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The next steps in IRRI's journey

Hats off to a master juggler
Revisiting the "Killing Fields"
Home among the heirlooms
Genebank tourism

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Matthew Morell, IRRI's new director general, says the institute is in a great position to forge ahead. "Our mission is compelling and our work is paramount," he says. "Our journey is not just a challenge of technology, but of humanity," See his guest editorial on page 5. (Photo by Isagani Serrano, IRRI)

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

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

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Fond farewell

PHOTO BY JESSIECA NARCISO, IRRI

With my retirement looming after more than 22 years at the International Rice Research Institute (IRRI), this is my last issue of *Rice Today* as editor-in-chief. A staff member on the magazine since its debut in April 2002, I have served as a contributing writer, Asia editor, and finally, since January 2014, editor-in-chief.

Over the last 14 years, I've worked with a great, continually evolving—and award-winning—team of writers, editors, designers, and photographers (photo). Together, we have witnessed the magazine's growth as it has become the institute's flagship publication. Certainly, being part of this magazine's team has been the pinnacle of my time at IRRI.

We have a fascinating set of stories and commentaries in this issue. Be sure to read the guest editorial (next page) in which Matthew Morell, IRRI's ninth director general, sets the stage for building further the institute's compelling mission and cutting-edge research that is paramount to alleviating poverty in the world.

IRRI is not the only rice research center experiencing major change in 2016. After more than 8 years leading the Africa Rice Center (AfricaRice) as deputy director general and director of research for development, Marco Wopereis will be taking the helm of The World Vegetable Center in Taiwan this coming April. On pages 12-13, read about Marco's significant contributions to rice research and development in Africa in *Hats off to a master juggler.*

Staying in Africa, find out about a *'SMART' choice for Africa's inland-valley rice farmers* on pages 30-31. These inland valleys are increasingly being considered as the continent's future food basket. And in our map section on pages 18-19, see how AfricaRice researchers are using satellite images to define flood-prone rice areas in West Africa. Doing so will help provide a more efficient and effective introduction of new flood-tolerant Sub1 varieties to the region's farmers.

Onward to Asia, January 2016 marks the 30th anniversary of IRRI's post-war involvement in a remarkable episode in agricultural history. I'm referring to the rebuilding of Cambodia after the horrendous genocide of the "Killing Fields" in that Southeast Asian country (1975-79). Glenn Denning told this amazing story during my latest IRRI Pioneer Interview featured on pages 22-29. Glenn, who spent 18 years at IRRI, points out that what was achieved there over the last three decades is a compelling example about why genetic conservation and human capacity are so critical to agricultural development.

Moving on to another Southeast Asian nation, see on pages 10-11 how Filipino farmers are recovering from another kind of disaster that was Typhoon Haiyan. This powerful storm devastated the island of Leyte a little more than 2 years ago. Green Super Rice is giving many of them a fighting chance to rebuild their families' livelihoods.

Also in the Philippines, the Department of Agriculture's Heirloom Rice Project, which has strong support from IRRI, is making great strides in empowering the farmers who grow these tasty traditional rice varieties in the northern Cordilleras region. The article, *Home among the heirlooms* on pages 16-17, expounds on the experiences of one farmer who has been able to maintain her ancestral farm as a profitable venture by growing the exotic purple-colored rice from the region called *Balatinaw.*

We feature a pearly-white heirloom rice, called Innawi, in our *What's cooking* recipe on pages 14-15. It is the main ingredient of a delicious dish, *Risotto carbonara*, prepared by none other than Margarita 'Gaita' Forés, executive chef for a number of restaurants in the Philippines. She has been named Asia's Best Female Chef for 2016.

In addition to having celebrity chefs, we also have celebrity scientists. On pages 32-34, read an entertaining interview with Michael Purugganan, IRRI collaborator and *reluctant rock star scientist.* He talks about making science and scientists approachable, his creative process, and the GMO debate. He also has some good advice for young researchers.

On pages 36-38, Sam Mohanty, IRRI's senior economist, examines whether or not the global rice market is headed for a repeat of the 2007-08 rice price crisis, which today seems like a distant memory. Market players will need to keep cool to avoid duplicating that turbulent time.

And finally, on page 39, Michael Jackson, former head of IRRI's Genetic Resources Center, introduces a new term: "genebank tourism." He sees this interesting concept as being an important tool to spread the good word about the strategic importance of genetic conservation.

I now pass on the reins of *Rice Today* to the capable hands of Lanie Reyes (to my left in photo), long-time contributor to the magazine, most recently as managing editor. She has proven to be truly enthusiastic about accurately reporting on the significance of this staple that is so important to nearly half the world's population. ■

Gene Hettel

Gene Hettel
Editor-in-chief

The next steps in IRRI's journey

PHOTO BY ISAGANI SERRANO, IRRI

This issue of *Rice Today* signifies many new beginnings for IRRI. As I begin my term as the institute's director general and reflect on the legacies of IRRI's past and opportunities that lie ahead, it would be remiss if I did not recognize those who came before me.

It is said that we stand on the shoulders of giants. When I reflect on the directors general of IRRI, from Robert Chandler, Jr., to Robert Zeigler, it is striking how each director general took an individual approach to leading the development of the organization and shepherded the delivery of its mandate during their terms. Yet, through this history, IRRI has retained a consistent focus on our mission and vision. My approach will necessarily and frequently differ from my predecessors' approach, but our focus on our core mission will remain.

I pay particular tribute to Bob, my immediate predecessor, who was at the helm during one of the most successful periods in IRRI's history. I have been in the unusual position of coming into the organization as deputy director general for research, and so I have had a unique opportunity to work closely with Bob. I saw first-hand his passion, his commitment, and his vision for the organization. His mentorship and wisdom have been of incredible value.

There is a great sense of humility at being the custodian of this wonderful institution as it continues its critical journey. IRRI has an irrefutable mandate to address global imperatives to lift people out of poverty and hunger, enhance nutrition and health, and ensure environmental sustainability. Our mission is compelling and our work is paramount. We serve hundreds of millions of rice farmers. A billion people rely directly on the livelihoods generated by those farms; a further two billion rely on rice as a critical part of their diet, in which rice provides not just calories but essential nutrients for health and well-being. In so many areas of the world, rice is much more than a commodity—it is part of the fabric of life.

Our journey is not just a challenge of technology—it is a journey of humanity. For a science organization, our mandate comes close to being a sacred commitment of a secular organization. There is no room to be less than successful, there is no time to waste, there are never enough resources to smooth the way, and we have to harness our collective passion and creativity to find the path forward.

Current international events remind us that the world faces challenging times. We see migration crises across the globe. We see political unrest, conflicts, and wars. We struggle with economic stringencies. We see science and economics under attack from those who express opinions as though they were facts. As we navigate through these uncertainties of an ever-changing operating environment, IRRI must continue to retool, evolve, and differentiate as an organization to advance our mission.

There are many paths to differentiation for IRRI such as leveraging developments in biology, leveraging information and computing technology, influencing policies, building novel partnerships with those who share our values for delivery and adoption, and providing comprehensive solutions tailored to local needs. IRRI is in an excellent position to forge ahead. We have a deep history with an enviable track record of delivery and impact, a pipeline of science and technologies to deploy, riches in our germplasm and tools, strongly supportive donors and connections, a passionate and talented workforce, and an extraordinary global network of partners. But, in 7–10 years' time, the assessment of that time must not be that all was done was to exploit these gifts. IRRI must build on this legacy to renew itself in all areas. We must surprise our stakeholders and partners and surprise ourselves.

I look forward to engaging with the beneficiaries of our work across the globe, our donor community, our broader network of partners, and our staff as we embark on the many futures of IRRI to achieve our shared commitment to a common good. Through *Rice Today*, IRRI's flagship publication, we aim to illustrate further impacts of our work and collaborative efforts to improve the lives of the one billion, and also share their compelling stories that remind us why we do what we do. ■

Matthew Morell

Matthew Morell
Director General
International Rice Research Institute

THEIR MAJESTIES Emperor Akihito and Empress Michiko at the LTCCE view deck with Yoichiro Kato. (Photo by Isagani Serrano, IRRI)

Imperial Couple's visit to IRRI underscores Japan's commitment to world food security

by Alaric Santiaguel

LOS BAÑOS, Philippines – Their Majesties Emperor Akihito and Empress Michiko received an overview of the International Rice Research Institute (IRRI) and the institute's vibrant partnership with Japan during a short visit to its headquarters on 29 January.

IRRI Director General Matthew Morell presented the institute's goals, financial supporters, and some prominent Japanese scientists who have been associated with the institute.

Emperor Akihito and Empress Michiko were briefed by V. Bruce J. Tolentino, deputy director general for communication and partnerships, on some of the improved rice varieties developed at IRRI. "Their Majesties expressed special interest in IRRI's work on climate change-ready rice, particularly submergence-tolerant rice," Tolentino reported. "They also seemed pleased about the long-term relationship IRRI has had with the Japan International Research Center for Agricultural Sciences (JIRCAS), and that the institute has always had a Japanese national on its board of trustees since its founding in 1960."

JIRCAS has through the years sent several Japanese scientists to work on collaborative projects at IRRI, under a special contribution from the Japanese government.

Japanese scientists on the IRRI staff interacted with the Imperial Couple.

Takashi Yamano discussed the institute's contributions to the Green Revolution. "They asked many questions about rice production and our contribution to increasing rice seeds and reducing rice prices," Yamano said. "They were very interested in our work."

Keiichi Hayashi showcased Japan's contributions to IRRI over the past decades. "They were curious about various stresses being caused by climate change that affect rice," Hayashi said.

The Imperial Couple visited the Long-term Continuous Cropping Experiment (LTCCE) where Yoichiro Kato explained the importance of the world's longest-running rice research project. "They were quite surprised that we have been planting rice at the LTCCE three times a year," Kato said. "In Japan, farmers usually plant only one crop a year. They were very interested in the different effects of fertilizer and pests on rice plants. Her Majesty was particularly keen on salt-tolerant rice."

Rice played a significant role in the creation of Japan. According to Japanese mythology, Amaterasu, a major deity of the Shinto religion and the Sun Goddess and the universe gifted one of her descendants with rice. That descendant was Jinmu, the legendary first emperor of Japan. Emperor Jinmu was tasked with turning Japan into a land of rice. Japan's emperors became priest-kings whose functions revolved around the rice crop.

Japan's creation myths were about "the transformation of a wilderness into a land of abundant rice at the command of the Sun Goddess, whose descendants, the emperors, rule the country by officiating at rice rituals," said Emiko Ohnuki-Tierney, a Japanese anthropologist and authority on its rice[1].

As Jinmu's 125th direct heir, Emperor Akihito is currently Japan's rice-farmer-in-chief, according to Ohnuki-Tierney. Emperor Akihito has maintained his ties to rice. Every year, he plants and harvests rice at the paddy on the Imperial Palace grounds, a tradition started by his late father, Emperor Showa, in 1927.

The Japan-IRRI partnership dates back to 1960 when IRRI was established. Since then, Japan has provided leadership to IRRI with a representative on the IRRI board of trustees. The government of Japan has been one of IRRI's most generous financial supporters, having given a total of more than USD 211 million since 1971. ■

Mr. Santiaguel is an associate editor of Rice Today.

[1] Tochikubo. (2009, December). *Rice in Japan: You are what you eat. The Economist*. Retrieved from http://www.economist.com/node/15108648

USD 10-million facility for studying climate change effects on plant growth opens at IRRI

by Gene Hettel

PARTICIPATING IN the plaque unveiling for the PGF (inset) were (from left): Fernando Sanchez, Jr., Matthew Morell, Amanda Gorely, John Evans, and Mellissa Wood. Photo by Gene Hettel, inset by Isagani Serrano, IRRI)

On a hot, breezy afternoon on 21 January 2016, an international gathering of agricultural scientists and development officials dedicated the Lloyd T. Evans Plant Growth Facility (PGF) on the campus of the International Rice Research Institute (IRRI). The opening of the USD 10 million state-of-the-art facility manifests IRRI's commitment to better understand the effects of climate change on plant growth in the ongoing effort to achieve food and nutrition security for future generations across the globe.

The Australian government, through the Australian Centre for International Agricultural Research (ACIAR), a major partner of IRRI, funded the PGF named after Lloyd T. Evans (1927-2015), a world-renowned Australian plant physiologist who also served as a member of the IRRI board of trustees (1984-89).

During the dedication rites, IRRI Director General Matthew Morell said that, as a tax-paying Australian, he was happy to see his tax dollars put to excellent work. He added that the PGF will contribute greatly to IRRI's plant breeding efforts, not only for irrigated rice, but also for the rainfed and unfavorable environments where the poorest and most underprivileged people live and where climate change will inflict its most dire effects. "It is not just a building for great science, but a building for great outcomes," he predicted.

Special guests on hand for the dedication included Fernando Sanchez, Jr., chancellor of the University of the Philippines Los Baños (UPLB); Amanda Gorely, ambassador of Australia to the Philippines; Mellissa Wood, general manager of ACIAR's global operations; and John R. Evans, head of the Division of Plant Sciences, Australian National University and son of Lloyd T. Evans.

Dr. Sanchez said he believes that the PGF will change the lives of generations of people worldwide. He added that the completion of the facility shows what cooperation and partnership can achieve. "IRRI has been a steady partner in many of UPLB's agricultural and scientific endeavors," he pointed out. "It is a partnership that has grown in importance as we have made headway in our efforts to achieve food security, not only in the Philippines, but in other areas of the developing world."

Ambassador Gorley pointed out that, since 1983, Australia, through ACIAR, has provided significant assistance to the Philippines to support agricultural research aimed at achieving food security in the country. "The Australian government is acutely aware of the importance of rice for more than 3.5 billion people worldwide," she said. "ACIAR and IRRI have worked closely on many projects over the years, such as the construction of the PGF, to reduce poverty through rice science."

Ms. Wood said the research partnerships that ACIAR builds with organizations, such as IRRI, reflect not only Australian aid priorities and the country's national research strengths, but also the agricultural priorities of developing country partners. "ACIAR encourages Australian scientists to use their skills for the benefit of developing countries and Australia," she said. "It is a valuable outcome that I think is beautifully exemplified by Dr. Lloyd Evans himself."

Dr. Evans, who followed in his father's footsteps as a plant scientist, spoke on behalf of the Evans family. "It is a great honor and a real personal thrill to be invited to the opening of this facility," he said. "When my father was a board member here at IRRI, he encouraged evidence- and research-based decision making rather than gut feelings passed on in a traditional way." He said that the PGF will carry on this model as it enhances researchers' ability to capitalize on the fantastic advances of molecular biology and genome sequencing.

After unveiling of the commemorative plaque, Abdelbagi Ismail, IRRI's acting deputy director general for research, led guests and IRRI staff on a tour of the PGF, which contains eight controlled-environment glasshouses, a large set of controlled-environment walk-in and reach-in plant growth chambers, plant processing and potting laboratories, and a large seed processing and storage setup. It also features optimum environment-friendly management support systems that employ rainwater capture and storage, natural ventilation, and other energy-saving technologies. ■

Mr. Hettel is editor-in-chief of Rice Today.

Mahabub Hossain (1945-2016) dedicated his life to the world's poor

by Gene Hettel

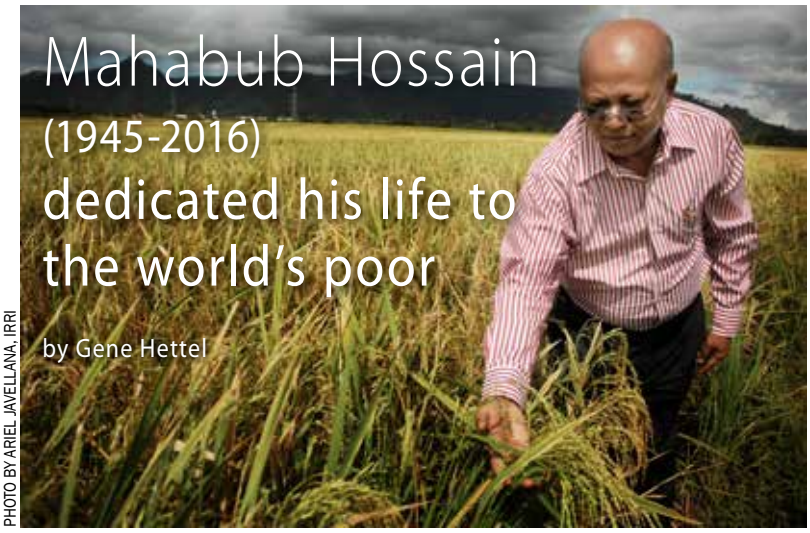


PHOTO BY ARIEL JAVELLANA, IRRI

Mahabub Hossain, former head of the Social Sciences Division (SSD, 1992-2007) at the International Rice Research Institute (IRRI), passed away on 3 January 2016, one day after his 71st birthday, while undergoing heart bypass surgery at the Cleveland Clinic in the United States.

During his 15-year stint at IRRI, the renowned Bangladeshi economist and colleague and friend to us all served in a dual role as a researcher and administrative head of SSD. His research at IRRI centered around socioeconomic studies on rice supply and demand trends in Asia, constraints to increasing rice productivity, understanding rural livelihood systems, and the impact of improved rice technologies on poverty reduction.

Prior to coming to IRRI in 1992, Dr. Hossain began his career in 1970 as a staff economist at the Bangladesh Institute of Development Studies and rose through the ranks to become its director general during 1988-91. In 2007, he retired from IRRI to become the executive director of the Bangladesh Rural Development Committee (BRAC), one of the largest NGOs in the world, to address the challenge of the re-emergence of food insecurity in Bangladesh.

He was most recently distinguished professor and chairperson of the Department of Economics and Social Sciences at BRAC University, advisor to the BRAC executive director, a member of the board of governance at Bangladesh Agricultural University, president of the Asian Society of Agricultural Economists, and a member of the Global Panel on Agriculture and Food Systems for Nutrition.

Muhammad Yunus, 2006 Nobel laureate, said of Dr. Hossain, "His contributions in the field of economics and agricultural research were groundbreaking and far reaching. He was the first scholar to study the Grameen Bank and produce a highly demanded research paper on the impact of the bank."

Sir Fazle Hasan Abed, BRAC founder and chairperson and 2015 World Food Prize Laureate, said of Dr. Hossain, "Very few people globally had the depth of understanding of development issues like him. His life was a story of success against all odds. During his time at BRAC, he had a persistent focus on creating opportunities for the poor."

"As an inspiring figure, his loss will be irreplaceable," said Sudhir Chandra Nath, program head for BRAC's Seed and Agro Enterprise. "He will be forever remembered for his brilliance in articulation of macroeconomic analysis, his path-breaking research work, his leadership in agricultural innovation, and above all his deep empathy for marginalized people of the world."

"We have lost a great stalwart in our profession," said Sam Mohanty, current head of IRRI SSD, who succeeded Mahabub in 2008. "He was a champion for the empowerment of the small and marginal farmers in Bangladesh and throughout South and Southeast Asia."

"Mahabub was an excellent scientist and had a sincere interest in the world's poor," said Ron Cantrell, former IRRI director general (1998-2004). "He was a major contributor to IRRI's success during his tenure at the Institute."

David Dawe, former colleague at IRRI and currently senior economist at FAO, said, "The world has lost a great researcher and mentor. His dedication to helping the poor will always be a source of inspiration. Even after he could have retired, he worked so hard to push this work further. The world could use a lot more people like him."

Dr. Hossain earned his Bachelor of Arts (with honors) in Economics at the University of Calcutta in 1966. He did his Masters of Arts in Economics at the University of Dhaka in 1969. He earned a Diploma in Development Economics at the University of Cambridge, England, in 1973 and a PhD in Economics at Cambridge in 1977.

Dr. Hossain published scores of research articles in international journals. Some of his seminal books (with others) include: *Asian rice bowls: a returning crisis?*, *Rice research in Asia: progress and prospects*, *Impact of rice research in Asia*; *Strategy of development in Bangladesh*, and *Rural economy and livelihoods: insights from Bangladesh*.

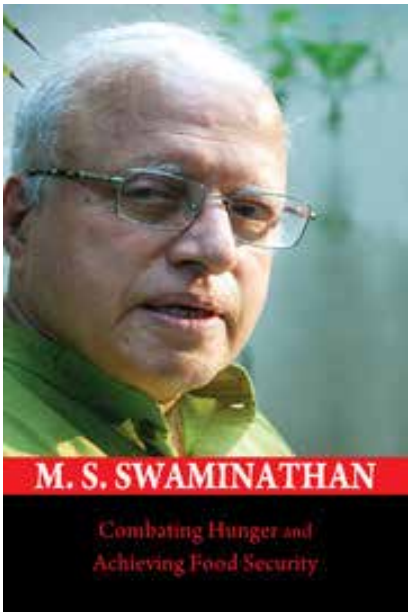
In his 2007 Pioneer Interview before departing IRRI (see *Pushing things forward* on pages 26-29 of *Rice Today*, Volume 6, No. 3), he stated, "The challenge is how to meet the demand for rice. Every input is scarce and, as long as the population continues to increase at an alarming rate, that challenge remains." On taking early retirement from IRRI in 2007, he said, "I am going back to my country to share what I have learned." That he did—in a grand way! ■

Mr. Hettel is editor-in-chief of Rice Today.

Combating hunger and achieving food security

by M.S. Swaminathan

Published by Cambridge University Press, 183 pages



The issues that need to be addressed in combating hunger and achieving food security are highlighted in this book by a great Indian geneticist. It also discusses the major causes of chronic and hidden hunger and emphasizes the need to redesign the farming system based on nutritional considerations. The role of an effective monsoon management program to maximize its benefits is examined.

There are chapters that analyze the importance of biodiversity conservation and enhancement and farmer skill development. Important issues to increase agricultural production including investment by financial institutions in agriculture and rural development, women's role in agriculture and youth employment in rural livelihoods are discussed in great detail in the text.

Dr. Swaminathan, former director general of the International Rice Research Institute (1982-88), writes in the preface: "The problem of hunger is not simply a lack of sufficient quantities of food. The chronic hunger caused by protein and calorie under-nutrition is exacerbated by malnutrition (the 'hidden' hunger caused by the deficiency of micronutrients, which include iron, iodine, zinc, vitamin A, and vitamin B_{12}), and sometimes by human diseases that disable the body's ability to absorb the micronutrients it receives. To address such intertwined problems, there must be synergy among national programs dealing with the availability, access to, and absorption of food. These nutrition security programs should be based on a life-cycle approach that starts with the 'first 1,000 days' from pregnancy to two years old, the critical period when stunting can cause irreversible damage."

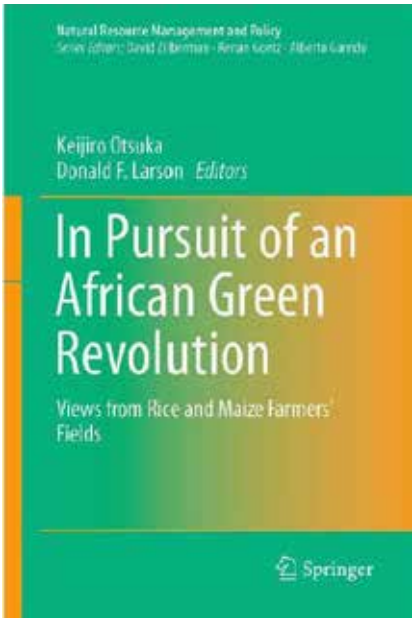
The book concludes that there must be synergy between scientific knowledge, political will and farmers' active participation to achieve the goal of overcoming chronic and hidden hunger in the populations of developing countries. ■

To view the table of contents, sample some chapters, and get ordering instructions, go to http://tinyurl.com/Swaminathan-combating-hunger

In pursuit of an African Green Revolution: Views from rice and maize farmers' fields

by Keijiro Otsuka and Donald F. Larson

Published by Springer, 208 pages.



Could the Green Revolution, which improved the agricultural productivity and economic development of many Asian countries, also happen in Africa? Can an African Green Revolution raise the incomes of smallholder farmers and eradicate poverty in Sub-Saharan Africa (SSA)?

This book attempts to answer these questions through recent experiences to bring about a Green Revolution in SSA. It focuses on rice and maize, which are promising and strategic crops for smallholder farmers. Significantly, an African Rice Revolution has already begun in many irrigated areas, using Asian-type modern varieties, chemical fertilizer, and improved management practices, according to the authors. Otsuka, former chair of the board of trustees of the International Rice Research Institute (2004-07) and Larson found that the same technological package significantly increases the productivity and profitability of rice farming in rainfed areas as well. They also have some evidence that effective management training can boost productivity of smallholder farms. The authors conclude that African governments could accelerate the pace of Africa's Rice Revolution by strengthening extension capacity.

With the increasing importance of rice as a staple crop in Africa, the authors believe the success of rice can serve as a model for green revolutions in other food crops. They also note that, while worldwide the number of rural poor has fallen in recent decades, those in SSA are increasing. Therefore, involving smallholder farmers in scaling up a Green Revolution in Africa will be important part of its success. ■

For a free preview and information about obtaining a copy of this book, go to http://www.springer.com/us/book/9784431556923

Growing hope with Green Super Rice

by Paula Bianca Ferrer

More than two years after Typhoon Haiyan devastated the island of Leyte in the Philippines, the survivors, especially the farmers, are still struggling to rebuild their lives. Green Super Rice (GSR) is giving them a fighting chance.

When Typhoon Haiyan struck Leyte Island in the central Philippines in November 2013, parts of the house of Nemesio Retales were destroyed, with the roof being torn off. Mr. Retales, a farmer and village councilor for a farming community within the island's southern municipality of Dagami, recalled, "I rushed inside our room to fetch my wife. Seconds later, a coconut tree fell down onto where I had originally been standing."

Felicito Montano, a farmer from the municipality of Tanauan, had a similar brush with one of the most powerful typhoons ever recorded. "If you could just experience what it was like then," he said. "Because our roof was gone, we slept under an umbrella. Some nights were more difficult because of the rains. I still feel like crying whenever I think of what we've been through."

Lost livelihoods

Destruction was everywhere, Mr. Montano vividly recalled: "Before the storm, the trees, especially the coconuts, were so thick and lush one could hardly see the sunlight coming through their leaves. Now, these lush trees are either uprooted or mangled."

Although some survivors are now recovering, others are still struggling to get back on their feet because most of the coconuts, on which most farmers depended for their livelihood, were destroyed. (See *Bouncing back from typhoon Haiyan* on pages 24-25 of *Rice Today* Vol. 14. No. 1).

Without the coconuts, Mr. Montano's financial circumstances changed. "Before the storm, I could earn enough income from the

COCONUT FARMER-turned-Green Super Rice farmer Felicito Montano shows off the superior grains of GSR 8. When typhoon Haiyan destroyed most of his coconut crops, GSR 8 provided him with a substantial alternative source of income. (Photo by Jessieca Narciso, IRRI)

coconuts and send money to my sister and mother and still support my family. I had 60 trees and I could harvest as many as 1,000 coconuts," he exclaimed. "When the coconut price was high, I could earn as much as USD 167 in three months. I was also growing rice and vegetables. I had enough to tide me over back then."

Farmers started replanting coconut palms, but it will take at least five years before these start producing fruits.

Another green option

A silver lining to their gloomy situation came in the form of Green Super Rice (GSR) seeds. GSR varieties bred at the International Rice Research Institute (IRRI) can thrive in harsh environments (see *Breeding for tough times ahead* on pages 14-15 on *Rice Today* Vol. 12, No. 4) such as areas prone to flooding, drought, and salty soils, according to Jauhar Ali, IRRI's GSR project leader and corrdinator for Asia. The seeds had reached the farmers through Evelyn Gergon, a crop protection specialist from the Philippine Rice Research Institute (PhilRice), several months before the typhoon came.

"Until now, most farmers in the Philippines prefer to use seeds they have saved from the previous crop instead of certified ones," explained Dr. Gergon. "This is why we decided to conduct training on high-quality seed production. I heard about GSR when Dr. Ali went to PhilRice to talk about the new rice in a seminar. That was the beginning of how my team and I were able to bring GSR to farmers in Leyte."

Mr. Montano was one of the first farmers to grow the tough variety GSR 8. "I planted it for the first time after I was given 2 kilograms of seed after I completed a two-day training course on high-quality seed production at Visayas State University," he said. He sowed those 2 kilograms of GSR seed and harvested 12 sacks from the first crop. Planting some of the harvested seed for his second crop, he was able to harvest 70 sacks, weighing from 45 to 50 kilos each. "That was double what I'd usually get from other varieties," he remarked.

Aside from being hardy and high-yielding, GSR 8 is an early-maturing variety. "That was fortunate because we were able to harvest our rice before the typhoon came in November," recounted Mr. Montano.

GSR—much better than the average rice

"Although many farmers were hesitant to plant GSR at first, we received really good feedback from them after they gave it a try," Dr. Gergon explained. "Many farmers told me how great GSR performed in their fields. Some farmers reported that they were able to obtain as much as 11 tons per hectare—2.75 times the average yield of 4 tons in Leyte! Some farmers asked us to try eating the cooked rice. We hadn't even tasted GSR then and so we did. It tasted good!"

"I like GSR because its grains are good and weigh considerably heavier than the previous rice grains I tried in the past," said Mr. Montano. "The crop is tolerant of pests and diseases. Lately, we've also started shifting to organic fertilizers instead of chemical ones.

"I wouldn't be surprised if everyone in our village will soon be planting GSR," added Mr. Montano. He has been using GSR 8 for six seasons and hasn't shifted to another variety yet and has shared his seed with other farmers, including Efren Lazarte, who planted GSR 8 on 2 hectares of his land.

"It really performed well even in rainfed fields such as mine," Mr. Lazarte said. "Growing GSR following the recommended management practices really paid off. Even after three weeks without rain, I was still able to harvest a good crop."

"I have shared these stories with Dr. Ali, but there are still countless farmer successes out there to regale," said Dr. Gergon. (see *Rice against the tide* pages 12-13 on *Rice Today* Vol. 14, No. 3)

Back to taking care of business

"Even though we were badly affected by the typhoon, we were able to improve our livelihood and get back on our feet because of GSR 8," Mr. Lazarte exclaimed. "Adjusting to the situation was hard at first because I am used to making more money from coconuts. But, I was even able to purchase a hand tractor. Now, it's easier for me to grow rice. I'm really thankful for GSR and I hope that many other farmers will also be able to plant it."

Mr. Retales agrees. "Since our coconuts were destroyed by the typhoon, our rice fields are now our main source of livelihood," he concluded. ■

Ms. Ferrer is a communication specialist at IRRI.

Listen to Mr. Lazarte and Mr. Montano talk about their success with GSR at https://youtu.be/k9CkEhHWiFI.

BRILLIANT BLUE skies and Green Super Rice bring a smile on Efren Lazarte's face after surviving a destructive super typhoon. (Photo by Jessieca Narciso, IRRI)

Hats off to a master juggler

by Savitri Mohapatra

A dynamic research leader, a well-respected rice agronomist, a mentor to young scientists, a widely published author, and a loving family man, Marco Wopereis wears many hats and juggles them all with equal efficiency.

Marco Wopereis, deputy director general and director of research for development at the Africa Rice Center (AfricaRice) since December 2007, is like a master juggler wearing many hats and juggling them all with equal efficiency. He is a dynamic research leader, a well-respected rice agronomist, and a passionate spokesperson for issues relating to rice research and development in Africa. He is also a mentor to young scientists, a widely published author, and a loving family man.

With an international research career spanning more than 25 years in Asia, Europe, and Africa, Dr. Wopereis is fluent in English, French, German, and Dutch, which is his mother tongue. He loves jazz, and adores soccer, which he plays whenever he gets a chance.

In October 2015, Dr. Wopereis was appointed the new director general of AVRDC (The World Vegetable Center), starting on 21 April 2016.

"Marco has made significant contributions to AfricaRice, especially in establishing a solid scientific direction and foundation," said AfricaRice Director General Harold Roy-Macauley in his congratulatory message.

"He has played a highly significant role in leading the implementation of the research for development program, which has ensured a sound scientific position for AfricaRice in the global rice research arena and the achievement of important successes."

IN JANUARY 2013, Martin Kropff, then CGIAR Consortium board member and future director general of CIMMYT, and Dr. Wopereis inspect a containment facility for rice pathogens and pests at AfricaRice in Cotonou, Benin. (Photo by R. Raman, AfricaRice)

Rooted in agriculture

Since his childhood, Dr. Wopereis has been associated with plants and soil as his parents ran a small nursery for ornamental plants. "The strong link our family had with plants and working outdoors greatly influenced me," he said.

His father was a soil scientist working for the Dutch Soil Survey Institute. Therefore, it seems quite fitting that he would take up agricultural sciences following in his father's footsteps. However, his first choice was to become a veterinarian.

Fortunately for the world of agronomy, Dr. Wopereis decided to take up soil science and fertilizer use instead as the veterinary institute was overbooked. He obtained his BSc and MSc (with distinction) degrees from Wageningen University in 1984 and 1988, respectively.

The rice connection

A few months later, Prof. Johan Bouma, his professor at Wageningen University who had seen signs of a promising agronomist in him, asked if he was interested in going to the International Rice Research Institute (IRRI) in Los Baños in the Philippines to coordinate a soil management project. Dr. Wopereis's positive decision proved pivotal, both professionally and personally.

"It was great to work at IRRI—great people, fantastic facilities," he said, describing this golden period of his life. His research focused on

DR. WOPEREIS with Dr. Bas Bouman, Director of the Global Rice Science Partnership (GRiSP). (Photo by R. Raman, AfricaRice)

A POURING rainstorm does not stop participants in the Japan-funded Emergency Rice Project in Liberia from posing with Dr. Wopereis (5th from left), Dr. Dobermann (white shirt), and Inoussa Akintayo (far right), African rice coordinator for AfricaRice, (Photo by R. Raman, AfricaRice)

quantifying the impact of soil and climate variability on rainfed rice production. This work led to a PhD thesis, which Dr. Wopereis defended at Wageningen University in 1993.

His stay at IRRI was very enriching at the personal level as well because he met his lovely wife, Myra, there.

A continental leap

Soon after this, Dr. Wopereis and Myra left for Africa, where he accepted an agronomist's position at the AfricaRice (then WARDA) regional station in Saint Louis, Senegal. This was a huge change from the lush greenery of Los Baños to the Sahelian town of Saint Louis. But it was exciting, too.

The six years (1994-2000) he spent in Senegal and the following couple of years spent in Bouaké, Côte d'Ivoire, as the scientific coordinator of the Inland Valley Consortium convened by AfricaRice, were one of the most productive periods for Dr. Wopereis as a scientist.

He, along with his colleagues, showed that farmers in the Senegal River Valley could increase their yields by 1–2 tons per hectare by simply modifying their agricultural practices. The team developed integrated crop management (ICM) options and decision support tools for irrigated-lowland rice farmers, which were widely disseminated.

"I am certain that our team contributed to the rise in average rice yield from about 4.5 tons per hectare to about 6 tons per hectare observed in Senegal from the 1990s onwards," explained Dr. Wopereis.

A thresher-cleaner developed by the team in 1997, based on an IRRI prototype, received the Senegal President's award in 2003. Virtually all rice grown in the Senegal River Valley is threshed with that machine and there are now hundreds of these threshers in neighboring countries.

He also co-developed a participatory learning and action research approach for lowland rice systems focusing on ICM options, which was adopted in seven countries.

Outside the rice world

In 2002, Dr. Wopereis joined the International Fertilizer Development Center as program leader of the Integrated Intensification Program in Togo, focusing on integrated soil fertility management in maize, sorghum, and millet-based systems.

In 2005, he became director of the Annual Crops Department at CIRAD, the French development-oriented agricultural research organization.

Back to Africa

However, after 2 years, Africa and the rice world called him back. AfricaRice selected him to lead its research and development program toward the end of 2007. Dr. Wopereis's passion for high-quality research and his drive to achieve impact in farmers' fields brought positive changes in the AfricaRice research agenda and structure, contributing to the center's achievements and continued relevance.

He and his research team, after extensive consultation with AfricaRice's national partners, were instrumental in developing a product-oriented 10-year strategic plan with a major shift in focus from supply-driven research to more demand-driven research. The plan presented a clear vision of success to help Africa achieve almost 90% self-sufficiency in rice by 2020.

Another milestone was the publication in 2013 of *Realizing Africa's Rice Promise*, for which he was the lead editor. This reference book provides a comprehensive overview of Africa's rice sector and ongoing rice research and development activities, indicating priorities for action on how to realize the promise of rice in a sustainable and equitable manner.

He was able to build and lead effective teams to secure significant research grant funding for the Center to sustain a continuous portfolio of collaborative projects. Consequently, AfricaRice's research and development activities, partnerships, and budget grew substantially during the last 10 years.

"One of the most rewarding experiences without doubt is the establishment of the Global Rice Science Partnership (GRiSP)," said Dr. Wopereis.

Robert Zeigler and Papa Seck, former directors general of IRRI and AfricaRice, respectively, pioneered the idea of a worldwide partnership for rice research as early as 2007.

"It was in the office of then IRRI deputy director general for research, Achim Dobermann, that we sketched the contours of GRiSP," he said, reiterating his conviction that GRiSP would outlast any other CGIAR Research Program. "It is essential that IRRI and AfricaRice work together for the benefit of rice farmers and consumers worldwide, particularly Africa."

Speaking fondly of his strong bonding with Africa, Dr. Wopereis said, "I look back at my time in Africa with great satisfaction. It is filled with unforgettable experiences, friendships, and achievements through solid teamwork. Working in partnership has always been AfricaRice's strong point." ■

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

PHOTOS BY ©ANTHONY PRUDENCIO (2)

Risotto carbonara with Innawi rice

No discussion on Philippine cuisine will be complete without Chef Margarita "Gaita" Forés. After all, Chef Gaita is a doyenne of the culinary arts. If there is a word to describe her career, that word would be "stellar."

Her talent is immense, garnering numerous accolades, including Asia's best female chef 2016. The award is bestowed by an influential group of over 300 leaders in the restaurant industry across Asia selected for their expert opinion of Asia's restaurant scene and of chefs such as Chef Gaita, who have earned the respect of the critics and peers through their skills, entrepreneurial spirit, and artistry.

Chef Gaita is a champion of Philippine ingredients, including the heirloom rice varieties of the Cordilleras. In fact, she graciously shared two recipes featured in the 2016 heirloom rice recipe calendar including the one presented here on risotto carbonara using Innawi rice from Banaue, Ifugao.

Her love affair with heirloom rice started in 2011 when she participated in the Asian culinary forum in California to showcase recipes in *Kulinarya: a guidebook to Philippine cuisine*. Since then, she has been passionately promoting these varieties through her cuisines and in various events such as Madrid Fusion. Thanks to her efforts, the heirloom rice varieties of the Cordilleras are getting much-deserved global recognition. ■

PHOTO BY ©MARC NICDAO

Risotto

Ingredients

10 grams white onion, minced
30 grams butter, divided
½ cup Innawi (heirloom rice)
5 ml white wine
3 cups vegetable stock, warm and divided
50 ml cooking cream
30 grams freshly grated Parmesan cheese
salt and freshly ground pepper to taste
50 grams bacon, crisp fried and chopped
cured egg (*see recipe*)
shaved Parmesan cheese, to finish
pansit-pansitan (*Peperomia pellucida*) to garnish

Preparation

1. In a pan over medium heat, sauté onion in 15 grams butter. When onion is soft and translucent, add the Innawi.
2. Lightly toast the rice then deglaze with white wine. Once alcohol has evaporated, pour 1 cup vegetable stock, then simmer and stir. Continue adding stock until the rice is cooked through.
3. Add cream, cheese, and remaining butter. Stir well. Adjust seasoning.
4. Transfer to plate. Top with fried bacon and cured egg. Garnish with shaved Parmesan cheese and pansit-pansitan. Serve.

Cured egg

Ingredients

25 grams rock salt
25 grams white sugar
1 egg yolk

Preparation

1. In a flat container, combine rock salt and white sugar. Stir.
2. Cradle the yolk in the middle then cover with mixture.
3. Cover and set in a cool, dry place. Cure for 12 hours.

Bon appétit!

PHOTOS BY ©MARC NICDAO (2)

See a video in which Chef Gaita talks about her experience with heirloom rice: https://youtu.be/5VTk6v7X6Fc.

PHOTO BY JESSIECA NARCISO, IRRI (2)

Home among the heirlooms

PHOTO BY ISAGANI SERRANO, IRRI

by Alaric Santiaguel

Neneng Wadingan left her hometown to seek greener pastures abroad. But she found her true calling and economic success when she returned to tend her ancestors' land and grow heirloom rice.

Finding work outside their country has become the economic Holy Grail for many Filipinos. Saturnina "Neneng" Wadingan (photos) from Bauko, Mountain Province in the Philippine Cordillera Region, was one of these having landed a good job in the People's Republic of China. By local standards, Neneng had it made. She was living the dream of the masses. But she had to let it go when her parents asked her to come home and take over their family farm.

Reluctant farmer

"We've had this farm for 200 years, since the time of our ancestors," Neneng told the Heirloom Rice Project team that conducted a socioeconomic survey of the farmers in the region. "My grandmother inherited it from her mother and my mother inherited it from my grandfather."

Yet, she started out as a reluctant farmer. "I didn't do any full-time farming before," she recalled when she returned to Bauko to help her parents with the farm. "At first, I wanted to cry. I asked myself, 'What is this work?' I couldn't accept it. But I helped in planting our field with rice."

In 2008, after planting a crop of rice, Neneng left her hometown to work in Macau. But she couldn't take her mind off their farm. "I returned after a month and a half because my father said the rice crop I planted was growing very well. Just looking at the rice plants filled me with joy."

After harvesting that crop, she planted rice again—and then she left to work, this time in Shanghai. Six months later, she returned when her father died.

"Before my father died, my parents would ask me about what would happen to our farm if no one took care of it," she said. "They were hoping I would stay since I was the only one in the family who seemed interested."

The following year, her mother passed away. Neneng knew she had to continue their legacy. Like her parents before her, she became her generation's family farmer.

Land, seed, and wisdom

Land was not the only thing her parents left her. "They always stored the seeds of several rice varieties they had been planting all these years." These were the varieties her ancestors planted on their farm.

PHOTO BY HEIRLOOM RICE PROJECT

"The seeds come with the land," Neneng said.

In time Neneng became a confident farmer. Her expertise was apparent. She was an authority on the profuse assortment of traditional rice varieties and the right time for sowing a particular variety. She was an expert at selecting the seeds for the succeeding planting season, the right time for harvesting, and the proper drying of the grains. She holds a body of knowledge that, like her land and seeds, is a kind of birthright.

"I finally focused on farming in 2009 after I met Vicky Garcia," she said. Ms. Garcia established the Philippines nonprofit RICE, Inc. to preserve heirloom rice grown in the Cordillera Region as well as the culture of the rice-based community. Ms. Garcia helped create an export market for the heirloom rice through Mary Hensley, founder of Eighth Wonder Inc., which sells the rice in the U.S. (see *Women who moved mountains* on page 22-23 of *Rice Today*, Vol. 13, No. 4). "Vicky told us that we were planting heirloom rice. To us, it is rice that we plant and eat. I was inspired by what Vicky said about our rice being more nutritious and aromatic."

Born to lead

Neneng now sees heirloom rice farming as her ticket to a better future. The export market demand for the purple-colored Balatinaw (center photo above), the heirloom rice that she and other farmers sell to Eighth Wonder, brought significant economic benefits. Every year, she is able to supply around 100 kilos of processed Balatinaw for export valued at about USD 170, which is twice the price of "nonfancy" varieties. "I can save money for my family's needs, especially for my children's education. My son was able to finish school because of heirloom rice."

Neneng eventually assumed a leadership role in her community. "I noticed the lives of rice farmers started to improve as more people started buying heirloom rice," she said. "I realized that our heirloom rice was important to our community. We need to keep planting it because some varieties are starting to disappear."

Neneng not only shared some of her inherited seeds, she also shared her know-how and even organized the farmers who were willing to plant heirloom rice. This informal group became the Blooming Hills Rice Terraces Farmers' Cooperative. It currently has 56 farmer members. "I wish more farmers would join us. That would make me very happy."

But she knows there is much room for improvement. "We need financial help from the government," Neneng said. "Yes, we have rice and land, but we don't have enough money for farming. We need money to purchase water buffaloes for plowing, not tractors—because they are not suited for our terraced farms.

"Our association could also use a portable thresher with a blower that we can bring closer to our rice fields so our farmers can minimize their postharvest losses," she added. "A collapsible drying canvas will be very helpful so that we can protect our harvested grains if it suddenly rains."

Home at last

At one point, Neneng found herself thousands of kilometers from her hometown pursuing a livelihood overseas. Upon her return, she realized that her heart and her soul had never really strayed far from the rice fields of her ancestors. Neneng, the heirloom rice farmer, is now where she wants to be. She is where she is needed. She is finally home. ■

Mr. Santiaguel is an associate editor of Rice Today.

The Heirloom Rice Project is an initiative under the Food Staples Sufficiency Program of the Philippine Department of Agriculture. With support from the various agencies of the Department and IRRI, the project aims to enhance the productivity and enrich the legacy of heirloom or traditional rice through empowered communities in unfavorable rice-based ecosystems.

Finding flood-prone rice areas in West Africa

by Sander J. Zwart and Mohamed Hamady

Rice, cultivated in the flood plains along the Niger River and its tributaries in Nigeria's northern states, is regularly inundated by floods. In 2015, floods submerged and destroyed rice crops that annually produce about 11% of the nation's consumption, equivalent to more than USD 200 million of imported rice. Such flood damage can be alleviated if farmers plant rice varieties carrying the *SUB1* gene, which can survive total submergence for up to 2 weeks.

The Africa Rice Center breeders have already incorporated the *SUB1* gene into WITA4 and NERICA L-19, two commonly grown rice varieties in Africa. To support the efficient and effective introduction of these new Sub1 varieties to the most frequently affected rice-farming communities, the hotspots in the flood plains were mapped.

The methodology uses a time-series of the Normalized Difference Vegetation Index (NDVI) to detect the agricultural seasons, while flooded conditions and duration are assessed using the Land Surface Water Index (LSWI). Flooding frequency was then determined using a 16-day composite of the NDVI and LSWI images taken from 2001 to 2015 by the MODIS satellite.

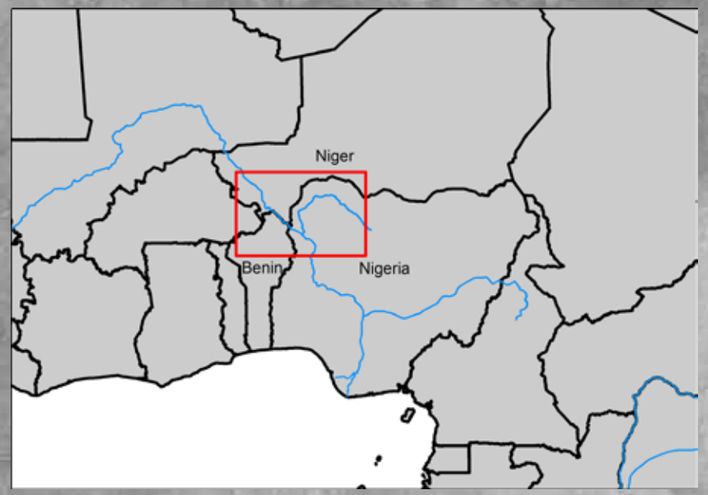
The generated flood-frequency maps of these major river basins in Nigeria will be used to introduce the WITA4 and NERICA L-19 varieties to selected rice-farming communities. ■

Sokoto River

Niger River

Kainji Lake

Number of years with flood events from 2001 to 2015
- 1-2 years
- 3-4 years
- 5-6 years
- 7 years >



Dr. Zwart is a senior researcher and Mr. Hamady is a remote sensing research assistant in the Sustainable Productivity Enhancement Group at AfricaRice.

Cambodian farmers transplant rice in Kampong Speu Province. In the following article (pages 22-29), read about the incredible advances made in rice production in Cambodia over the last 30 years since the "Killing Fields" of the late 1970s. (Photo by Gene Hettel, IRRI)

Glenn Denning on IRRI's Cambodia Experience:

Revisiting the "Killing Fields" 30 years later

Glenn Denning, a professor of Professional Practice at Columbia University's School of International and Public Affairs, directs a Master of Public Administration in Development Practice program and teaches a graduate course in Global Food Systems. He also serves as Senior Policy Advisor at the Sustainable Development Solutions Network, launched by UN Secretary-General Ban Ki-moon in August 2012, to mobilize scientific and technical expertise from academia, civil society, and the private sector in support of sustainable development.

Denning spent 18 years at the International Rice Research Institute (IRRI; 1980-98), starting out as a visiting associate field specialist and later serving in many other capacities and senior management positions. He has also worked at the World Agroforestry Centre in Kenya. Honored by the governments of Vietnam and Cambodia for his contributions to agriculture and rural development, Denning holds agricultural science degrees from the University of Queensland and a PhD from the University of Reading. He has an MPA from the Harvard Kennedy School.

While at IRRI, Denning was heavily involved in what he calls an "amazing story more people should know about because it is such a compelling example about how genetic conservation and human capacity are so critical." It has to do with the follow-up to the horrendous genocide of the "killing fields" in Cambodia (1975-79). It illustrates the power of international collaboration and a commitment to inclusive and sustainable development. January 2016 marks the 30th anniversary of post-war involvement of IRRI in this remarkable episode in agricultural history. With funding from the Australian Agency for International Development (AusAid), the Cambodia-IRRI-Australia Project (CIAP) was ultimately created in 1987 to solidify the effort.

Coming to IRRI in 1980

How I got into IRRI is actually very similar to how I got into most places in my career—it's serendipity, almost a random chance. I was working in Zamboanga del Sur, Mindanao in the southern Philippines on a big Australian rural development project. I'd been there about 3 years and was really looking to do something different after that. I was an agronomist and I had made some connections with IRRI while in the Philippines. A lot of the work that I was doing in Mindanao was inspired by the work of Hubert Zandstra who, at that time, was the head of the Cropping Systems Program at IRRI. I'd read about all his work in South America before he actually came to IRRI and truly admired him for the systems work that he had done there.

But it was another IRRI colleague, Dale Haws, a crop production specialist, who was in charge of Rice Production Training and Research. It

was essentially the applied research part of IRRI, which did field trials all over the country, working very closely with the Philippine ministry of agriculture. We had conducted several field trials for Dale as part of our project in Zamboanga del Sur. Every now and then, maybe once every couple of months or so, Dale or one of his colleagues would come down and visit the trials. On one of these trips, Dale said to me, "I'm going on a sabbatical leave next year for 12 months. Is there any chance you might be interested in coming to IRRI just for a 12-month period, manage my office, conduct these farm trials?" First, I was blown away by the opportunity to work at IRRI—such an amazing, famous, successful organization—really was a great attraction; and also, to have a chance to work with Hubert Zandstra, the person I'd been following so closely over the years. So, I came up to IRRI for an interview.

In those days, interviews were basically with the director general and he decided whether to hire you or not. So, I was to meet with Nyle Brady. On the day I arrived, I was told he was going to a meeting at the (U.S.) Ambassador's residence so I could travel in the car with him from Los Baños to Manila. And so, I actually did my interview in the backseat of a car, while Dr. Brady, in his usual busy style, was signing memos and letters and various things. But we had a chat about what I'd been doing in the southern Philippines. He went to the Ambassador's residence and I got dropped off at a hotel.

IRRI DIRECTORS general Nyle Brady, M.S. Swaminathan, and Klaus Lampe. (Photos: IRRI archives)

About a week or two later, I got a letter inviting me to come to IRRI for a year as a visiting associate field specialist. So, I came for a year and I stayed 18. One thing simply led to another. I worked very closely with Dale for a couple of years once he came back from the States. He eventually moved on and then M.S. Swaminathan arrived as director general in 1982 and he invited me to stay—but again, as a visiting scientist. At that point, I didn't have a PhD and one of the things that Dr. Brady said when he brought me on was: "We're glad to have you here but, of course, you can never become a scientist at IRRI until you have a PhD." So, very early on I enrolled in a PhD program at Reading and worked on it part time for a few years. In 1984-85, I went to Reading, taking a personal sabbatical leave to finish up my PhD.

When I came back, Dr. Swaminathan converted the visiting appointment to a regular appointment, and that is when I started my regular career as an agronomist and scientist at IRRI, which lasted through to 1998. I started in the Training Center, which was then actually a combination of applied research and training. It had an outreach function to it, but it was primarily focused on the Philippines, not the whole international world of IRRI or the country programs that IRRI was very successfully working on in various parts of the world—Bangladesh, India, Nepal, Indonesia, Burma, as it was back then, Thailand, and even beyond.

On the IRRI international circuit

The Training Program eventually became the International Programs Management Office (IPMO) under Klaus Lampe when he became director general in 1988. As a management specialist himself, Dr. Lampe wanted IRRI's international programs better organized with greater harmony across the programs and better coordination in terms of our support to those country programs. But even before then, I got interested in what we called the "country programs". I went to Bhutan in 1983 on the first IRRI mission there and that started the relatively long-term collaboration in that country, with support from IDRC Canada. I went to Africa, making one of the earlier trips to

IRRI BREEDER Gurdev Khush and agronomist Donald Puckridge joined Dr. Denning on the 1986 Cambodia mission. (Photos: IRRI archives)

Eastern and Southern Africa in the early '80s (1984-85).

I started to get more and more interested in how IRRI's work—the first-class research on varietal improvement, agronomy, engineering, etc.—could be relevant to other countries, particularly countries that had been bypassed by the Green Revolution for a number of reasons, including their environment—they were largely rainfed areas—and also because of conflict. And that's what got me interested in the Indo-China region.

On to Cambodia

In January 1986, I was invited by Dr. Swaminathan to be part of the team that he was about to send to Cambodia, then known as Kampuchea. The team included [future World Food Prize winner] Gurdev Khush, Don Puckridge [author of the uplifting Cambodian story, The Burning of the Rice], and myself. We spent about 10 days there. The visit had been requested by the Kampuchea Ministry of Agriculture at the urging of some NGOs working in Cambodia (including Catholic Relief Services). They were asking IRRI to return some of the seeds lost in the conflict that the Institute had in the genebank. There was much interest to have the rice industry up and running again after a long period of a great disruption to rice farming in the country. Lots of interesting things came out of that first mission as a result.

It's a remarkable story that I wish more people knew about. It is such a compelling example about how genetic conservation is so critical, particularly for countries like Cambodia that are so reliant on agriculture and, in this case, so reliant on rice production. Cambodia has had quite a checkered history. Leading up to the end of the Vietnam War, the country was actually very productive—not necessarily high-yielding, but Cambodian farmers were generating surpluses of rice, leading up to about 1972-73, as the Vietnam War was coming to an end (and then), spilling over into Cambodia and Laos.

KILLING FIELDS: forced laborers dig canals in Kampong Cham Province, as part of the massive agrarian infrastructure that the Khmer Rouge planned for the country. (Photo source: chanderspage)

At one point in the late 1960s, the country had an area of around 2 ½ million hectares of rice. They were exporting small amounts to other parts of the world, particularly Africa. But as the war spilled over, there was a very strong anti-government movement going on in the rural areas. More and more Cambodians fled the countryside and made their way into Phnom Penh where they sought refuge.

The population of the city increased from about half a million to about 2 million people. At the same time, the area planted to rice decreased, decreased, and decreased. Large areas were affected by landmines as the conflict continued. So, Cambodia went from being a net rice surplus country to being a country that really couldn't feed itself because everybody, or at least a big proportion of the population, was huddled into the capital city.

The killing fields begin

This leads us up to 1975. It was sometime in April that the Khmer Rouge actually took over the government. The nominal government disappeared and then we had a period of 3 ½, almost 4 years, of what's known as "the killing fields." The Khmer Rouge came in with a very unorthodox and brutal approach to development. Their view was to bring the whole country back to year zero. A way to do that in order to rid the country of all the ills that they saw had affected Cambodia over the years was to remove everybody from Phnom Penh. So, here we are. We have 2 million people essentially crowded into the city. Within a few weeks of the arrival of the Khmer Rouge, the population went down to 10,000. Imagine from 2 million to 10,000!

And so where did they send the people? They basically redistributed them all over the country—and not necessarily back to the places where they came from. Part of the ideology of the Khmer Rouge—and a very interesting one—was that they recognized that rice was important to Cambodia. But they wanted to modernize it and their idea of modernization was to irrigate rice somehow, loosely using the rice-growing concept of the old Angkor civilization, i.e., using large grids of irrigation canals. And so now you can sort of conjure up those images of the killing fields of very large numbers of essentially slave laborers out there digging ditches and trying to create irrigation canals.

At that time, the Chinese government supported the Khmer Rouge and so, there were Chinese

HUN SEN, Cambodian leader since 1979. (Photo by Gene Hettel, IRRI)

advisers helping to introduce rice varieties from China to plant in these areas. But with hindsight, the engineering was extremely faulty; very little of that infrastructure ever led to any increase in irrigated rice production. The Khmer Rouge did not allow farmers to plant traditional deepwater rice like they used to around Tonlé Sap Lake. So, over that period, production went right down to less than a million tons—some statistics show even a half million tons—which was way less than needed to feed a population, notwithstanding the fact that the Khmer Rouge killed upwards of 2 million people over that period—one of the greatest genocides in human history.

This went on for 3 ½ to 4 years. Finally, in January 1979, the Vietnamese came into Cambodia and installed a new government. They removed the Khmer Rouge partly because this government was launching attacks on Vietnam. Vietnam, of course, was a much more powerful force and, at that time, I think China had also reduced and eventually stopped supporting the Khmer Rouge because Vietnam had had its battles with China on the northern front as well. Anyway, Vietnam comes in and installs a new government led by Hun Sen, who is still the leader to this very day. That was 1979. NGOs only slowly came into the country because, for many years, the Hun Sen government was considered illegitimate because it had been installed by an occupation force in which the Vietnamese had removed the Khmer Rouge.

Even when IRRI ultimately started working in Cambodia, the Khmer Rouge occupied a seat in the UN. So, there was no UN presence. In fact, all through this period during the early days that we worked there, the only governments that recognized the Hun Sen government were the Soviet Union and the Soviet Block countries, including Cuba—and one other country not in that sphere of influence—India.

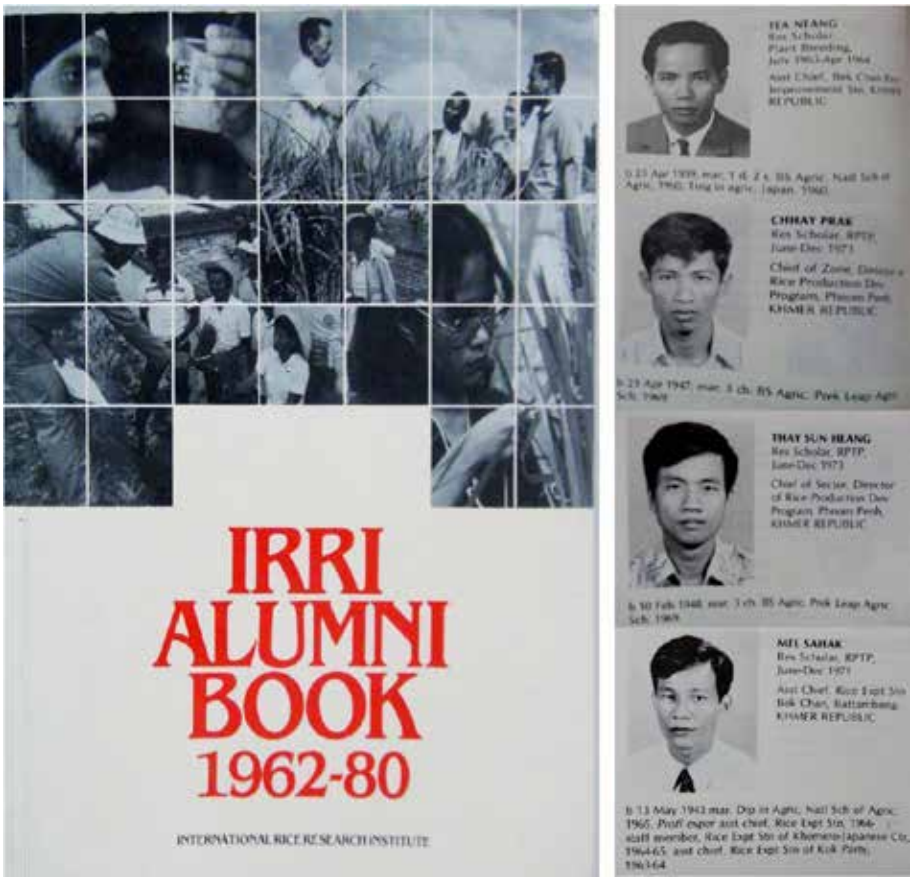
Okay, so you had all Soviet Block but no Western governments recognizing the government in Cambodia, including Australia. Several years passed and then, finally, in 1986, Dr. Swaminathan received the invitation; we went into the country. Production had crept back up to about 2 million tons. Yields were still very low but there had been land area expansion and some of the security problems had been solved. It wasn't completely secure. There were still landmines everywhere, which seriously affected agriculture, particularly rice farming. People, as well as animals, were being blown up by stepping on landmines. But anyway, there was a bit of an increase in rice production.

Shocking revelations

The IRRI team came in and we looked around and we were shocked, I would say, during that first mission. We couldn't quite believe what we saw or heard. Not a lot of information came to the outside world during that 1975-79 Khmer Rouge period. But we started to talk to people, including the government officials. We talked to everyday folks. This was a hard-line communist government, by the way, that we were dealing with back then. But they did realize they had to feed their people. They had to increase production. They had that idea.

We started looking for anyone we can work with. In other countries,

DESTROYED CAMBODIAN infrastructure scarred the nation's countryside. (Photo by Glenn Denning)



IRRI ALUMNI book (1962-80) listing Cambodian trainees prior to the Killing Fields. (Photo: IRRI archives)

THAY SUN Heang, 1973 IRRI trainee who survived the Killing Fields then and now (in 1973 photo, second from bottom, appearing in IRRI Alumni book and above right with *Rice Today* editor-in-chief Gene Hettel). (Photo by Jessieca Narciso, IRRI)

we've typically worked with their national research organization, which becomes our partner. We looked around Cambodia, all the buildings were destroyed; everything had been destroyed. We took some horrific photos from that era of what formerly were research institutions in the 1970s, totally flattened. There was nothing.

Where were the people? There were 400 trained agriculturists in the country prior to the war. After the war, there were 40. So, we had a literal decimation of the skilled agricultural expertise—people who would work in the extension ministry of agriculture, in the university, and so on. IRRI had this book with little photographs of all the IRRI trainees going back for years. One of the things we did before we went was to see who from Cambodia had done training courses at IRRI. Actually, there were only six names and four photos. We started asking around. Of course, the first thing we tried to do was ask who had a connection to IRRI. We didn't physically locate them, but we heard that only two of those six were still alive. So, the human resources and the physical infrastructure were wiped out. [Editor's note: Since this interview was conducted, the last surviving trainee of those six, Thay Sun Heang, was located].

The varieties were lost as well because of all that dislocation and the fact that everybody moved to the countryside and then they went through this horrendous period of slave camps. People were so hungry they ate their rice seeds. So, the country basically lost so much of its rice genetic resources, which were essential in Cambodia, because 85% of the fields are rainfed. IRRI's impact [in Asia] up to that point had been very much focused on the irrigated and favorable rainfed lowlands. It had had very little impact on harsher environments. All these traditional varieties in Cambodia had evolved under these harsher conditions and appeared to have been lost.

Re-introducing Cambodia's traditional varieties

However, we have a very good news story that, luckily—probably more than luck!—very strategically, IRRI had sent in some collectors of traditional rice varieties in 1972-73 just before all the turmoil began. I believe more than 750 rice varieties were actually collected and stored in the IRRI genebank. So, we called up the folks in the genebank and we found out that yes, indeed, we've got all these varieties that were collected about 13 or 14 years previously! These varieties had lived safely in the genebank while the horrendous human genocide civil war was going on in Cambodia.

Over a period of several years [1981-90], part of the IRRI program in Cambodia was actually to reintroduce those varieties. We had a couple of plant breeders there, Ram Chaudhary and Edwin Javier. They worked on the reintroduction of these traditional varieties. Farmers grabbed them and multiplied them. So, we had a two-pronged process to get these traditional varieties back in the places where they best fitted. The other part was where we had irrigated rice, perhaps 15% of the country, maybe a little more. So, we started to get state-of-the-art modern IR varieties in there, such as IR36 and

DRS. DENNING and Chaudhary in Cambodian rice plots circa 1990. (Photo: IRRI)

so on. Not many good quality seeds of the new irrigated varieties had found their way into Cambodia. So, we had these two things going on at once. It wasn't big to start with. It was slow improvement in production that has continued to this very day. So the varietal improvement part of it was very important.

The importance of human resources

I can't underestimate the importance of human resources. As I mentioned, human capital had been decimated as a result of the war. People were either killed or fled as refugees and disappeared off the map as far as Cambodia was concerned. So, our major initial focus was on capacity building. This wasn't easy because virtually nobody there spoke English.

One of the first things we did was to bring a group of 13 Cambodians to IRRI sometime in 1987. This was the largest group of Cambodians ever to leave the country. Well, let's say, ever to leave the country to go elsewhere than the Soviet Union or other parts of the world that were friendly with Cambodia at that time. We organized to bring them to IRRI for 5 months of training. We had a special rice production training course and everything had to be translated. We had a translator. Everything had to be translated into Khmer. In the mornings, they did rice production, and in the afternoons, they learned English. We had them out in the field planting rice, doing all the physical stuff while it wasn't raining. In the afternoon, they came in and we had an instructor, Jill Sullivan, teach English for beginners.

So, this went on for 5 months. These people went back to Cambodia and we ended up being able to work with them. So, parallel with improvements and technical assistance and all the rest, we were building up this capacity. Over a period of about 12-15 years or so, about 6,000 Cambodians have been trained by IRRI at all levels. Many of them, of course, we trained in-country when, at one point, we had a team of about five or six IRRI scientists working there. But many of them we brought back to IRRI. We sent them on tours; they got to see other parts of the world where we actually made good progress in rice production. And some of them went on to get master's degrees and even PhDs.

Cambodia today

Let's look at Cambodia today. CIAP helped set up the Cambodian Agricultural Research and Development Institute (CARDI), founded in August 1999. [See *Cambodia ushers in new era* on page 16 of *Rice Today*, Vol. 6, No. 2.] We did that very early, and then we worked very closely to build up national capacity from scratch—physical infrastructure as well as the human resources to go with it. With support from the AusAid, we were able to send quite a large number of students for advanced education to do master's and PhDs, mostly in Australia; some of them did it here in the Philippines as well.

CAMBODIA REGAINED 766 of its lost traditional varieties by repatriating them from IRRI's genebank. (Photo: IRRI)

Main entrance of CARDI today. (Photo by Gene Hettel, IRRI)

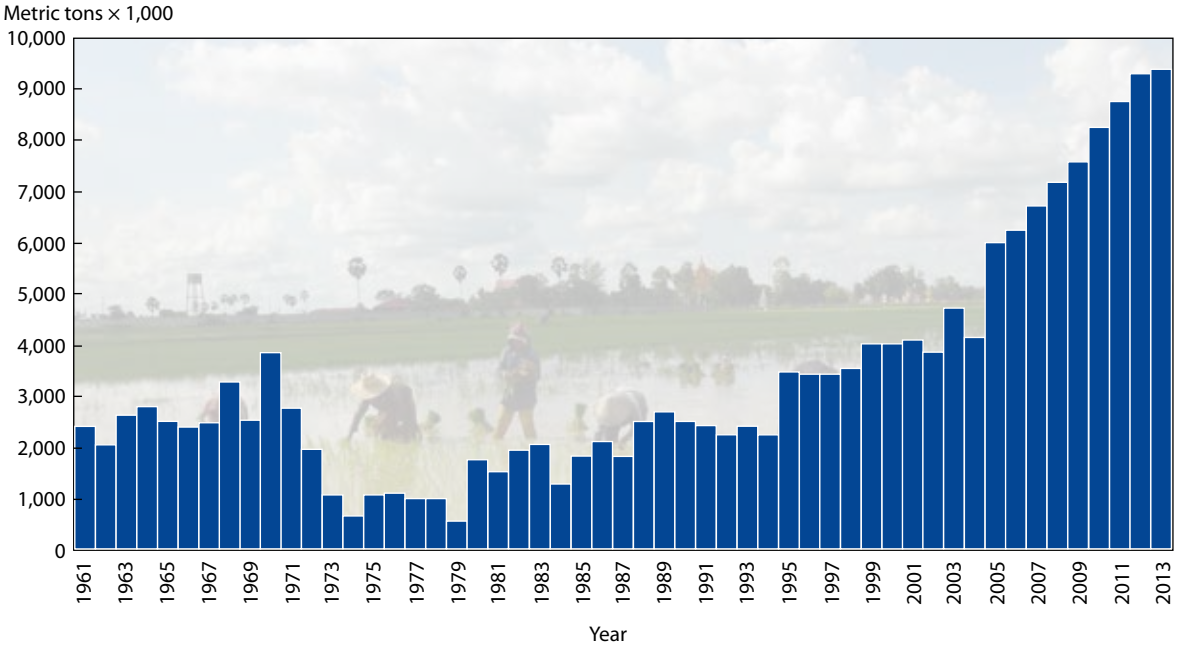
To this day, if you go and look at the organizational chart of CARDI over the last several years, the people who are running the organization, the current director, for example, Ouk Makara, got their PhDs in Australia. He's one of our counterparts, one of the trainees. Many others in the organization, leading in breeding, soils, entomology and so on, all came through this IRRI partnership that was supported mainly by Australia over a period of a couple of decades.

So that's the history in terms of what we did. I talked a lot about varieties, but we worked on agronomy. We als o worked on integrated pest management, postharvest technology, mechanization—all of these things were going on at the same time over long periods.

When we went there in January 1986, the production in the country was a little over 2 million tons (Figure on next page). The average yield was just over 1 ton per hectare. Looking at it today, almost 30 years later, total production in the country is around 9 million tons (Figure on next page). The country is an exporter again. In fact, for the last several years, Cambodia has been exporting

OUK MAKARA, current CARDI director (*right*), with Glenn Denning. (Photo by Gene Hettel, IRRI)

A CROWD of more than 4,000 attended the dedication ceremonies of CARDI's new facilities on 9 January 2007. (Photo by Gene Hettel)



Rice production in Cambodia, 1961-2013 (in MT rough rice). Source: FAOSTAT.

somewhere around 800,000 to a little over 1 million tons per year. They really developed their export of rice as a source of income. The area has gone back to about the level before the war from about 2 ½ million hectares, having gone down to half a million, now back up to 3 million hectares. So the area hasn't greatly expanded.

Much of the improvement has come through yield increases. So, the yield is now around 3 tons per hectare, which isn't as good as Vietnam or Indonesia, but you've got to remember that, still, the country is largely rainfed. Irrigation has expanded. Investments have expanded. But to be able to get 3 tons per hectare on land that is principally rainfed means that a lot has gone into the improvement of crop production. So, I think Cambodia itself is a great credit to IRRI and, initially, the vision of Director General Swaminathan; and consistent long-term partnership with that country through thick and thin. For the most part, Australia was the big supporter, but we were able over the years to diversify that level of support.

One of the key successes is we've been able to connect Cambodian scientists with scientists in other countries. We've always wanted that. We did not want them to be dependent only on IRRI. We wanted them to be able to work with the Thais, with the Lao, with the Vietnamese, with the Indonesians, with the Chinese again, to build collegial relationships which would give strength to the national research system. So that's basically the Cambodia story.

Applying lessons from the Cambodian experience elsewhere

I think Cambodia is a very good lesson, which by the way, I've shared with a number of other colleagues in other parts of the world as far away as Africa. When we see countries coming out of conflict, I think we can take some lessons from what happened in Cambodia. I've used some similar approaches in East Timor (Timor Leste), again, a country coming out of conflict. It's not a predominantly rice-growing area, but I think the general principle when you come out of conflict is you often have minimal infrastructure, you have very limited human resources, and you often need to borrow technology and build up research capacity yourself. So we've looked at that in Timor Leste.

We've also looked to do this in Mozambique. I know IRRI is now working in Mozambique, I think doing a very similar approach—improving varieties, building national capacity, and strengthening national institutions. It's a good model and I think it should be shared more widely. It's going to be probably very relevant to Afghanistan and perhaps some other parts of the world in the years ahead—and not just for rice, but for any crop. ■

Gene Hettel is editor-in-chief of Rice Today.

For additional background on the Cambodian experience, see Towering legacies *on pages 14-19 of* Rice Today, *Vol. 1, No. 1;* The Burning of the Rice: A Cambodian Success Story *by Don Puckridge;* Fostering international collaboration, for food security and sustainable development: a personal perspective of M.S. Swaminathan's vision, impact, and legacy *by Glenn Denning (in* Current Science*);* Rice production in Cambodia *by Harry Nesbitt; and* The soils used for rice production in Cambodia *by Peter White, Thomas Oberthür, and Pheav Sovuthy.*

by Savitri Mohapatra

With rapid population growth and climate change, Africa's inland valleys are increasingly being considered as the continent's future food basket.



PHOTOS BY SANDER ZWART, AFRICARICE (4)

A SMART choice for Africa's inland-valley rice farmers

"The potential is there, but you can't eat potential." This is one of the most memorable statements of Nobel Peace Prize Laureate Norman Borlaug. His remark would perfectly fit the case of the inland-valley lowlands in Africa, which are known to have high agricultural production potential, but have remained largely untapped until now.

However, with rapid population growth and climate change, inland valleys are increasingly being considered as the continent's future food basket since they are generally more fertile than uplands and have higher water availability. They are particularly important for realizing Africa's rice promise.

The inland-valley challenge

The main challenge is how inland valleys can be efficiently and sustainably used to boost Africa's rice production. The key is improved water control.

Over the years, many attempts have been made in West Africa but with little success as inland valleys are diverse and complex ecosystems and are generally difficult to manage. Some of the big inland-valley water management schemes in West Africa in the 1970s were either abandoned or underused because of their dependency on foreign expertise for heavy engineering infrastructure. There was also lack of technical know-how of smallholder rice farmers in the region.

But most importantly, the failure is often due to the lack of participation of local communities in the selection, planning, design, implementation, and use of the inland-valley schemes.

New hope with the *sawah* system

A new hope for increasing the area under rice cultivation in inland valleys arose with a relatively simple, low-cost, and participatory land preparation method from Asia called *sawah*. *Sawah* is a Malay-Indonesian word for leveled, bunded, and puddled rice fields with water inlets and outlets to control water and facilitate soil fertility management. Although relatively new to West Africa, *sawah* has been used for hundreds of years in Madagascar.

The *sawah* system was introduced and tested in 1997 in the Ashanti region in Ghana and the Bida region in Nigeria by Japanese scientists in collaboration with local research and development partners. The system helps improve land preparation and transplanting, reduce water runoff and loss of fertilizer, and maintain a water layer in the field to help control weeds.

More than 20 million hectares of the 190 million hectares of inland-valley lowlands in Africa are reportedly suitable for the *sawah* system. Seeing its promise, farmers in Togo started using it in 2004.

In 2009, with strong technical and financial support from the Japanese Ministry of Agriculture, Forestry, and Fisheries (MAFF), the Africa Rice Center (AfricaRice) launched the *Sawah, Market Access, and Rice Technologies for Inland Valleys* (SMART-IV) project in Togo and Benin (see photos). The project is carried out in collaboration with national and nongovernment partners.

After the first two years of the project, farmers did not widely adopt the conventional *sawah* system because the targeted areas had a continuous natural water supply while there were fewinland-valley sites in Benin and Togo with a continuous water supply. This limited the scope for achieving large-scale adoption of the system.

The project scientists had to modify and adapt the system to local conditions of rainfed smallholder farmers.

The SMART alternative

The modified *sawah* approach was code-named *Smart-valleys*. It is also the name of the follow-up project to SMART-IV developed and validated in the project countries. It can be used by smallholder farmers in inland valleys that are fully rainfed or where additional water resources are available for irrigation.

The *Smart-valleys* approach is low-cost, easy to replicate, and has a short implementation period. It is, in fact, a smart option instead of traditional interventions, which are usually expensive and time-consuming.

The philosophy of the *Smart-valleys* approach is that farmers know their lands better than anyone else, including the experts. Farmers are fully engaged throughout the development process, which creates a strong sense of ownership among them.

"Farmers are the key players in this system; otherwise, this system will not be sustainable," remarked Worou Soklou, AfricaRice land-development specialist. "Farmer organization is critical to the success of the *Smart-valleys* process. But the first condition is to ensure that there are no problems with land tenure."

Sander Zwart, AfricaRice project coordinator, explained, "Although the site selection is based on climate and geomorphological data and using GIS and remote-sensing tools, it is the farmers themselves who provide the researchers with the information regarding the inland valleys' soil and the behavior of crops in the field.

"But most importantly, the farmers provide information that enables scientists to determine the drainage axis of the inland valley and site the main canals and bunds appropriately according to the topology," he added.

According to AfricaRice Deputy Director General Marco Wopereis, the main advantage of the approach is higher yield and lower risk—thus stimulating farmers to start using inputs such as mineral fertilizers, thereby raising rice production in these systems to a totally new level.

High degree of success

The *Smart-valleys* approach has proven to be quite successful despite initial setbacks. The hard work of the project participants, particularly farmers, paid off when they found that average rice yields had more than doubled from 1.5–2 to 3.5–4.5 tons per hectare at the end of the first phase of the project.

"Since we have been cultivating rice, we have never harvested such a vast quantity," said Aboko Daniel, a rice farmer in Zoungo, Benin. So impressed are the farmers with the rise in income, thanks to the *Smart-valleys* approach, that some of them are expanding their site without any external help. Impact studies indicate the potential adoption rate is 67%.

"At the end of the project, 139 *Smart-valleys* sites were operational in Benin and Togo and about 2,000 farmers cultivated rice in them, of which 55% were women," Dr. Zwart said, summing up the project achievements. "The area developed using the *Smart-valleys* approach was more than 200 hectares in Benin and 135 hectares in Togo."

The project provided inputs to the national strategy for inland-valley development in Benin that is being prepared by the Ministry of Agriculture, Livestock, and Fisheries.

Scaling up

From the onset, the project emphasized the need for scaling up of the approach through capacity building of technicians and lead farmers and through demonstration sites. By the end of the project, 87 technicians and 47 lead farmers had been trained in the *Smart-valleys* approach. Demonstration sites were developed in six zones.

AfricaRice and its partners have identified *Smart-valleys* as one of the key technologies that will be scaled up in the rice sector development hubs that focus on lowland rice. A training video was produced and a guide for field technicians is being prepared. Once farmers are familiar with the technique, they are then introduced to power tillers to speed up land development.

According to Dr. Soklou, the lesson to be learned from this approach is that, even with limited means, it is possible to bring in significant change in rural areas of African countries. ■

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

A reluctant rock star scientist talks about making science and scientists approachable, his own creative process, and the GMO debate. He also has good advice for young researchers.

Picking the brain of IRRI collaborating scientist Michael Purugganan

Interview by Alaric Santiaguel

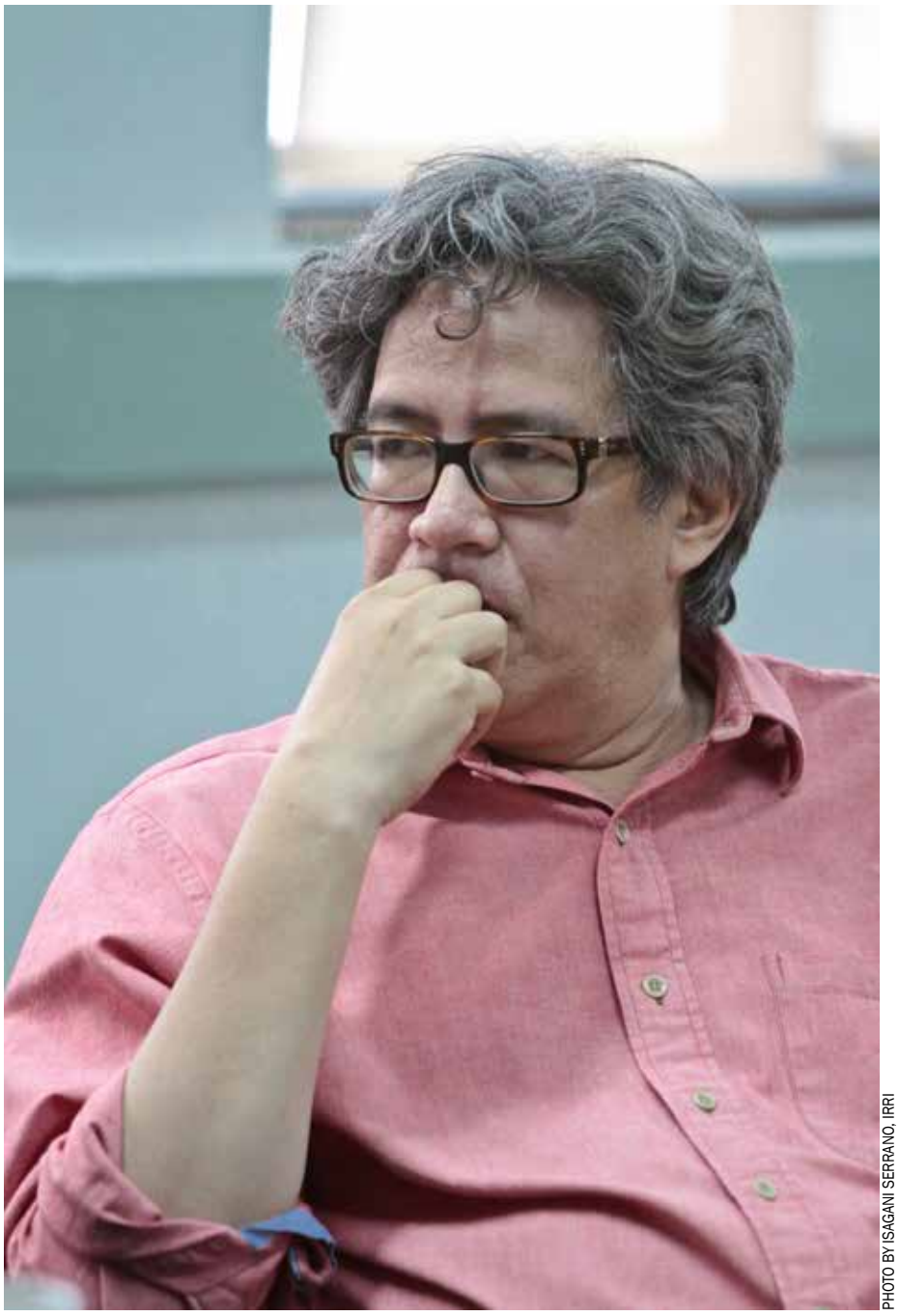


PHOTO BY ISAGANI SERRANO, IRRI

There are scientists and then there are rock star scientists. What's the difference? Unlike their counterparts in the entertainment industry, rock star scientists aren't surrounded by an entourage. They do not make dramatic entrances nor do they strut around the lab wearing flashy gowns. They are actually regular scientists but with a little something extra. Writer Matt Hickman described it best:

> *It's all about the charisma, a willingness to communicate, and, at times, stir up a bit of controversy … challenging convention and getting people to wake up and acknowledge the world around them, to think.*

Michael Purugganan, Dorothy Schiff Professor of Genomics and Professor of Biology at New York University and a collaborator with the International Rice Research Institute (IRRI), certainly fits the description. In a recent interview, during one of his stops at IRRI to monitor an ongoing project on the systems genomics of adaptation to rice drought stress, the Filipino-American biologist and former journalist covered his strategy for a successful career in research, the importance of making the general public excited about science, paying it forward, and the touchy subject of genetically modified crops.

What is the secret of being a rock star scientist?

I don't like the term "rock star scientist." Let's just say I am happy people recognize our work and we're able to make contributions to our fields. That took a lot of hard work

and some bit of luck. But I think a lot of hard work more than anything else.

What is your advice to young scientists who want to have the same kind of success?

The one thing I would advise young scientists is to keep on asking questions and keep on thinking of projects. I tell people I am constantly thinking of new ideas and that maybe only one in a hundred will survive. But if I weren't constantly thinking of new questions, I wouldn't find those gems of ideas that I eventually work on.

Describe your creative process in coming up with those ideas.

I make connections in very different areas of work. That's the other advice I would give to young scientists. Reach out beyond the area you specialize in working and explore very different areas of knowledge. I would read a paper in another field, for example, and think, hmmm…, that's interesting. I wonder if I can do it in rice. If you can have a very open mind and see connections between what seem to be very different areas of research, that is when very interesting things happen.

You head the Purugganan Laboratory for plant evolutionary genomics. How did you manage to get your own laboratory?

After getting my PhD (in botany, with a minor in global policy) from the University of Georgia and doing postdoctoral work, I applied for faculty positions in research universities and I was able to establish my lab. I remember I was given my first laboratory at North Carolina State University. It was a small lab. It had no windows. It was an empty room. I had to equip it myself but it was still my lab.

That was a special moment because, for the first time, I could work on my own ideas. Prior to that, I was always working in somebody else's lab. It has grown and grown. Now I have two labs, one in New York and one in Abu Dhabi.

What is your opinion on making science sexy for the general public?

Sexy is the wrong word. I think it's more about getting people excited about what we're doing. I think it is important to make science accessible to people so they understand what we're doing.

As scientists, when we do research, we are excited about many things about that project. However, a lot of things we're excited about may not be exciting for the public. Find the things in your project that you think will excite the public and then, when you talk to the public, emphasize those things. Hopefully, people will then be excited too about what you're doing.

Also, try to make scientists more accessible and less invisible to the public. I think if you ask the average persons, their image of a scientist is probably the Hollywood image that is nerdy or geeky. People don't realize that there are scientists around them. Some of them are just ordinary people; some of them are quite interesting persons. I think people will be surprised about who scientists really are. Just be accessible to the public and show people who you are and what you really look like.

Scientists are not the nerdy persons you might think of … well, we're all nerdy but we might not all look nerdy to the public. People might find scientists more approachable. That's something that I would like to do as well.

But why is it necessary to make science accessible to the general public?

I think this is important because, at the end of the day, it is society that funds our research. Whether it's a government grant or it's a private foundation, our work is supported by the rest of society. It's important that society become part of what we do.

To try to make your research accessible should really be part of the normal things scientists do. I really believe that. That is part of what you have to produce as a scientist. It is not just the research you do or the applications it may have but transmitting that knowledge not only to fellow scientists but also to the general public. At the end of the day, the entire scientific community is going to advance or collapse based on whether society thinks what we're doing is worthwhile. If we don't make science accessible to people and make them support and understand what we're doing, then we failed.

I am constantly thinking of new ideas and that maybe only one in a hundred will survive. But if I weren't constantly thinking of new questions, I wouldn't find those gems of ideas that I eventually work on.

You have also been a journalist. The media have been strongly biased against genetic engineering and genetically modified organisms (GMOs) in the past. What is the situation today?

I think the media, both internationally and in the Philippines, are fairer, especially in the last few years. In the Philippine context, there are several science journalists who think deeply about the science and understand the issues. Although they look at different sides of the question, they're not alarmists.

Internationally, it's the same thing. If anything, the media have become much more skeptical of the anti-GMO stance because, after several years of talking to both sides, they have come to realize that

many of the issues brought up by the anti-GMO groups have weak or nonexistent scientific basis and may be off the mark in terms of what their real targets are and what they really care about. So, I think it's actually getting better.

How do you counter the negative image of GMOs?

It is tough. It's a matter of education. When I talk to the anti-GMO folks as an evolutionary biologist, it doesn't matter how much evidence I present. People who are completely opposed to GMOs are probably not going to change their minds. They're just not going to listen. Sometimes, what the anti-GMO people say is completely wrong. For some reason, certain people hold on to certain opinions even if those opinions are based on incorrect information. It can be very frustrating. However, that shouldn't stop us from continuing to be the rational voice in this debate.

Some people initially may not like GMOs, but they haven't really thought about it clearly or deeply. But they're open minded. These are the people I try to talk with. They're the ones that I've seen change their minds after talking with them about the issues involved.

It is also important for scientists, especially those not connected to GMOs, to step up to the plate. I have written some articles on the issue and tried to be a public advocate for GMOs in certain contexts. I think one of the reasons these articles have penetrated more is because I don't do GMO work. I've never been connected to the industry. I've never received a single cent from any industrial organization. It's just that, scientifically, I do believe GMOs are useful and important. To be able to say that with integrity—and to get people to understand it—is important.

How safe are GMOs?

The technology itself is safe. The products need to be looked at individually. In other words, we have to test every product that's genetically modified to make sure that it is safe and won't harm the environment and people's health.

People think that classic (conventional) breeding is somehow better than GMO technology. My real sense is that in breeding there is a lot of uncertainty. In traditional breeding, one crosses strains that have not come into contact with each other and mixes hundreds and thousands of mutations. With GMOs, breeders insert only a few genes that they know a lot about. I actually have stronger confidence in our ability to control GMOs than the products of classical breeding.

GMOs go through enormous regulatory testing but traditionally bred crops do not. I guarantee that we know much, much less about what we did with a traditionally bred crop than what we did with a GMO crop.

What makes GMOs so scary?

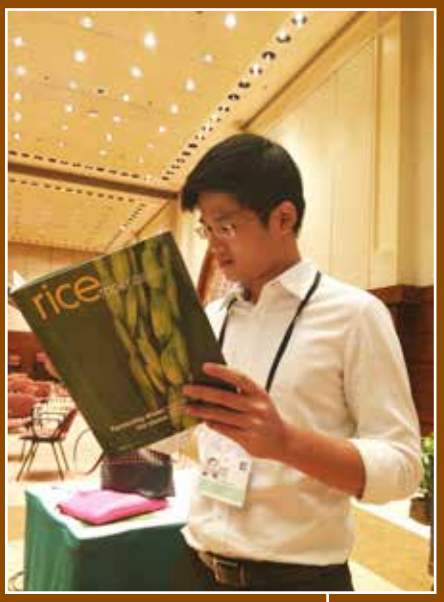
People fear most a certain risk that may not be known yet. But that's true for everything. We can always think of a worst-case scenario. Certain GMO products have been used for a long time. The reality is, with so many GMO products in the market and available all over the world, nobody, not one person, can be shown to have died or have had a health problem because of a GMO. There have been no issues with GMOs. I don't know what else we can do. ■

Mr. Santiaguel is associate editor of Rice Today.

BUDDING SCIENTISTS have a lively discussion with Dr. Purugganan (right) during one of IRRI's Young Researchers' Lunches. (Photo: IRRI)

rice TODAY around the world

RETIRING BUT STILL STORYTELLING. Retiring *Rice Today* editor-in-chief Gene Hettel (center) at the Cambodia Agricultural Research Institute (CARDI) in Phnom Penh with (from left): Zhao Dule, IRRI representative for Cambodia; Thun Vathany, head of CARDI Plant Breeding Division; Seng Vang, CARDI deputy director; Sieng Layheng, deputy head of CARDI Plant Breeding Divison; Glenn Denning, professor at Columbia University's School of International and Public Affairs; and Kong Kynet, CARDI researcher in plant transformation. Read the rice production miracle in Cambodia as told by Dr. Denning in his *Pioneer Interview* on pages 22-29.



DRONE TO *Rice Today*. Mark Yong, CEO and co-founder of Garuda Robotics, browses through the 2015 4th quarter edition of *Rice Today*. Singapore-based Garuda Robotics provides drone solutions for agriculture, security, infrastructure, and telecommunications to help businesses make decisions for better productivity and efficiency.

TOWERING FIGURES. (Left to right) Bryce Blackman, former agronomy and extension specialist at IRRI; Noel Magor, head of IRRI's Impact Acceleration Unit and Training Center; and Poornima Shankar, knowledge management and outreach specialist at IRRI—all experts in their fields—are dwarfed by the towering Brihadeeswarar temple. At 66 meters, it is one of the tallest temples of its kind. The Brihadeeswarar is part of the UNESCO World Heritage site known as the "Great Living Chola Temples" in Thanjavur, Tamil Nadu, India.

Is the global rice market headed for a repeat of the 2007-08 rice price crisis?

by Samarendu Mohanty

The 2007-08 rice price spike seems to have taken place ages ago considering the calmness in the rice market in the past few years despite El Niño and other weather-related scares. Rice prices in the international market have stabilized in the past few months after a steady decline prior to mid-2014 (Fig. 1). There has been some support for rice prices in the past few months because of weather scares such as drought in India, Indonesia, Thailand, and the Philippines, but this has not been enough to turn things around.

Despite the current stability in the rice market, there are reasons for concern about the medium-term (mid- to late 2016) direction of the market. The rice stocks of five major exporters (India, Thailand, Vietnam, Pakistan, and the United States) continue to slide since peaking at

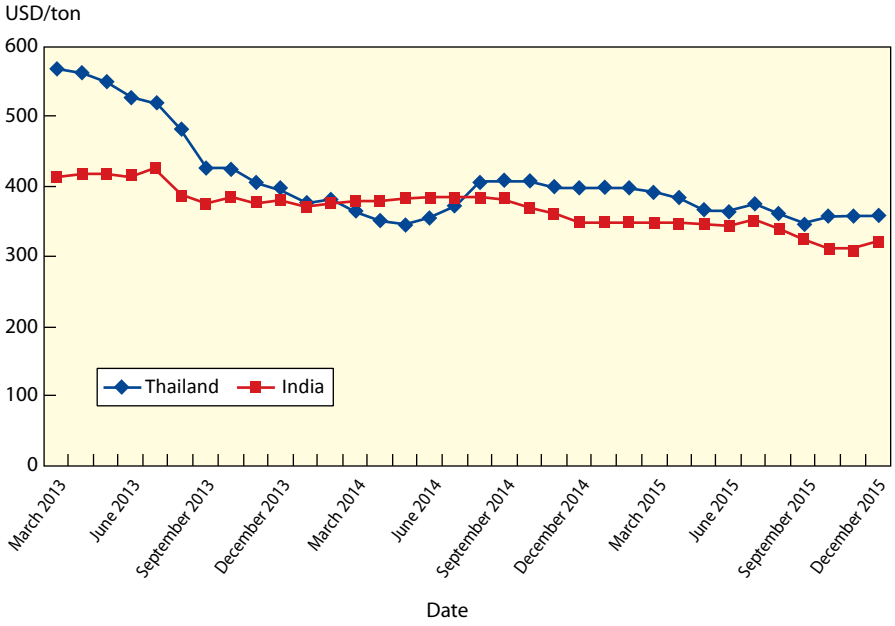


Fig. 1. Price of 25% broken rice (March 2013-December 2015).
Source: FAO Rice Market Monitor.

nearly 41 million tons in 2013 (Fig. 2). The biggest drawdown of stocks in these countries is underway this year, with a 40% drop from 2015, to reach 19 million tons by late 2016, according to USDA data.

The majority of the 13 million tons drop in total inventory will come from the top two exporters, India and Thailand. To put things in perspective, the combined stocks of India and Thailand are projected to be around 16 million tons by the third quarter of 2016—around 70% lower than in 2013. With Thai rice stocks dropping to 5 million tons by late 2016, the buffer that the Thai mortgage stocks provided to the market in the past two years will be almost gone by the end of this year.

But, more significantly, India's deteriorating grain situation is particularly worrisome to the market. In 2013, India exported 24 million tons of grains: 10.5 million tons of rice and 13.5 million tons of wheat and corn combined. In 2016, the combined exports of wheat and corn are projected to drop to 1.5 million tons because of weather-related supply problems. Some even predict that India will be a net importer of wheat and corn in 2016. The rice situation is not as bad as that of corn and wheat, but Indian rice exports are also expected to drop this year. The procurement stock as of 1 February 2016 was close to 29 million tons (milled rice equivalent), according to information available on the Food Corporation of India website (Fig. 3). The rice stock is not as much as it was three years ago but it seems to be at an acceptable level.

The problem for rice is likely to come from wheat, with an expected lower harvest in April and possible upward swing in the wheat price, which might drag rice prices upward, thus creating anxiety among policymakers. Ultimately, the 2016 wet-season rice crop, which accounts for nearly 90% of the total crop, will ultimately decide whether or not the government decides to restrict the flow of rice out of the country to stabilize domestic prices.

Uncertainty about India's situation in the coming months does not augur well for the international rice market and global food security. Also, major Asian importers such as Indonesia and the Philippines are battling their weather-related supply uncertainty and low inventory and have been aggressively procuring rice from the international market. On the positive side, global wheat stocks, which were at a record 215 million tons in 2014-15, are projected to go even higher by another 24 million tons this year (Fig. 4). This should provide some limited protection for prices in case there is a supply concern for rice in Asia in 2016.

It will be an interesting few months for the global market, which faces a tight supply situation for the first time since 2007-08. If the 2016 wet-season crop turns out to be normal in the major rice-growing

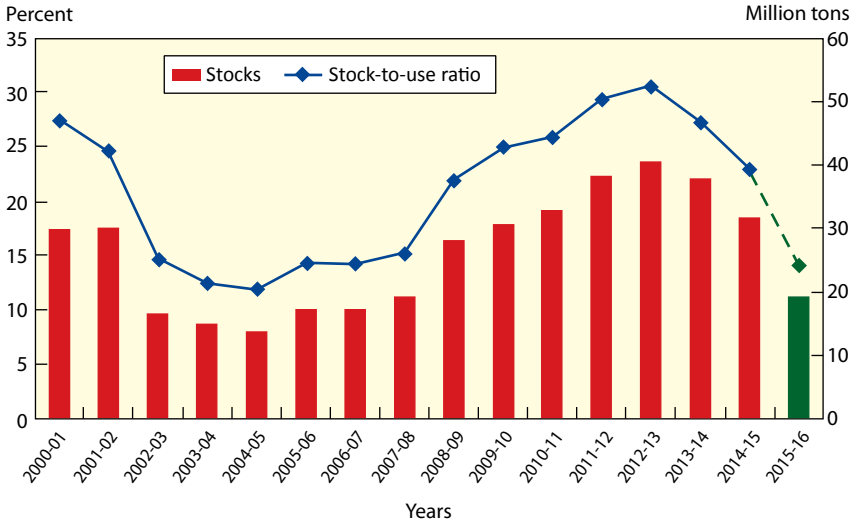


Fig. 2. Top five exporters rice stocks vs. stock-to-use ratio.*
Source: PSD Online Database, USDA (accessed on 12 February 2016).
*India, Thailand, Vietnam, Pakistan, and the United States.

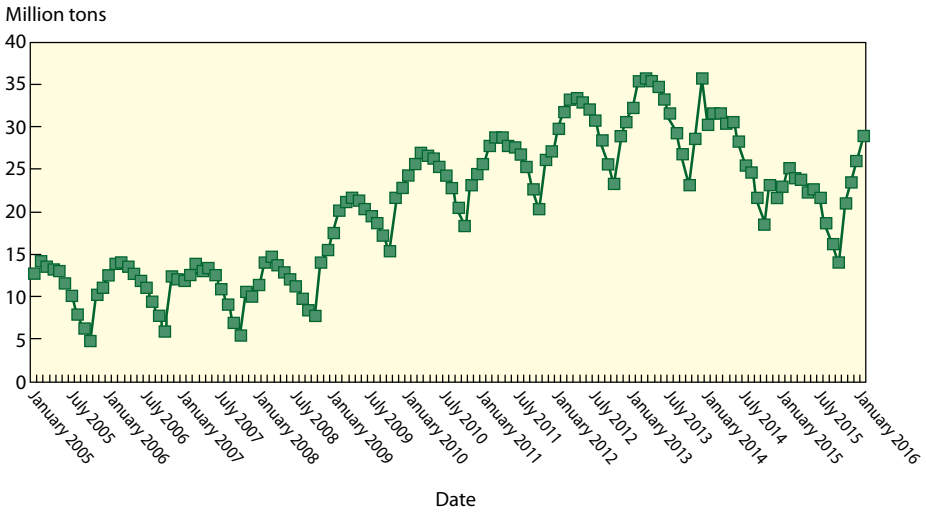


Fig. 3. Indian rice stocks in central pool (1 January 2005 to 1 February 2016).
Source: Food Corporation of India.

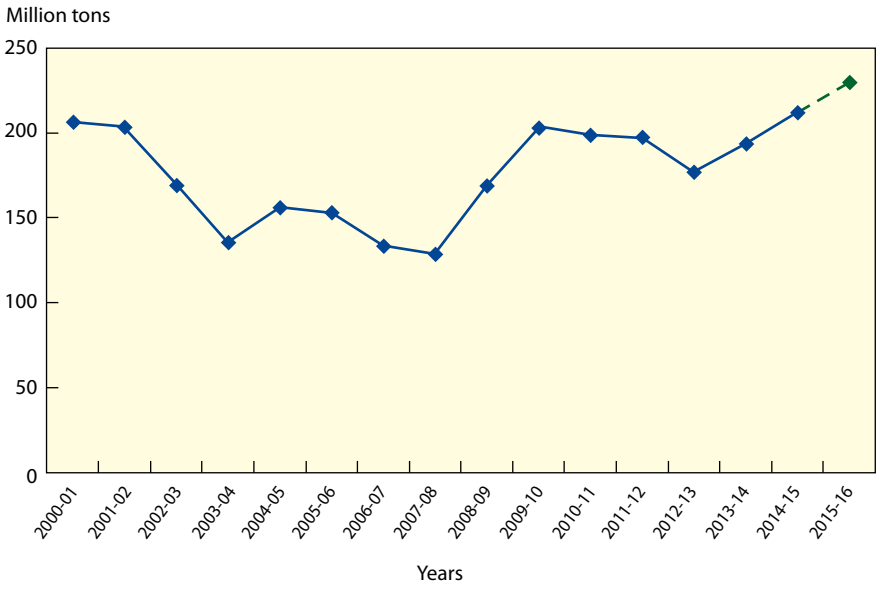


Fig. 4. Global wheat stocks.
Source: PSD Online Database, USDA (accessed on 12 February 2016).

PHOTO: IRRI

Late 2016 and early 2017 will be an interesting period for the global rice market. This will be the first time the market will be tested with a tight stock situation similar to what was witnessed in 2007–08.

countries, then the pressure on rice prices will be significantly relieved, and the market will likely remain fairly stable through early 2017. However, if the season is rocked by some major weather events such as drought, cyclone or typhoon, and flooding in a few major countries, the mettle of the market will definitely be tested. With limited Thai rice stocks in the warehouse, it remains to be seen how major exporting and importing countries react to such uncertainty. If they panic similar to 2007-08 and resort to excessive buying and export restrictions, then another price spike is in the offing. However, if they keep their cool and remain rational regarding their needs, the market price may still go up, but up only to a level that is consistent with market fundamentals. ■

Dr. Mohanty is the head of the Social Science Division and program leader (Targeting and policy) at the International Rice Research Institute.

Genebank tourism

by Michael Jackson

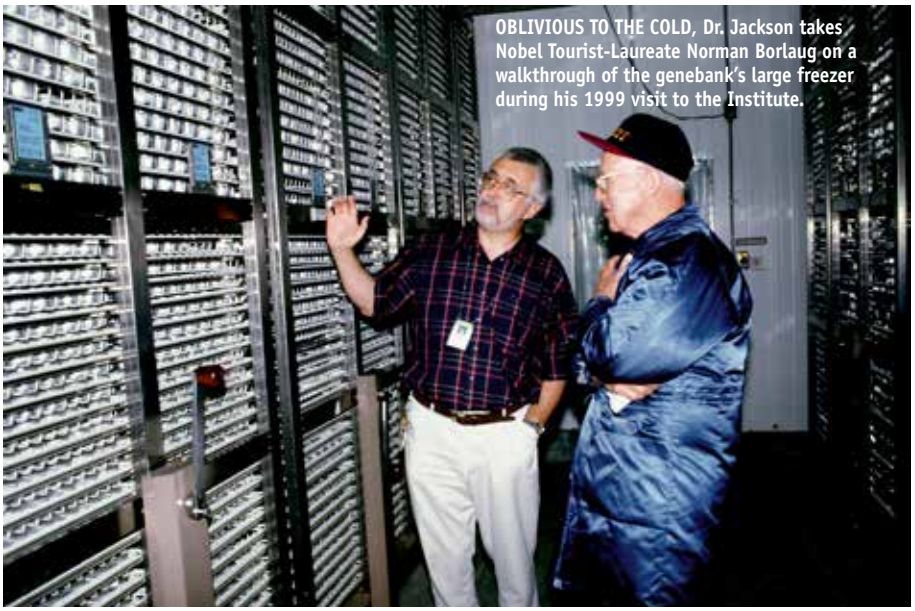
Even though I managed a large genebank for 10 years at the International Rice Research Institute (IRRI), I still don't fully understand why seeing lots and lots of packets of seeds in cold storage at -18°C—essentially a very large freezer—holds such a fascination for so many people. There's nothing particularly glamorous about that, but it just seems everyone wants to walk inside and see for themselves.

In a tropical country like the Philippines, this is a novel experience, of course. Not so at the Svalbard Global Seed Vault inside the Arctic Circle. I guess there are times of the year when it must be colder outside than inside. There again, that genebank has a particular attraction and significance.

Visitors to IRRI's genebank have ranged from royalty (Princess Maha Chakri Sirindhorn of Thailand, Prince Albert of Monaco, and The Duke of Gloucester from the UK); heads of state (from the Philippines, India, Lao People's Democratic Republic, and Myanmar to name just a few, even disgraced former President Fujimori of Peru); heads of government and other politicians (from Bangladesh, Vietnam, and the Philippines, of course); ambassadors and other members of the diplomatic community in the Philippines; Nobel Laureates such as Norman Borlaug (Peace, 1970) and Joseph Stiglitz (Economics, 2001); heads and representatives of donor agencies to IRRI; eminent scientists; and germplasm specialists with a particular interest in seeing how IRRI tackles the challenge of managing such a large germplasm collection.

Usually, I had just 10–15 minutes at most to describe why conserving rice seeds was so important for the future of rice agriculture—after all, rice is the staple food of half the world's population. Most visitors had never been inside in a genebank before, let alone seen the diversity of rice varieties, or, in fact, realized that such diversity even existed.

There's no doubt however that explaining the role and work of the genebank to these visitors is not only necessary, but it is a rather important aspect of genebank management. These visitors are "genebank ambassadors" and can spread the good word about the strategic importance of genetic conservation. Time (mostly) well spent! ■



OBLIVIOUS TO THE COLD, Dr. Jackson takes Nobel Tourist-Laureate Norman Borlaug on a walkthrough of the genebank's large freezer during his 1999 visit to the Institute.

The International Rice Genebank is the largest collection of rice genetic diversity in the world, holding more than 127,000 rice accessions and wild relatives for safe keeping and sharing for the common public good. It is a virtual universe that contains many important traits that rice breeders need, according to Ruaraidh Sackville Hamilton, an evolutionary biologist who succeeded Dr. Jackson.

"The diversity in the Genebank is massive," he says. "There is diversity for almost every conceivable trait, almost every conceivable development objective."

IRRI works to ensure the long-term preservation of rice biodiversity as a part of the global strategy for the conservation of rice genetic resources. This is in partnership with national programs and regional and international organizations worldwide, including the CGIAR Research Program for Managing and Sustaining Crop Collections.

Dr. Jackson started his career in genetic resources in the UK and Latin America during the 1970s and '80s and then spent 19 eventful years at IRRI (1991-2010) in various capacities—germplasm specialist and the first head of the Genetic Resources Center (created in 1991); program leader for Rice Genetic Resources: Conservation, Safe Delivery, and Use; and then, in a complete turnabout, director for Program Planning and Communications (in 2001). This GOT is based on one of his Balanced Diet *blog posts.*

Creating the Future
SATAKE

The changing market in Myanmar

Traditionally rice was a crop consumed locally in the country of production. However, in the last 20 years this trend has been changing rapidly. Exports of rice have doubled, reaching over 40 million tons in 2012. Among the already well-known exporters of rice (such as Thailand, India, and Vietnam) Myanmar has also shown a tremendous growth with exports of 800,000 tons in the year 2010 rising to 1,200,000 tons by the year 2014.

Under such a trend, the rice mills in Myanmar are rapidly transforming themselves to highly efficient, more modern production facilities. One such state of the art rice mill adopting the latest technologies from Satake has been completed in Naypyidaw, the capital of Myanmar. This was the first private rice mill to adopt the modern rice milling system in the region but many are set to follow. The rice mill includes complete processing lines from pre-cleaning, paddy husking, milling, fine grading, sorting and packing. Color sorters employed are of the latest model manufactured in Japan. The laboratory room is also equipped with a full set of laboratory equipment to control the product quality.

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