www.irri.org
Rice Today
International Rice Research Institute
January-March 2015, Vol. 14, No. 1

Rice in Latin America:
past, present, and promising future

Where's my GM rice?
Trends in global rice trade
Green revolutions 2.0 & 3.0: No farmer left behind

US$5.00 ISSN 1655-5422

contents

RiceToday Vol. 14, No. 1


NEIL PALMER/CIAT

About the cover. Veteran Peruvian rice grower Marina Mejía plants a kiss on one of her grandchildren, a potential next-generation farmer in the country's Rioja Province. Read about her story and the rise of rice on Peru's sacred ground beginning on page 20. (Photo by Adriana Varón Molina)

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).

Responsibility for this publication rests with IRRI. Designations used in this publication should not be construed as expressing IRRI policy or opinion on the legal status of any country, territory, city, or area, or its authorities, or the delimitation of its frontiers or boundaries.

Rice Today welcomes comments and suggestions from readers. *Rice Today* assumes no responsibility for loss of or damage to unsolicited submissions, which should be accompanied by sufficient return postage.

The opinions expressed by columnists in *Rice Today* do not necessarily reflect the views of IRRI or GRiSP.

International Rice Research Institute
DAPO Box 7777, Metro Manila, Philippines
Web: www.irri.org/ricetoday

Rice Today editorial
telephone: (+63-2) 580-5600 or (+63-2) 844-3351 to 53, ext 2725;
fax: (+63-2) 580-5699 or (+63-2) 845-0606; email: l.reyes@irri.org, info_ricetoday@irri.org

From the editor's desk

Expanding horizons in rice

As we usher in the year 2015, *Rice Today* continues to survey the near and far horizons of the rice world and report the latest on sustainable development, trade, and other issues that surround the favorite grain of half of humanity. So, what will the new year bring? We hope that it will bring more breakthroughs from rice scientists.

Rice Today will continue to examine the many issues that affect the rice industry across its value chain—from the overall economic and international trading conditions of rice and those that are alleviating poverty to resources and technologies that farmers are turning to for help with their rice growing.

In our first installment of 2015, we have a special set of six "ricetorical" pieces (pages 10-23) that chronicle the successes of breeding in Latin America and the Caribbean (LAC). We highlight the Latin American Fund for Irrigated Rice (FLAR) and its 20-year history of being the primary force behind the region's rice technology development. We feature two women in LAC who have put wind in the sails of the rice revolution in the region. Read about *A passion for growing rice in Venezuela*, which is a testament to how the country is working hard to regain its strength through expanding innovation in LAC. Read about *A four-decade quest to improve rice in Latin America and the Caribbean* by scientists at the International Center for Tropical Agriculture (CIAT) who have been developing an ideal rice plant type for the region's changing needs. Find out how a small country such as Uruguay has become an exporter in less than 100 years. (*Read Uruguayan rice: the secrets of a success story.*) And finally, learn about the *Rise of rice on Peru's sacred ground* as the country has become LAC's most important producer after Brazil. All these success stories would not have been possible without the region's spirit of working together and partnership.

Elsewhere in this issue, Sam Mohanty, senior economist at the International Rice Research Institute (IRRI), looks at the current trends in the global rice market (pages 40-42). We also report on outcomes during the Global Rice Market and Trade Summit that took place in Bangkok, 28-29 October 2014 (pages 36-39). Economists there discussed driving forces such as government policies, climate change, increasing population, and migration of farmers to cities among other factors that will most likely affect the global rice industry now and what it will take to attain an open and transparent rice trade in the future.

We have all heard about the Green Revolution. However, during his keynote address that opened the 4th International Rice Congress (IRC2014) in Bangkok last October, Robert Zeigler, IRRI director general, added a new twist, suggesting that a three-phase Green Revolution series actually exists, GR1.0, 2.0, and 3.0. He declared that GR2.0, which already started by his reckoning in July 2008, will be fruitful—and quicker than GR1.0—and that GR3.0, which will kick in around 2030, will stagger the imagination in what will be achieved. Read about Dr. Zeigler's intriguing presentation and his insights in *No farmer left behind* (pages 32-35).

Bas Bouman, director of the Global Rice Science Partnership (GRiSP), shares concrete examples of GRiSP's unprecedented successes worldwide in finding solutions to the problems in rice production, storage, and distribution through sharing of resources, ideas, and technologies among research development partners across the continents. Check his *Grain of Truth—GRiSP: Partnership for success* on page 43.

As shown by the GRiSP model, breeders are combining forces to modernize programs for an efficient and effective delivery of improved varieties and biotechnology tools are being improved all the time in accuracy and usability. However, some of these tools remain needlessly controversial and are being held back by politics, according to Mark Lynas, a former anti-GM activist, who gave one of the plenary presentations at IRC2014. He advocates bringing about a food-secure world this century by using both conventional and transgenic techniques to contribute meaningfully in helping marginalized sectors of society, particulary poor women and children. See pages 30-31 for his thoughts as he asks, *Where's my GM rice*?

On lighter notes, check out a Korean rice fable, *The good brothers* (pages 26-27), which centers on helping one another and fraternal love. And then try out our featured *What's cooking* recipe, Tah Chin saffron rice and chicken (page 28)—a very tasty Iranian dish!

Happy reading!

Lanie Reyes
Rice Today managing editor

News

Technologies for weed control in rice to lessen labor in Tanzania


J. RODENBURG, AFRICARICE

"Rotary-hoe weeders reduce weeding labor by 60–65% while herbicides reduce it by more than 80%," said Jonne Rodenburg, a weed scientist at the Africa Rice Center (AfricaRice). "However, farmers do not always use the herbicides correctly and this can negatively affect their health and the environment."

To help farmers in Tanzania learn how to use weed management technologies and boost their production, AfricaRice launched a project, *Building local capacities in weed management for rice-based systems*. To achieve this goal, the project targets not only the farmers but also research and development partners and the private sector, among those involved in rice production.

Twenty-two R&D professionals and 15 weed science students were trained initially through a workshop at the Sokoine University of Agriculture in Morogoro. They learned some weed control and management practices and how to use AFROweeds, an online interactive weed identification tool, as well as how to make use of Weedsbook, an open-access online African weed science network to enhance their networking capacities.

Blacksmiths drawn from all over the country took part in a training activity to fabricate rotary weeders, a machine to control weeds for lowland rice. It is hoped to make rotary weeders widely available to farmers at competitive prices.

To increase awareness among farmers, the project produced two farmer-to-farmer videos on labor-saving weed management technologies such as the rotary-hoe weeder and how to use herbicides safely and efficiently. The videos will be translated into four languages and distributed to at least 10,000 farmers and extension workers from the rice-growing areas in sub-Saharan Africa.

Source: http://africa-rising.net

New rice technologies to boost rice production in Africa

"Making innovations accessible to rice farmers could boost rice production, reduce imports, and increase food security in Africa." This was the recurring message in a recently held workshop organized by the Africa Rice Center. Attended by stakeholders in the rice production sector from Benin and Togo, the workshop, *Rice Innovation Fair of Scalable Technologies*, aimed to identify areas of collaboration to help deliver technologies to benefit farmers in rural populations.

Eleven technologies were discussed during the workshop, including new rice varieties, a high-capacity thresher for rice, a mobile application called RiceAdvice that provides tips on rice farming, mechanical weeders that could reduce labor in rice production, and a localized farmer advice for nutrient management.

"I am convinced that the dissemination of the technology and know-how on a large scale would certainly increase local rice production, ensure food security, and improve the living standards of farmers," said Daini Tsukahara, the Japanese ambassador to Benin.

Source: www.scidev.net

New partnership for rice development in Africa formed

R RAMAN, AFRICARICE

The Program for Rice Development in Africa, a partnership initiative, has been recently created to tackle the problem of inadequate rice production in Africa. Also with an aim to benefit governments and rice farmers across the continent, the Program will start in 23 countries in sub-Saharan Africa and will work closely with key rice development institutions and organizations in the region such as the Africa Rice Center.

"We expect this initiative to contribute to reducing high food import bills and to have an impact on small producers," said Bukar Tijani, FAO Africa regional representative.

Mr. Tijani added that the program will support synergies and comparative advantages, as well as lessons and experiences of key national and international institutions, and initiatives to promote food security and rice self-sufficiency in Africa.

Source: www.scidev.net

JEC NARCISO, IRRI

Vietnam, IRRI to craft strategy to boost country's rice industry

Vietnam's Ministry of Agriculture and Rural Development (MARD) supported a national strategy designed to make rice production an even larger engine of inclusive economic growth. Agriculture Minister Cao Duc Phat (at right in photo with IRRI Director General Robert Zeigler) and Vice Minister Le Quoc Doanh convened a multistakeholder effort to refine key elements of the strategy, which includes developing rice varieties with high export value, adopting advanced crop management techniques, and more intensive use of machines and other technologies in rice farming.

Together with the top leadership of the International Rice Research Institute (IRRI) and other public and private sector partners, MARD seeks rapid and sustained growth of the agricultural sector, especially the rice subsector in which Vietnam is already a global leader. The rice industry serves as the foundation of Vietnam's inclusive development success story.

Source: http://irri.org

Hybrid rice promoted for food sufficiency in the Philippines

WILLIAM STA. CLARA, IRRI

With the Philippines being part of the Food Basket Pillar of the Brunei Darussalam, Indonesia, Malaysia, Philippines-East ASEAN Growth Area (BIMP-EAGA), the planting of hybrid rice is currently being promoted on the islands of Palawan and Mindanao in a bid to attain food sufficiency, not only in the Philippines but also for the ASEAN subregion.

According to the DA Agri-Pinoy Rice Program, for the first quarter of 2014, the total area of hybrid rice plantations in the P-EAGA region was at 11,798 hectares.

Source: www.sunstar.com.ph

U.S. rice industry welcomes trade with Cuba

The U.S. Treasury's Office of Foreign Assets Control (OFAC) has published the new trade norms with Cuba in the Federal Register. This follows U.S. President Barack Obama's announcement to relax trade restrictions on food items that were in place as part of the 50-year embargo with Cuba. This would allow Cuban importers to make payment even while goods are in transit.

The regulatory changes were welcomed by the U.S. rice industry as Cuba is one of the closest export destinations to the U.S. and imports about 50% of its annual rice consumption needs. Farmers in the U.S. rice-producing states of Arkansas and Louisiana would benefit most from the revised policy. Up until now, U.S. government restrictions have limited the ability of the U.S. rice industry to compete in Cuba.

Source: www.ricepluss.com

Preparing Nepal's farmers for climate change

The Nepal government has launched three new improved varieties of paddy seeds—Sukhha dhan 4, Sukhha dhan 5, and Sukhha dhan 6—that are tolerant of extreme climatic changes. These varieties of paddy seeds, which can survive under stress and retain desirable grain quality, are likely to be released to farmers by June 2015.

These new varieties, also known as climate-ready rice, can tolerate drought for up to one and a half months and can grow under water-deficiency stresses. They have been recommended for the Tarai, inner Tarai, and river basin areas. Among these three rice varieties, Sukhha dhan 6 has the ability to re-grow even two weeks after submergence. It has an average yield of 4–4.5 tons per hectare and, under good irrigation conditions, the output can go up to 5.5 tons per hectare on average. The plant stands 125 cm tall and the maturity period is 120–125 days. Swarna-Sub1 and Sambha Mahnsuri-Sub1 rice varieties that are flood-tolerant have already been made available to farmers.

Source: www.ekantipur.com

Japan's largest supermarket chain adds rice paddies to farming ventures

Aeon Co. plans to add rice fields to its farming portfolio, possibly making it the nation's biggest corporate grower of the grain. Starting with 11 hectares of rice paddies leased from local farmers, its Aeon Agri Create Co. farming subsidiary will start producing the grain north of Tokyo in 2015, said Aeon spokesman Norihito Ikkai.

Chiba-based Aeon aims to lease 100 hectares—almost 50 times the average farmer's plot—by 2020. That would make it the biggest rice-producing company in the country, according to Arihiro Muroya, chief economist at Norinchukin Research Institute. Larger areas are farmed by cooperatives.

"We want to supply rice and vegetables to consumers at more affordable prices and in a stable way," Ikkai said. "As Japanese farmers are aging and retiring, we can take over production through our farming subsidiary."

Source: www.bloomberg.com

Government extends support for rice farmers in northern Ghana

The Northern Rural Growth Programme (NRGP) is advancing toward making rice a major export commodity in northern Ghana. Management of the NRGP is thereby encouraging smallholder farmers to adopt best farming techniques as a means of increasing the quality and production of rice. The program's national coordinator, Roy Ayariga, said that the government was committed to rebranding northern Ghana as the country's rice city. This, according to him, will attract multinationals to invest in rice production in the three regions in northern Ghana.

Source: www.citifmonline.com

Small-scale farmers deserve big share of climate funds: IFAD

As important food producers, small-scale farmers in the developing world should have a significant share of funds raised to help poorer countries adapt to climate change impacts and curb emissions, agriculture officials said at U.N. climate negotiations in Peru.

Investment in easy-to-access weather information, extension services, improved disaster preparedness, and other cost-effective and efficient new technology could help small-scale farmers keep feeding themselves and their families, they said.

Farmers "are more than victims of climate change impacts," said Gernot Laganda, head of the Environment and Climate Change Division of the International Fund for Agricultural Development (IFAD).

Source: http://uk.reuters.com

Vietnam eyes water-saving technology for its rice farms

Vietnam, along with Bangladesh and Colombia, recently partnered with the Climate and Clean Air Coalition (CCAC) to introduce large-scale application of alternate wetting and drying (AWD) technology (photos below), in which farmers periodically drain rice paddies rather than keeping them perpetually flooded. Aside from economic savings through lower water consumption and pumping costs, there is evidence that AWD can help crops perform better and improve soil conditions so that machines can operate more efficiently in the fields, says Björn Ole Sander, collaborative research scientist at the International Rice Research Institute, who is coordinating the effort.

But AWD is not without controversy. Adopting the irrigation method will increase nitrous oxide emissions. Still, given that paddy rice does not produce much nitrous oxide to begin with, the decrease in methane, which the crop produces in heaps, will more than offset any increase in nitrous oxide, says Dr. Sander.

Source: www.scidev.net

EDNA REYES, IRRI (2)

JICA partners with Nigeria on rice

The Japan International Cooperation Agency (JICA) is partnering with Nigeria in developing the agricultural sector in rice production with more than 3,500 Nigerians benefiting from its training program abroad.

The chief representative of JICA, Mr. Seki Tetsuo, disclosed this at a one-day seminar titled "Agribusiness and Investment" organized by the JICA Alumni Association of Nigeria in Abuja. He explained that JICA specifically targeted the rice subsector as a result of the comparative advantage that Japan has developed in rice production and processing over decades.

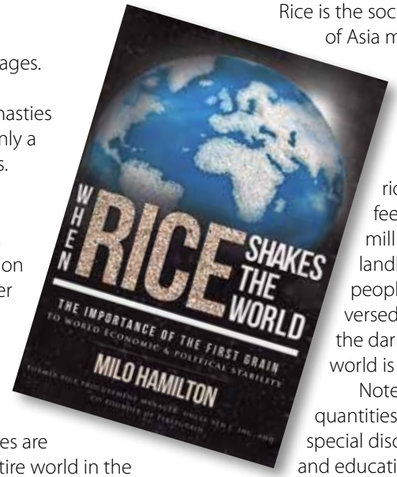
Source: http://allafrica.com

Books

When rice shakes the world: The importance of the first grain to world economic and political stability

by Milo Hamilton

Published by Advantage Media Group, 165 pages.



For millennia, rice has sealed the fate of dynasties and kingdoms in Asia but has remained only a cultural curiosity to Western financial markets.

Today, the food and agricultural markets of India and China are in motion. The history of agricultural change is littered with hunger, poverty, and failure. Will that curse pass itself on to this Asian generation? Or, is there a brighter future ahead of us?

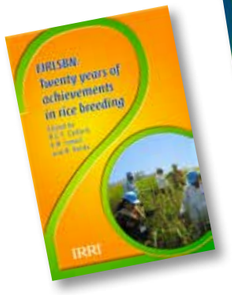
China is rapidly becoming the wealthiest country in the world. China's water shortages and its rice market are fault lines that finger their way beneath the surface of the world economy. These fault lines are sending out tremors that could shake the entire world in the next few years.

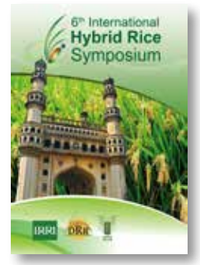
Rice is a little grain but a big deal in Asia. The Great Wall of China is cemented together with sticky rice. Rice uses up to 70% of the water resources of China. The crop's 200 million farms feed 3 billion people. Yet, it is grown on an area the size of France.

Rice is the social cement of Asia and the rice farms of Asia may crack that ancient cement. This book explains the ancient yet curiously modern story of rice that binds feudal farms to the new super cities across China.

At the center of this story is the rice farmer, whose backbreaking labor feeds millions. In the next 15 years, millions of farmers must transition from landless serfs into modern business people skilled in all the technologies and versed in market risk. The rice world lies on the dark side of this digital earth. But, that world is turning rapidly toward the light.

Note: The book is available in bulk quantities and in customized versions at special discounts for corporate, institutional, and educational purposes. To learn more, please contact the Special Sales team at 1 866 775 1696, sales@advantage.com. Read about the author and buy the book at http://advantagefamily.com/milo-hamilton-bio/.





Find and download IRRI books at http://books.irri.org

TRAINING COURSES AT IRRI

Course title	Date	Venue
Scientific Writing Workshop	2-6 March	IRRI, Philippines
Rice Production and Research Course *(by invitation only)*	9-20 March	IRRI, Philippines
Rice Breeding Course	16-27 March	IRRI, Philippines
Research Data Management	17-19 March	IRRI, Philippines
Basics of Rice Production *(1st offering)*	6-8 April	IRRI, Philippines
ORYZA Training Program for Beginners	13-17 April	IRRI, Philippines
Rice: Postproduction to Market *(1st offering)*	13-24 April	IRRI, Philippines
Effective Presentation Skills Workshop	28 April	IRRI, Philippines

For inquiries, contact IRRITraining@irri.org, m.maghuyop@irri.org, or a.aquino@irri.org. Phone: (63-2) 580-5600 ext 2538 or +639178639317; fax: (63-2) 580-5699, 891-1292, or 845-0606; mailing address: The IRRI Training Center, DAPO Box 7777, Metro Manila, Philippines (Attention: TC Course Coordinator); Web site: www.training.irri.org.
Note: Fees and schedules are subject to change without prior notice.

Making rice more competitive in Latin America

by **Eduardo Graterol**

For 20 years, FLAR has been the primary force behind the region's rice technology development and it is looking forward to future challenges

"Twenty years is nothing," say the lyrics of a 1930s' song. But, in 2015, as the Latin American Fund for Irrigated Rice (FLAR) celebrates its 20th anniversary, many of the Fund's members might not agree. For them, FLAR's 20 years have been filled with achievement, and they're looking forward to more.

From the 1960s to 1980s, international rice breeding in the Latin America and the Caribbean (LAC) region carried the brand of the International Center for Tropical Agriculture (CIAT). But, by the mid-1990s, funding for CIAT's Rice Program had declined, and there was a lot of uncertainty about the future. This had many people worried, and for a good reason, because CIAT had contributed to the development of about 60% of the more than 400 improved varieties released in LAC.

CIAT (3)

FLAR BRINGS together farmers' associations, national agricultural research institutes, government ministries, seed companies, and the rice milling industry, together with CIAT to ensure that research and technology transfer meet the needs of its members. The two photos were taken when members of FLAR gathered during its first technical meeting in 1995.

Pioneering vision

Uncertainty and concern plus the pioneering vision of a few key people provided the necessary inputs for the groundbreaking creation of FLAR. Time has proven that they had the right idea.

CIAT took the initiative to create FLAR and soon won support for it from Colombia's National Rice Growers' Federation (Fedearroz), Uruguay's National Agricultural Research Institute (INIA), Venezuela's Western Plains Association of Certified Seed Producers (Aproscello), and the Rice Institute of Rio Grande Do Sul (IRGA) in Brazil. The Fund has since evolved into a strong and fully regional organization, which encompasses 36 public and private sector partners in 17 countries, and it influences two-thirds of the 5.7 million hectares sown to paddy rice in LAC and about 80% of the 27.8 million tons produced.

Through FLAR, diverse actors in the rice value chain—including farmers' associations, national agricultural research institutes, government ministries, seed companies, and the rice milling industry, together with CIAT—all invest in a shared agenda to ensure that research and technology transfer meet the needs of its members. A unique feature of the Fund is its ability to reconcile diverse interests around the common pillar of technology development.

THROUGH FLAR, 54 rice varieties have been released in 14 countries, a strong testimony of FLAR's success in rice breeding.

Testimony to success

Every year, FLAR delivers elite rice germplasm to a network of 23 breeding programs, operated by about 150 rice breeders and technicians at more than 100 experimental stations. The 54 rice varieties released so far in 14 countries give a strong testimony to the success of FLAR's breeding effort.

Juana Viruez, a rice breeder at the Center for Research on Tropical Agriculture in Bolivia, says that FLAR's germplasm has been fundamentally important for her country. Of the 30 rice varieties released by the center, six were selected from FLAR nurseries, including MAC-18, the country's most widely grown variety. Roberto Celi of Ecuador's National Institute for Agricultural and Livestock Research (INIAP), explains how receiving advanced lines from FLAR saves time and resources in field evaluations. INIAP also uses FLAR materials as parental lines in its own crosses.

Rice breeding, however, is just part of FLAR's portfolio. Partners in 12 countries work with the Fund to adopt the best agronomic practices for their agroecosystems. This work has had a direct impact on more than 500,000 hectares, with average rice yields increasing by 1.5 tons per hectare and production costs declining by 20–30%.

Mario Torres of Cindearroz, a consortium of 13 organizations working on rice research and development in Mexico, believes that new long-grained varieties, introduced by FLAR and released by the country's National Institute for Research on Forests, Agriculture, and Livestock (INIFAP)—together with FLAR-supported work on rice agronomy—will make farmers more competitive. "Our goal is to reduce rice imports by 30% over the next 4 years," says Mr. Torres.

With partners in Mexico and Nicaragua, FLAR has undertaken projects on water harvesting, which aim to switch from rainfed to irrigated rice production. This work has helped smallholder rice farmers to diversify their systems with maize, beans, livestock, and other options, thus boosting rural income and employment, among other benefits. Norman Oviedo, manager of SENUMISA, a private seed company in Costa Rica, suggests that "more should be done on water harvesting in my country and others in the region, where most rice-growing areas are rainfed, even though there's huge potential to capture runoff water from the rains for irrigation."

Looking forward

From its inception, FLAR has been an integral part of CIAT, and CIAT has always been a Fund member. The rice research of the two organizations is complementary and more closely aligned than ever with the needs of the end users of the technologies that are delivered.

But it pays to be cautious: FLAR's past successes with its partners provide no guarantee of future success. In the face of climate change, low yields, pest problems, land degradation, high production costs, inadequate infrastructure, and adverse policies, LAC's rice sector needs more investment, more partnerships, and more innovation. This is crucial for making rice production more competitive.

Competitiveness is the central theme of the XII International Rice Conference for Latin America and the Caribbean, being held in February 2015 at Porto Alegre, Brazil. Organized by IRGA, CIAT, GRiSP, and FLAR, this is the region's biggest rice science meeting and also the occasion on which the Fund is celebrating its 20th anniversary.

The organizers couldn't have chosen a more appropriate theme: "horizons for competitiveness." The message is that we look forward to seizing new opportunities, no matter how difficult the current situation may seem. FLAR will be there to help bring these opportunities within the reach of all of its members.

Dr. Graterol is the executive director of FLAR.

A tale of two women leading rice revolutions in Latin America

by **Adriana Varón Molina**

Patricia Guzmán (left) and Salomé Tupa deliver on the promise of women's hard-won leadership in a traditionally male-dominated rice sector

NATHAN RUSSELL, CIAT

Salomé Tupa took a sip of hot coffee, hoping it would help her cope with the suffocating heat, as she listened intently to her colleague Patricia Guzmán, who was delivering the welcome remarks at an event for rice researchers. It was the opening session of the technical committee meeting and rice selection workshop for the tropics, held by the Latin American Fund for Irrigated Rice (FLAR) with representatives of its member organizations, at Colombia's National Rice Growers' Federation (Fedearroz) in Villavicencio. Along with Ms. Tupa and Ms. Guzmán, plant breeders and researchers from all over Latin America came in search of the best rice varieties for further testing in their home countries.

The making of a Colombian comeback

Addressing an audience of more than 50 scientists, Ms. Guzmán emphasized the importance of improved production technologies, easier access to credit for farmers, and more training for technicians. She spoke with the confidence that her 25 years of work in the rice sector have given her and with the responsibility that comes with being the technical manager for Colombia's principal rice growers' association.

Ms. Guzmán's words were clear and convincing. After the session, she retired to a provisional office; her permanent workplace is in Bogotá, 115 kilometers from Villavicencio. She answered emails, accepted invitations to give more presentations, arranged a meeting with her boss, and organized visits to various Fedearroz experiment stations and farmers' fields for follow-up on her organization's new flagship initiative—Amtec—the Spanish acronym for a name that means "massive technology adoption."

Ms. Guzmán studied agronomy at the University of Tolima and earned her master's degree in agricultural science, with emphasis on plant pathology, from the National University. Her work with Fedearroz started in 1989. For 15 years, her job was to combat disease problems through research and technology transfer. Later, she took up the challenge of managing a business, *Central de Granos de Coclé* (Coclé Grain Central), in Panama. But, like "the good child" of a traditional Colombian saying, Patricia eventually came home, returning to Fedearroz in January 2011 as technical manager, the first woman to occupy this post in the organization's 70-year history.

Ms. Guzmán readily admits that these have been tough times. Over the past 5 years, Colombia's average rice yield has dropped by 1 ton per hectare, from 6.2 to 5.3 tons (although 2014 saw a slight increase in productivity). Part of the problem is the rice sector's vulnerability to the effects of climate change.

In the face of this challenge, Ms. Guzmán has shown leadership, visiting other rice-producing countries, building alliances with international and national organizations, and working closely with the Colombian government to find ways of lowering production costs and raising yields on around 438,000 hectares sown to rice in this country.

"Our goal is to first achieve national self-sufficiency in rice and then within 8 years be ready to penetrate international markets," said Ms. Guzmán. To this end, she'll keep working with Colombia's rice growers in their fields, because "that's where the problems are and also the solutions."

Breathing new life into a Bolivian rice growers' association

The technical discussions in Villavicencio lasted 2 days giving rice researchers a good overview of recent advances in genetic improvement for Latin America. Over the next 3 days theory gave way to practice as the Santa Rosa experiment station, where the workshop was held, became an epicenter for the selection of elite rice lines.

That's when Ms. Tupa came to life. She didn't care anymore about the 30-degree heat; as the sky cleared, she immersed herself in the rice fields and began feeling right at home.

SALOMÉ TUPA selecting elite rice lines at the Santa Rosa experiment station in Villavicencio, Colombia.

PATRICIA GUZMAN with CIAT researcher Sylvain Delerce examining rice disease symptoms at Monteria, Colombia.

ADRIANA VARÓN MOLINA, CIAT 2

Accompanied by her colleague James Cabrera, Ms. Tupa made the rounds of the experimental plots. Her mission: to identify rice varieties that might give good results on Bolivian soil. Like Ms. Guzmán, she went about this task with the assurance gained from 25 years of working in the rice sector and also with the responsibility that comes with leading Bolivia's most important rice growers' organization, the National Association of Rice Cooperatives (Fenca).

Before taking up her current post, and while still working in support of Fenca's technical management, Ms. Tupa was invited to visit South Korea. During her 21-day trip, she had a close-up look at the extraordinary experience of Korean rice growers. This encouraged her to accept the offer of a new leadership role in her own country's struggling rice sector.

The immediate challenge was getting the nearly extinct association back on its feet. The year 2012 was the most difficult in Fenca's 50-year history. Of the 60 cooperatives that originally made up the association, only 10 remained. In a race against time, Ms. Tupa began to organize events; to build strategic alliances with public and private sector organizations, both locally and abroad; and to show Fenca members, both former ones and those remaining, that the association was by no means a lost cause. One of her main projects, as the first woman to lead Fenca, is to train member cooperatives in the six steps that make up FLAR's initiative on improved crop management for higher yields.

"The rice sector had to either transform itself or die," says Ms. Tupa, who was born in the city of Potosí but grew up in Santa Cruz de la Sierra, where she earned a bachelor's degree in agriculture at the Bolivian Evangelical University. "We couldn't keep on making the same mistakes. We had to learn more about new technology for precision crop management, about options for helping farmers obtain credit, and about working as a team to move ahead."

Ms. Tupa inherited her commitment to rice production from her parents; farming is in her blood. That's why, in addition to leading Fenca, she also finds time to tend to her own 50-hectare farm, which she sows to upland rice. Her husband and two small children claim their share of her time as well. But she'll keep working to regain credibility and confidence among the cooperatives that have said goodbye to Fenca.

Delivering on the promise of women's leadership

These are the challenges and achievements of Patricia Guzmán and Salomé Tupa. While living and working on distant lands, they are united by a shared commitment: to deliver on the promise of women's hard-won leadership in Latin America's traditionally male-dominated rice sector.

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

A PASSION for GROWING RICE in Venezuela

by **Adriana Varón Molina**

The country's rice sector is working hard to regain its strength by expanding culture of innovation

OSCAR ALVAREZ is improving his rice yields on rented land in Portuguesa State through improved management.

ADRIANA VARÓN MOLINA, CIAT (2)

Finding a way to increase rice production in the country with the largest petroleum reserves in the world—and thus ample means to pay for imports—has posed a colossal challenge for Venezuela's farmers over the last 4 decades. Today, they produce about 1 million tons of paddy rice annually—down 300,000 tons from 8 years ago. But the country's rice sector is working hard to regain its strength of an earlier 20-year period, when it not only met local demand but also exported its surplus to its neighboring countries.

For now, though, Venezuelan growers can supply only 65% of the rice consumed domestically—about 1.2 million tons. According to Pedro Luis Cordero, president of the National Rice Foundation (Fundarroz), the breaking point for the country's rice growers came in 2006, when the government changed the rules of the game, pushing production in both the public and private sector to the edge of the abyss.

Since then, growers have been hard pressed to obtain inputs, such as seed, fertilizer, and replacement parts for agricultural machinery, and have met with logistical obstacles in transporting harvested grain. Against this background, a resurgence of rice in Venezuela has just one thing going for it: an expanding culture of innovation.

Six steps to success

Farmer Rafael Urdaneta, though originally from the city of San Cristóbal, began growing rice 23 years ago near Calabozo in the state of Guárico, one of Venezuela's main rice-growing areas. He has decided to give new crop management practices a try on his 600 hectares, following to the letter the six key steps that Fundarroz and the Latin American Fund for Irrigated Rice (FLAR) are promoting to boost productivity. His reward is rice yields of 8–11 tons per hectare, well above the national average of 4.27 tons.

Adjusting the planting date and density, using treated seed to ward off disease pathogens, ensuring proper weed control and fertilization, and managing water adequately are the practices that have made the difference for Mr. Urdaneta.

"The key is using exactly the right amount of inputs and planting at the optimum time to realize the full genetic potential of the improved varieties," says Mr. Urdaneta, a beneficiary of the Guárico River Irrigation System. He cites two other factors that also help account for the unprecedented rice productivity in his fields: direct seeding and his passion for what he does.

Crazy neighbors

About 500 kilometers away, near Majaguas in the state of Portuguesa, other passionate farmers are following the six points to success as well, in addition to using direct seeding in their rice fields. Eubencio Terán, Óscar Álvarez, Venturino Cicconetti, and Nicola Campo have all exchanged conventional production practices for the new approach. After several years of trial and error, they now serve as models for other farmers who visit their fields to see their secret formula.

"We started rotating rice with other crops such as maize, sugarcane, and soybean, and we've also adopted direct seeding and now plant in straight lines rather than in contour lines," says Mr. Cicconetti, who boosted his average rice yield from 5 tons per hectare to 9–11 tons. "We've gone from three rice harvests annually to two or just one, and we're using newer machinery."

Mr. Terán is following Mr. Cicconetti's footsteps. Four years ago, he began rotating crops on his farm, *La Celinera*: irrigated rice in the dry season and rainfed maize in the rainy season. Mr. Terán now harvests 8 tons of rice and 5 tons of maize per hectare. But still, he has set his sights on the goal of raising the yield of both crops by 2 tons per hectare.

"Before, people called me the 'crazy neighbor.' They were convinced that the new technologies would fail," says Mr. Terán, who has been farming for 25 years. "There are still some small-scale farmers in this area who are reluctant to change, but there are also a lot more crazy neighbors like me."

Racing to close yield gaps

In Venezuela's race to raise rice productivity and close yield gaps, various organizations deserve recognition for their efforts in support of this work. FLAR, the International Center for Tropical Agriculture (CIAT), and several national organizations—including Fundarroz, the Western Plains Association of Certified Seed Producers (Aproscello), the Venezuelan Federation of Rice Producers' Associations (Fevearroz), the Danac Foundation, and other public and private sector actors—have joined forces, using their respective experiences with innovation in technology development, genetic improvement, and marketing to restore the country's self-sufficiency in rice.

Daniel Brito, a Fundarroz agronomist and extension officer, is in charge of the program for technology transfer in the state of Portuguesa. Every week, he visits farmers in the region who are following the six steps as well as those who haven't yet decided to take the technological leap. "The idea is to increase the number of rice growers to learn about successful experiences and to adopt innovative practices on their farms," says Mr. Brito.

According to Fuaz Kassen, the president of Fevearroz, Venezuela's rice growers can satisfy local demand and cater to Central America and the Caribbean markets. "The future of rice in Venezuela lies outside the country," he says. "We need more capital investment to expand production into new areas and the adoption of new technologies with state support."

Apart from giving Venezuela plenty of "black gold," nature has provided it with other riches as well, including fertile land, abundant water, and an ideal climate. These, together with new technologies, should suffice to allow innovative rice growers to regain control of the nation's food security, win back former clients, and open new pathways toward rice exports.

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

SOME VENEZUELAN farmers, such as Venturino Cicconetti, rotate their rice crops with maize for making silage.

A four-decade quest to improve rice in Latin America and the Caribbean

by **Edgar Torres**

For four decades, rice scientists at the International Center for Tropical Agriculture (CIAT) have been developing an ideal rice plant type for the region's changing needs

CIAT (2)

The past 40 years have seen major advances in rice improvement for the unique and diverse growing conditions of Latin America and the Caribbean (LAC). The Rice Program of CIAT has contributed greatly, working in collaboration with its many national partners.

In search of an ideal grain

Each new rice variety is an expression of the ideal plant type that the breeder has in mind. This is one of the insights that guided the work of renowned rice scientist Peter Jennings, who led CIAT's research on the crop in its early years. During a four-decade quest to boost yield potential, CIAT breeders and their partners developed hundreds of rice varieties—some of which demonstrate the steady genetic gains in yield amounting to 3.4 tons per hectare—and accruing over 32 years between the release of CICA 8 in 1978 and the development of the elite line CT21375 in 2010.

This finding comes from an experiment for measuring the amount of increase in performance that is achieved through artificial genetic improvement (or genetic gain) programs designed by the author and Camila Rebolledo, a rice physiologist, at CIAT in Palmira, Colombia. The idea was to evaluate 17 rice varieties (see Figure) grown under the same conditions and agronomic management for two seasons.

The experiment showed genetic gains in yield (an annual average of 106 kilograms per hectare) as well as changes in other traits that characterize the plant types developed over four decades. The resulting rice plants produced more total biomass, are higher yielding, and are more efficient because they waste less energy on unproductive tillers. Instead, these plants produce stems that mostly develop large and fertile panicles with more grains.

The plant type that has guided much of the work of CIAT's Rice Program since its beginnings was developed at the International Rice Research Institute (IRRI) in the early 1960s and reached CIAT through the variety IR8 (see *Breeding history* on page 34-38, Vol 5, No. 4 of *Rice Today*). The design of this plant type allows more sunlight and less lodging (or falling over), and responds efficiently to fertilizer.

In 2002, Dr. Jennings and other researchers proposed to develop another plant type based on results obtained by CIAT's Rice Program through selection under direct seeding. This plant type has an adequate number of panicles containing more full grains, while staying green longer, thus increasing its productive period, and it has greater height. This experiment showed that combining several traits can effectively raise yield potential in rice—a key aim of CGIAR's IRRI-led Global Rice Science Partnership (GRiSP).

FERTILE SPIKELETS are a prerequisite of fertility.

Outwitting rice diseases

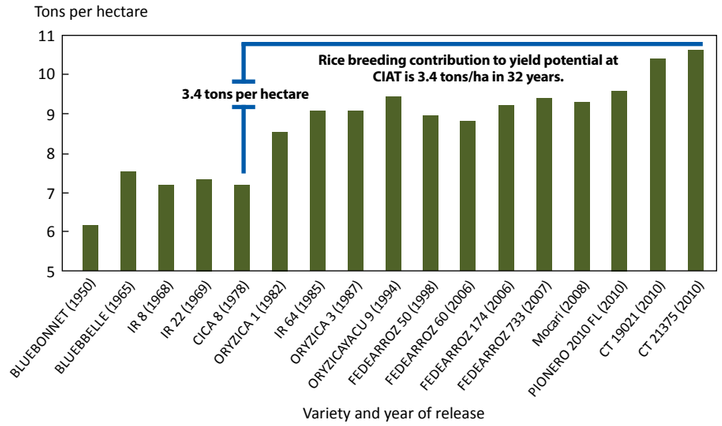
CIAT's Rice Program has devoted considerable effort to combating pest and disease threats, especially rice *hoja blanca* virus and rice blast (caused by the fungus *Pyricularia oryzae*).

Genes conferring resistance to hoja blanca were found in tropical japonica varieties such as Takao Iku 18 and its offspring, Colombia I, as well as in African lines, such as IRAT 120. Just as critical were the methods developed to check rice for resistance to both the virus and its insect vector under controlled conditions.

Dealing with rice blast required an innovative approach designed by Dr. Jennings, which involved combining desirable traits, known as gene pyramiding, through multiple crosses between diverse sources of resistance from plants from different locations.

The idea was to combine different genes that had evolved with the pathogen separately, making the pathogen unable to accumulate all of the virulence genes needed to overcome disease resistance. In addition, rice plants will be selected for resistance under a wide fungus diversity at the Santa Rosa experiment station in Villavicencio, Colombia—a "hotspot" site with exceedingly high levels of rice blast—that has optimal conditions for disease development.

Segregated populations were moved between CIAT headquarters in Palmira—where rice is transplanted, complete irrigation is used, and conditions are very favorable for high yield—and Santa Rosa—where direct seeding is used and rice is grown under rainfed conditions with more stresses, in general, to enable the plants to adapt to wider environments. The results were excellent.



Average yield of commercial varieties evaluated at Palmira, Colombia, in the 2012 cropping seasons.

Innovators in abundance

Breeding rice for resistance to rice blast under direct seeding in favorable upland environments led to many useful innovations. One was a system for detecting rice blast, developed and improved by Dr. Carlos Bruzzone, Dr. Edward Pulver, Dr. Jennings, and other researchers.

Dr. César Martínez and Dr. Surapong Sarkarung devised an approach for selecting rice in uplands with acid soils. Dr. Martínez also developed superior lines using wild rice relatives, such as *Oryza rufipogon*. Dr. James Gibbons contributed excellent varieties and crosses, including CT8008, which gave rise to more than 12 varieties in Latin America.

Dr. Elcio Guimarães, CIAT's regional research director for LAC, and Dr. Marc Chatel undertook rice improvement through recurrent selection, using methods developed by the Brazilian Agricultural Research Corporation (Embrapa) and French Center for Agricultural Research for Development (CIRAD).

Manuel Rosero, Federico Cuevas, and Luis Eduardo Berrío disseminated thousands of improved lines through the IRRI International Network for Genetic Evaluation of Rice (INGER), leading to the development of important commercial varieties; Mr. Cuevas and Mr. Berrío also devised a method for delayed harvest under controlled conditions to select for high milling yield.

Plant pathologist Robert Zeigler, now IRRI director general, improved selection methods for rice blast and rice hoja blanca virus. Several innovative concepts, such as lineage exclusion, were introduced by Purdue University Professor Morris Levi and Fernando Correa, currently with RiceTec Solutions, to facilitate the development of blast-resistant varieties. Economist Luis Sanint conceived and played a critical role in creating the Latin American Fund for Irrigated Rice (FLAR), which works with rice organizations across the region through plant breeding and other activities in an integrated approach designed to make the sector more competitive.

Tangible results of CIAT's and FLAR's ongoing collaboration with Colombia's National Rice Growers Federation (Fedearroz), which focuses on improving yields, grain quality, and disease resistance, while stabilizing production, include varieties such as Fedearroz 50, Fedearroz 2000, Fedearroz 60, and Fedearroz 174. Edgar Corredor, Pompilio Gutiérrez, James Gibbons, and Luis Berrío all contributed importantly to this work.

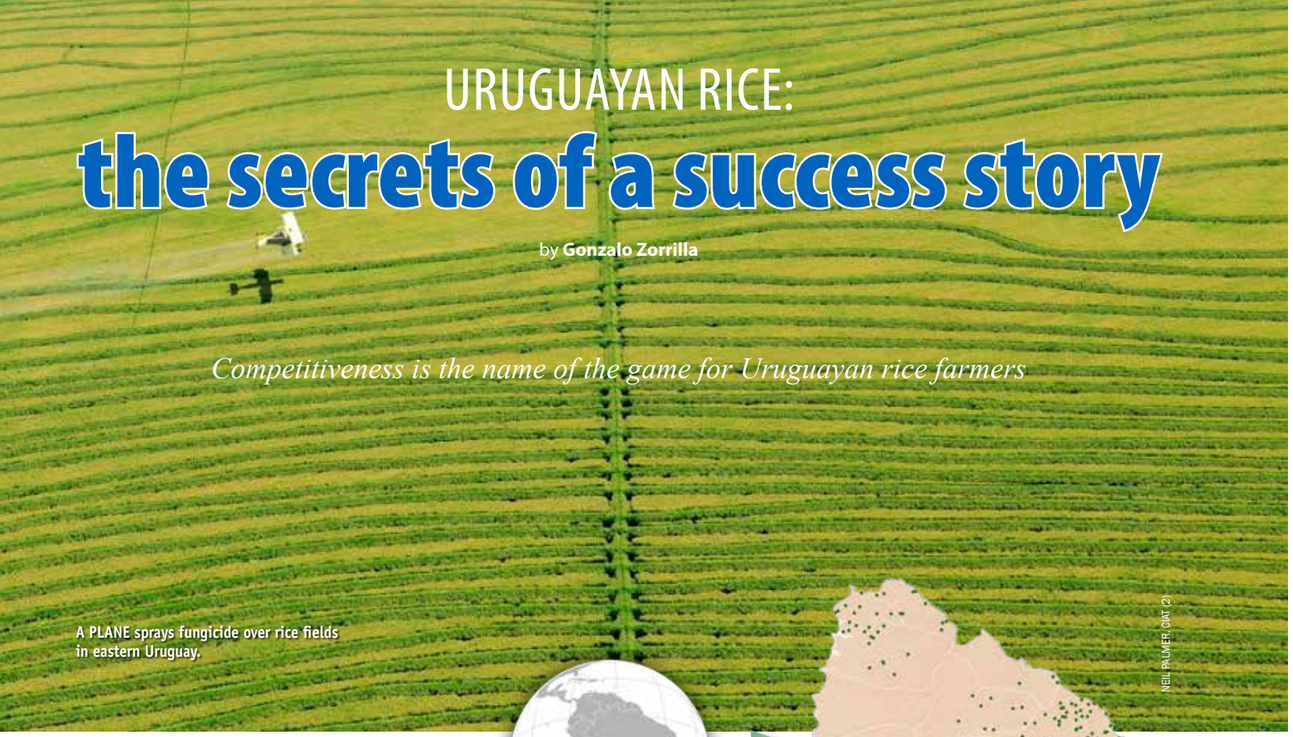
Recent years have placed new demands on rice research, including greater resilience in the face of the impacts of climate change, higher yield potential, superb grain quality, and more competitive rice sectors overall. A new generation of rice researchers has arisen to confront these challenges, benefiting from new tools and more abundant information. Even so, they still look to the past for inspiration in confronting future challenges.

Edgar Torres is leader of the Rice Program at CIAT.

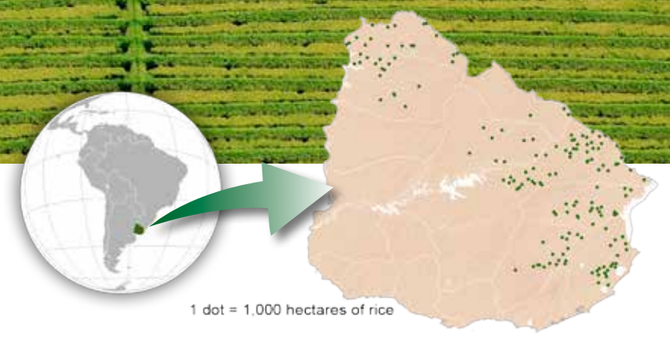
URUGUAYAN RICE: the secrets of a success story

by **Gonzalo Zorrilla**

Competitiveness is the name of the game for Uruguayan rice farmers



A PLANE sprays fungicide over rice fields in eastern Uruguay.



NEIL PALMER (CIAT (2)

Uruguay is a small country in the Southern Cone of South America, located in a corner between the Río de la Plata and the Atlantic Ocean. Rolling hills, excellent natural grasslands, and temperate climate have made the country a perfect place for beef, wool, and dairy production, while typical temperate agriculture has been a tradition since the early period of the Spanish colonization. The country's traditional products are wheat, barley, sunflower, and maize, with soybean dominating the scene these days.

Rice is a relatively new crop. The first rice fields were recorded back in 1926. In less than 100 years, Uruguay developed an export-oriented rice production system that grew continuously on up to 180,000 hectares (Fig. 1). The country has attained high yields and a premium position in the international market. Having a tiny fraction of world rice production, it is seventh on the list of rice-exporting countries, behind only the big players.

Farmer-miller alliance

How has this happened in the most intervened and protected grain market in the world? Natural conditions favored rice production with good land, abundant water, and climatic conditions affecting high potential for an irrigated crop. But the key to the country having a competitive and successful position as a rice exporter was the private and public institutional array of support that was constructed over time.

Farmers and millers organized the Rice Farmers' Association (ACA by its Spanish acronym) and the Rice Millers' Association (GMA by its Spanish acronym) in the late 1940s. Since then, both organizations have been articulating all aspects of the rice agribusiness chain, knowing that each has specific needs and interests, but that both are in the same boat of the rice industry. The best example of this integration is a private rice price agreement, which is based on transparency between ACA and GMA in which, for more than 50 years, the final value the farmer receives depends on the total value of rice from one season (exported and sold internally), less the milling cost and a fixed millers' gain.

This farmer-miller alliance was reinforced with sound government policies that, without intervening in the markets or with prices, helped producers with roads, electricity for irrigation pumps, opening markets with country-to-country agreements, and farmer and miller loans, among other things.

Institutional innovations

In 1970, *Estación Experimental del Este* (Eastern Experimental Station) was established, which started local research and innovation for rice. Since its early days, research has been highly integrated with ACA and GMA, thus ensuring well-oriented, demand-focused actions. In 1980, a government–rice sector agreement channeling private funds to Estación Experimental del Este started the research investment of farmers and millers in Uruguay.

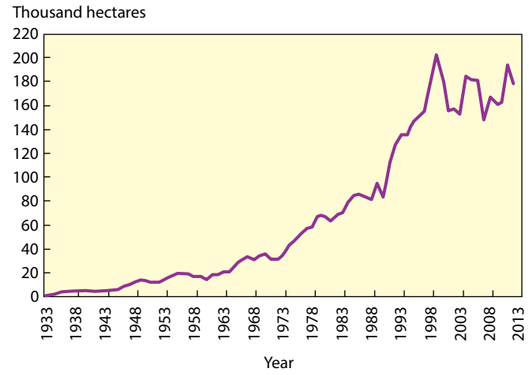


Fig. 1. Rice area in Uruguay.

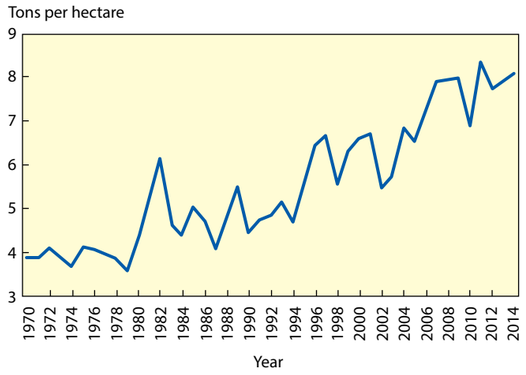


Fig. 2. Average rice yields in Uruguay.

Estación Experimental del Este became *INIA Treinta y Tres*, with the creation of the National Institute for Agricultural Research (*Instituto Nacional de Investigación Agropecuaria*, INIA) in 1989. INIA was established as an institutional innovation that had its roots in the rice farmers' experience, in which government and farmers' funds come together. This is recognized in the Institute board, of which half of the members are elected by the Ministry and half by farmers' associations.

In the last 40 years, a whole technological revolution based on local research took place, resulting in the highly competitive indicators today. Now, 90% of the area is planted with national varieties, which were developed by considering not only agronomic and high-yielding traits but also the highest standards of grain quality, and taking into account the markets to which Uruguay exports.

All rice is planted in dry soils with minimum tillage and using no-till planters that are adapted for planting over levees. The country's rice production is extensively mechanized, with an average farm size of 300 hectares. Rice is planted in rotation with pastures, with a typical rotation of two years of rice and three years of grasses and legumes, which allow for highly productive cattle farming. This low-intensity rotation system improves sustainability because it reduces pest and disease pressure and maintains good soil conditions. This crop technology package is carefully followed by most farmers. The national average yield reached 8 tons per hectare in the last five years, with top farmers surpassing 10 tons per hectare (Fig. 2).

Well-organized farmers' and millers' groups, sound government policies, and an articulated research and innovation system brought the institutional framework to success. This has become possible even without any kind of subsidy, without a domestic market to rely on (Uruguay's local market is only 5% of the rice it produces per year), and depending on highly volatile international markets (95% of the rice is exported).

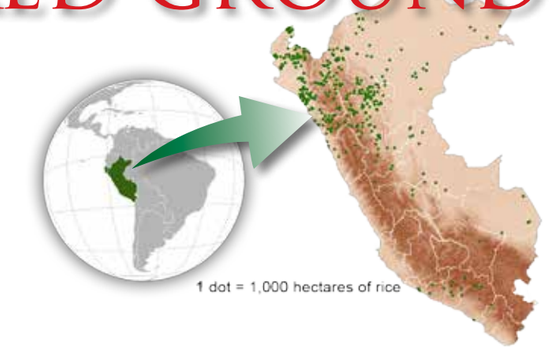
Competitiveness is the name of the game for Uruguayan rice farmers and the race is never over. Now, they are figuring out how to profit with increasing production costs and weaker rice prices, and pressing for new technologies to further increase yield potential.

Mr. Zorrilla is the director of the National Research Program at the National Institute of Agricultural Research in Uruguay and a member of the Rice Today *editorial board.*

A RICE mill in eastern Uruguay.

The rise of rice on Peru's sacred ground

by **Adriana Varón Molina**



With its rising national rice production, Peru is now Latin America's most important rice producer after Brazil

César Puerto's half-hectare rice plot yields him 3 tons of grain each harvest. Mr. Puerto has dedicated 10 of his 32 years to growing rice. It provides a living for him, his brother, sister-in-law, and two nieces, who help sow and harvest the crop on this small farm, located at the end of a dusty road.

His neighbor, veteran grower Marina Mejía, with 30 hectares, produces 300–360 tons of rice each season. Mrs. Mejia has been working her land for nearly 3 decades. "Thanks to rice, I've been able to raise my four sons and nine grandchildren," she says proudly. (See cover photo of her with one of her grandchildren.)

Since there are two cropping seasons each year, the combined average of more than 600 tons of rice that Mr. Puerto's and Doña Marina's farms produce annually near the town of Sinamal in Rioja Province of Peru's San Martín Department contribute to rising national production, which reached 3.1 million tons in 2013. Peru now accounts for 12.25% of South America's total rice output, which amounted to 25.3 million tons in 2013, making this country the region's second most important producer after Brazil, according to the Food and Agriculture Organization of the United Nations (FAO).

About 380,000 hectares are sown to the crop in this country, with an average yield of 7.7 tons per hectare, which is well above the regional average of 5 tons, says Orlando Palacios, head of the National Rice Program at Peru's National Institute for Innovation in Agriculture (INIA). In coastal areas, such as Piura and Arequipa, some growers obtain yields as high as 16 tons per hectare–among the highest in the world.

Secrets to success

So, what's the secret to Peru's abundant rice harvests? For César and Doña Marina, the answer is clear.

"This is sacred ground—so rich in nutrients that we don't have to apply much fertilizer," says César, who also believes that La Esperanza, the variety he's been planting for years (and whose name means "hope"), plays a big role in the success of rice on his land.

Looking beyond local perceptions, plant breeders such as Carlos Bruzzone, the director for research and development at Hacienda El Potrero SAC, a company producing certified rice seed, cite other reasons for Peru's high rice yields. Significantly, 84% of the area sown to the crop is irrigated, and it is also favored by high amounts of sunlight and limited rainfall. On an estimated 50% of the irrigated area, climatic conditions are just right for high yields. Dr. Bruzzone further believes that transplanting of seedlings, the method used most commonly to sow rice in Peru, contributes importantly to rising output.

ADRIANA VARÓN MOLINA, CIAT (3)


TO SOW 3 hectares of rice, César Puerto needs 120 kilograms of seed, which he buys from a neighbor.

Eduardo Graterol, the executive director of the Latin American Fund for Irrigated Rice (FLAR), cites other factors, particularly the adoption of modern varieties with high yield potential and resistance to pests and diseases, together with tolerance of environmental stresses as well as the use of certified seed on about 50% of the cultivated area.

Dreaming of exports

James Pinedo is the president of the Rice Producers Association of Jaén and San Ignacio, which has 88 members. All members have the same dream: that a part of the nearly 100,000 tons of rice their farms produce each year will someday cross national frontiers.

"Our biggest ambition is to export rice and to do so directly with no intermediaries," says Mr. Pinedo.

According to INIA, it is within Peru's capacity to produce some surplus for export. Currently, between 300,000 and 350,000 tons of white rice are already being exported informally to neighboring countries. Nonetheless, to fulfill the export ambitions, small- and medium-scale growers, who have less than 20 hectares and are estimated to account for 68.9% of the country's rice production, together with large producers, representing 31.1%, will need to meet certain quality conditions in order to compete internationally.

For Edgar Torres, the leader of the Rice Program at the International Center for Tropical Agriculture (CIAT), it's important for the rice sector to invest more crop management practices that help realize the genetic potential of improved varieties that are already available, and that of new hybrids, which CIAT and FLAR are developing through the Hybrid Rice Consortium for Latin America and in Peru with Hacienda El Potrero. Dr. Torres also emphasizes the need for more site-specific crop management (based on big-data approaches to the use of soil and other data) as a strategy for boosting rice yields to 3 tons per hectare above the regional average, while adapting production to the impacts of climate change.


IN SOME areas of Peru, rice yields are as high as 16 tons per hectare, among the highest in the world.


RICE CULTIVATION in Peru employs about 161,000 people.

"Already high yields and the innovative capacity of Peru's farmers and the private sector are key conditions for making our production more competitive," says Jonatan Requejo, manager of Hacienda El Potrero. "The challenge ahead is to strengthen the ability of the rice industry to open windows for exports."

In addition, growers need new production technology and farm machinery plus the support of national and local government to make credit, training, and technical support more widely available in rural areas.

Beyond potato

Per capita consumption of rice in Peru is high at 60 kilograms per year, on average. Rice has surpassed potato and is the preferred food on Peruvian menus today. About 7% of the rice consumed is imported, with Uruguay supplying 81% of the imports, Brazil 9%, Argentina 6%, and the rest coming from other countries.

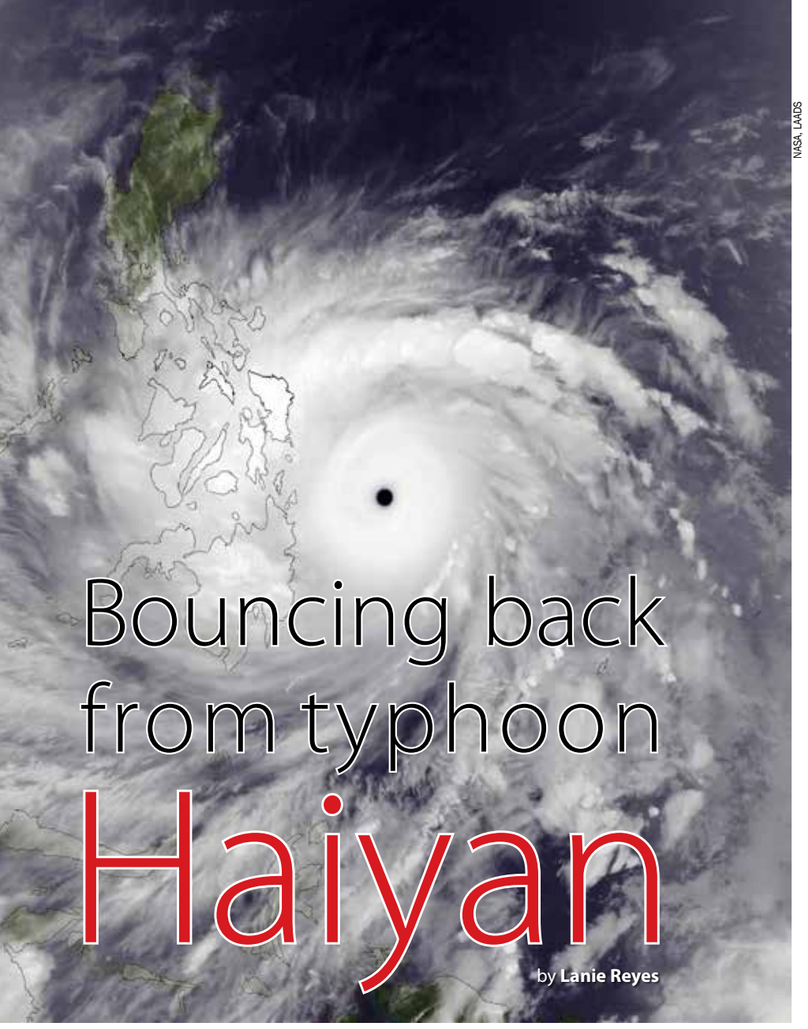
"Peru imports rice for class A markets with high prices," says Mr. Requejo. "We don't have varieties that can compete with imported rice, which varies between 80,000 and 150,000 tons per year."

For now, the scientists will continue to release new varieties—and, in the future, rice hybrids—that can surpass the varieties IR43 and INIA-La Esperanza (based on an elite line from CIAT) and subvert their rule in Peru's rice fields. In the meantime, small, medium, and large producers will continue building knowledge and investing resources for them to take advantage of the hidden properties of Peruvian soils.

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

ADRIANA VARÓN MOLINA, CIAT

In the Piura area of northeastern Peru, rice growers regularly obtain yields as high as 16 tons per hectare—among the highest in the world. According to researchers, this is the result of high solar radiation, low rainfall, and (in a departure from common practice in Latín America, where direct seeding predominates) transplanting of rice seedlings in irrigated fields.



NASA, LAADS

Bouncing back from typhoon Haiyan

by **Lanie Reyes**

A family of farmers bounces back from a disaster by growing a high-yielding rice variety and vegetables

Husband and wife Joven and Lydia Ganapin, farmers in a small village in Babatngon, Leyte, Central Philippines, clearly remember the floods triggered by super typhoon Haiyan on 7 November 2013 that submerged their home and the farm they were renting. "Nothing was left," Joven said. He was able to recover about 28 sacks of rice from his farm before the typhoon hit. He took them to a rice trader. He agreed to paid by the trader after the typhoon. But, unfortunately, all the rice of the trader, including Joven's, was looted. Joven was not paid because his rice had not even been weighed.

"We suffered a great loss," said Joven. "All was taken by Haiyan." He did not feel that badly because "everyone here had the same fate." What mattered to them was that no one in their family became part of the 6,000 casualties of the super typhoon.

Life after the storm

For this farming couple, everything about Haiyan is now a faint memory. Thirteen months later, all the debris is gone. There's almost no trace of the scars the super typhoon left in Babatngon, 33 kilometers away from the provincial capital, Tacloban. Life has returned to normal.

Lydia excused herself to attend to someone who wanted to buy from her small store, which doubles as their home. At first glance, it seems that they have no neighbors. The village was silent. One could hear only the swishing and swooshing sound of a neighboring farmer harvesting his rice.

Joven harvested his rice earlier. His house was filled with sacks of rice—some milled, others not. He proudly showed the grains of NSIC 2013 Rc344SR, a high-yielding newly released rice variety, fondly called "344" by the couple. The rice is said to be special for some good reasons. He raved about the quality of his newly harvested grain just like a father would of his newborn baby. He excitedly mentioned the long grains and "basmati-like" traits and that it is tasty and has a good aroma, and how the cooked rice doesn't harden easily when it becomes cold. His wife praised the variety's 60% milling recovery and that they were able to harvest a little bit more than 6 tons per hectare.

A profitable variety

Joven does not regret trying 344, which was introduced by Paul Maturan, an associate scientist at the International Rice Research Institute (IRRI) through the Philippine Department of Agriculture and IRRI project *Accelerating the Development and Adoption of Next-Generation Rice Varieties for the Major Ecosystems in the Philippines* (Next-Gen). Mr. Maturan said that his mission for the Next-Gen project was to share the seeds of new rice varieties, such as NSIC 2013 Rc344SR, with other marginal farmers in Leyte and other rice-growing areas in the Philippines.

At Joven's request, Lydia pulled out her records of how much they profited from 344. Lydia was very diligent in jotting down their expenses and computing the profit, which is not surprising for entrepreneurs like them. Her records indicated that they have harvested 75 sacks of rice, with 15 sacks used as rent payment to their landowner. Some were used for paying the harvesters and some

LANIE REYES/IRRI (2)

PAUL MATURAN/IRRI

1. Husband and wife Joven and Lydia Ganapin are happy to try some seeds distributed by IRRI. 2. Mr. Carlito Torreon, municipal agricultural officer of Kananga in Leyte, receives some seeds of NSIC 2013 Rc344SR from Paul Maturan, IRRI associate scientist. 3. Dr. Francisco Dayap, the superintendent of Babatngon Experiment Station in Leyte (*right*), shares some good management practices with Joven Ganapin.

went for the rent of a thresher. In the end, they had 46 sacks of rice left. Multiplied by 46 kilos per sack at about US$0.39 per kilo, the couple made $459 in profit.

Joven liked 344 so much that he did not sell all the harvest from this variety. He set aside 13 sacks for family consumption and for sowing. Mr. Maturan then decided to buy one sack of 344 from Joven to add to his seed stock to be distributed to farmers in Abuyog, Kananga, and Hinunagan, Leyte.

Overcoming adversity

The couple said that they were able to bounce back after Haiyan because of farming. Aside from rice, they grew vegetable crops—sweet corn, sweet bell pepper, eggplants, and string beans—that they planted in rotation to avoid diseases and pests. Crop rotation is a practice they learned from from Dr. Francisco Dayap, the superintendent of Babatngon Experiment Station, one of the research stations of the Department of Agriculture, Regional Field Office VIII and located just two kilometers away from Joven's farm.

Since the vegetables can be harvested in 40 to 65 days, they have something to tide them over until the next rice harvest.

During interviews with the farmers, municipal agricultural officers in Leyte identified the lack of seeds suitable to the area as the main problem. Farmers usually plant whatever seeds are available or distributed to them even if these seeds have not been tested for the local areas. Mr. Maturan said that the new DA-IRRI Next-Gen project is currently conducting field trials for farmers to select the most adoptable new varieties and establish an efficient seed production and distribution system.

Mr. Gerry Bauya, the municipal agricultural officer in Abuyog, said that they have not heard of rice that can tolerate flooding, salinity, or drought. He said they need such varieties because 200 hectares of their rice areas are flood-prone while some 30 hectares have problems with salinity. In Kananga, Ms. Maria Cristina Aras, agricultural technologist, said the problem of farmers in their municipality is stem borer infestation. She added that the white stem borer is the most destructive because its larval stage could last up to 32 days.

The Next-Gen project is also targeting remote and marginal rice areas with similar problems. In line with the mission of the Global Rice Science Partnership, the project aims to speed up the introduction and adoption of higher-yielding rice varieties and hybrids that have resistance to or tolerance of pests and diseases and environment-related stresses such as drought, flooding, and salinity.

A collaboration between IRRI, the Philippine Department of Agriculture, Philippine Rice Research Institute, and the University of the Philippines Los Baños, the project is expected to help the country attain rice self-sufficiency under the Food Staples and Sufficiency Program.

Aside from the sharing of advanced breeding methods, expertise, and germplasm, another strategy of the project is "a modified farmers' participatory varietal selection scheme and improved seed system that can make these new rice varieties and hybrids more widely available to Filipino farmers," Glenn Gregorio, IRRI plant breeder, said.

"Multi-environment trials (MET) of the newly developed rice lines in many different environments will greatly improve the quality of materials going through the National Cooperative Tests, leading to the release of a better and improved next generation of varieties and hybrids," Dr. Gregorio added.

"Developing and promoting effective technologies through R&D is a viable option to attain the government's goal of self-sufficiency," Dr. Dayap, said. A DA document indicates that, at today's rate of population growth, the country's average rice yields must rise to at least 4.75 tons per hectare to attain self-sufficiency.[1]

"Hopefully, through this partnership, varietal development programs and continuous availability of high-quality seeds can support the goal of rice self-sufficiency of the country," Dr. Dayap said.

Ms. Reyes is the managing editor of Rice Today.

For more on Typhoon Haiyan, see http://tinyurl.com/Haiyan-Super-Typhoon.

[1] Tanchuling H. 2010. Palay sufficiency outlook: first quarter 2010 DA performance report. Rice Self-Sufficiency Bulletin, January-March 2010.

The good brothers

Retold and illustrated by **Jeehyoung Shim-Chin**

This rice fable centers on fraternal love, a value that many Koreans have considered important for a very long time

A long time ago, two brothers together owned a rice field, which was the only inheritance they received from their parents, who passed away because of old age.

These two brothers knew how their parents had valued the land, so they cared for it the way their parents did. They worked together to grow rice from plowing the soil to sowing the seeds, from weeding until the rice was ready for harvest. They were diligent and industrious; they worked on the farm from dawn till dusk. Come harvest time, their labor came into fruition. They had a very bountiful harvest, the largest in the village.

They divided the harvest equally. As they were stacking their harvest, the older brother thought, "My younger brother is newly married; he will need more rice to sell to cover the expenses of a new home."

Knowing that his younger brother would not accept his offer of an additional sack, he thought of going to his brother's barn at night and secretly placing the extra sack of rice on his younger brother's pile.

As soon as night came, he found his way in the dark carrying a heavy sack of rice and placed it above his younger brother's pile of rice.

The next morning he was surprised to see that the height of his pile of rice seemed to be the same. He counted the number of sacks and wondered why the number did not change.

"I think we miscounted them when we first divided the sacks of rice between us," he said to his younger brother.

Thinking about his younger brother, who will be starting to build a family, he decided to carry another sack of rice to add to his his brother's stack that night.

The next morning, he went to his barn to check how many more would be left should he decide to sell some. He was shocked to know that the number was still the same. He asked his son to count it for him and lo and behold he arrived at the same number. "Well," he said. "I'll just carry a sack of rice to my younger brother again tonight."

After dinner, he again loaded another sack of rice on his back and started walking on the same road to his brother's place. The moon shone so bright that night and he could clearly see the pathway to his brother's place. As he was halfway to his destination, he saw a silhouette of a man who seemed to be carrying a bulky load. As the shadow came nearer, the moonlight revealed the familiar face of his younger brother.

As soon as their eyes met, they both called out to each other, "Why brother!" They heartily laughed together as they both understood the mystery of the unchanging number of their respective stacks of rice. Happy to see each other, they unloaded their sacks of rice, sat down, and talked. The older brother found out that his younger brother was also thinking the same way. He thought of his older brother having many children and thus his family would consume more rice than he would. Surely his older brother could use some of his rice.

It is said that the story of the loving ways of these two brothers was the talk of the village. It spread from village to village until it reached far and wide.

Ms. Shim-Chin likes telling stories, an activity she enjoyed when she was a preschool teacher in South Korea. She temporarily gave up her job in Korea to join her husband, IRRI plant breeder Joong Hyoun Chin, and their children in the Philippines. She devotes some of her free time to painting.

What's cooking?

by **Iman Zarei**

JEC NARCISO (3)

Iranian culinary style, also known as Persian cuisine, has a long history and it is strongly influenced by the country's neighboring regions. In fact, several of Iran's famous dishes originated from Greece, the Middle East, Turkey, and Russia. These dishes commonly use dairy products, fresh herbs, and fruits such as plums, pomegranates, quince, prunes, apricots, and raisins.

Typical Iranian main dishes are a combination of rice with meat, lamb, chicken, or fish and onion, vegetables, nuts, and herbs. In special dishes, saffron, dried limes, cinnamon, and parsley are often added to give them unique and subtle flavors. *Tah Chin* ("rice cake" in Persian) combines saffron, chicken, and yogurt to create an exotic blend of decadence and extraordinary flavor. It is traditionally served on special occasions such as weddings and family reunions.

Ingredients

500 grams basmati or other long-grain rice
1 kilogram chicken, cut into desired pieces
300 grams yogurt
1/2 cup cooking oil
1/2 teaspoon saffron
1/4 cup rose water, optional
2 to 3 pieces large onions, peeled
3 to 5 cloves garlic
3 eggs
salt
black pepper powder
red pepper powder
turmeric
parsley for garnishing

Directions

- Wash uncooked rice in a pot with water. Do this three times. Add enough water to cover the rice. Add 3 tablespoons of salt and soak for 15 minutes.
- After soaking for 15 minutes, remove the water.
- Boil the water in a pot. Add the soaked rice when the water starts boiling. Cook for 30 to 40 minutes. Remove any foam that forms on top while cooking.
- Take a grain of rice and squeeze it with your middle finger and thumb. The rice is parboiled if you do not feel any hardness. Remove from heat. Place the rice in a strainer and drain the water. While the rice is in the strainer, pour water over it to reduce stickiness.
- Place the chicken in a pot and add onion, garlic, salt, and turmeric. Add enough water to cover the chicken. Cook for 30 minutes.
- When the chicken is tender, take the chicken from the pot. Remove the meat from the bones and shred it. Set aside.
- Remove the onion and garlic from the pot. Put in a bowl, add some broth, and mash them. Set aside.
- Add half a cup to one cup boiling water to the saffron. Set aside.
- Put the yogurt in a pan and add eggs, cooking oil, a pinch of turmeric, black pepper powder and red pepper powder, 1 tablespoon of salt, half a cup of oil, the saffron dissolved in water, and the mashed onion and garlic. Mix all ingredients well.
- Add the shredded chicken and rice, and mix well.
- Cover and cook for about 45 minutes.
- After 10 minutes, add 3 tablespoons of rose water (optional).
- Wrap the lid with a clean towel or cloth, and cover the pan to absorb the water forming from the steam.
- When done, invert the pan on a dish.
- To serve, cut into wedges and garnish with parsley.

Iman is working on his PhD in human nutrition at the University of the Philippines Los Baños. He joined the Grain Quality and Nutrition Center at IRRI in 2012 and worked on research under the global rice core collection. His work included rice metabolomic experiments and the development of predictive models based on the results of those experiments. Currently, he is working on iron bio-fortification in rice.

Cooking is a relaxing and enjoyable hobby for Iman. As a nutritionist, he likes to add new twists and variations to traditional dishes. His favorite cuisines are Middle Eastern, Indian, Russian, Uzbek, and Thai. Tah Chin saffron rice and chicken, based on his grandmother's recipe, is his favorite Persian dish.

Watch Iman prepare this sumptuous Persian rice dish in an 11-minute video on YouTube at http://youtube/klclqXeo0q4.

RiceToday around the world

NETWORKING WITH *Rice Today*. Savitri Mohapatra (*left*), the head of marketing and communications of Africa Rice Center, joined staff of CGNET Services International to cultivate productive relationships. CGNET, based in Menlo Park, California, is one of the world's most well-known email providers in the international nonprofit community. Its first client was the CGIAR, from which CGNET derived its name. From left to right after Savitri are Kim Reed, administrator; Karin Cornils, senior systems engineer, Lonni Ton, systems and network engineer; Georg Lindsey, president and CEO; Dan Callahan, vice-president for cloud services; Dante Palacios, global technologies and services manager; and Richard Hsu, data center engineer.

RICE ON Africa's peak. Dr. Negussie Zenna (*left*), rice breeder from Africa Rice Center, and a fellow hiker from New York take *Rice Today* magazine to new heights—on top of Mt. Kilimanjaro. Mt. Kilimanjaro is the highest mountain in Africa and the world's highest free-standing mountain at 5,895 meters above sea level.

IN THE midst of the judges. *Rice Today* editor-in-chief Gene Hettel (*left*) meets with members of the Philippine Agricultural Journalists, Inc. (PAJ) and fellow judges in the annual Binhi Philippine Journalism Awards. From left after Mr. Hettel are Noel Reyes, PAJ vice president and chairman of the 2014 Binhi awards committee; Jayson Brizuela, San Miguel Corporation (SMC) Media Affairs Group; Roman Floresca, PAJ president and business editor of The Philippine Star; Rolly Gonzalo, PAJ coordinator for broadcast; Cora Abio, PAJ director; Gani Oro, Binhi judge and anchorman of Serbisyo All-Access, 9NewsTV; Senen Bacani, chairman of the board of Binhi judges and president of La Frutera, Inc.; Inez Magbual, PAJ treasurer; and Ruby Lumongsod, PAJ secretary. SMC was a major sponsor of the 2014 Binhi awards program.

Where's my GM rice?

by **Mark Lynas**

"It is not science that has held back the use of molecular genetics in rice breeding," says a former anti-GMO activist, "it is politics"

IRRI (3)

It has been estimated that, for every 1 billion people added to the world's population, 100 million tons more of paddy rice need to be produced annually—ideally using less land, water, nitrogen, and energy, and resulting in fewer greenhouse gas emissions.

Crop genetics comes into every aspect of this picture. Changing the biology of rice plants offers a chance to combat major and emerging diseases, to tackle pests with fewer and less toxic pesticides, to increase water- and nitrogen-use efficiency, and to increase overall productivity to feed more people on less land.

However, in order to be able to access the widest possible pool of germplasm, it will be essential for rice breeders to be able to use transgenic techniques as well as conventional breeding.

And yet, the use of these molecular biotechnology tools—which are improving all the time in accuracy, variety, and usability—remains needlessly controversial. It is not science that has held back the use of molecular genetics in rice breeding—it is politics.

Indeed, politics can surely be the only reason why, after two decades of rice breeding involving many projects using molecular techniques for genetic improvement, there is still currently no commercially available rice anywhere in the world that might attract this dreaded moniker "GMO."

Rice breeders are wary of putting forward GM rice varieties for approval, however much promise they show. Regulators have yet to approve GM rice, however safe and beneficial the new traits may be. Traders are nervous about trading GM rice. Retailers are worried about losing markets with GM rice. Consumers are wary of eating GM rice.

I would be very surprised if Golden Rice were ever able to be released in China now given consumer fears stoked by anti-GMO groups, so vitamin A deficiency in Chinese children must be tackled by other means or, more likely, not at all. I won't guess at a number of likely resulting deaths, but we can get a sense of the probable order of magnitude from a recent paper published in the journal *Environment and Development Economics*[1] estimating the impact of 10 years of nonavailability of Golden Rice in India.

The authors estimate 1.4 million life years lost over the past decade in India, thanks to vitamin A deficiency. Remember, these years of life lost mainly affect vulnerable young children, 125 million of whom suffer from vitamin A deficiency around the world.

This in turn leads to a quarter to a half million cases of blindness in children per year, and half of these children die within a year. Many more have their immune systems compromised by a lack of vitamin A, thus increasing the risk that common childhood diseases will end in death.

The anti-GMO lobby is full-scale psychological denial—refusing to admit that the expert opinions of the American Association for the Advancement of Science, the Royal Society, numerous Academies of Science around the world, the American Medical Association, and every relevant academic body in the world add up to a meaningful scientific consensus on the inherent safety of GM technology.

Golden Rice is the poster child, and has received a lot of attention, but there are many others. In West Africa, for example, NEWEST rice is proceeding well in field trials. NEWEST stands for nitrogen-efficient, water-efficient, salt-tolerant rice. This rice aims to improve both the productivity and sustainability of rice production across sub-Saharan Africa. And yes, it is GM.

An even more ambitious project is C_4 rice, another international collaborative scientific project being piloted by the International Rice Research Institute (IRRI). Converting rice from using the C_3 to the C_4 photosynthetic pathway could result in dramatic productivity gains—again resulting in more rice per unit of land, water, and fertilizer.

As well as Golden Rice, at IRRI, good progress is being made toward iron rice, thanks to a *ferritin* gene added from soybean that codes for iron storage. Iron rice could help overcome anemia, which affects more than 1 billion people globally, particularly poor women and children.

I am not religiously attached to this technology. Many non-GM rice breeding projects exist that are already delivering clear benefits in the real world.

However, saying GM technology should be banned because non-GM technology also works is like saying mobile phones should be banned because people can already make phone calls using landlines.

I don't think we have to choose between GM and agroecological farming—I think they can be complementary and mutually supporting. Organic and ecological farming methods have many important lessons to offer to conventional farming.

I would like to celebrate all those who are involved with rice growing, whether using GM technology or not. Most will acknowledge that we need the second Green Revolution in rice, which is already underway and delivering increased productivity combined with increased sustainability (see *Green revolutions 2.0 and 3.0: No farmer left behind* on pages 32-35). Let us not throw out any tools that can help achieve this better world.

And then, in the words of the founder of the first Green Revolution in wheat, Norman Borlaug, we must "take it to the farmer." This is the leap we have yet to make with GM rice, anywhere in the world. I would hope that, by the time of the next International Rice Congress, in 2018, many more rice breeding projects—whether GM or not—will be out in the field delivering benefits to farmers.

And, I hope these benefits to farmers will also be benefits to consumers and benefits to the environment. Rice is too important a crop to be locked out of the biotechnology revolution. For the sake of more than 3 billion rice consumers, and for the sake of the world's environment, we can and must use this technology when appropriate to make farming more productive and more environmentally sustainable.

GOLDEN RICE grown at IRRI's screenhouse. IRRI is the coordinating institution for the Golden Rice Network and has been working to develop Golden Rice with national partners since 2006.

RICE IS too important a crop to be locked out of the biotechnology revolution said Mr. Lynas in his plenary speech at the IRC2014. Read the full text of his speech at http://tinyurl.com/Lynas-IRC-plenary.

Mr. Lynas, an author and environmental campaigner, has written several books on the environment. He is now working on a project promoting food security and environmental sustainability with the Cornell Alliance for Science at Cornell University's Office of International Programs at the College of Agriculture and Life Sciences. See 10 minutes with Mark Lynas *at http://tinyurl.com/Lynas-interview.*

[1] Wesseler J, Zilberman D. 2014. The economic power of the Golden Rice opposition. Environment and Development Economics 19(6):724-742. http://tinyurl.com/Golden-Rice-opposition.

Green Revolutions 2.0 & 3.0:

No farmer left behind

by **Gene Hettel**

Green Revolutions GR2.0 and GR3.0 will benefit the poorest of the poor who, for various reasons, did not reap rewards of the first one

GENE HETTEL (5)

Several million of the world's poorest farmers are already adopting one of the first new technologies of the second Green Revolution (GR2.0)—flood-tolerant rice! This was the optimistic pronouncement of Robert Zeigler, director general of the International Rice Research Institute (IRRI), during his keynote address to kick off the 4th International Rice Congress (IRC2014) in Bangkok on 28 October 2014. More than 1,500 delegates from 69 countries (photo) attended the week-long IRC, touted as the Olympics of Rice Science.

Start of GR2.0 pinpointed

It is thanks to one farmer, Mr. Asha Ram Pal from the Indian state of Uttar Pradesh, that Dr. Zeigler pinpoints, at least in his opinion, the exact start of GR2.0. It was 31.07.2008 13:17 (1:17 in the afternoon of 31 July 2008)—the exact moment in time when, ignoring the advice of his neighbors by showing faith in the science, Mr. Pal decided not to plow under his severely flood-ravaged and sick-looking rice crop on his 1-hectare field that had been submerged for around 17 days across two floods.

Well, those rice plants with the *SUB1* flood-tolerance gene recovered to yield 4.5 tons, a good yield for any rainfed paddy in the world!

"This was—unambiguously—the start of GR2.0," Dr. Zeigler said, "because for any agricultural revolution to be successful, farmers must adopt the product of the science. Since then, Sub1 rice varieties have spread like wildfire in eastern India and other regions where flooding is a perennial problem for farmers growing their crop in such marginal environments."

According to the internationally respected plant pathologist who has led IRRI for the last 9 years, the new technology can be attributed primarily to high-level and high-quality science—science publishable in the top scientific journals in the world—brought to bear on the problems in farmers' fields.

Indeed, one scientific study indicated that "the scheduled castes are likely to be a major beneficiary from the spread of Swarna-Sub1 in India.[1] "When I read this last paragraph of the study, I literally got goose bumps," he told the delegates. "The scheduled castes are the lowest of the low. So, this technology—the most exquisite research from some of the finest laboratories in the world—is significantly benefiting the poorest of the poor. Now if that is not scientific revolution, I don't know what is. It gives me great pride to be a scientist and to be associated with the people who have done this work."

GR3.0 will stagger the imagination

"GR2.0's run will be fruitful—and quicker than GR1.0—particularly for farmers in marginal weather-stressed environments," Dr. Zeigler predicted. He said there is a very wide array of problems, previously thought to be absolutely insurmountable, that researchers can now address more rapidly using the scientific tools coming out of parallel high-science revolutions in genetics, molecular biology, and plant physiology.

According to Dr. Zeigler, GR2.0 is allowing researchers to successfully meet great challenges with unprecedented research efforts that will result in unparalleled impact—ranging from mining the rice genomes and wild relatives of rice for needed traits to developing climate-ready rice and from fighting human malnutrition with more nutritious rice to better management of water and nutrient resources in farmers' rice fields.

[1] Dar MH, de Janvry A, Emerick K, Raitzer D, Sadoulet E. 2013. Flood-tolerant rice reduces yield variability and raises expected yield, differentially benefiting socially disadvantaged groups. Sci Rep. 3: 3315. www.ncbi.nlm.nih.gov/pmc/articles/PMC3837307.

IRRI ARCHIVES

A breeder's epiphany sets the stage for GR1.0

Pinpointing the beginning of GR1.0 might have been when the first farmer, most likely in the Philippines in 1966, harvested a field of the newly released IR8, the semidwarf rice variety that started it all and ultimately prevented famine across Asia.

However, with no documentation of that significant event, one can go back in time 3 more years to July 1963, when IRRI's first breeder, Peter Jennings (photo), visited the experimental rice plots on the Institute's research farm and most likely got his own goose bumps. Dr. Jennings was walking a plot of F2 (second-generation) rice plants derived from a set of 38 crosses involving dwarf rice varieties from Taiwan when he had what he later called "his epiphany."[2]

He observed tall plants and short plants in a ratio of 3:1—classic Mendelian inheritance indicating that he had just discovered a single recessive gene for shortness (later called *sd1-d*). Well, the rest is history as selections in later generations ultimately resulted in the semidwarf IR8—and all succeeding modern rice varieties

July 1963 to July 2008, 45 years between the respective starts of GR1.0 and GR2.0, was an unusually long time period. But a lot had to be done. Once the high-yielding semidwarfs were in place with a recipe for proper irrigation and fertilization to go with them, various GR1.X_n's kicked in as scientists painstakingly worked to incorporate insect and disease resistances for farmers and grain quality for consumers. ■

[2] Listen to Peter Jennings tell this story himself during his Pioneer Interview on YouTube at http://tinyurl.com/Jennings-Pioneer.

"Over the next 10 to 20 years, during which GR2.0 will phase into GR3.0, we will seize opportunities for sustainable rice production in ways that will stagger our imagination," he confidently forecasted. In another bold prediction, he envisions the start of GR3.0 sometime around 2030 when farmers start planting yield plateau-busting C4[3] and nitrogen-fixing rice varieties and consumers begin finding broad-based nutritious rice in the marketplace.

Summarizing the GR series

Dr. Zeigler summarized for the delegates what he calls the ongoing Green Revolution Series. "GR1.0, which basically built a high-yield plant architecture adapted to the low-stress environments, is justly criticized for benefitting only farmers in those relatively stress-free areas," he said. "GR2.0 is incorporating tolerance to severe stresses and additional nutritional value and ultimately, as already mentioned, is leaving no farmer behind. GR3.0 will accelerate the evolution of the rice plant itself. It will effectively produce *designer rice* by leaving no *Oryza* species untapped."

Young scientists will lead the charge

During a media briefing following his keynote, Dr. Zeigler told reporters that leading the charge of the science-based GR2.0 and 3.0 is the next crop of vibrant, intelligent, and caring young scientists. They are in league with IRRI through the Global Rice Science Partnership (GRiSP) and its five rice-breeding hubs in Asia, Africa, and Latin America. Many attended their first-ever International Rice Congress in Bangkok. Twenty-nine of these young rice scientists were chosen to present their research during the science sessions and they were formally recognized for this notable achievement during the IRC gala dinner (photo above).

"The future of rice science is at stake because without new blood in the experiment plots and laboratories, the outlook for a continuing GR2.0 would be grim and there wouldn't even be a GR3.0," he warned reporters.

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

[3] http://C4rice.irri.org

Spreading the good news about rice: IRC2014 wrap-up

The far-ranging IRC2014 scientific program had something for everyone including plenary sessions, symposia, and poster sessions on the latest advances in rice research and technologies coming out of GR2.0 and what is on the drawing boards for GR3.0.

The week-long agenda also included a temperate rice conference, a workshop on drip irrigation, and an investors' forum on nature and success of agricultural research.

Held under the patronage of the Royal Government of Thailand, specifically the Ministry of Agriculture and Cooperatives, IRC2014 was organized by IRRI and Kenes MP Asia Pte. Ltd.

A great wrap-up of the milestone event has been put together by Michael Jackson, chair of the IRC Science Committee. It can be found on his blog at http://tinyurl.com/IRC2014-wrap-up. For a video playlist of IRC2014 activities, go to: http://tinyurl.com/IRC2014-videos. ■

IRRI (3)

UNLEASHING THE RICE MARKET

by **Lanie Reyes**

The global rice market is driven by factors that may radically change how rice is traded in the future

What is the true price of rice? Do we have enough rice to feed the growing population? Where will the rice in the future come from? What drives the global rice market? What are the game changers? These were just some of the questions raised by economists and other participants at the Global Rice Market and Trade Summit in Bangkok, Thailand, on 27-29 October 2014.

Government policies, climate change, increasing population, migration of farmers to cities, and the rising middle class are some of the game changers in the global rice market that echoed among the speakers during the Summit.

Climate change

There was a note of concern on the projected impact of climate change on agriculture. Most agreed that rising sea levels, increasing soil salinity in farm areas, higher temperatures, and more frequent occurrence of floods and droughts will have great adverse effects on rice production.

In Asia, large areas of rice are grown in low-lying deltas and coastal areas such as the Mekong River Delta in Vietnam and the Ganges basin in Bangladesh and India. A 1-meter rise in sea level could wipe out these prime rice production areas.

With increasing sea levels, saltwater could penetrate more inland areas and contribute to soil salinity, thus radically reducing rice yields as most rice varieties are only moderately tolerant of salt.

Increases in temperatures will also decrease rice output. A study at the International Rice Research Institute (IRRI) indicates that a rise in nighttime temperature by 1 degree Celsius could reduce rice yields by about 10% while many varieties are sensitive to higher daytime temperature.

About 20 million hectares of the world's rice-growing area are at risk of occasionally being flooded, particularly in major rice-producing countries such as India and Bangladesh.

Although more research is needed to tackle the challenges posed by climate change, IRRI has already developed several climate-smart rice varieties that have made huge impacts in unfavorable environments in Asia and Africa. IRRI Director General Robert Zeigler said the second Green Revolution is benefiting the marginalized sector of society—the poorest of poor farmers—who live in areas most vulnerable to climate change (see *Green revolutions 2.0 and 3.0: No farmer left behind* on pages 32-35).

Booming population

There will be more mouths to feed in the future. The population is increasing, particularly in South Asia, where most of the world's rice supply is grown. "Thirty percent of the global population growth in the next 5 years will be coming from this region," said Dr. Suthad Setboonsarng, a Thai economist and currently member of the IRRI Board of Trustees. In addition, the number of nontraditional rice eaters is rising, especially in African countries. With global rice demand estimated to increase from 439 million tons in 2010 to 555 million tons in 2035, rice production must be able to keep up if world market prices are to be stabilized at affordable levels for billions of rice consumers.

Rising urbanization

The changing economic structure of Asia and the increasing number of its middle class will have an influence on the international rice market. "The higher the income of the people, the more diversified are their diets," said Dr. David Dawe, FAO senior economist. "This change will have an effect on the demand for rice."

And, 50% of this change is coming from India and China, according to Dr. Setboonsarng. China's economic progress will result in mass outmigration from farms to cities. The rural migration will be massive, according to Milo Hamilton, senior agricultural economist and co-founder of Firstgrain.com. More than 250 million people in China will leave their farms and move into cities in the next 15 years. In China alone, 1 billion more people will live an urban life by 2030. This phenomenon is also occurring in other parts of Asia. Southeast Asian farmers are leaving rural areas for better wages in cities. For example, Cambodians in rural areas are migrating to the cities of Thailand to work in construction or in factories.

A worrisome question is who would be left on rice farms to feed the ever-growing cities that need increasing quantities of food, said Mr. Hamilton. "This is a double whammy on the rice market—increase in urban consumption and reduction of rural food sector workers," added Dr. Setboonsarng.

EUROPEAN SPACE AGENCY

THE ENORMOUS Ganges Delta (formed by the confluence of the Ganges, Brahmaputra, and Meghna Rivers) is the world's largest. Located in the South Asia area of Bangladesh (visible in photo) and India, it is a key area for growing rice that could be wiped out by a 1-meter rise in sea level.

SINCE RICE is a water-intensive crop, it will be coming from countries whose water resource has not yet been depleted.

Water and rice

According to Dr. Setboonsarng, the expansion of urbanization in Asia is leading to an increase in domestic consumption of water, which will compete with the use of water for agricultural production, especially rice production. It is a fact that rice is the most water-intensive crop. "Water, a limited resource, is diminishing," Dr. Setboonsarng said. "The groundwater used to irrigate rice in countries such as Bangladesh, India, and China is stressed because of the expansion of irrigation."

Mr. Hamilton said that rice production is more like water conversion. When one trades rice, one is also trading water. Samarendu Mohanty, IRRI senior economist, said that "when the government of India is subsidizing rice production, it is, in one way or another, subsidizing the water need of the country that buys the rice." It is said that China has the capacity to produce more rice if it wants to, but, unlike India, it is conserving its water by importing rice.

This goes back to the issue of finding the true value of rice. Mr. Hamilton said that water, itself, is not usually priced but what is priced is the cost of obtaining the water. How we put a price on rice is akin to how we put a price on water. Water scarcity will have an effect on where the rice is coming from in the future. According to Mr. Hamilton, rice will be coming from countries whose water resource has not yet been depleted.

A political commodity

Since rice is the staple food of more than half of humanity, it is easy to understand that it is a political commodity. Governments will do everything possible to make rice available to their constituents. They have done a lot of things to control its price so their constituents or "voters" can still afford it, or buying from farmers at a higher price to encourage farmers to produce it. When the price of rice spiked during 2007-08, riots erupted in different corners of the world and posed tremendous challenges to many governments.

Government policies

The rice price crisis was a wake-up call for many governments. Many created policy interventions to prevent food crises from occurring again. For rice-importing countries such as the Philippines, Indonesia, and Malaysia, the policy is self-sufficiency. The Philippines is doing its best to increase its rice production through its Food Staples Sufficiency Program, at the same time encouraging its citizens to diversify their diets by eating carbohydrate alternatives such as sweet potato and cassava. In addition, the Philippine government launched national campaigns discouraging consumers from wasting rice.

But, "government interventions in the form of rice policies often hide the true price of rice," said Dr. Mohanty. For example, the rice-pledging scheme of Thailand made the price of its rice less affordable—and less competitive—in the international rice market. India's policy on rice subsidy makes rice production cheap for farmers so they can sell rice at a low price. With India's low price, plus its bumper crop in 2013, it temporarily displaced Thailand as the top rice exporter in the world.

"The government intervention in rice policies is two-pronged," explained Dr. Setboonsarng. "Most governments control the price of food, including rice, to keep the price low. At the same time, they subsidize the producer, especially the farmers to enable them to keep up with the production. And as a consequence, the indirect recipient of subsidies to farmers is, in fact, the rice consumer, not only in one's own country but also in other countries. For the domestic rice market, low prices discourage innovation in the whole rice value chain—from production and marketing to storage and distribution."

And what does this mean to the international rice market? "As both the exporter and importer control the consumer price of rice and subsidize rice farmers, the supply curve of rice is shifted and lowers the price and quantity traded in the international market," Dr. Setboonsarng added. "As a result, the world rice market becomes small and volatile. Moreover, the self-sufficiency policy of most rice-importing countries adds to the uncertainty."

Lack of transparency

"Another reason for uncertainty is the lack of reliable information," said Bruce Tolentino, IRRI's deputy director general for communication and partnerships. "Uncertainty in the global rice market leads to speculation, and speculation can lead to confusion and panic." He also emphasized the importance of transparency as a key to a stable global rice market.

"In fact, the root cause of the 160% price increase during the 2007-08 rice crisis was not the lack of supply but a lack of transparency," Dr. Zeigler pointed out. "And, those hundreds of millions of people who suffered are the poorest of the poor. That became the wake-up call for us.

"For many, they think that the wake-up call was to pay attention to production technology," he continued "But for us, we needed to understand what was going on in the rice trade and what we could do to make a difference."

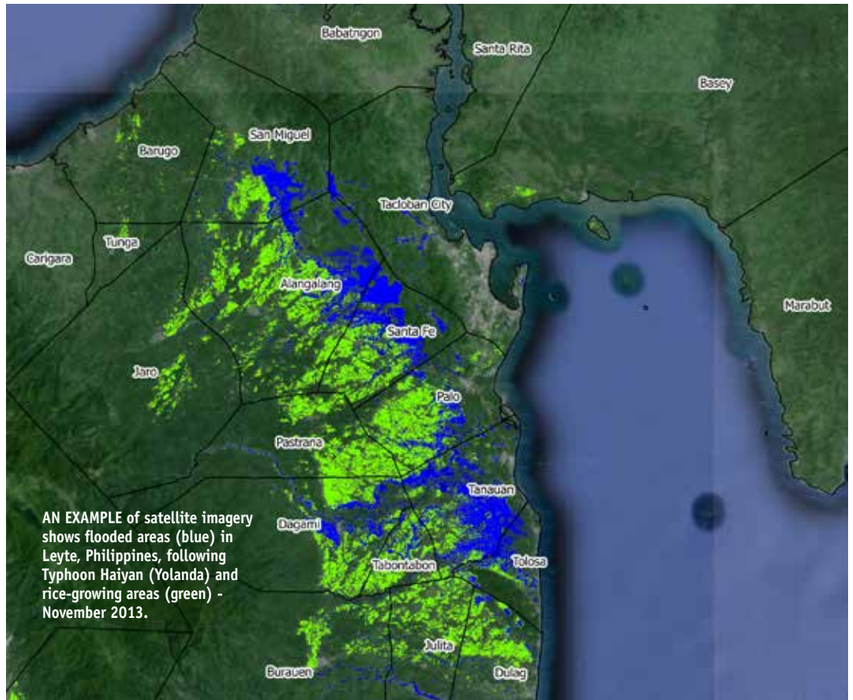
Over the years, IRRI has been focusing its expertise on what drives the global market and the kind of information required to attain a stable environment. The Institute has been gathering data and information on the socioeconomic aspects of rice: how much rice is needed, what it takes to grow a good crop, what a good rice crop is, and what consumers want.

"The underlying foundation is that IRRI is viewed as an honest broker," said Dr. Zeigler. "We don't have a dog in the fight in rice trade. This allows us to provide unbiased and accurate information on rice production."

IRRI has been developing state-of-the-art tools to provide timely and accurate estimates of rice production in Asia. "We have a suite of technologies on board," he said. "First, we have a much better way of estimating the realizable yield of the rice crop using a crop growth model, a technology that we have been developing for the last 25 years. We have an extraordinarily accurate assessment of what a rice paddy is going to do."

Dr. Zeigler added that, through satellite imagery, data can be gathered and processed in real time to obtain a good assessment of actual rice production. The real breakthrough is that IRRI now uses radar imagery, which can provide superior penetration capability through any type of weather condition, and this can be used in daytime or nighttime.

He explained that, unlike before, because most rice is produced during the monsoon season, all we got were beautiful pictures of clouds. With radar imagery, IRRI can obtain a very good assessment of rice distribution.



AN EXAMPLE of satellite imagery shows flooded areas (blue) in Leyte, Philippines, following Typhoon Haiyan (Yolanda) and rice-growing areas (green) - November 2013.

It can collect data on soil, water, and temperature and even obtain a weekly estimate of rice area, and determine the time when rice was planted. And, combining all these with crop growth data, we can estimate the harvest. This timely and accurate information will remove much uncertainty around production.

"Rice demand can be determined by income growth and distribution, and government policy, among other data," Dr. Zeigler said. "As a rice research institute, IRRI can contribute in providing highly accurate information on the rice crop. Having a good understanding of both the supply and demand side of the equation is an important part of having a stable rice trade."

IRRI's expanding role

Indeed, IRRI has an important role to play in the development of rice policies. A number of interventions that governments have made, although reasonable in the short term, such as making sure that rice is available so that people will not have riots on the streets, have long-term adverse impacts.

According to Dr. Zeigler, organizations such as IRRI and the International Food Policy Research Institute are well placed to help governments work through the implications of their policy choices. Those policy choices will have a dramatic impact on rice trade—locally, regionally, and in the overall global rice market.

"From our perspective, we see a transition from a strictly research orientation attending to the issues around how to produce more and better rice in a more sustainable way as a good starting point for moving to a much richer engagement with the global community," he said. "We think that it is increasingly important that we bring an unbiased point of view to the table to help provide the information that the global community needs for an open and transparent rice trade."

Ms. Reyes is the managing editor of Rice Today.

TRENDS in global rice trade

by **Samarendu Mohanty**

Historically, a small amount of rice is traded globally compared with other crops such as wheat, corn (maize), and soybeans. However, after remaining stagnant for almost two and a half decades, rice trade expanded in the late 1980s in the wake of trade liberalization in many countries and the General Agreement on Tariffs and Trade in 1994.

Global rice trade now stands at around 42 million tons compared with 10–12 million tons in the late '80s. The current trade accounts for nearly 9% of global production compared with 4% in the late '80s (Fig. 1).

Structure of global rice trade

Rice is a political commodity in the majority of Asian countries and its price is an important barometer of government performance. Thus, it becomes imperative for policymakers to control rice trade flow for domestic rice market to be stable. State agencies are involved in controlling the flow of rice in and out of countries and, in many cases, they also take part in importing/exporting rice through government-to-government (G-G) contracts.

State agencies in many rice consuming countries such as the National Food Authority of the Philippines, the Bureau of Logistics of Indonesia, and BERNAS of Malaysia are solely in charge of importing rice into their respective countries. Similarly, state agencies in many exporting countries are also involved in rice exports through G-G contracts. For example, Vietnam exported in excess of 400,000 tons of rice monthly in 2013 and 2014 through G-G sales to Indonesia, the Philippines, Malaysia, and other Asian and African countries (2014 World Rice Conference, Cambodia). The extent of the hold of the governments in rice trade was evident during the 2007-08 rice crisis when exporting countries such as India and Vietnam enforced an export ban, and importing countries such as the Philippines, Indonesia, and Nigeria scrambled to stockpile rice for domestic food security.

The rice export market is highly concentrated with the top five rice exporters accounting for 80% of global rice trade. Of the five top exporters, four (Thailand, India, Vietnam, and Pakistan) are from Asia. Thailand has occupied the top spot for the most part of the past four decades. For these Asian rice-exporting countries, rice is still the most important staple, and domestic food security and strategic reserve is extremely important.

Unlike the high concentration in export market, the import side is quite fragmented. The top five rice importers account for around 30% of the total trade and the top ten account for less than 50% of total imports. Many of the major importers, including the current top importer, China, are from Asia and account for a quarter of the total trade. The other major importing regions are the Middle East and Africa, with nearly half of the total global trade. These two are the fastest growing rice markets, with the trade volume doubling from 10 to 20 million tons in the past decade.

Types of rice traded

Global rice trade can be broadly divided into fragrant and nonfragrant rice. The fragrant rice market includes basmati and jasmine rice while the nonfragrant rice market includes white, parboiled, and glutinous rice. In the case of basmati trade, India and Pakistan export 100% of this rice to all parts of the world, with Middle Eastern countries as the major destinations, followed by the European Union. In the past 15 years, the global trade of basmati rice has grown from 1 to more than 4 million tons, with India capturing almost all the market expansion while Pakistan's market share declined from 50% to less than 20% during the same period.

For the jasmine rice market, Thailand used to dominate with an almost 100% market share a decade ago. But, Vietnam and Cambodia have made significant inroads into the market in recent years, with Thailand's share dropping below 50%. Vietnam has evolved to become the biggest competitor for Thai Hommali jasmine rice, with nearly 40% of the market share. But, despite its rising market share, Vietnamese jasmine still sells for a hefty discount in the market. The average spread between Thai Hommali and Vietnamese jasmine has been around US$400 per ton ($1,000 per ton for Thai Hommali vs. $600 per ton for Vietnamese jasmine) in recent years.

In the past decade, the volume of jasmine trade was growing at a snail's pace from 1.7 million tons in 2005 to 2.5 million tons in 2013 (Source: *The Rice Trader*). The major markets for jasmine rice are the United States, China, Hong Kong, Singapore, Ghana, Côte d'Ivoire, and Malaysia. In addition, 600–700 thousand tons of 100% broken jasmine rice, primarily Thai Hommali, are mostly exported to three West African countries, namely, Senegal, Côte d'Ivoire, and Ghana.

In the case of white and parboiled rice, the market is segregated based on the percentage of broken rice (major types are 5%, 15%, 25%, and 100%). All major exporters are involved in white rice trading to all parts of the world. On the contrary, the majority of parboiled rice originates from India and Thailand, with African and Middle Eastern countries as its main destinations.

Future trends

Since the 2007-08 rice crisis, many rice-consuming countries have been reluctant to depend on imported rice and have rolled out measures to improve self-sufficiency. Many rice-importing countries have initiated programs to expand their

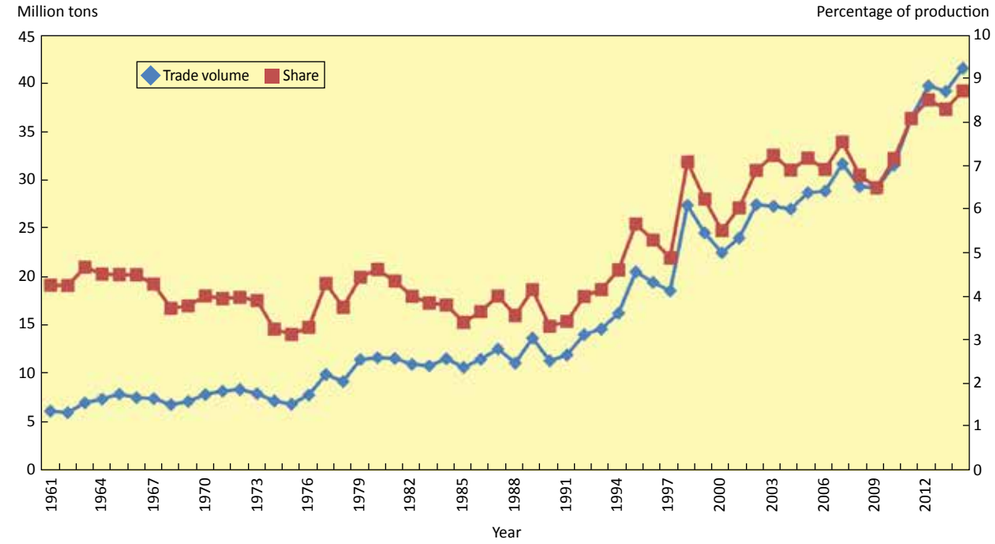


Fig. 1. Global rice trade.
Source: PSD, USDA.

IRRI

A SHIPMENT of rice in a warehouse in Manila, Philippines.

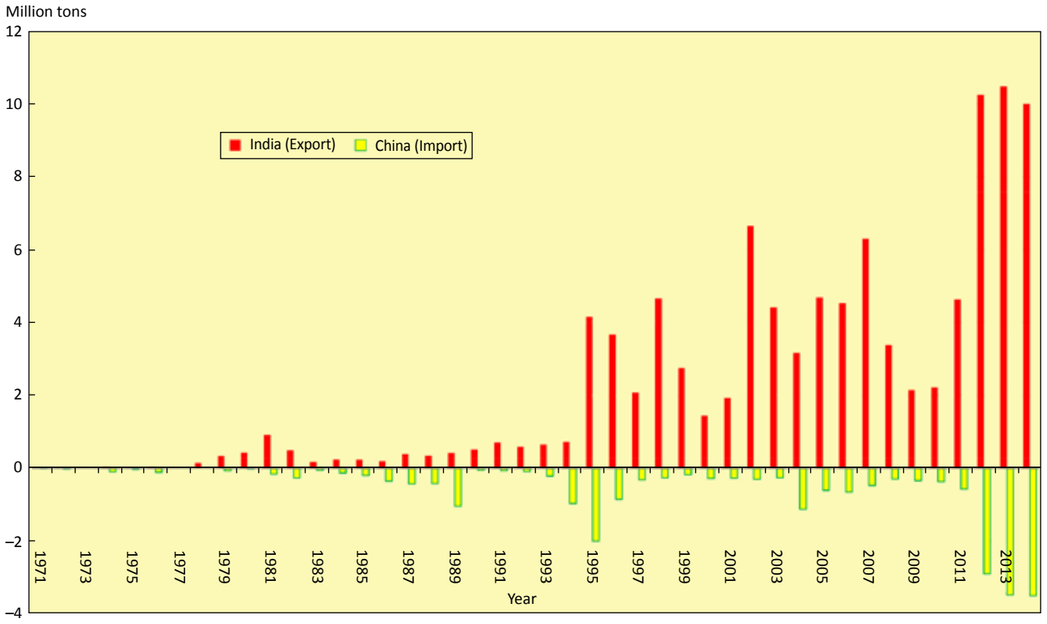


Fig. 2. The rise of India and China in global rice trade.
Source: PSD online database, USDA.

rice production and reduce their dependence on foreign rice.

Both India and China have also emerged as major players in the global rice market in the past few years with India's unprecedented rise to the top of the export chart and China's unexpected rise to the top of the import chart (Fig. 2). In 2012, India displaced Thailand from the top spot by exporting 10.4 million tons of rice vis-à-vis 6.9 million tons for Thailand. Like India, nobody expected China to become the largest importer of rice in the world, displacing Nigeria, with 3.5 million tons of imports in 2013.

India's lifting of its export ban on the nonbasmati market in late 2011 after a 4-year gap, burgeoning domestic stocks, and a weak rupee supported India's exports in the past two years. But, earlier in 2014, Thailand stopped the rice pledging scheme and has regained the majority of markets lost to India in 2012. Thailand recaptured the top spot in 2014 and is expected to further strengthen its position in 2015.

Despite all these uncertainties, the global rice trade will continue to rise in the future. The rising popularity of rice in many non-Asian countries, including parts of Africa and the Middle East, is likely to greatly contribute to the uptrend in rice trade. A lot depends on Africa, where rice consumption is expected to grow much faster than in any other regions in the world. Based on our projections, 112 million tons of additional rice will be needed globally by 2040 and nearly 40% of this additional demand will be coming from Africa. If African production growth cannot keep pace with its rising consumption, then the continent will emerge as a growing importer of rice from Asia.

Many Asian countries are likely to simultaneously export and import different types of rice as consumers diversify their diet and create demand for different types of rice. China, however, remains the biggest question mark in the rice market. It appears that the rapidly rising costs of production, pressure on rice area from competing crops, and water shortages are likely to make imported rice an attractive option for Chinese traders. In addition, the demand for different types of rice such as sticky rice from Vietnam, jasmine rice from Thailand, and long-grain rice from Pakistan is growing as Chinese consumers diversify their consumption habit with rising income. As long as the Chinese government is not strongly determined on self-sufficiency and allows imported rice to enter the country, it is reasonable to assume that Chinese imports will steadily rise in the near to medium term. On the export side, the current major exporters (India, Thailand, Vietnam, and Pakistan) will continue to remain in the market, while Myanmar and Cambodia have the potential to upgrade their rice sectors and become bigger exporters in the future.

Dr. Mohanty is the head of the Social Sciences Division and program leader (Targetting and policy) at IRRI.

Grain of truth

GRiSP: Partnerships for success

BY BAS BOUMAN

In 2015, the Global Rice Science Partnership (GRiSP) enters its fifth year, and it is gearing up to develop a phase II proposal for 2017 and beyond. Thus, this is a good time to take stock of GRiSP's accomplishments so far and discuss where we want to go next.

To recall, GRiSP is a CGIAR Research Program led by the International Rice Research Institute (IRRI) and coordinated by six research-for-development organizations: IRRI, Africa Rice Center (AfricaRice), the International Center for Tropical Agriculture (CIAT), Centre de Cooperation Internationale en Recherche Agronomique pour le Développement (Cirad), L'Institut de Recherche pour le Développement (IRD), and the Japan International Research Center for Agricultural Sciences (JIRCAS).

These six organizations have fully aligned their rice R&D activities and share the same vision, mission, objectives, and R&D structure. Under the umbrella of GRiSP, they bring together more than 900 partners from academia, the public and private sector, and civil society with a stake in the rice development sector. Their joint mission is to reduce poverty and hunger, improve human health and nutrition, reduce the environmental footprint, and enhance ecosystem resilience of rice production systems.

To gauge the achievements and success of GRiSP so far, we need to ask the following questions: "What did the collective of research organizations achieve that they would not have achieved without GRiSP?" "And what has been the added value of the partnership approach?"

And the truth is—when traveling across the globe—I've seen the successes of the GRiSP partnership blossom in each place it is active! The collaboration among institutes and staff across continents is unprecedented, leading to enormous exchanges of ideas, information, knowledge, and technologies, and to new collaborative efforts and mechanisms.

In the field of variety development, for example, breeders are combining forces to modernize their programs so they are more efficient and more effective, and they can deliver improved varieties faster than ever before. Under the banner of accelerating genetic gain, AfricaRice, CIAT, and IRRI are designing novel breeding strategies that reap the fruits of the rapid advances in genomics. They share rice germplasm across continents and pick the best genes and varieties for testing in their respective environments.

While I was in Peru, a national seed company showed me an experimental field with promising hybrid parental lines that were developed in Asia and made available through GRiSP. Back in the Philippines, IRRI has tested hybrid parental lines from Latin America and germplasm from Africa, thus broadening the genetic base for improvement.

Moreover, a global network of phenotyping platforms—in Africa, Asia, Australia, Europe, and North and South America—characterizes novel germplasm under a wide range of environmental conditions, using standardized protocols and sharing data for genome-wide analyses.

Also in other fields, such as agronomy and natural resource management, ideas, tools, and technologies are shared and co-developed. In Latin America, our partners at CIAT in Colombia and the National Institute of Agricultural Research (INIA) in Uruguay are applying crop growth simulation models, which have been developed at IRRI and by Wageningen University in the Netherlands, to explore the impacts of weather conditions and climate change on rice production. GRiSP facilitated this through exchange visits and by organizing training courses.

In Africa and Asia, GRiSP scientists from AfricaRice, IRRI, and the national systems are developing rice management advisory tools delivered through mobile phones and Internet applications. GRiSP-sponsored workshops and exchange visits catalyzed collaboration across continents on topics such as agronomy, innovation platforms, postharvest, value adding, grain quality, and rice supply and demand analyses.

Specialized expertise on rice diseases at Cirad and IRD is being tapped to help solve rice disease problems in Africa, while JIRCAS strengthens GRiSP with new discoveries of genetic traits such as those governing phosphorus uptake and the ability to produce high yield.

So, when looking ahead to GRiSP phase II, we will keep catalyzing cross-institutional and cross-continental collaboration. We will explore mechanisms to expand the global partnership concept by drawing in more allies and providing more opportunities for collaboration. We will develop partnerships on equal footing, whereby we subscribe to common goals and objectives; commit to joint research and development outcomes; and assume joint accountabilities for our ultimate goals of poverty alleviation, food and nutritional security, and a sustained and healthy resource base!

Dr. Bouman is the director of GRiSP. View his recent seminar about GRiSP at http://tinyurl.com/GRiSP-Bouman.

Creating the Future
SATAKE

Brunei Builds its 1st National Rice Mill

Completely Supplied and Engineered by Satake

A stable supply of food has always been a priority for countries like Brunei Darussalam where land for agriculture is limited. When the country decided to pursue 100% self-sufficiency in rice supply as a national policy, it chose Satake equipment for the processing system, because of its reliability, stability and superior performance.

Satake has supplied a complete set of 30TPD rice mills, with design and engineering also provided by Satake.

The official inauguration ceremony was held on August 20, 2014. (For more details, please contact Satake at the address below.)

SATAKE CORPORATION HIROSHIMA, JAPAN Tel:+81 824 20 8560 Fax:+81 824 20 0865
international@satake-japan.co.jp

www.satake-group.com