assessment methodologies. Also, RICE will collaborate with all other crop-based agri-food system research programs and with the Water, Land, and Ecosystems program on the development of genomics and breeders' tools (genebanks, genetic gains, and Big Data).

RICE and the Agriculture for Nutrition and Health (A4NH) program will work together in mainstreaming the development of healthy and nutrient-dense rice varieties. And lastly, RICE and the Climate Change, Agriculture, and Food Security program will work together toward developing, evaluating, and disseminating climate-smart rice varieties and farming systems.

Geographically, RICE will be part of a strong collaboration through the integration of research and development sites among the CRPs where practical. RICE's flagship project on sustainable farming systems will be a main mechanism for collaboration on the ground.

Partnerships and comparative advantage

RICE continues to be led by the same institutes that led the first phase (2011-16) of the CRP on rice: the International Rice Research Institute as the the lead institute, Africa Rice Center; International Center for Tropical Agriculture (CIAT), Centre de Cooperation Internationale en Recherche Agronomique pour le Développement (Cirad), L'Institut de Recherche pour le Développement (IRD), and the Japan International Research Center for Agricultural Sciences.

Together, these centers are aligned and bring to the table consortia, networks, platforms, programs, and collaborative projects with about 900 partners from government, nongovernment, public, private, and civil society sectors.

The first phase of the CRP on rice was synonymous with the Global Rice Science Partnership (GRiSP), established in 2010. In the second phase, RICE will be the main CGIAR program contribution to a larger GRiSP. The comparative advantage of RICE to pursue its goals and objectives is that virtually all potential alternative suppliers worldwide have already become partners in its first phase.

The 2012 CGIAR survey on partnerships in its research programs reported that 82% of the respondents were satisfied with their partnership in the GRiSP. The program performed strongest in research outcomes and expertise, with global expertise and innovation being the top two performing dimensions. Respondents described it as one of the best rice research programs in the world.

Anchored in strong and continuing partnerships, RICE maintains close collaboration and interaction with regional fora, subregional bodies, regional economic communities, and international development funds and banks. ■

Dr. Bouman is the director of the CGIAR Research program on rice agri-food systems (RICE). Ms. Reyes is the editor-in-chief of Rice Today.

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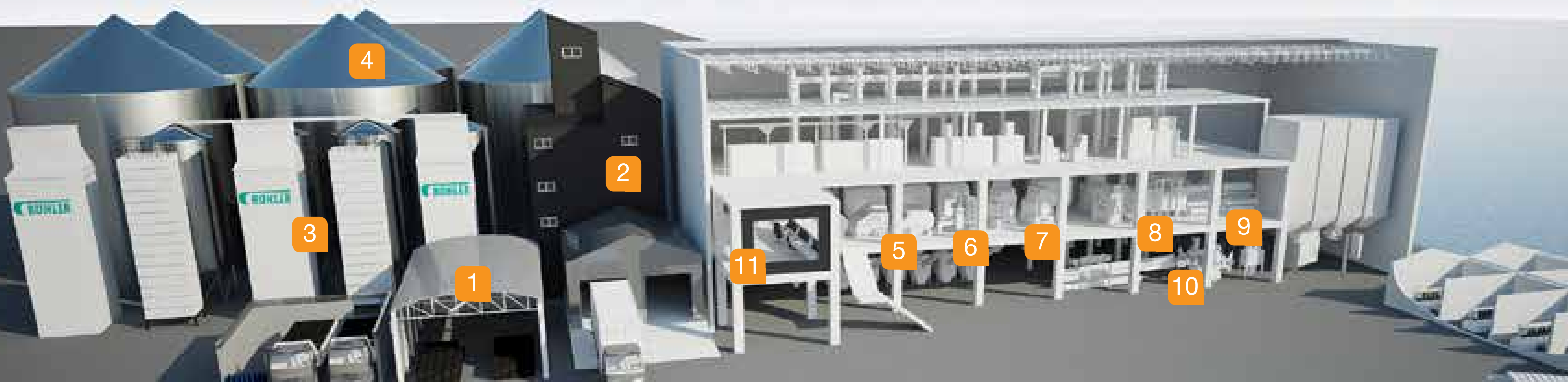

12 Additional services

- Engineering, technology and project management
- Research and development support
- Processing of by-products
- Education and training programs
- Local on-site services

1 Paddy reception and handling
2 Pre-cleaning
3 Paddy drying systems
4 Paddy storage systems
5 Cleaning
6 Hulling
7 Whitening and polishing
8 Grading
9 Optical sorting
10 Weighing, dosifying and bagging
11 Automation systems
12 Additional services

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